CHARLIE VAN DER GEEST

EXPERIMENTAL STUDY AND MODELING OF THE STARTUP FLOW OF WAXY CRUDES IN PIPELINES AND THE RHEOLOGICAL BEHAVIOR OF GELLED WAXY CRUDES.

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Orientador: Prof. Dr. Antonio Carlos Bannwart
Co-orientador: Dra. Vanessa C. B. Guersoni

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EXPERIMENTAL STUDY AND MODELING OF THE STARTUP FLOW OF WAXY CRUDES IN PIPELINES AND THE RHEOLOGICAL BEHAVIOR OF GELLED WAXY CRUDES

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Campinas, 12 de fevereiro de 2015.

DEDICATION

Dedico esse trabalho à minha família. Principalmente aos meus pais, Simão e Lucia, pela dedicação incansável, inúmeros sacrifícios realizados para que eu pudesse atingir meus objetivos.

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"Eu quase que nada não sei. Mas desconfio de muita coisa."

João Guimarães Rosa

ABSTRACT

The Procedure of shutdown of an oil production unit for equipment maintenance or emergency occurs with high frequency during its operational lifetime. In the case of waxy crude oil production, when, the crude stays at the bottom of the sea at 4°C, the loss of heat leads to the WAT (Wax Appearance Temperature) of the oil, which leads to the crystallization of wax. If the oil stays static for sufficient time, it might form a structure that completely blocks the pipeline.

Flow lines filled with gelled waxy crudes oil is a severe problem to flow assurance. It is important to know the minimum pressure necessary to restart the subsea flowline to design the surface pump facilities. Gelled waxy crudes are complex fluids and have been studied for a long time. One of the main factors that explain the complexity of the problems is the rheological behavior, though, in order to predict the minimum pressure, others physical parameters are required, such as compressibility and shrinkage.

An experimental study was done with a rheometer to study the rheology, then, with the PVT cell to study the compressibility and the shrinkage. These parameters were studied individually and afterwards an apparatus was built to study the behavior of the oil in a pipeline were their influence were evalueted. All the experiments were performed with two waxy crudes oils to better generalize the results.

The oil has a temporal rheological behavior defined as thixotropic. Thixotropy is a complex flow phenomenon and is not completely understood by the scientific community, and was defined by the Oxford Encyclopedic Dictionary of Physics as: *"Certain materials behave as solids under very small applied stresses but under greater stresses become liquids. When the stresses are removed the material settles back into its original consistency. This property is particularly associated with certain colloids which form gels when left to stand but which become sols when stirred or shaken, due to a redistribution of the solid phase."*

In this study, the idea was to simulate the behavior of two different commercial waxy crude oils, based on the experimental results. From the literature survey, the model of Souza-Mendez-Thompson (2013) was chosen to evaluate the rheological behavior. The model was not able to predict the data perfectly, then, a modification was made to improve its predictions without changing the physical meaning of the equations. A mathematical approach was done based on mass and momentum balance to simulate the results of the pipeline with a difference finite method.

The main goals of this study was to simulate the pipeline with an elasto viscoplastic thixotropic model within the algorithm based on mass and momentum equations. But, as the experimental results were showing that the rheological behavior was not a relevant phenomena in the restart process, the final phase of the algorithm was reconsider, since did not apply for our experimental data. The results considering the oil as a Newtonian fluid with high viscosity had good accuracy.

Key Word: flow restart, non-Newtonian fluid, waxy crude oil.

RESUMO

Os procedimentos de manutenção de equipamentos ou desligamento de emergência de uma unidade estacionária de produção de petróleo no mar ocorrem com freqüência na produção de petróleo. No caso de produção de petróleo parafínico escoando em uma linha de produção no fundo do mar, onde a temperatura é em torno de 4 ° C, a perda de calor pode conduzir o óleo a TIAC (Temperatura Inicial de Aparecimento de Cristais) do óleo. Isso leva à cristalização de parafinas. Dependendo do tempo que o óleo permaneça estático, neste ambiênte, perdendo calor, é possivel que se forme uma estrutura parafínica que bloqueie completamente a linha de produção.

Linhas de produção com óleos parafínicos são um problema grave para a garantia de escoamento. É importante saber a pressão mínima necessária para reiniciar o escoamento para projetar as instalações de bombas na superfície. Óleos parafínicos são fluidos complexos e tem sido estudados há muito tempo. O comportamento reológico é um dos principais fatores que aumenta a complexidade do problema, no entando, para se prever o comportamento do óleo, o estudo de outros fenomênos é necessários, tais como compressibilidade e encolhimento térmico.

Estudos experimentais foram feitos para estudar a reologia, compressibilidade e o encolhimento térmico, individualmente, em um reômetro Hakke Mars 3 e em uma celula PVT. Depois de todos os parâmetros estudados individualmente uma linha em escala reduzida foi construída para estudar o comportamento do óleo numa tubulação com a influência de todos os fenômenos físicos juntos. Todos os experimentos foram realizados com dois óleos reais parafínicos para melhor generalizar os resultados.

O óleo apresenta o comportamento reológico denominado tixotrópia. Tixotropia é um fenômeno complexo e não é completamente compreendido pela comunidade científica, e foi definida pelo Dicionário de física de Oxford: *"Certos materiais se comportam como sólidos sob pequenas tensões aplicadas, mas sob tensões maiores se tornam líquidos. Quando as tensões são removidas do material este volta para sua consistência inicial. Esta propriedade é particularmente associada com determinadas colóides que formam géis quando deixados em repouso, mas que se tornam líquidos quando mexido ou agitado, devido a uma redistribuição da fase sólida ".*

Neste estudo, o obetivo era simular o comportamento de dois óleos comerciais parafínico diferentes, com base nos resultados experimentais. A partir da revisão da literatura, o modelo de de Souza Mendez and Thompson (2013) foi selecionado para a reologia. O modelo não foi capaz de prever os dados perfeitamente, então, uma alteração foi feita para melhorar suas previsões, sem alterar o significado físico das equações. A abordagem matemática da linha foi feita com base no balanço de massa e quantidade de movimento, para simular os resultados da linha de produção foi feito um algoritmo baseado no método númerico das diferenças finitas.

Um dos principais objetivos deste trabalho era simular a linha, baseado nas equações de conservação de massa e movimento, implementando o modelo elastico viscoplástico tixotrópico. Porém, como os resultados experimentais não mostraram um resultado onde a reologia era realmente relevante, a fase final do algoritmo considerou somente um fluido newtoniano fracamente compressível.

Palavras Chave: Reinicio de Ecoamento, Não Newtoniano, Óleo Parafínico.

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LIST OF ACRONYMS

WAT	Wax Appearance Temperature
DSC	Differential Scanning Calorimetry
PVT	Pressure-Volume-Temperature
PIG	Pipeline Intervention Gadget
De	Deborah Number
API	American Petroleum Institute
PDE	Partial Differential Equation
Re	Reynolds Number
DP	Differential Pressure
Erf	Error Function

LIST SYMBOLS

Roman Symbols:		
a, b, m	Empirical Parameters	-
C	Atom of Carbon	-
H	Atom of Hydrogen	-
t_{eq}	Equilibrium Time	s
n	Herschel Buckley exponential term	-
k	Herschel Buckley apparent viscosity	$Pa.s$
G_0	Storage Modulus of the completely structured material	Pa
G_s	Structural Elastic Modulus	Pa
G’	Storage Modulus	Pa
G’’	Loss Modulus	Pa
P	Pressure	Pa
T	Temperature	$°C$
v	Specific volume	$m^3.kg^{-1}$
c	Isothermal compressibilty	Pa^{-1}
v	velocity	$m.s^{-1}$
ρ	Density	$m^3.kg^{-1}$
t	time	s
d	Diameter	m
R	Radius	m
A	Area	m^2

Greek Symbols:		
λ	Structural Parameter	-
λ_0	Initial Value of the Structural Parameter	-
λ_{eq}	Structural Parameter at equilibrium	-
γ	Strain	m
γ_e	Elastic Strain	m
τ	Shear Stress	Pa

τ_y	Static limit of the Shear Stress	Pa
τ_{yd}	Dynamic Shear Stress	Pa
$\dot{\gamma}$	Shear rate	s^{-1}
$\dot{\gamma}$	Transition shear rate from static to viscous	s^{-1}
η	Apparent Viscosity	$Pa.s$
η_∞	Purely Viscous	$Pa.s$
η_s	Structural Viscosity	$Pa.s$
η_v	Addition of η_∞ and η_s	$Pa.s$
η_0	Initial Viscosity	$Pa.s$
η_{eq}	Viscosity at equilibrium	$Pa.s$
θ_1	Relaxation Time	s
θ_2	Retardation Time	s
α	Volume expansivity	T^{-1}
μ	Viscosity	$Pa.s$

1 INTRODUCTION

1.1 Motivation

In the present, hydrocarbons are the main source of energy of the planet. With population growth, hence energy demand, the search for oil reservoirs does not stop expanding and has become one of the great challenges of Engineering and Geology in the twenty-first century.

Since the nineteenth century, when the oil production started, the society has exhausted almost all the easily accessible reservoirs. These reservoirs were on land or in the sea under shallow waters. The remaining fossil fuels, however, are in increasingly more remote locations such as under deep-water or offshore Arctic, which imposes difficulties to be accessed. There are offshore reservoirs located all over the planet, from North Sea up to Antarctica.

Because environmental conditions in these reserves are complex, there are significant challenges to drill and complet the wells, extract and transport the produced crude oil. Transport the oil from the reservoir to the surface requires an enormous effort. Time, technology and experience must be applied simultaneously to allow the exploitation of these natural resources. PETROBRAS is the main company that produces oil in Brazil and, among others, has developed technology applied today to solve those challenges. One demonstration of the Brazilian technological evolution is the offshore drilling depth development in the history of PETROBRAS, shown in Figure 1.1.

When transportation of crudes is the concern, many of the difficulties in lifting and flow occur in subsea environments. Examples of these difficulties are: formation of hydrates, pumping a multiphase current and problems caused by waxy crude oils, like wax deposition and blocked pipelines.

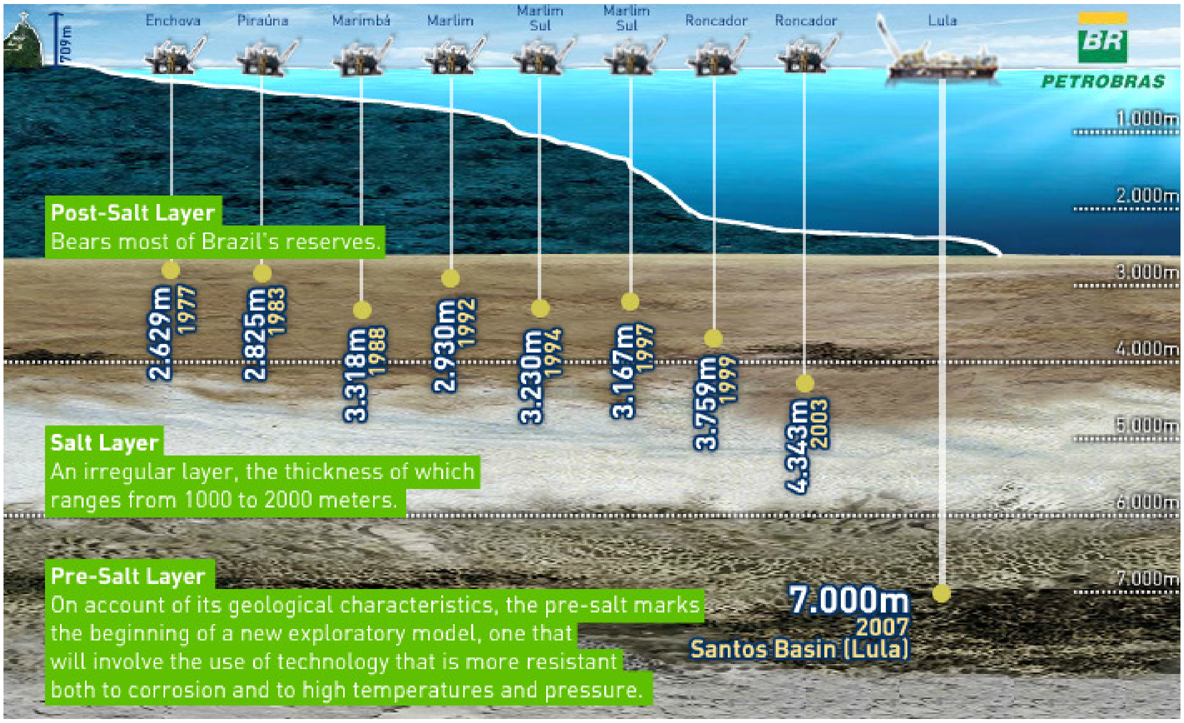

Figure 1.1. PETROBRAS depth drilling expansion (Petrobras, 2014).

There are waxy crude oils in many places in the world, such as the North Sea, Middle East, North Africa, Alaska and Brazil. A deep understanding of all the physical phenomena and all boundary conditions that influence the behaviour of these oils are necessary to minimize the undesirable effects.

The research in this dissertation contributes to the undestanding of problems in the production and transportation of waxy crude oil. More specifically, a study about the consequences of the precipitation of wax molecules during a production shutdown.

1.2 The restart after shutdown

The problem of formation of gelled waxy crudes may occur when there are a planned shutdowns or unexpected shutdowns. At the bottom of the sea, at 4 °C, the loss of heat leads to the appearance of solids when fluids, inside the flowline, are cooled below a threshold temperature, named WAT (Wax Appearance Temperature) of the oil. This phenomenon in the oil leads to nonlinear characteristics of the rheological behavior, which can delay or even preclude the restart of the flow and production of the pipeline (Thomason, 2000; Fung *et al.,* 2006).

When designing the pipelines and the pump facilities engineers usually do a simplified force balance. The assumption is that when the pressure is enough to overcome the yield stress, the restart occurs. The problem is that there is evidence that this calculation is overestimated, therefore, a better rheological modeling of these oils is necessary once they presents an “elasto-viscoplastic thixotropic” behavior, which is a complex mixture of plasticity, elasticity and thixotropy.

For a number of years, researchers have discussed the concept of yield stress, with Barnes and Walters (1985) going so far as to call its definition a myth. For engineering concerns, however, the notion of yield stress is quite useful, capable, as de Souza Mendes and Thompson (2013) pointed out, of predicting the behavior of real fluids. On the other hand, thixotropic behavior has received varied definitions along history. For instance, *The Oxford Encyclopedic Dictionary of Physics* (1962) says:

“Thixotropy: certain materials behave as solids under small applied stresses but under greater stresses become liquids. When the stresses are removed the material settles back into its original consistency. This property is particularly associated with certain colloids which form gels when left to stand but which become sols when stirred or shaken, due to a redistribution of the solid phase”.

Although it is the interest of the oil industry to know more about these behaviours there is not a lot of information of commercial waxy crude oils in the literature (Borghi *et al.,* 2003).

When the material reaches the yield stress a transition from solid-like to liquid-like behaviour occurs. In some cases, it was believed that the yield stress of this gel was so high that the necessary pressure to restart could not be applied for safety reasons. An example happened involving the Company London and Scottish Marine Oil (LASMO), which finally decided to abandon one well for safety reasons and suffered a loss of US$ 100 million (Singh, 2000).

In order to evaluate all possibilities of the restart procedure, it is necessary to perform experimental studies of the oils rheology and investigate the restart process itself. Analyses of the oil's yield stress, shrinkage and compressibility are necessary in order to understand the problem.

1.3 Research Objectives

Through the design and installation of an apparatus to represent an horizontal pipeline, this study aims to represent in experiments the process of restart of a blocked line with gelled waxy crude oil.

First, in bench experiments, it is necessary some physical analyses: a) volumetric properties such as shrinkage and compressibility; b) rheological properties such as apparent viscosity, yield stress and thixotropic behaviour and c) microscopic analyses to understand the process of wax crystallization and gelation of the oil. All of these studies aim to understand the impact of these parameters on the necessary pressure to restart a flow in a pipeline at the bottom of the sea conditions.

Second, we test the restart of a horizontal pipeline. Through these experiments, we sought to examine the propagation of the pressure inside the pipeline and determine the minimum pressure required to break the gel and, thereby, resume the waxy crude oil flow.

Finally, we develop algorithms to simulate all the experimental results. A model of the rheological behaviour based on an elasto viscoplastic thixotropic models existing on the literature and a model of the pipeline considering conservation of mass and momentum. To verify the theory with the experimental results, this study presents comparisons of the model with experimental data by calculating the errors and showing the discrepancies between them.

1.4 Thesis Overview

This overview describes the discution developed in each chapter:

Chapter 1: This chapter provides an overview and background on petroleum composition, the wax deposition process and the flow restart phenomenon. Also presents an overview of Rheology and a study on the rheological models existing in the literature relevant to this study.

Chapter 3: This chapter describes the apparatus and procedures used in all the experiments. Subjects include the basic preparation and properties of the commercial waxy crudes, the procedures and apparatus to perform the experiments in the PVT cell, Karl Fischer and rheometer, and finally, all the components of the start-up flow loop and all the procedures used for this study.

Chapter 4: States the problem to be modeled and the method to simulate the results of pipeline. Subjects includes Stokes flow hypotesis, the continuity equation and momentum equation. The manipulation of them to generate a diffusion-like equation that could be solved by the classic method of finite difference and, finally, the finite difference discretization and analysis of the stability of the problem.

Chapter 5: Results and discussion of the experiments. Contains the main thermodynamics features, the rheometer results which lead to the need of a change in the rheological model, the differences obtained when comparing the simulation of the modified model with the experimental data, all the results of the pipeline experiments and the comparison of the pipeline simulation with the experimental data.

Chapter 6: Final remarks and conclusions based on the experimental and theoretical study presented in the preceding chapters. Recommendations for future study, including a study of the same procedures with crudes without water, and a study on the constant value obtained related to the elastic behaviour of the oils, regardless the aging time.

2 LITERATURE REVIEW

2.1 Petroleum

The naturally occurring petroleum is a combination of organic and inorganic compounds. The mixture is mainly composed by Carbon and Hydrogen, but many other chemical components, such as Nitrogen, Oxygen, Sulphur and metals, can be found. The high percentage of Carbon and Hydrogen is due to the oil's organic origin. Carbon and Hydrogen are usually arranged by covalent bonds creating the hydrocarbons (McCain, 1990). All other components that are not hydrocarbons will be disregarded in this study.

Hydrocarbons can be found in solid, liquid or gaseous state. Depending on the conditions of pressure and temperature in the reservoir, the mixture can appear in only one or more phases. The state is usually verifiable by an approximate phase diagram of the mixture (Rosa *et al.*, 2006).

The small molecules, with less than six carbons (C_{6-}) in the structure, usually are in gaseous state at standard condition of pressure and temperature and are defined as hydrocarbon gases. The bigger molecules compose the liquid phase, usually named crude oil. The hydrocarbons can be separated in four different groups: Paraffinic, Naphthenic, Aromatic and Asphaltic. According to the definition of Lake (2006):

"Paraffins: This class includes n-alkanes and isoalkanes that consist of chains of hydrocarbon segments (CH_2, CH_3) connected by single bonds. Methane (CH_4) is the simplest paraffin and the most common compound in petroleum-reservoir fluids. The majority of components present in solid-wax deposits are high-molecular-weight paraffins."

"Naphthenes: This class includes the cycloalkanes, which are hydrocarbons similar to paraffins but contain one or more cyclic structures. The elements of the cyclic structures are joined by single bonds. Naphthenes make up a large part of microcrystalline waxes."

"Aromatics: This class includes all compounds that contain one or more ring structures similar to benzene (C_6H_6). The carbon atoms in the ring structure are connected by six identical bonds that are intermediate between single and double bonds, which are referred to as hybrid bonds, aromatic double bonds, or benzene bonds."

"Resins and Asphaltenes: Resins and asphaltenes primarily are a subclass of the aromatics, although some resins may contain only naphthenic rings. They are large molecules consisting primarily of hydrogen and carbon, with one to three Sulphur, Oxygen, or Nitrogen atoms per molecule. The basic structure is composed of rings, mainly aromatics, with three to ten or more rings per molecule."

A critical analysis is now needed. Paraffin is an old term used to alkanes, in other words, the saturated hydrocarbons without cyclic structures. Petroleum waxes are complex mixtures of n-alkanes, isoalkanes and cycloalkanes, which are the combination of heavy paraffins and naphthenes, according to the definition of Lake (2006)**.** The waxy crude oils are composed by petroleum waxes (nowadays paraffin wax). From now on, in this study, the term "paraffin" will refer to the high weight hydrocarbons that will be discussed next.

2.2 Waxy Crude Oils

The molecules that precipitate when waxy crude oil flows through the pipeline and eventually may form a structured gel are, essentially, hydrocarbons alkanes and isoalkanes with carbon numbers in the molecules ranging from 18 ($C_{18}H_{38}$) to about 60 ($C_{60}H_{122}$), there are around 2% of cycloalkanes as well. The strucures of this hydrocarbons can be seen in Figure 2.1 (Lake, 2006). Ajienka and Ikoku (1991) define that the oil can be considered waxy if the percentage of paraffin waxes ranges from 1 up to 50%.

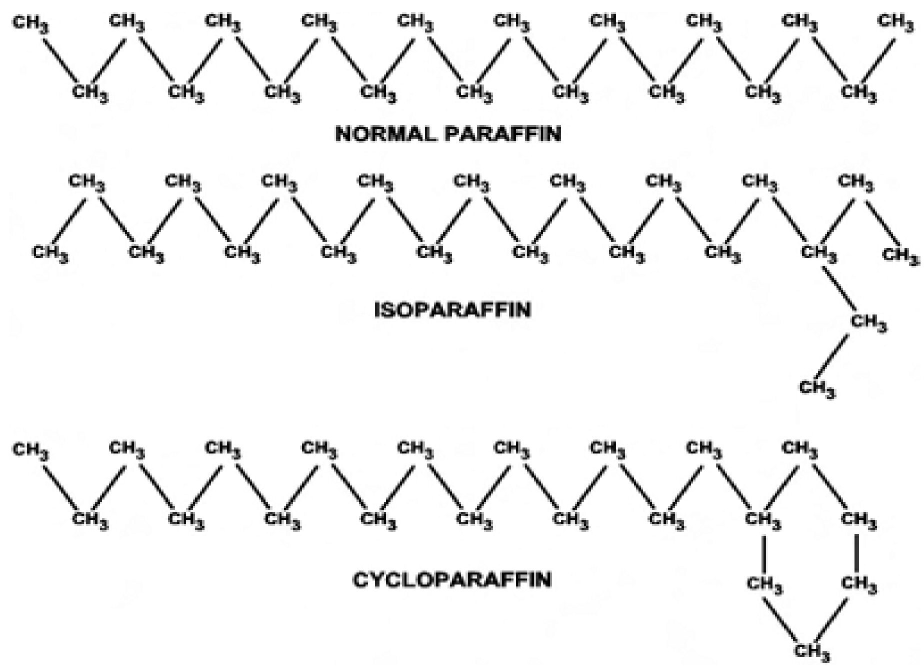

Figure 2.1. Structure examples of wax-forming components (Lake, 2006)

2.2.1 Waxy crude oil problems

The temperatures of the reservoirs usually are between 70 and 150 °C and pressures between 50 and 100 MPa. Under these conditions, the wax is fully dissolved in the liquid phase and it behaves similarly to a Newtonian fluid with low viscosity (Singh *et al.*, 2000). In deep waters, during the flow through the seabed, the pipeline is in contact with water at 4°C, thus, the oil loses heat to the environment from the wellhead until the oil production unit. With this heat loss, the oil temperature can reach the solubility bottom limit to paraffin. Below this temperature, the two problems in flow assurance for waxy crude oils can occur: deposition during flow and gelification of crudes in case of shutdown.

The Pre-Salt layer brought the flow assurance problems with waxy crude oils back, since in the Brazilian scenario, the conditions of the Campos Basin fields were not leading to wax deposition and gelification very often. The difficulties are due to two features of the scenario: first is that Pre-Salt oils wax contents are considerably high, and the other is that the temperature of the reservoir is usually lower than average (Fleming *et al*., 2013).

Wax deposition is caused by crystals that stick to the pipeline wall. The precipitated molecules are solid and stable crystals, which initiate the formation of a complex structure of paraffin crystals, adhering to the cold pipeline's wall and forming a thin layer of gel. The formation of this gel on the surface is the first step in the deposition process. The deposited paraffin ages and becomes more dense and hard over time, reducing the pipeline diameter and its flow efficiency (Singh *et al*., 2000). Figure 2.2 shows a picture of a pipeline in which the Company London and Scottish Marine Oil (LASMO) had a wax deposition problem**.**

Figure 2.2. Wax deposit reducing the effective diameter in a retrieved pipeline (Singh *et al.,* 2000).

The second problem is the subject of this study: gelled crude oil. In the event of shutdown for maintenance or for emergency reasons, the main issue is the possibility of a blocked pipeline. As oil temperature slowly decreases, paraffin crystals precipitate all over the pipeline, forming a crystalline matrix distributed in the oil, which becomes a gel (Davidson *et al.,* 2004). The formation of this gel, and its aging in the pipeline might result in serious problems for flow assurance, such as partial or complete blocking of the production pipeline (Ajienka and Ikoku, 1995).

There are a few methods to solve this problem, and some techniques to remedy the formation of this structure: divers in shallow waters, mechanical scraping using PIG, if the blocking is not complete, melting of wax by exotermic chemical reactions, among others. Just to illustrate the difficulty of the situation, the scraping operation via PIG may have problems if the PIG itself gets stuck. When this is a concern, the paraffin's melting could be more effective, but, in isolated areas, it is about 50% more expensive to use such an operation. Therefore, economic and technical analysis are necessary to find the best solution to remedy the problem.

The solution considered in this study is to find out the necessary pressure to break the structure and to use a pumping facility capable of applying it. In theory, this breaking of the structure would occur if the applied pressure is enough to create a shear stress to destroy it or to induce an adhesive failure at the pipe wall which would provoke a core flow of gelled crude (Lee, 2008). Figure 2.3 shows outcome of the pigging process after the problem of gelled waxy crude.

Figure 2.3. Outcome of the pigging process for gelled waxy crude (Hydrafact, 2014).

In order to determine the necessary pressure, a study based on thermodynamics and rheology will be developed. From thermodynamics, compressibility is necessary to analyse the pressure wave and thermal shrinkage because some voids might be created in the middle of the gellified core of the oil or at the top of the pipeline. There is a radical change in the rheological behaviour, due to the appearance of a large population of distributed crystals within the oil. Gelled crudes behave as non-Newtonian fluids and, supposedly, they have a yield stress under which they behave as an elastic solid.

2.3 Thermodynamics Relations

Gelled waxy crudes can be characterized by mechanical properties that describe the behaviour of the gel as the thermal shrinkage and compressibility (Ewkeribe, 2008). Considering that the oil is at a single-phase region, in which pressure and temperature are independent, we can consider the specific volume as being a function of them "$v = v(T, P)$" (Moran *et al.*, 2010). The differential of such a function is shown in Equation (2.1).

$$dv = \left(\frac{\partial v}{\partial T}\right)_P dT + \left(\frac{\partial v}{\partial P}\right)_T dP \tag{2.1}$$

The thermodynamic properties related to the partial derivatives appearing in this differential are volume expansivity (α), the first term on the right-hand side, and isothermal compressibility (c), the third term on the right-hand side.

2.3.1 Isothermal Compressibility

Isothermal compressibility is an indication of the change in volume that takes place when pressure changes while temperature remains constant. The value is positive for all substances in all phases. Isothermal compressibility is defined as shown in Equation (2.2), where the subscript represents that the parameter is considered constant (Moran *et al.*, 2010).

$$c = -\frac{1}{v}\left(\frac{dv}{dP}\right)_T \tag{2.2}$$

The restart occurs after the oil reaches the temperature of the seabed and stays aging for a while. That is why this study consider that the oil will be in a homogeneous temperature when pressure is applied, hence, an isothermal compressibility has been considered.

2.3.2 Thermal Shrinkage

Volume expansivity is the variation of volume with temperature at constant pressure, which is formulated exactly like thermal shrinkage. The only difference being that volume expansivity is calculated when temperature increases and thermal shrinkage when temperature decreases. The equation (2.3) shows thermal shrinkage (Moran *et al.*, 2010).

$$\alpha = \frac{1}{v}\left(\frac{dv}{dT}\right)_P \tag{2.3}$$

During the heat loss the volume of oil decreases. If we consider that both the wellhead pressure and the hydrostatic pressure are kept constant during the cooling and aging time, this would allow the shrinkage process to be at constant pressure.

2.4 Rheology

Rheology is the science that investigates mechanical properties and materials deformation (Tanner and Walters, 1998). There are two extreme rheological behaviours, which are related to the states solid and liquid. The solid is purely elastic, referring to the ability of a material to return to its original shape when the external force ceases to operate, and the liquid is purely viscous, whose deformation ceases when the external force is removed (Sperling, 2005).

Starting with the purely viscous fluid, two basic parameters of Fluid Mechanics defined firstly by Newton (1687) need to be defined: the shear stress and shear rate. Shear stress is the shear force per unit of area, shown in equation (2.4). The shear rate is the relative displacement of particles of liquid molecules, also called velocity gradient, shown in equation (2.5).

$$\tau = \frac{F}{A_{shear}} \tag{2.4}$$

$$\dot{\gamma} = \frac{du}{dy} \tag{2.5}$$

With shear rate and shear stress, it is possible to define another basic physical parameter of fluid mechanics: viscosity. Viscosity is defined as the resistance to relative motion between two adjacent layers of the material (Lee *et al.*, 2009). Equation (2.6) shows the relationship between shear stress and shear rate for a fluid (Newton, 1687), defined as Newton’s Law.

$$\eta = \frac{\tau}{\dot{\gamma}} \tag{2.6}$$

The other extreme behaviour studied in Rheology is the purely elastic. Hooke (1678) was the first to quantify it, and the Equation (2.7) is defined as Hooke's law. The law defines that the stress (τ) is equal to the multiplication of the strain (γ) by the elastic constant (G).

$$\tau = G\gamma \tag{2.7}$$

When mixing solid-like with viscous-like behaviour, it is useful to consider the response of a Newtonian fluid and of a Hookean solid to a strain with a sinusoidal variation with time. G' is the storage modulus, defined as the stress in phase with the strain divided by the strain in a sinusoidal deformation: it is a measure of energy stored and recovered per cycle of deformation, i.e., the extent of elastic behaviour. G'' is the loss modulus, defined as the stress in quadrature (90° out of phase) with the strain, divided by the strain: it is a measure of energy dissipated per cycle, i.e., the extent of viscous behaviour (Chhabra and Richardson, 2011).

When dealing with complex rheology, time is an important parameter because behaviours change with it. There are characteristic times that quantify the response of the material with time. The *relaxation time* is the necessary time for the fluid to respond after stress is applied, while *retardation time* is the necessary time for the material to reach back the initial position after the stress stops.

When the response to the shear rate is more complex, fluids are classified as non-Newtonian. There is a simplistic classification, where the materials may be conveniently grouped into three general classes, according to Chhabra and Richardson (2011):

1. *"fluids for which the rate of shear at any point is determined only by the value of the shear stress at that point at that instant; these fluids are variously known as time independent, purely viscous, inelastic or generalized Newtonian fluids (GNF)".*
2. *"More complex fluids for which the relation between shear stress and shear rate depends, in addition, upon the duration of shearing and their kinematic history; they are called time-dependent fluids".*

3. “Substances exhibiting characteristics of both ideal fluids and elastic solids and showing partial elastic recovery, after deformation; these are categorized as viscoelastic fluids”.

This classification scheme is a simplification, considering that most real materials often exhibit a combination of two or even all three types of non-Newtonian features. Generally, it is, however, possible to identify the dominant non-Newtonian characteristic. Also, it is appropriate to define an apparent viscosity of these materials as the ratio of shear stress to shear rate, though the latter ratio is a function of the shear stress or shear rate and/or of time (Chhabra and Richardson, 2011).

Although this classification is useful for most engineering concerns, there is a relevant debate in the scientific area about the reality of some of the classic definitions of rheology. First, all the classic parameters will be presented, and then, a review will be made on this scientific discussion.

2.4.1 Time-Independent Fluids

The first simplified group has the apparent viscosity depending only on the shear stress and shear rate, and can be classified as plastic, shear-thinning and shear-thickening.

The classical plastic materials are known for having a yield stress, a minimal stress where there is no shear rate. The first to explore and adjust this behaviour was Bingham (1916), who proposed the model shown in equation (2.8). That is why these kinds of fluids are also called Bingham fluids.

Bingham’s mathematical modelling:

$$\begin{aligned} &\tau = \tau_0 + \eta\,\dot{\gamma} \quad \text{for} \quad |\tau| > |\tau_0| \\ &\dot{\gamma} = 0 \qquad\qquad \text{for} \quad |\tau| \leq |\tau_0| \end{aligned} \tag{2.8}$$

The most common type of time-independent non-Newtonian fluid behaviour observed is shear-thinning, characterized by an apparent viscosity which decreases with increasing shear rate (Chhabra and Richardson, 2011). Shear-trickening or Dilatant fluids are similar to shear-thinning materials: they show no yield stress, but their apparent viscosity increases with increasing shear rate. These two behaviours can be described by the same model, the power law or Ostwald-de Waele model (Morrison, 2001). The power law model, is shown in equation (2.9), with n<1 representing the shear-thinning behaviour and with n>1 representing the shear-thickening behaviour.

$$\tau = \eta\dot{\gamma}^{n} \tag{2.9}$$

There are some generalizations of these models, as the Herschel-Bulkley (1926) model, Equation (2.10) and the Casson (1959) model, Equation (2.11). These generalizations consider the yield stress definition and apply the concept of shear thinning and shear thickening to allow the representation of more materials.

Herschel-Bulkley's mathematical modelling:

$$\begin{aligned} &\tau = \tau_0 + K\,\dot{\gamma}^{n} \quad \text{for} \quad |\tau| > |\tau_0| \\ &\dot{\gamma} = 0 \qquad\qquad \text{for} \quad |\tau| \leq |\tau_0| \end{aligned} \tag{2.10}$$

Casson's mathematical modelling:

$$\begin{aligned} &\sqrt{\tau} = \sqrt{\tau_0} + \sqrt{K\dot{\gamma}} \quad \text{for} \quad |\tau| > |\tau_0| \\ &\dot{\gamma} = 0 \qquad\qquad\qquad \text{for} \quad |\tau| \leq |\tau_0| \end{aligned} \tag{2.11}$$

The most common type of time independent models can be observed in Figure 2.4.

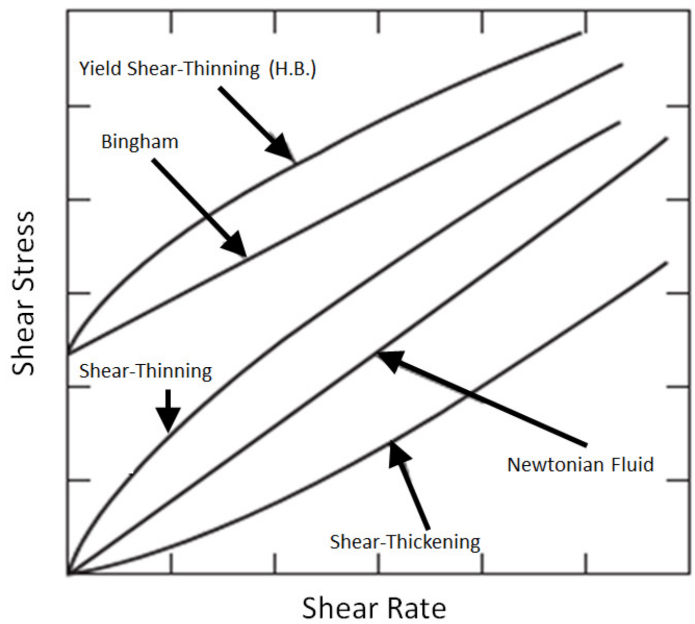

Figure 2.4. Types of time-independent flow behaviour

2.4.2 Time-Dependent Fluids

Apparent viscosity may depend not only on the shear rate or stress, but also on the time for which the fluid has been subjected to its influence. Behaviour of time dependent fluids can be divided in two categories, thixotropy and rheopexy.

Thixotropy has been defined in many different ways in the history of rheology. The literature on the subject has been reviewed by Bauer and Collins (1967), Mewis (1979), Barnes (1997) and Mujumbar *et al* (2002). Viera da Rocha (2010) reviews the concept's evolution, the term is generally used to describe the reversible breakdown of particulate structures under shear, structures which are frequently associated with a yield stress (Mujumbar *et al.,* 2002).

There is a dimensionless number that represents the time dependence of the behaviour, and the behaviour of all materials. In Rheology, the classification of solid or liquid is determined by the Deborah number (De) shown in equation (2.12). This dimensionless number establishes the relationship between relaxation time of the material (θ_1) and the time (t) of applying a deformation or strain. Relaxation time has already been discussed, and it basically means the necessary time for the fluid to respond to a stress. A purely viscous has $De \rightarrow 0$ and a solid has $De \rightarrow \infty$.

$$De = \frac{\theta_1}{t} \quad (2.12)$$

The Deborah number has been defined here because it helps understanding the time dependent behaviour. If a material has a high Deborah number it means that the necessary time for the material to start to flow is long, but the fluid can change its behaviour when shear stress or shear rate is applied for a long time, which means it is time dependent. Though the Deborah number helps understanding the influence of time in behaviour, it does not describe the thixotropic behaviour in the full sense. Thixotropy is a reversible behaviour, which means that when stress is applied viscosity decreases, but when stress ceases to operate, viscosity increases again, in theory, reaching the same value after the retardation time.

One of the main parameters that influence the relaxation time is viscosity. It is important to note that for a thixotropic behaviour the Deborah number is not constant, because it decreases with apparent viscosity. Figure 2.5 shows the variation of viscosity for a red mud suspension (Nguyen and Uhlherr, 1983) a test at constant shear rate.

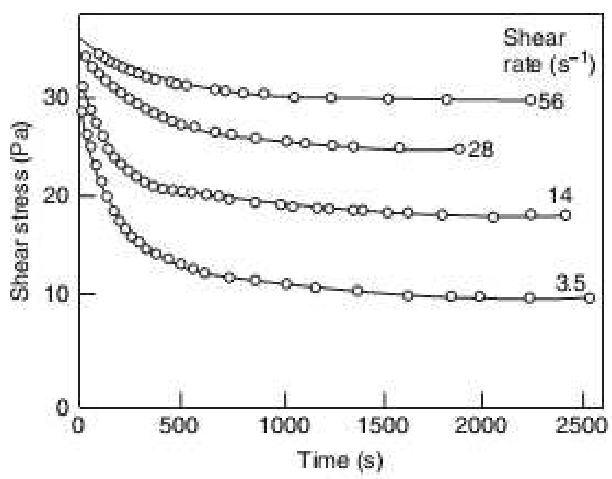

Figure 2.5. Representative data showing thixotropy (Chhabra and Richardson, 2011).

The second time dependent behaviour is rheopexy. It is exactly the opposite of thixotropy, and therefore can be called anti-thixotropy. In this case, the structure builds up when at shear and breaks down at rest. The Figure 2.6 shows the rheopexy of some polar fluids studied by Steg and Katz (1965).

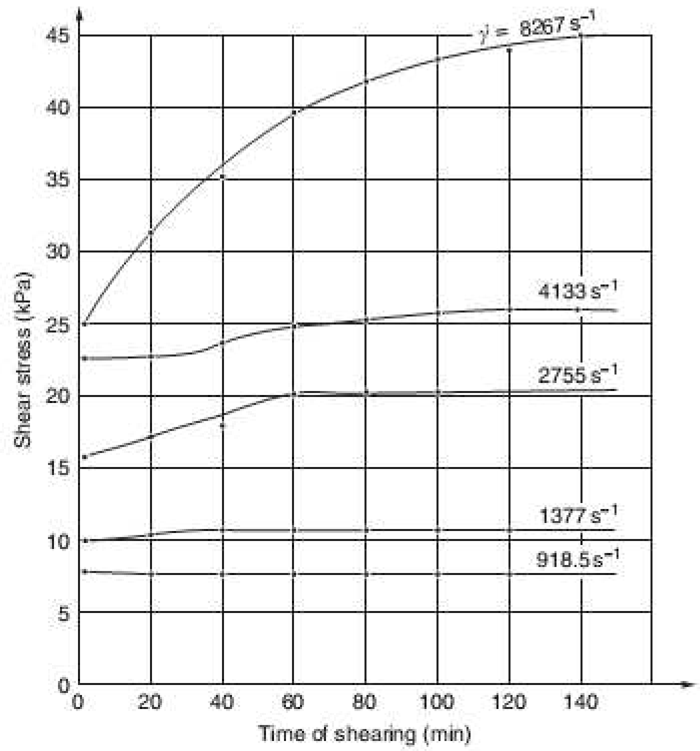

Figure 2.6. Rheopexy Behaviour (Steg and Katz, 1965).

Hysteresis curve, which is the reversible behaviour discussed before, is used to verify those rheological features. Figure 2.7 shows both thixotropic and rheopetic fluid.

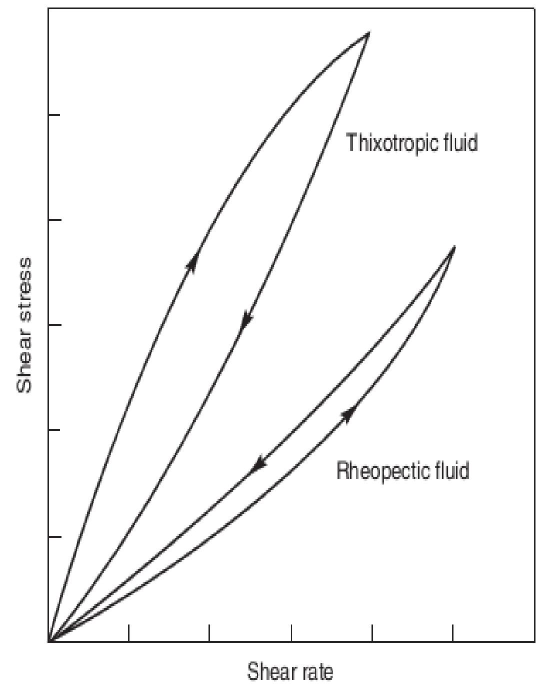

Figure 2.7. Schematic shear stress-shear rate curve for time dependent fluids (Chhabra and Richardson, 2011).

2.4.3 Viscoelastic Fluids

The first model in this classification was made by Maxwell (1867), and the goal was to describe both the ideal elastic and the perfect viscous behaviour. Maxwell model is pioneer in this approach. The mechanical analogue can be seen in Figure 2.8, and the constitutive equation obtained from this analogue is described in equation (2.13).

$$\tau + \frac{\eta}{G}\dot{\tau} = \eta\,\dot{\gamma} \qquad (2.13)$$

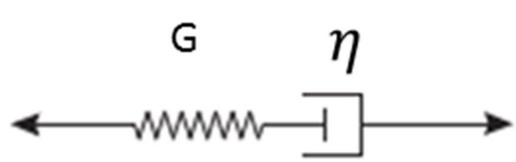

Figure 2.8. Maxwell model's mechanical analog.

Viscoelastic materials have been discussed for a long time. The definition is useful for engineering purpose because there are variations from solid-like behaviour to fluid-like in many applications. There are plenty of materials that are well defined as viscoelastic. Some obtained or used in the petroleum exploration are: gelled waxy crude oils, polymers injected in reservoirs and most of the oil-based drilling mud.

2.4.4 Complexity of Rheology

Most real materials often exhibit a combination of two or even all three types of non-Newtonian features, which demonstrates the complexity of rheology. Predicting and understanding yield stress is a challenge, and there is disagreement between rheology experts on the comprehension of this physical phenomenon (de Souza Mendes and Thompson, 2013). Bingham (1916) characterized the existence of a yield stress which must be exceeded before the fluid deforms or flows (Chhabra and Richardson, 2011).

Barnes and Walters (1985) argue that there is no material that does not flow eventually, there are wrong experiments. The argument is that the experimental time is either too small or too long. If the material has a solid-like behaviour, when stress is applied for long enough time, the material will flow**.** Barnes (1999) considers that the material would deform irreversibly even under stress smaller than the yield stress, which would violate the classic concept that the shear rate is null under the yield stress.

This discussion has been going on for a long time. Many authors (Hartnett and Hu, 1989; Astarita, 1990; Evans, 1992; de Souza Mendes and Thompson, 2013), among others, have been discussing if there is a yield stress, if the experiments are wrong, or even if technology is not advanced enough to measure this phenomenon.

Even with all argumentation, important for the science of rheology, for engineering concerns, there is no doubt that yield stress exists. For the start-up of a flow of gelled crude, a peak where there is a shift in the oil from solid-like to fluid-like behaviour is reached. This shift means that the time of the process is enough to visualize the yield stress. To design the pump facilities it is necessary to consider a yield stress, which probably would be better defined as apparent yield stress by Barnes (1999). The definition of the apparent yield stress is: there is an irreversible displacement under the yield stress, which means that the shear rate is not necessarily null. The apparent yield stress would be the point where the fluid stops the plastic and starts the viscous behaviour as the dominant. From now on in this study the term "yield stress" will refer to the apparent yield stress.

Yield stress is one of the problems in modelling rheological behaviour. Another problem is the change on material's behaviour between the simplistic classifications done before, as discussed by de Souza Mendes and Thompson (2013). Attempts in modelling go basically in two ways: first, starting from the viscoplastic consideration and adding the Hooke's law, and then dynamic equations for thixotropy, and second, from the viscoelastic equation adding dynamic equations to represent the plasticity and the thixotropy.

2.5 Rheological Models

There are a number of models that attempt to predict the thixotropic behaviour (Slibar and Paslay, 1959; Tiu and Borges, 1974; Toorman, 1997; Chang *et al.,* 1999; Dullaert and Mewis, 2005; Mewis and Wagner, 2009; de Souza Mendes, 2011; de Souza Mendes and Thompson, 2013), and there are a few reviews on those models (Mewis, 1979; Barnes, 1997; Barnes, 1999; Mujumdar *et al.,* 2002).

Mujumdar et al., (2002) have classified all the models in three ways, phenomenological approach, direct microstructural and indirect microstructural approach. Phenomenological, as can be deduced by its name, is based on phenomenon analysis, and quantified by the direct response of the material. The other two approaches depend on the structure itself. The direct microstructural approach tries to quantify the number of connections between particles and the indirect approach creates a structural parameter to quantify the structuring levels, where, when is completed structured the parameter has the highest value and when is completed destroyed the parameter is null.

This study has considered two indirect microstructural approaches, Dullart and Mewis (2006) and de Souza Mendes and Thompson (2013).

De Souza Mendes and Thompson (2012) have criticized the majority of the models arguing that they do not have a consistent physical meaning or are not able to predict all possible behaviours. There are two main arguments why the de Souza Mendes and Thompson (2013) were considered over Dullaert and Mewis (2006): first, the Dullaert and Mewis (2006) model does not have a consistent mechanical analogue, which would provide a physical interpretation. Second, the structure equation depends only on the shear rate, the model does not have a dynamic equation depending on the shear stress, which makes little sense considering the discussion above. Considering that the material eventually flows, it is required one equation dependent on the shear stress.

2.5.1 Dullaert and Mewis (2006) model

The shear stress equation for the model is separated in a particle contribution and a medium contribution, the particle contribution is divided as the sum of elastic and a viscous, hydrodynamic, contribution (Dullaert and Mewis, 2006).

$$\tau(\lambda, \dot{\gamma}) = \tau_{elas} + \tau_{visc} + \tau_{medium} \tag{2.14}$$

This distribution of the shear stress allows some physical explanation. The medium stress is characterized by the contribution of a medium viscosity. For the elastic contribution a Hookean spring is assumed. The viscous term is divided in two, the first comparing the medium viscosity with the viscosity of the completely broken down, and the second, defining the viscosity increment due to variation on the structural parameter (λ), which, in this case, is a variation from $\lambda = 1$ for completely structured and $\lambda = 0$ for completely viscous. The constitutive equation for the model is shown in Equation (2.15).

$$\tau = G(\lambda)\gamma_e(\lambda, \dot{\gamma}) + \left[\eta_{eq}(\lambda)\dot{\gamma} + (\eta_\infty - \eta_m)\dot{\gamma}\right] + \eta_m\dot{\gamma} \tag{2.15}$$

The variation of the shear modulus (G) and of the viscosity of equilibrium (η_{eq}) is defined as linearly related to the structural parameter and to the storage modulus and the initial viscosity respectively, as shown in (2.16) and (2.17) respectively.

$$G(\lambda) = \lambda G_0 \tag{2.16}$$

$$\eta_{eq}(\lambda) = \lambda\eta_{eq,0} \tag{2.17}$$

By adding Equations (2.16) and (2.17) in (2.15), the result is Equation (2.18).

$$\tau = \lambda\left(G_0\gamma_e + \eta_{st,0}\dot{\gamma}^n\right) + \eta_\infty(\dot{\gamma}) \tag{2.18}$$

The kinetic equation for the structural parameter can be seen in the Equation (2.19), where k_1 is the kinetic constant for shear-induced breakdown, k_2 and k_3 are the corresponding constant for respectively shear induced and Brownian build-up (Dullaert and Mewis, 2006).

$$\frac{\mathrm{d}\lambda}{\mathrm{dt}} = \left(\frac{1}{\mathrm{t}}\right)^{\beta} \left[-\mathrm{k}_1\lambda\dot{\gamma} + \mathrm{k}_2(1-\lambda)\sqrt{\dot{\gamma}} + \mathrm{k}_3(1-\lambda)\right] \tag{2.19}$$

The elastic equation (2.20) is composed by two terms. First one is the relaxation after a reduction in the stress and the other is the stretch when the stress increases (Dullaert and Mewis, 2006).

$$\frac{\mathrm{d}\gamma_e}{\mathrm{dt}} = \left(\frac{\mathrm{k}_4}{\mathrm{t}}\right)^{\beta} [\tau(\lambda,\dot{\gamma})\gamma_c - \tau_{RP}(\dot{\gamma})\gamma_e] \tag{2.20}$$

The dynamic equation for the structural parameter, Equation (2.19), is dependent on the shear rate, the structural parameter itself and a few empirical parameters, not dependent on the shear stress. The structure variation need to be dependent on the shear stress, Luthi (2013) has done an experiment, Figure 2.9, which demonstrates this necessity. For structured oil at a constant shear stress, only after around 30 min the oil started to flow, the model of Dullaert and Mewis (2006) is not able of predicting such behaviour because the structural parameter is only dependent on the shear rate.

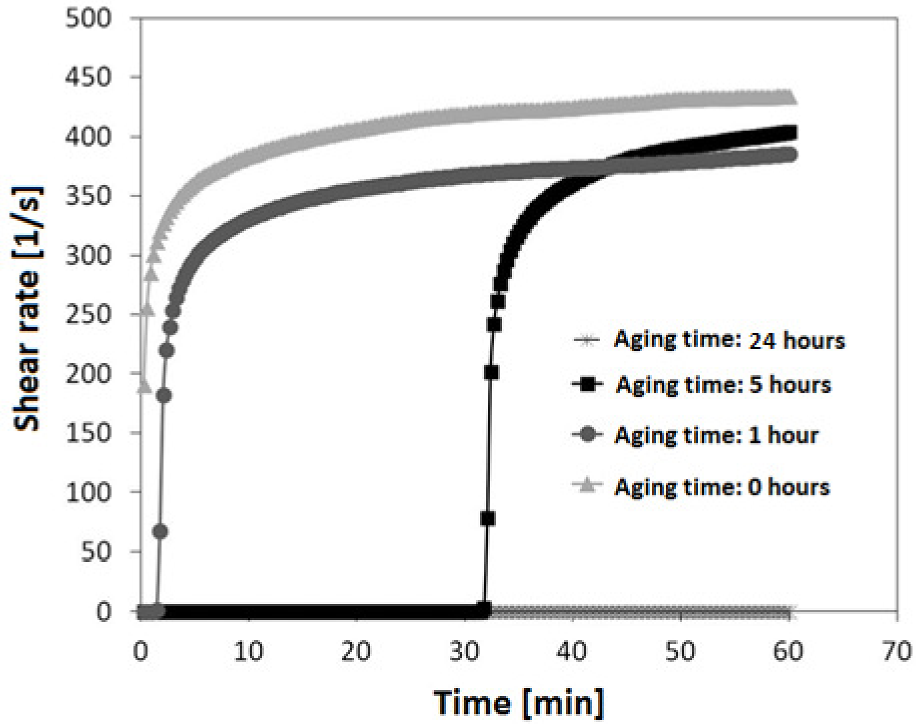

Figure 2.9. Shear rate vs time at a constat shear stress (Luthi, 2013).

2.5.2 De Souza Mendes and Thompson (2013) model

The analogy of the model, shown in Figure 2.10 is: the solid-like behaviour can be compared to spring and the fluid-like behaviour with dampers. The model is proposed to describe the thixotropy, elasticity, plasticity and the viscous behaviour. The basic model is classified as viscoelastic and the others behaviours are implemented with kinetic equations, with the structure parameter. Then, it is possible to represent the thixotropy and the plasticity effects. A full discussion on the generalization of rheological models was done by de Souza Mendes and Thompson (2012). The idea of the model in its extremes is that when the oil is fully structured the spring is the component that resists and, when there is no structure the dampers are the resistance.

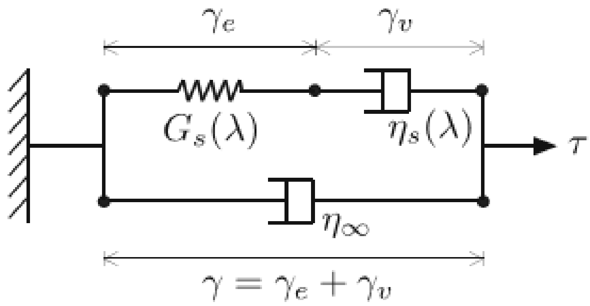

Figure 2.10. Physical analogy of de Souza Mendes and Thompson model (2013).

The spring resistance is (G_s), also called shear modulus, the resistance of the dampers are the structural viscosity (η_s) and the final viscosity (η_∞). The structural parameter (λ) represents the structure parameter, as have been discussed, the model is classified as indirect microstructural (Mujumdar *et al.,* 2002). Usually the definition is: λ=1, when the fluid is fully structured, and λ=0 when the fluid behaves like a liquid. De Souza Mendes and Thompson (2013) model uses a different approach; $\lambda_0 \neq 1$ when the fluid is fully structured.

The domain of the viscosity "$\eta_v(\lambda) \rightarrow [\eta_\infty, \eta_0]$" is directly proportional to the structural parameter "$\lambda \rightarrow [0, \lambda_0]$". Hence, it is possible to define the initial structural parameter, shown in Equation (2.21).

$$\lambda_0 = \ln\left(\frac{\eta_0}{\eta_\infty}\right) \tag{2.21}$$

2.5.2.1 Equilibrium functions:

The next definition necessary is the equilibrium state (steady-state). This happens when the build-up and the breakdown rates are equal. Equation (2.22) is the equilibrium structure parameter.

$$\lambda_{eq} = \ln\left(\frac{\eta_{eq}}{\eta_\infty}\right) \tag{2.22}$$

The next parameter is the equilibrium viscosity. There is an equilibrium value for each shear rate or shear stress, and they can be related by a Newtonian relation, shown in Equation (2.23). Equation (2.24) shows an equilibrium viscosity function proposed by de

Souza Mendes (2009), the main goal of this is to represent the results of the experimental data.

$$\tau = \eta_{eq}(\dot{\gamma})\,\dot{\gamma} \tag{2.23}$$

$$\eta_{eq}(\dot{\gamma}) = \left(1 - e^{\frac{\eta_0\,\dot{\gamma}}{\tau_y}}\right)\left(\frac{\tau_y - \tau_{yd}}{\dot{\gamma}}\, e^{-\frac{\dot{\gamma}}{\dot{\gamma}_{yd}}} + \frac{\tau_{yd}}{\dot{\gamma}} + K\,\dot{\gamma}^{n-1}\right) + \eta_\infty \tag{2.24}$$

There are a number of variables in this equation that have not been explained yet. Those variables are related to the equilibrium state (Flow Curve). The static limit of the stress (τ_y), hence is the point where the fluid will stop to behave like a solid and start to behave like a liquid. The second parameter is the shear stress caused by the flowing of the completely destroyed structure (τ_{yd}), the shear rate of transition ($\dot{\gamma}_{yd}$) from the solid-like behaviour to the fluid-like behaviour.

The last two parameters are apparent viscosity (k) and the power law term (n) related to the classical viscoplastic model of Herschel-Bulkley.

2.5.2.2 Constitutive Equation:

The constitutive equation (2.25) comes from the manipulation of the stress and the strain in the system.

$$\frac{\theta_2}{\eta_\infty}\left(\frac{\tau}{\theta_1} + \dot{\tau}\right) = (\dot{\gamma} + \theta_2\ddot{\gamma}) \tag{2.25}$$

The Equation (2.25) relates the stress (τ), derivation of stress related to time ($\dot{\tau}$) with the shear rate ($\dot{\gamma}$) and derivation of shear rate with time ($\ddot{\gamma}$). The two new terms (θ_1) and (θ_2) are the relaxation and retardation time, respectively.

The Equation (2.26) and (2.27) are the relaxation and retardation times, respectively. When the material is fully structured ($\lambda = \lambda_0$) the structural viscosity is extremely high, and the term that rules is the spring. Thus, the relaxation time and the Deborah number are extremely high, representing a solid-like behaviour. When the material is completely destroyed ($\lambda = 0$) the ratio of the viscosities goes to zero and, therefore, the characteristic times become null, representing a purely viscous behaviour (de Souza Mendes, 2011).

$$\theta_1 = \left(1 - \frac{\eta_\infty}{\eta_v(\lambda)}\right)\frac{\eta_v(\lambda)}{G_s(\lambda)} \tag{2.26}$$

$$\theta_2 = \left(1 - \frac{\eta_\infty}{\eta_v(\lambda)}\right)\frac{\eta_\infty}{G_s(\lambda)} \tag{2.27}$$

2.5.2.3 The structural elastic modulus function:

Shear modulus (G_s) is a function depending on the structural parameter (λ) and on the structural elastic modulus of the completely structured material (G_0). It represents the variation of the elastic resistance of the spring. The last term is an empirical parameter (m). Equation (2.28) has been modified in this study and will be discussed later. The test to quantify the elastic modulus of the completely structured material is shown in Figure 2.11.

$$G_s = G_0 e^{m\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)} \tag{2.28}$$

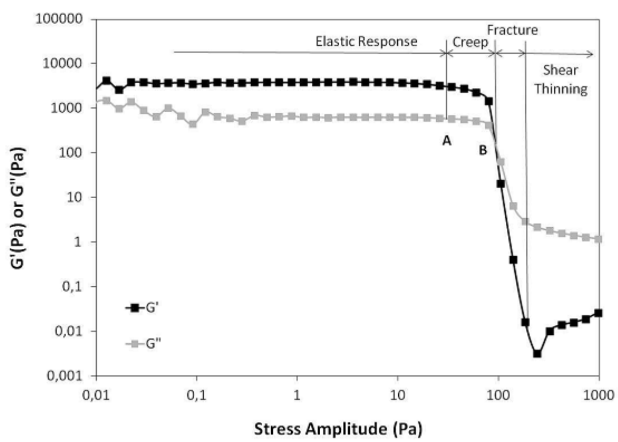

Figure 2.11 Oscilatory test for Oil 2 and 1 hour of aging time at 5°C (Luthi, 2013).

Elastic modulus (G_0) of the completely structured material is the plateau value of the storage modulus (G'), shown in Figure 2.11. It is mathematically defined in Equation (2.29).

$$\lim_{\lambda \to \lambda_0} G' = G_0 \tag{2.29}$$

2.5.2.4 The structural viscosity function:

The structural viscosity (η_s) is represented by a function of the viscous response of the microstructure. It is necessary to analyze that when "$G_s \rightarrow \infty$" a purely viscous behaviour is reached, whose viscosity is: "$\eta_v = \eta_s + \eta_\infty$".

In Equation (2.30) there is a correlation of the viscosity function with the structural parameter "λ" and the purely viscous component "η_∞". De Souza Mendes and Thompson (2013) do a full discussion of the physical meaning of this equation**.**

$$\eta_v(\lambda) = \eta_\infty e^{\lambda} \tag{2.30}$$

To obtain the purely viscous component, the Equation (2.31) was used in the oscillatory test, Figure 2.11. Where the plateau of the loss modulus (G'') for the structured fluid divided by the purely viscous stress is equal to the multiplication of the viscosity of the completely destroyed fluid with the frequency applied in the oscillatory experiment.

$$\lim_{\lambda \rightarrow \lambda_0} G'' = \omega \eta_\infty \tag{2.31}$$

2.5.2.5 Structural Parameter:

The main criticism of de Souza Mendes and Thompson (2012) is that very often all other models that try to describe the thixotropic behaviour varies the structural parameter with the shear rate, but the main point is that the structure should depend mainly on shear stress. This argument can be observed in the following example: If a small stress is applied on the structured oil, it shall have a strain. If it stays in the elastic behaviour, then the oil should restructure after the stress stops. Although, if the applied stress stays for a long enough time, it would possible reach a point where the structure would start to break down and then, and only then, it would start a viscous behaviour and consequently there would be a shear rate, this example is the experiment shown in Figure 2.9. That is why the criticisms of de Souza Mendes and Thompson (2012) model were accepted and the model was used in this study. And then, after this discussion, it is possible to present the equations. The equation (2.32) represents the idea of the structural parameter. Where "t_{eq}" is the characteristic time; the first term of the right hand side is the structure build-up, where the superscript (a) is an empirical parameter, while the second term is the breakdown, and the superscript (b) is also an empirical parameter.

$$\frac{d\lambda}{dt} = \frac{1}{t_{eq}}\left(\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)^a - f(\tau)\lambda^b\right) \tag{2.32}$$

Equation (2.33) is the final equation presented by de Souza Mendes and Thompson (2013). Since all the parameters have been discussed already, the development shall not be demonstrated.

$$\frac{d\lambda}{dt} = \frac{1}{t_{eq}}\left[\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)^a - \left(\frac{\lambda}{\lambda_{eq}(\tau)}\right)^b \left(\frac{1}{\lambda_{eq}(\tau)} - \frac{1}{\lambda_0}\right)^a\right] \tag{2.33}$$

3 EXPERIMENTAL APPARATUS AND PROCEDURE

3.1 Crude Oils

In the present research two commercial waxy crudes were used, obtained from Repsol-Sinopec. These oils have been studied and characterized by Badin (2012) and Luthi (2013). They have both performed bench experiments and the main difference from the oils is the weight percentages of heavy n-paraffins. The percentages were 5% and 10%, and they shall be called further on in this study as Oil 1 and Oil 2, respectively.

The goal of this study is to relate the results of the pipeline with the bench experiments, hence, the oil was first inserted in the restart test apparatus and, after an entire procedure, as will be described, the samples to the bench experiments were collected from the restart test apparatus. Three procedures were done, for both oils, before the tests could start, one to insert the oil in the apparatus, one to remove the water and one to remove light hydrocarbons.

We received and stored the waxy crude in barrels of 50 L. The WAT of the crudes is around 40 °C; hence, the barrels would have precipitated molecules in walls and within the oil at ambient temperature. Before inserting these oils in the test apparatus they need to be homogenized, otherwise the percentage of wax would not be realistic. The procedure was to heat the barrel up to 80°C for 8 hours and stir every thirty minutes this would guarantee that the precipitated molecules would be dissolved again, and then, the oil was inserted in the tank of the restart apparatus.

For an unknown reason, all the barrels, of both the oils, had a reasonable quantity of water, as shown by Luthi (2013). A procedure was done to remove the water: the oil stood at rest in the tank for 96 hours at 80°C, due to the density difference, two separate phases of fluids appeared and the water was at the bottom layer, allowing the removal of it through the bottom of the tank.

Badin (2012) and Luthi (2013) tried to do experiments before the procedure to remove the gas of the oil, but they had no reproducibility, consequently, a procedure for removing the light hydrocarbons was executed. After the process of removing water, the oil was stirred for 48 hours at 80°C, with the tank open to the atmosphere, which would remove light hydrocarbons. In a basic analysis, considering that the mixture is composed by pure substances that do not interact with each other, the hydrocarbons up to hexane (C_6H_{14}) probably were removed. After those procedures, there was dead oil with less water in the tank. The samples for the PVT, rheometer and Karl Fischer were then collected.

3.2 Crudes' Characterization

3.2.1 PVT

Saturation pressure measurements were carried out in a PVT cell placed in a thermal-bath which controls the temperature to within an error of ±0.1°C. The initial volume of the sample was 1L. The maximum pressure rating for the PVT cell is 69.2 MPa, and the cell was operated at temperatures ranging from −15 to 200°C. Inside the PVT cell, a floating piston separates the hydraulic and test fluids. The volume of the cell and hence the pressure of the test fluid were monitored by a variable volume computer-controlled positive displacement pump which allowed for the injection or removal of hydraulic oil (Guersoni et al., 2013).

As have been discussed, the samples were removed from the tank of the restart test apparatus after the procedure of stabilizing the oil. Hence, the oil tested in the bench test was dead oil, and to produce live oil a procedure of injecting light hydrocarbons was done.

3.2.1.1 Dead *Oil*

The oil at 70°C was transferred to the cylinder where PVT tests were made. A vacuum cylinder (vertical position) was filled by gravity with a mass of 183,11 grams of oil with the aid of a Mariotte bottle. The cylinder was cooled and kept at 5°C for 48 h while keeping pressure constant at 62 MPa, a value which is known to be above the bubble point of the crude. After 48 hours, the pressure was decreased until 4,83 MPa at step-wise volume expansions. After each step (2,76 MPa) a sufficient time was given until the oil reach equilibrium state (Guersoni et al., 2013).

3.2.1.2 Live Oil

Hydrocarbon light ends were added to the original dead oil in the PVT cylinder to reconstitute the live oil composition. The cylinder was then pressurized to 62 MPa. The set cylinder/live oil was kept at 70 °C by 72 hours. In short time intervals, the bottle was stirred for complete homogenization and solubilisation of the gases. The gas used to make live-oil samples was provided by Gama Gases Ltd. and had the following composition: 64 mol% Methane, 17 mol% Carbon Dioxide, 0,7 mol% Nitrogen, besides other light hydrocarbons. The set cylinder/live oil was cooled and kept at 5 °C while keeping pressure constant at 62 MPa. After 48 h, decompression was performed in the same manner as for the dead oil (Guersoni et al., 2013).

3.2.2 Karl Fischer

The procedure for Karl Fischer titration is one of the analytical methods used in industry for the determination of water in many organic solids and liquids. The amount of water in the waxy crude was measured by Karl Fischer's equipment, Thermoprep 832, Metrohm. This equipment is fully automated, requiring only add the sample to be analysed. The solutions used for the analysis were a solution Hydranal Karl Fisher, supplied by Fluka Analytical, and a solvent Chromasolv methanol, supplied by Sigma-Aldrich (Luthi, 2013).

The equipment performs an automatic calibration using distilled water. Three drops of water are injected, with the aid of a syringe, in the septum of titration vessel. In this calibration process, approximately 5 ml of Karl Fisher solution is used, and the procedure should be performed in triplicate, so that a standard mean value can be calculated. The product software itself (also supplied by Metrohm) warns when the standardization process was completed successfully or whether it should be repeated. After standardization, the analysis of the percentage of water in the fluid can be performed (Luthi, 2013).

3.2.3 Rheometer

All the experiments were performed in a controlled-stress rheometer from Thermo Scientific, HAAKE MARS III. The software Reowin Job was used to perform all the rheological tests. All the data was analyzed and manipulated using *Matlab ® 7.10.*

A cone and plate geometry was used. This geometry is considered to be better for working with non-Newtonian fluids because it guarantees that the shear stress and shear rate are constant for all the fluid (Roenningsen, 1992; Chang *et al.*, 1998; Marchesini *et al.*, 2012). The measures were: diameter of 60 mm and a cone angle of 1 degree. Luthi (2013) has shown that this geometry could be used because the paraffins crystals occupy less than 1% of the gap in the rheometer, which means that there is no influence from the crystals' size on the result. Sample temperature and cooling rate were controlled using the rheometer Peltier plate and gap adjustable with the thermo gap option.

3.2.3.1 Tests Procedures

Samples were preheated to 70°C and kept at that temperature for 2 hours. After, samples were put in the rheometer, heated to 70°C and kept at a shear rate of $10\ s^{-1}$ for 10 minutes to erase thermal history effects, to ensure stable chemical composition and, therefore, reproducibility of the data. Following, the samples were cooled to 5°C at the rate of 1°C/min for 1, 5 and 24 hours of aging time. Luthi (2013) also showed that any temperature rate lower than this would always form basically the same structure. The experiments to analyse the rheology were basicly three: Flow curve, oscillatory test and a kinetic test with constant shear rate.

3.3 Start-up Flow in a Pipeline

The apparatus was design to support up to 30 bar, because it was designed considering the classic literature, which suggests that the necessary pressure to restart the flow would be obtained from a force balance, considering the yield stress as minimum shear stress that will restart the flow. Equation (3.1) show the relation between yield stress and necessary pressure (Perkins *et al.,* (1971); Ajienka *et al.,* (1995); Chang *et al.,* (1998); Borghi *et al.,* (2003); Vinay *et al.,* (2009); El-Gendy *et al.,* (2012)). The consideration of a simplistic force balance has been observed to be too conservative in some new studies. Fleming *et al.,* (2013) argue that it is around 20 to 30 times higher than the measured necessary pressure.

$$\Delta P_{min} = \frac{4\,\tau_y L}{D} \qquad (3.1)$$

Every component on the system and the procedure utilized for all the experiments shall be described. The system was designed with basically two heated tanks, a cold bath, a pipeline and the pressurization system.

3.3.1 Apparatus and Algorithm

There are two circuits in this experiment. One for the water's circulation (cold bath) and one for the start-up test. Two methods were used to acquire the data and control the experiment. An analytical one, using the National Instruments (NI cDAC 9178) and a Wireless using the Smart Wireless Gateway.

3.3.1.1 The Water Bath

The water circuit was built with a chiller, a pump and the bath. A chiller, model 30RA/RH Pro-Dialog Plus, from Carrier, was used to control the water's temperature**,** cooling it during testing and heating it during the process cleaning up the pipeline. A pump, model HUP2Kl7 from Ind. MARK BRAS, was used to pump the water from the water bath back to the chiller. Figure 3.1 and Figure 3.2 show the chiller and the pump respectively.

Figure 3.1. Equipment used to control the temperature of the bath during the restart flow tests and during the cleaning of the pipeline (Luthi, 2013).

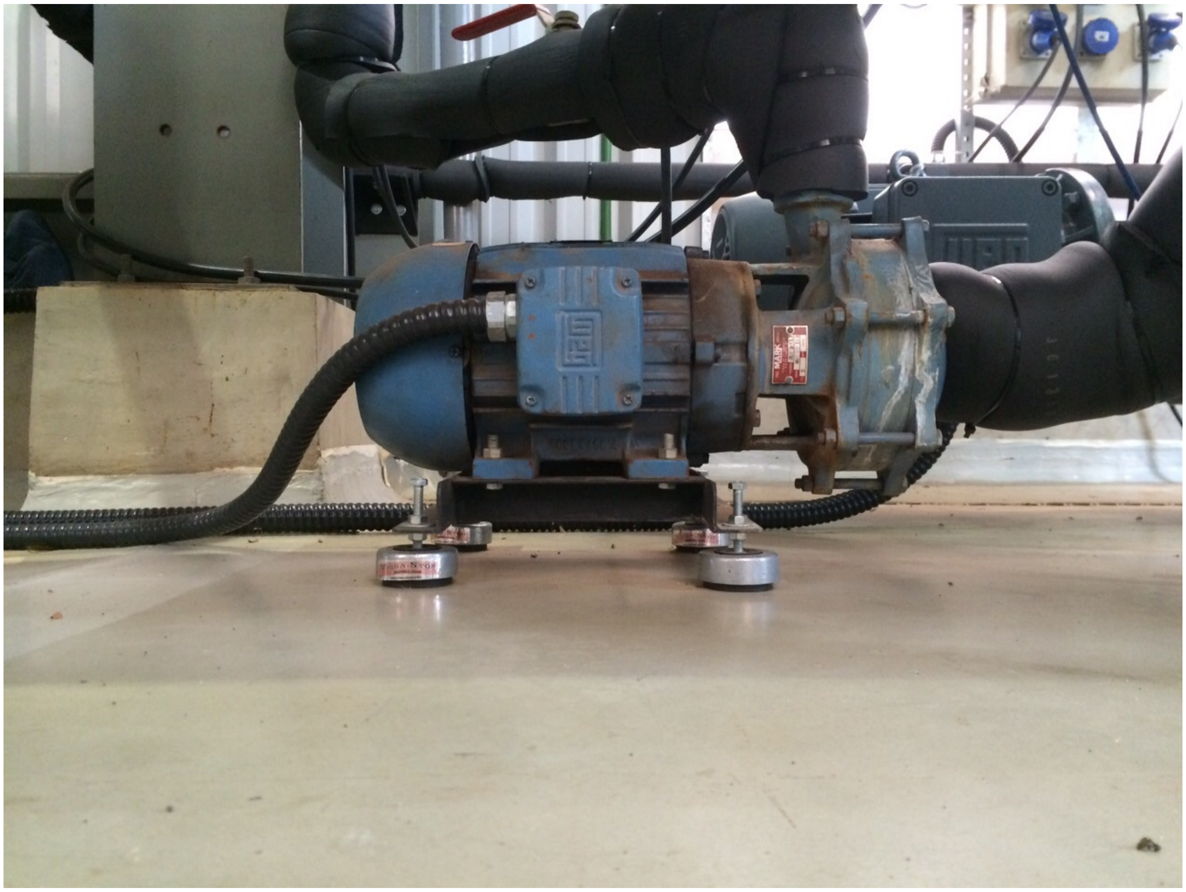

Figure 3.2. Pump used to circulate the water back to the chiller.

The LABVIEW software, from National Instruments, was used in the measurement and system controlling. The algorithm (block diagram) to control the water's level on the bath was done by controlling the rotational speed of the pump. Besides the water control, the algorithm also handles the data from one sensor of the circuit of restart. The details of the instrument shall be presented further on.

3.3.1.2 The Start up Test

Schematic layout of the horizontal pipeline start-up test is shown in Figure 3.3. In this apparatus, the test section is composed by API steel tubing of 6 meters long and 1 inch diameter. The pipeline is immersed in the water bath, which has two differential pressure sensors (Rosemount) coupled. The first sensor (DP1) is located in the pipeline's inlet and the second (DP2) is located at the end of the pipeline. These are wireless transmission, with pressure range between -0.01 to 0.1 bar. Figure 3.4 show the sensor and the pipeline assembled. There are manually operated ball valves placed in the pipeline, one before and one after the water bath.

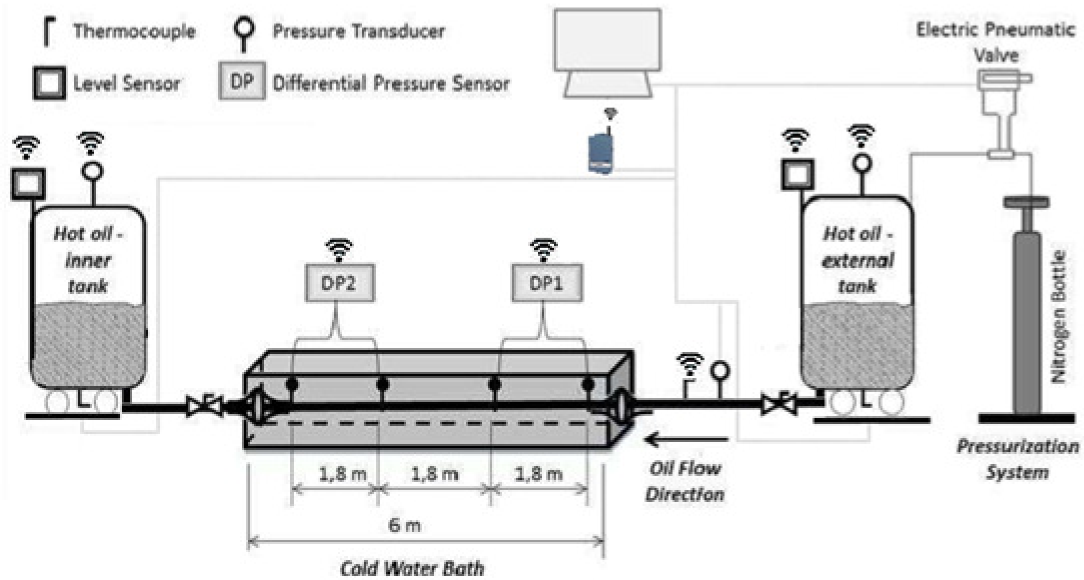

Figure 3.3. Layout of the apparatus for the restart test.

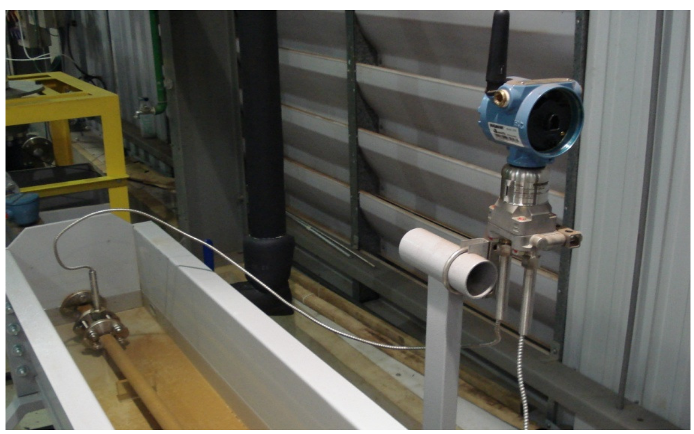

Figure 3.4. Rosemount sensor (DP2) in the water bath (Luthi, 2013).

A pressure gauge (Rosemount) with wire transmission, with pressure range of -1 to 55 bar and calibrated to work up to a maximum pressure of 5 bar was attached to the line near the inlet of the test section, as can be seen in Figure 3.5. A Thermocouple (PT 100), with wireless transmission, in the inlet of the pipeline to measure the temperature during the experiments, can also be seen in Figure 3.5.

Figure 3.5. Pressure gauge and thermocouple in the inlet of the pipeline (Luthi, 2013).

Two identical tanks with pressure vessels for up to 30 bar and 50 L each were used to store waxy oil during the experiments. These tanks depending on the position relative to the test section were called external tank (outer tank), and the one located after was called internal tank (inner tank). Both tanks were heated and had mechanical agitation system.

The heating was performed by a thermal strap, wrapped on the outside wall of each tank and connected to a temperature controller. The temperature control was performed by thermocouples integrated with the tanks, which measured the oil's temperature. The stirring system consists of a gearhead positioned at the top and outside of each tank and an axis with shovels located inside the tank.

Each tank was equipped with a pressure gauge (Rosemount) in a range from -1 to 55 bars, calibrated to operate up to 30 bars. Level sensor with transmission by Guided Wave Radar (Rosemount) and total probe length of 1 meter. Both sensors have wireless data transmission. A safety valve, model 951102MA, manufactured by Tyco Flow Control. Manually operated ball valves placed, one on top and one at the bottom of each tank, respectively, to relieve pressure when necessary, and removal of oil samples for rheological analysis.

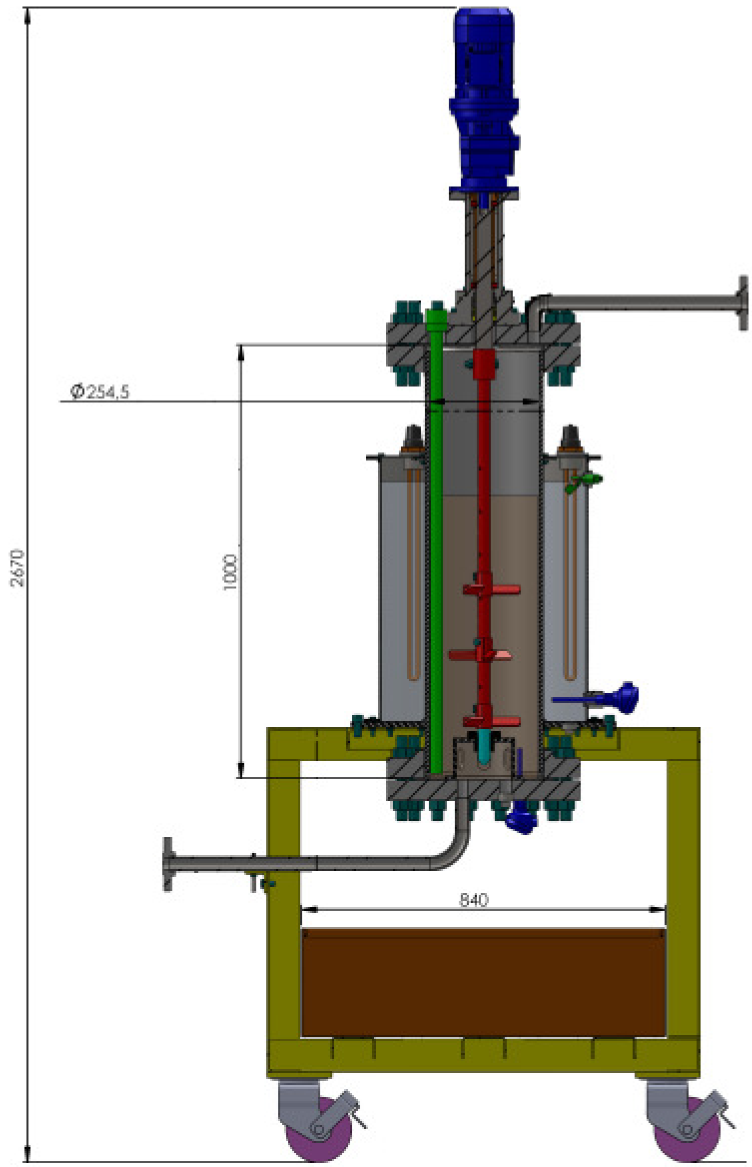

Figure 3.6. Tank with the thermocouple and the stirring.

The pressurization system is composed by two hydrogen tanks, one for applying the pressure and one reserve, this way, when one tank is empty, the experiments do not have to stop while the tank is replaced, Figure 3.7 show both hydrogen tanks. An electric pneumatic valve BR240S, from HORA, Holter Regelarmaturen GmbH & Co. KG is the connection between the hydrogen tank and the oil tank. This valve has a control, shown in the block diagram in **Erro! Fonte de referência não encontrada.**, that every time the pressure is under the set pressure the valve would open, and every time the pressure goes over the set pressure the valve closes.

A Smart Wireless Gateway, model 1420, from Emerson, was used to connect with all the wireless sensors, pressure gauge and level in the tanks, the differential pressure (DP1) and (DP2) in the pipeline and thermocouple in the inlet of the pipeline. From the gateway, all the data was sent via wire to the computer where were manipulated, Figure 3.8 show the Smart Wireless Gateway.

Figure 3.7. Pressurization system (Luthi, 2013).

Figure 3.8. Gateway used for receiveing the data from the wireless sensors.

The data of the wireless sensors were analysed and manipulated with the algorithm also from LABVIEW. The basis of this algorithm is to save the data and control the external tank's pressure.

The monitoring front panel of LABVIEW is shown in Figure 3.9, during the preparation for the test and during the test, the monitoring was done by checking the values sent by the sensors. The operational process, as setting the pressure of the external tank was done in the operational front panel, shown in Figure 3.10.

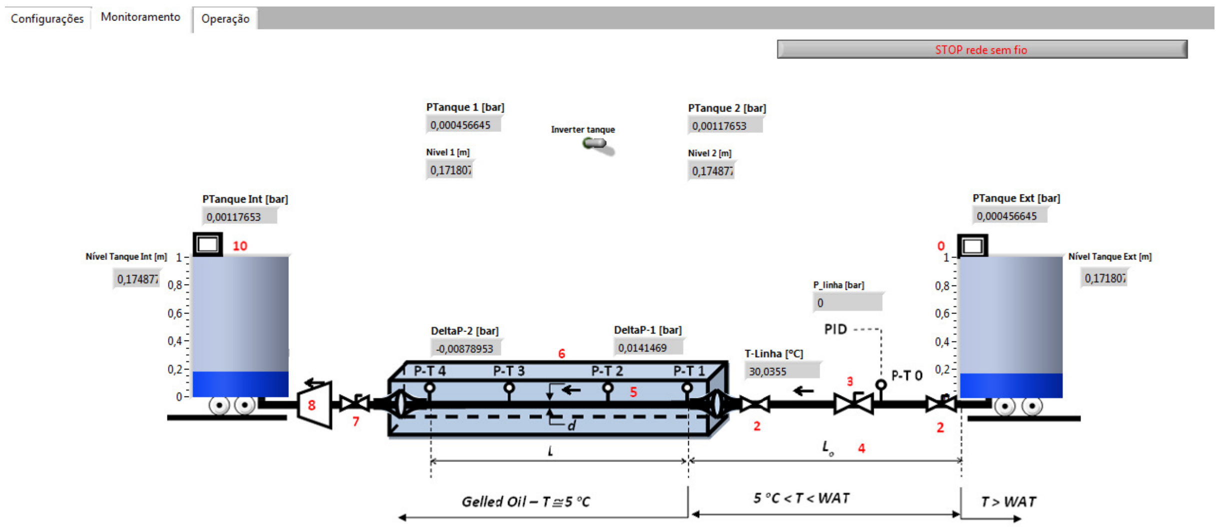

Figure 3.9. Front panel used for monitoring the experiments.

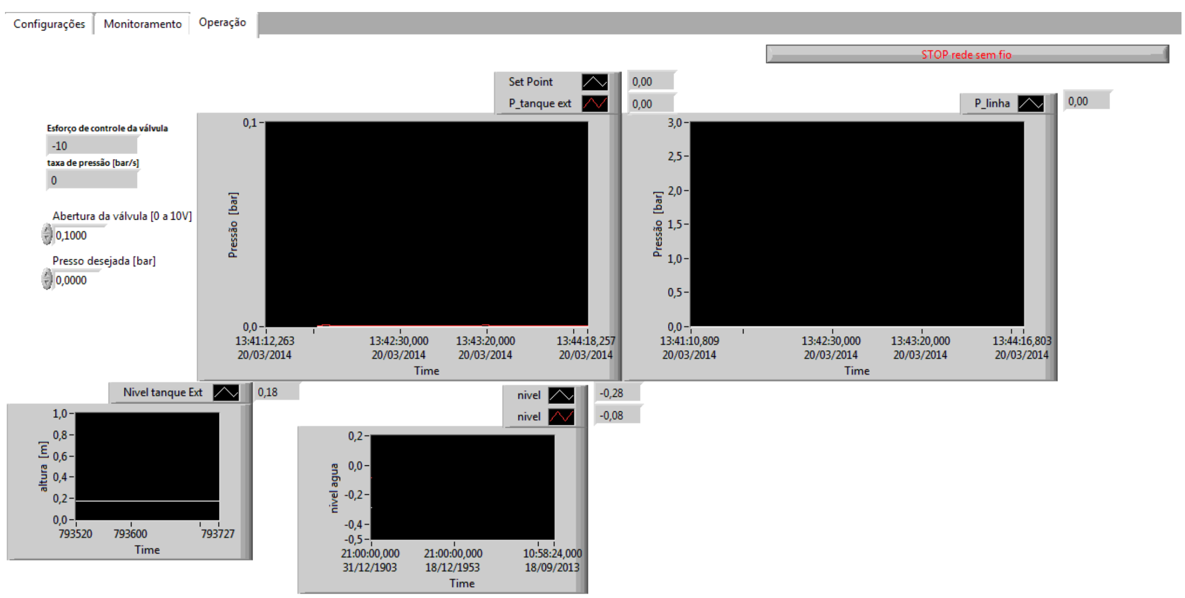

Figure 3.10. Front panel used to control and set the pressure of the external tank.

3.3.2 Tests Procedure

For all restart tests the procedure were nearly the same. The external tank filled with waxy crude oil (inner tank empty) was heated for 2 hours at 70°C and kept under stirring ensuring a good homogenization of the waxy crude. In parallel, the water bath was kept at 50°C, heating the test section. Following, all the valves that connect the external tank, the test section and the inner tank were opened and the section test was filled with waxy crude oil, until the oil levels in both tanks were equal. To ensure the complete occupation of oil in the pipeline, the valves in the top of the tanks were kept open to atmosphere, allowing the oil to flow slowly and occupy the entire pipeline.

The temperature of the water bath was then cooled to 5°C at a cooling rate of 0.3°C/min. Reaching this temperature, the gel was aged for the chosen period of time (5 or 24 hours).

Although the protocol above was the same, there were three different procedures in those tests; the difference between them was the boundary condition of the oil during the cooling.

3.3.2.1 First Procedure

After the oil had filled up the pipeline, the valves between the tanks were kept open and the valves in the top of the tanks were kept open to atmosphere for the hole cooling and aging time, in this case 24 hours, and then the lower pressure controllable was applied, the set value was 0,01 bars and the oscillations were of 0,005 bar.

This procedure was the easiest one to do, because during the whole cooling down and aging time, there was no valve control, since all the valves were open, and consequently the fluids stood at atmospheric pressure.

3.3.2.2 Second Procedure

Once the pipeline was filled, the valve in the end of the cooling bath was closed, and then, the pressurization system was activated to apply 15 bar of pressure during the cooling and aging time, after the 24 hours of aging time, the pressure was released slowly and then the restart test was done.

Since there is a hydrostatic pressure in the fluid at the bottom of the sea when the production stops, the second procedure was applied to eliminate the influence of shrinkage during the cooling down and aging time.

3.3.2.3 Third Procedure

The most realistic procedure would be to do the experiment under pressure the entire time. The whole system was kept at 5 bars for filling up, cooling and aging time. In this case, there was a problem in controlling the pressure, since the pressurization system is only in the external tank, there was no way to control the pressure in the internal tank, for this reason the test was done only for 5 hours of aging time. Restart was done with ΔP, where the difference between the external tank and the internal tank was around $0{,}01$ bar.

4 PROBLEM STATEMENT AND SIMULATION

Consider a horizontal pipeline filled with waxy crude gel under rest at uniform pressure and temperature, the pressure is applied in the inlet and the end is opened to the atmosphere. The equation (4.1) represents initial and boundaries condition of the problem.

$$\begin{gathered} t = 0, x \geq 0: p = p_0 = constant;\ u = 0. \\ t > 0, x = 0: p = p_f = constant. \\ t > 0, x = L: p = p_0 = constant. \end{gathered} \tag{4.1}$$

Analysing fluid motion, it is possible take one of two paths: seeking an estimate of gross effects (mass flow, induced force, energy change) over a finite region or control volume, or seeking the point by point details of a flow pattern by analysing an infinitesimal region of the flow, mathematically, the partial differential equations (PDE). In this study, the second option was the path chosen. General Navier-Stokes equations, Equation (4.2), and a general differential equation for conservation of mass, Equation (4.3), were considered to allow the generalization of the analysis.

$$\rho \frac{Du}{Dt} = \nabla p + \rho f \tag{4.2}$$

$$\frac{\partial \rho}{\partial t} + \nabla.(\rho u) = 0 \tag{4.3}$$

The start-up problem of waxy crude has a domain of small velocities, if the oil has high velocities it has already restarted to flow. Therefore, a Stokes flow has been considered, which means that the advective inertial forces are considerable smaller than the viscous forces.

One important observation is that the crude’s compressibility is small; hence, it is reasonable to consider the fluid as weakly compressible. This means that the compressibility is considered only in mass conservation, as discussed by Vinay *et al.*, (2006).

Paraffin in the oil would lead to a non-linear rheological behaviour, this is treated carefully in the mathematical approach, since a generic solution is the goal, the solution described below will not enter precisely on the rheology, but it allows the rheology to be implemented, as shown by Guersoni *et al.,* (2013).

The solution for the problem was based on the method of finite differences, and an algorithm was built on *Matlab*® to verify the model with the experimental data.

4.1 Stokes Flow

Navier-Stokes equations are nonlinear since the substantial derivative contains an order two homogeneous term. Only in exceptional cases, such as steady laminar flow between parallel infinite plane walls or in an infinite circular pipe (Poiseuille flows), will the nonlinear terms vanish from these equations (Kim and Karrila, 2013).

The class of "solvable problems" is expanded when the nonlinear terms are neglected. The linearized Navier Stokes equations for steady motion are known as the creeping motions or Stokes equations, and these are obtained by neglecting the substantial derivative in the Navier-Stokes equations (Kim and Karrila, 2013). In other words, Stokes-Flow is defined as a flow where the advective inertial forces are neglected compared to viscous forces, and it is characterized by a low Reynolds number (Re<<1).

To verify that the problem has a low Reynolds Number, we calculated for the case where Luthi (2013) obtained the highest Reynolds number, therefore, the worst scenario for a consideration of Stokes flow. With that calculation will be possible to consider if the dimensionless number is low enough in all cases. The Apparatus's geometry described before, and repeated here for convenience: the diameter of the pipeline is $d_p = 0{,}0254\, m$ and the diameter of the tanks is $d_t = 0{,}255\, m$. There is no velocity sensor, but in the tanks there is a level sensor. The highest speed measured in the tank was $v_t = 0{,}0052\, m\, s^{-1}$ and using a simplifying continuity equation to an incompressible Newtonian fluid for this basic consideration, the velocity in the pipeline is: $v_p = 0{,}52\ \ m\, s^{-1}$. Figure 4.1 shows the restart results published by Luthi (2013).

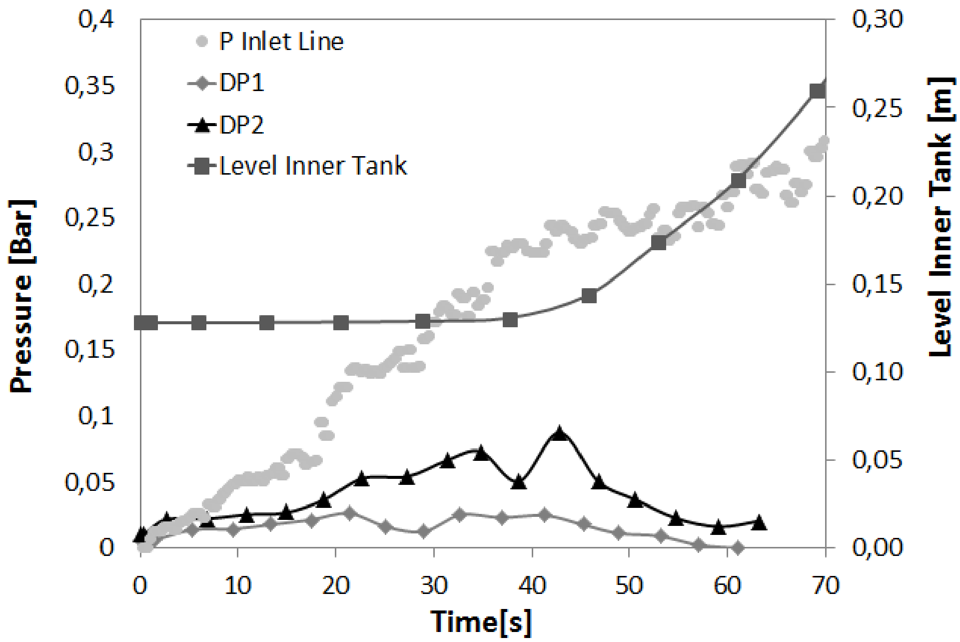

Figure 4.1. Startup experiment (Luthi, 2013).

Density considerably changes with temperatures. Luthi (2013) worked with the same oils, and the density at 4 °C is $\rho = 901\ kg\ m^{-3}$ for the Oil 2 as shown in Table 4.1.

Table 4.1. Density variation with temperature (Luthi, 2013).

Temperature (°C)	Density (kg/m3)
40	873
20	888
15.56	892
10	896
4	901
°API	27.2

The apparent viscosity is directly related to the shear rate when studying with complex fluids. A reasonable consideration for the start-up problem is: the shear rate would not be higher than $\dot{\gamma} = 0{,}1 s^{-1}$. The variation of viscosity with shear rate was also studied by Luthi

(2013) and the viscosity goes down to $\eta = 500\ Pa.s$, when the shear rate is $0.1\ s^{-1}$. Figure 4.2 shows the steady state curve for Oil 2.

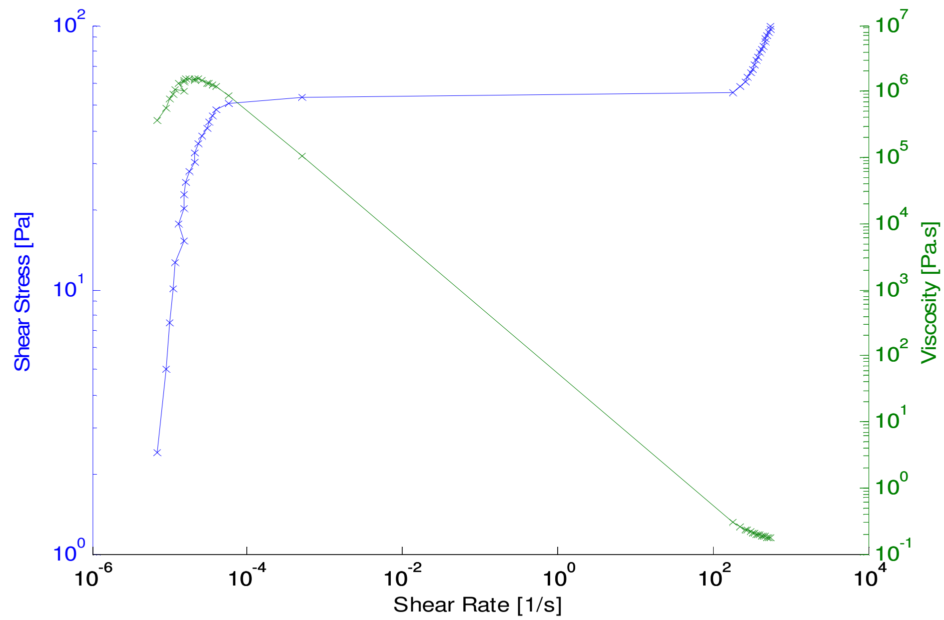

Figure 4.2. Steady state experimental curve for Oil 2 (Luthi, 2013).

All the consideration for this calculation is the worse example, for the other cases the Reynolds number is lower, the viscosity is considered the smaller obtained in the flow curve and the velocity is considered the higher.

$$Re = \rho v \frac{d}{\eta}$$

After these observations, we can calculate the Reynolds number, expressed in Equation 0: Re=0,024. This result allows considering the restart process as a Stokes flow and consequently neglecting all the advective inertial forces.

4.2 Continuity Equation

Starting from the general differential equation for conservation of mass, also known as continuity equation, Equation (4.3) and considering the Stokes flow, it possible to neglect the convective term. The result is shown in Equation (4.4):

$$\frac{\partial \rho}{\partial t} + \rho \nabla.(v) = 0 \tag{4.4}$$

The next consideration is the isothermal compressibility. As has been discussed before, the crude stays in the pipeline for some time before the restart, hence, the consideration that the oil is at a constant temperature during the restart process. Equation (2.2) can be rewrite to (4.5):

$$c = \frac{1}{\rho}\left(\frac{d\rho}{dP}\right)_T \tag{4.5}$$

An algebraic manipulation on Equation (4.4) and Equation (4.5) can result in Equation (4.6).

$$c\frac{\partial p}{\partial t} + \nabla.(v) = 0 \tag{4.6}$$

Finally, to verify a simplistic behaviour of the system and, considering the pipeline diameter reasonably small relative to the length, it was considered a one-dimensional problem. The Equation (4.7) is the final continuity equation used to simulate the pipeline.

$$c\frac{\partial p}{\partial t} + \frac{\partial v}{\partial x} = 0 \tag{4.7}$$

4.3 Momentum Equation

Starting from the general equation of Navier Stokes, Equation (4.2), considering a Stokes flow, and neglecting the inertial convective terms, the result is shown in Equation (4.8)**:**

$$\nabla \mathrm{p} + \rho f = 0 \tag{4.8}$$

The isothermal compressibility for a weakly compressible fluid is only considered in the continuity equation, so the last considerations are horizontal pipeline, resulting in a null field term, one-dimensional and the normal stress is considered negligible to the shear stress ($\tau_{xx} \ll \tau_{rx}$), resulting in Equation (4.9).

$$\frac{\partial p}{\partial x} = -\frac{2\tau_w}{R} \tag{4.9}$$

4.4 Final Equations

Guersoni *et al.* (2013) has developed a simplified solution for the restart problem, it begins by taking the derivative term from the simplified equation of conservation of momentum Equation (4.9), shown in Equation 0.

$$\frac{\partial^2 p}{\partial x^2} = -\frac{2}{R}\left(\frac{\partial \tau_w}{\partial v}\right)_t \frac{\partial v}{\partial x}$$

Applying the continuity Equation (4.7) in Equation 0 the result is a diffusion equation for the pressure, shown in Equation 0.

$$\frac{\partial p}{\partial t} = \kappa \frac{\partial^2 p}{\partial x^2}$$

The diffusion coefficient is non-linear. Here the rheology can be implemented. Equation (4.10) shows the term of the derivative of the velocity with the shear stress.

$$\kappa = \frac{R}{2c}\left(\frac{\partial v}{\partial \tau_w}\right)_t \qquad (4.10)$$

Parameter κ translates into a single term the combined effects of compressibility and rheological behaviour of the fluid. The pressure diffusion process can be explained in the following terms: pressure signals propagate at a speed related to fluid's compressibility, but their amplitude is damped by the fluid's viscosity (Guersoni *et al.,* 2013).

For a weakly compressible Newtonian fluid, since inertia is negligible, a parabolic velocity profile can be assumed in the pipe cross section. Thus:

$$\tau_w = \frac{4\eta v}{R} \qquad (4.11)$$

$$\kappa = \frac{R^2}{8\eta c} \qquad (4.12)$$

With the diffusion coefficient for a Newtonian fluid, shown in Equation (4.12), the Equation (4.9) becomes linear and its solution, satisfying the boundary conditions described by Equation (4.1), can be expressed in analytical form, shown in Equation (4.13):

$$p(x,t) = p_f - (p_f - p_o)\,\frac{Erf\left(\frac{x}{2\sqrt{\kappa t}}\right)}{Erf\left(\frac{L}{2\sqrt{\kappa t}}\right)} \tag{4.13}$$

The velocity can also be expressed in analytical form, shown in Equation (4.14):

$$v(x,t) = \frac{R^2(p_f - p_o)}{8\sqrt{\pi}\mu}\frac{e^{-\frac{x^2}{4\kappa t}}}{\sqrt{\kappa t}Erf\left(\frac{x}{2\sqrt{\kappa t}}\right)} \tag{4.14}$$

The procedure described here was done by Guersoni *et al.* (2013). There is another example for a Herschel Bulkley fluid, Equation (2.10), where the solution is not analytical, but it demonstrates how to apply the rheology in this modelling.

4.5 Numerical Procedure

The PDE obtained has been named as diffusion like equation because this is the classic equation for a group of differential equations called Parabolic Partial Differential Equations. Parabolic PDE’s occur when propagation problems include dissipative mechanisms, such as viscous shear or heat conduction. The incorporation of dissipative mechanism also implies that even if the initial conditions include a discontinuity, the solution in the interior will always be continuous (Sirinivas and Fletcher, 1992).

To convert the PDE to a system of algebraic equations, the method of finite differences was applied. The discretization process can be demonstrated by considering the Equation 0, repeated here for convenience, and replacing the derivatives by equivalent finite difference expressions.

$$\frac{\partial p}{\partial t} = \kappa\frac{\partial^2 p}{\partial x^2} \tag{0}$$

$$\frac{p_j^{n+1} - p_j^n}{\Delta t} = \kappa\frac{p_{j-1}^n - 2p_j^n + p_{j+1}}{\Delta x^2} \tag{4.15}$$

The step sizes Δt and Δx and the meaning of the subscript *j* and superscript *n* are better explained from the Figure 4.3.

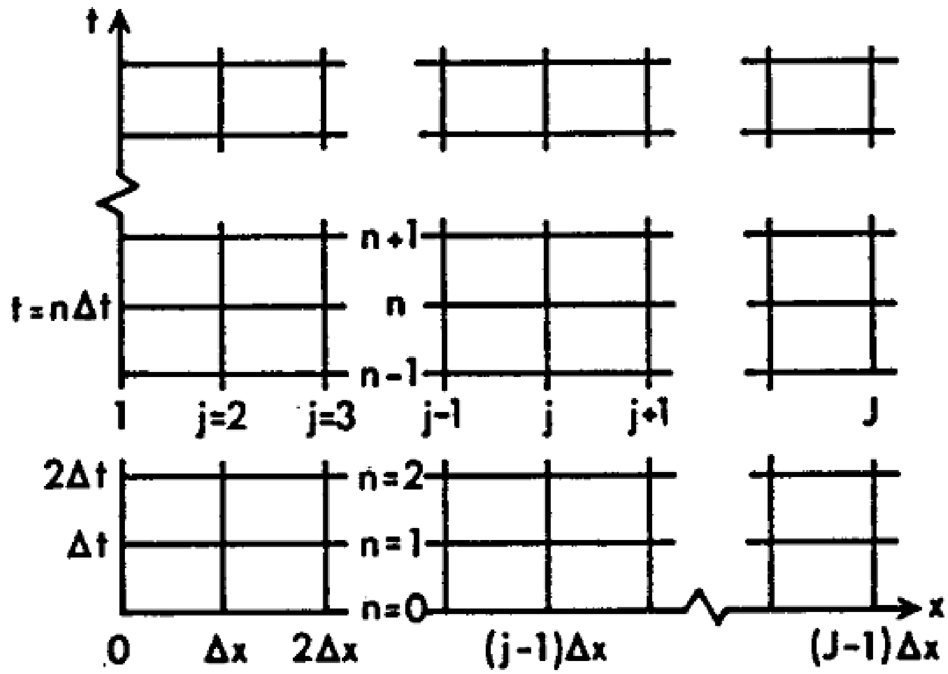

Figure 4.3. The discrete grid (Sirinivas and Fletcher, 1992).

Before proceeding further with the method of solving the partial differential equation, it is worthwhile to discuss the features of a well-posed problem. The governing equation and the initial and boundary conditions are well-posed mathematically if these conditions are found: the solution exists, is unique and depends continuously on the auxiliary (Initial and boundary conditions) data.

The first two criterions do not need any explanation. The third criterion requires that a small change in the initial or boundary conditions should provoke only a small change in the solution. The auxiliary conditions are often introduced approximately in a typical computational algorithm. Consequently, if the third condition is not found, the errors in the auxiliary data will propagate into the interior causing a fast solution grow (Sirinivas and Fletcher, 1992).

Computational algorithm is typically constructed from the governing PDE and must be stable in order for the above criterions to be met. Therefore, for a well-posed computation, it is necessary that not only should both the underlying PDE and auxiliary conditions be well-posed but also the algorithm should be stable. The initial and boundary conditions for this problem have already been well-posed and can be seen in Equation (4.1). The necessary discussion is the stability of the algorithm.

Von Neumann stability analysis is the most commonly used method of determining stability. It can only be used in linear initial value problems with constant coefficients, which is the condition for the weakly compressible Newtonian fluid case (Sirinivas and Fletcher, 1992). The analysis is based on the Fourier decomposition of numerical error. For an explicit method, the criterion of stability is shown in Equation (4.16).

$$s = \frac{k.\Delta t}{\Delta x^2} \leq \frac{1}{2} \tag{4.16}$$

A discretization of the pipeline that would have a small error comparing with the analytical solution and would not create a grid that rises the computational time substantially is the goal of the analysis. The distance $\Delta x = 0{,}15\ m$ and the time $\Delta t = 0{,}0045\ s$ for a weakly compressible Newtonian fluid with viscosity obtained from the flow curve, Figure 4.2, $\mu = 500\ Pa.s$ and the compressibility, that will be presented on the results section, $8{,}5\ 10^{-8}\ Pa^{-1}$, accomplish the goal. The comparison between the analytical solution and the numerical solution can be seen for a step of $P = 1500\ Pa$ at $t = 0$ on Figure 4.4.

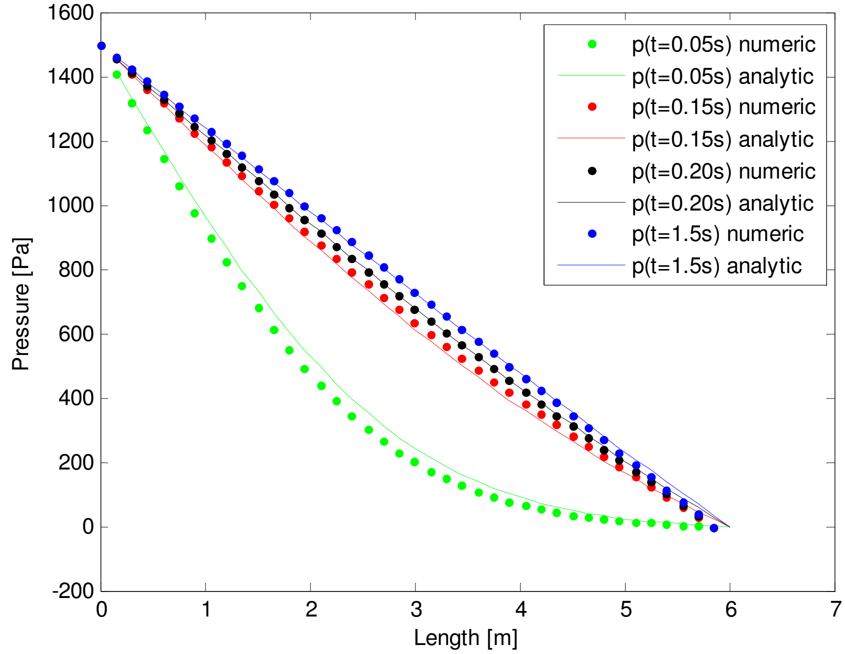

Figure 4.4. Pressure propagation during restart, Analytic solution vs Numeric solution.

In this case, from Equation (4.12), k=0,4744 m^2/s. Then, the stability condition, showed in equation (4.16) is: s=0,0949<0,5. Hence the von Neumann Criteria applies, and the model is stable in the entire domain.

5 RESULTS AND DISCUSSIONS

5.1 Crudes' Characterization

DSC result for Oil 1 and Oil 2 are shown in Figure 5.1 and Figure 5.2 respectively. For both oils the WAT is around 42°C. The results represent that the wax precipitated at that temperature. This test was done to prove that the temperatures at the bottom of the sea and in the experiments were low enough to have precipitated crystals in these oils.

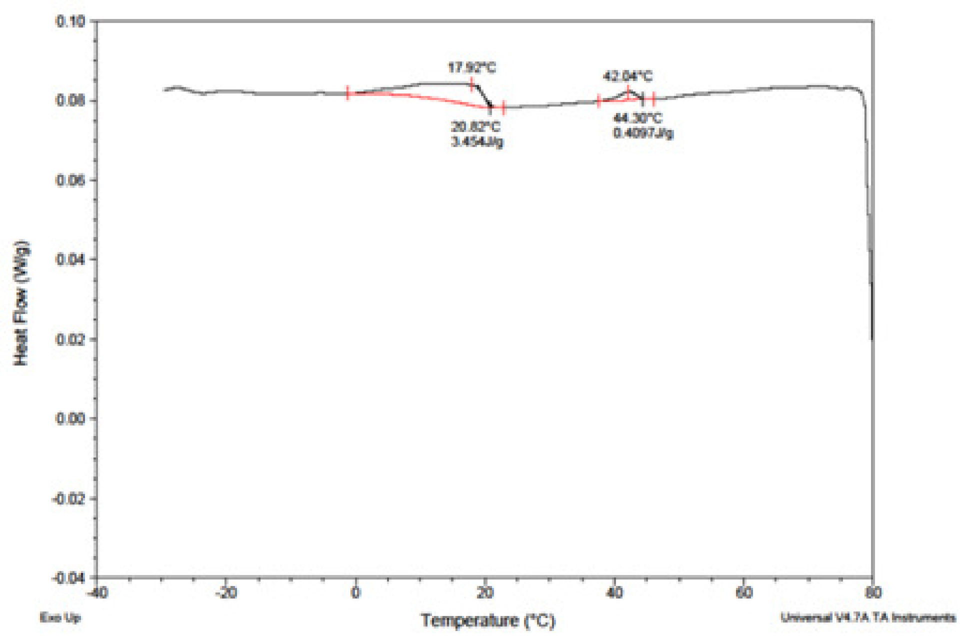

Figure 5.1. DSC for the oil 1.

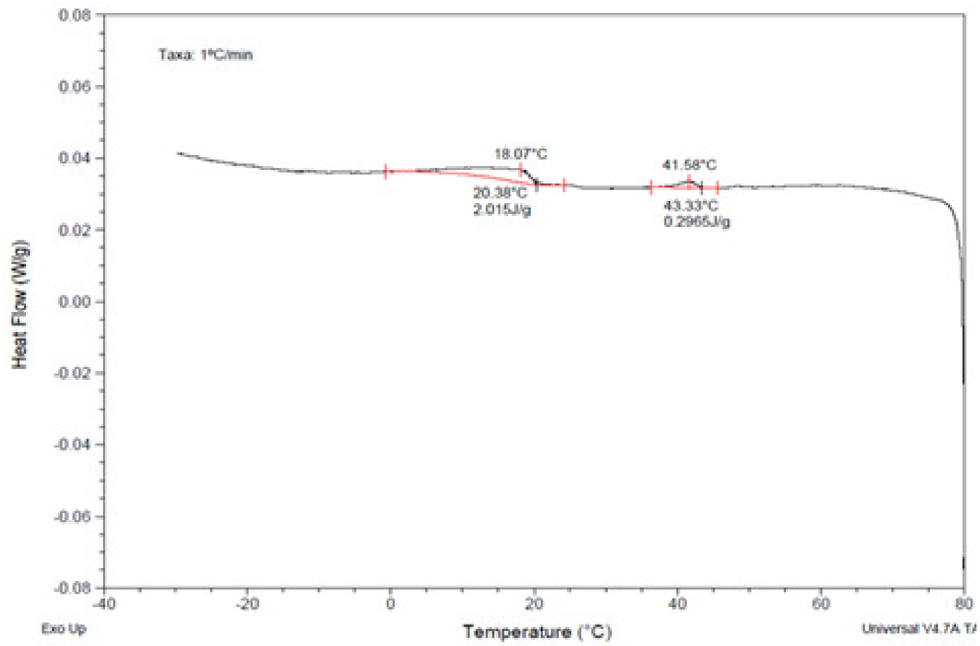

Figure 5.2. DSC for the oil 2.

The first peak corresponds to the WAT, while the second one is another crystallization event (de Oliveira *et al.,* 2012). The high values obtained for the WAT are mainly due the amount of wax present in the composition of the crude oils (Oseghale *et al.,* 2012).

The DSC test was done to prove that these oils would provoke a major problem for flow assurance at the bottom of the sea. Because the WAT is around 42 °C, and the water is around 5 °C, hence, the precipitation of paraffin will occur.

5.1.1 Compressibility

The results from the PVT cell show the compressibility measurements of the Oil 2 at 5°C, the data can be seen in Figure 5.3 for dead and live oil. In both cases the compressibility is very low. However, for live oil, the presence of dissolved light-ends decreases the formation of solids and therefore helps in increasing the compressibility of the mixture.

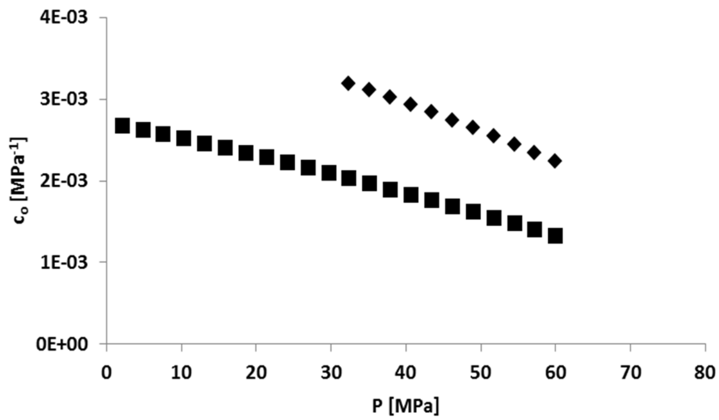

Figure 5.3. Compressibility for live (♦) and dead (■) Oil 2 at 5°C (Guersoni *et al.,*2013).

The compressibility was not measured for the Oil 1, as the compressibility is really small for dead oils; the consideration used in the simulation was that the compressibility of both the oils is the same.

5.1.2 Shrinkage

The results of the PVT cell can be seen in Table 5.1. The main result is that the dead oil shrinkage in about 5%.

Table 5.1. Results of the PVT cell for the oil 2 (Guersoni *et al.,*2013).

Temperature [°C]	Volume Live Oil [mL]	Volume Dead Oil [mL]
70	245.03	211.10
5	218.21	200.76
ΔV [mL]	26.82	10.34
ΔV [%]	10.9 %	4.9 %

The second experiment was done in the pipeline, and the results were done exclusively for the dead oils. They can be seen in Table 5.2.

Table 5.2. Results for the shrinkage on the pipeline for oil 1 and 2.

Crudes	Oil 1	Oil 2
Volume at 70 °C	515	430.5

Volume 5 Hours [mL]	505	421
Volume 24 Hours [mL]	503	420
ΔV [mL]	12	10.5
ΔV [%]	2.3 %	2.4 %

There is a big difference of the results from Table 5.1 to Table 5.2. The difference is because not all the oil was cooled to 5 °C. Even with the oil in the tanks staying at atmospheric temperature, there is a reasonable shrinkage on the oil. If considered that only the oil in the pipeline had shrunk, the value would be around 16%, which is too much. There was no way to measure the shrinkage only in the pipeline, so this was considered reasonable to show that the shrinkage influences the process.

5.1.3 Amount of water

The Karl Fischer results for the Oil 2 can be observed in Table 5.3. The percentage of the initial water is high, but after the stabilization and removal of the water, this percentage decreased considerably. $S_1$and S_2; S_3 and S_4 are, respectively, the samples of Oil 2 before and after stabilizing and removing the water.

Table 5.3. Karl Fischer of the Oil 2.

Oil 2	Water (%)
S_1	24.9
S_2	23.0
S_3	0.8
S_4	2.7

Water in the oil could influence the interphase of the oil with the pipeline's wall, which would probably decrease the necessary pressure to restart the flow. This water influence could be seen as a decrease in the viscosity of the fluid.

5.1.4 Rheology

5.1.4.1 Flow Curve

The most classical rheological curve is the flow curve. Most of the terms in the model could be obtained by it. This steady-state curve represents the shear stress and viscosity as a function of the shear rate. The Figure 5.4 and Figure 5.5 are the experimental curves for Oil 1 and Oil 2, respectively, after 1 hour of aging time at 5 °C.

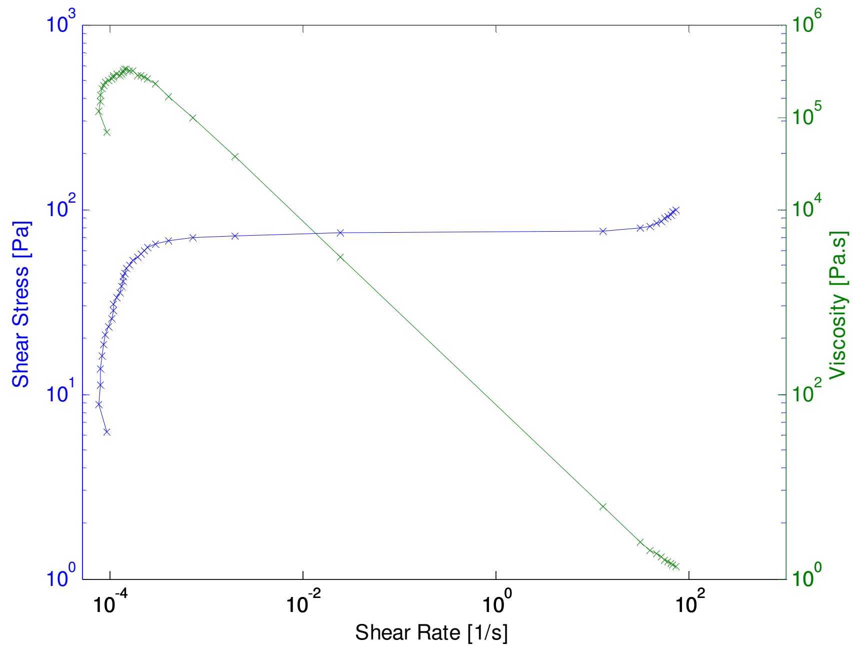

Figure 5.4. Flow curve for Oil 1.

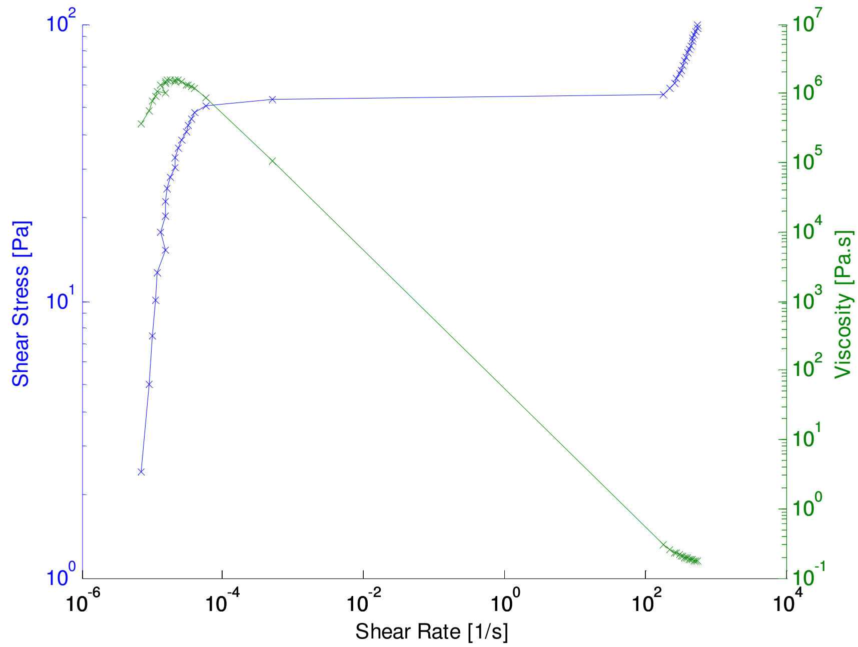

Figure 5.5. Flow curve for Oil 2 (Luthi, 2013).

It is possible to see that the initial viscosity of the Oil 2 is higher than the Oil 1. This was expected because the paraffinic percentage of the Oil 2 is higher and consequently would precipitate more crystals increasing the viscosity.

For the rheological model of de Souza Mendes and Thompson (2013) a few parameters are obtained from this curve. Adjusting the Herschel Bulkley model, Equation (2.10), by the least square method, the result can be seen in Figure 5.6 and Figure 5.7 respectively and the values in Table 5.4 and Table 5.5 respectively. There are another two parameters shown in those tables, they are the only ones that can be obtained exceptionally by the flow curve, according with de Souza Mendes and Thompson (2013).

The third row of those tables is the initial viscosity; it is obtained by the plateau of the viscosity at low shear rates. The experimental data shown in Figure 5.4 and Figure 5.5, does not show a real plateau. This is because of the error in the rheometer, therefore, we consider that the value is the maximum value of the viscosity.

The fourth row is the shear rate point where is assumed that the behaviour changes from solid-like to liquid-like. This was presented in the Equation (2.30), and can be observed in the Figure 5.6 and Figure 5.7 by the point where the simulation starts. Before the yield stress there is no shear rate.

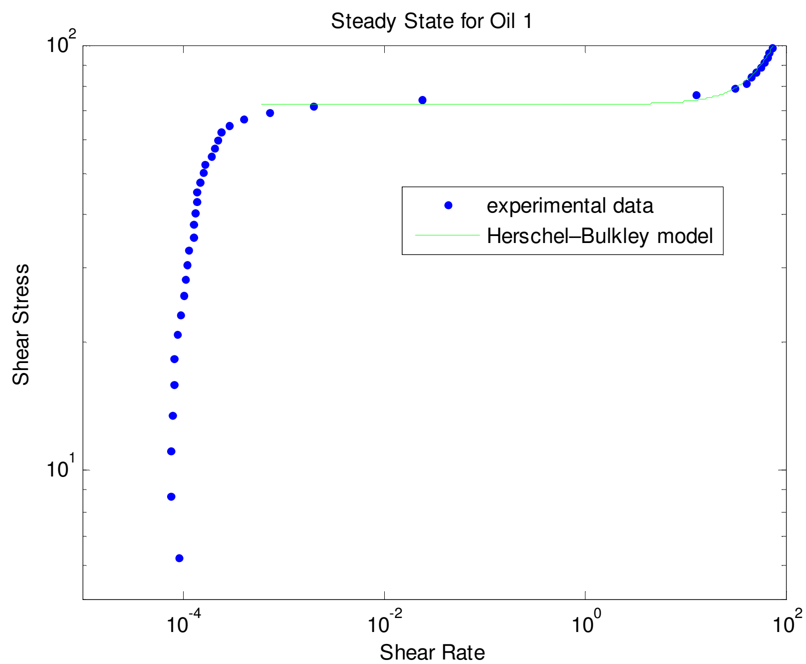

Figure 5.6. Steady-State shear stress experiments and Herschel-Bulkley simulation for Oil 1.

Table 5.4. Parameters obtained from the steady state test for Oil 1.

Parameters	Values	Units
K (Hershel-Bulkley)	2.07×10^{-2}	$Pa.s^n$
n (Hershel-Bulkley)	1.661	-
η_0	10^5	$Pa.s$
$\dot{\gamma}_{yd}$	6×10^{-4}	s^{-1}

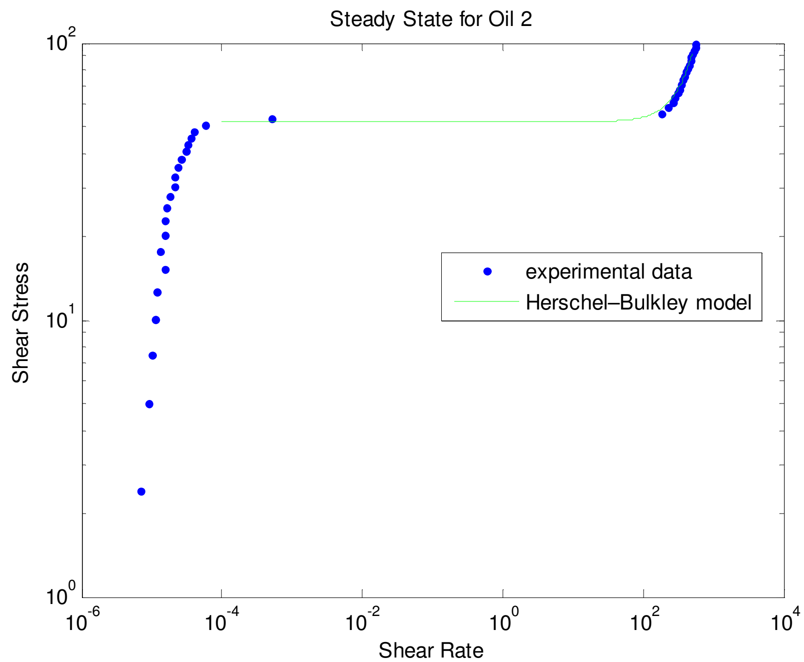

Figure 5.7. Steady-State shear stress experiments and Herschel-Bulkley simulation for Oil 2.

Table 5.5. Parameters obtained from the steady state test for Oil 2.

Parameters	Values	Units
K (Hershel-Bulkley)	0.32 x 10^{-3}	$Pa.s^n$
n (Hershel-Bulkley)	1.885	-
η_0	10^6	$Pa.s$
$\dot{\gamma}_{yd}$	10^{-4}	s^{-1}

In this point is really important to entry in a special discussion. The flow curve is not a stable curve based on what Luthi (2013) has shown and have been discussed in other studies (Chang *et al.,* 1998; de Souza Mendes, 2009). That is why all the others parameters are not obtained by it. Oscillatory tests are more reliable, so most of the parameters shall be obtained by those tests, as discussed by Chang *et al.* (1998); de Souza Mendes (2009) and Luthi (2013).

5.1.4.2 Oscillatory Tests

This is a popular technique used in the study of complex rheological materials. Usually the experiment is performed only in a linear region to record true viscoelastic properties (Chang *et al.,* 1988). The test was done with a fixed low frequency of 1 Hz and the responses of the linear and non-linear regions were measured. This process allows the study of the elastic response, in the linear region, and the yielding in the non-linear region. Figure 2.11 shows an oscillatory test and its theoretical behaviours, depending on the stress amplitude. The value of the plateau has been discussed and can be described by Equation (2.29). The Figure 5.8 shows the result for the Oil 2 and Table 5.6 show the values of the plateau depending on the aging time for the same oil.

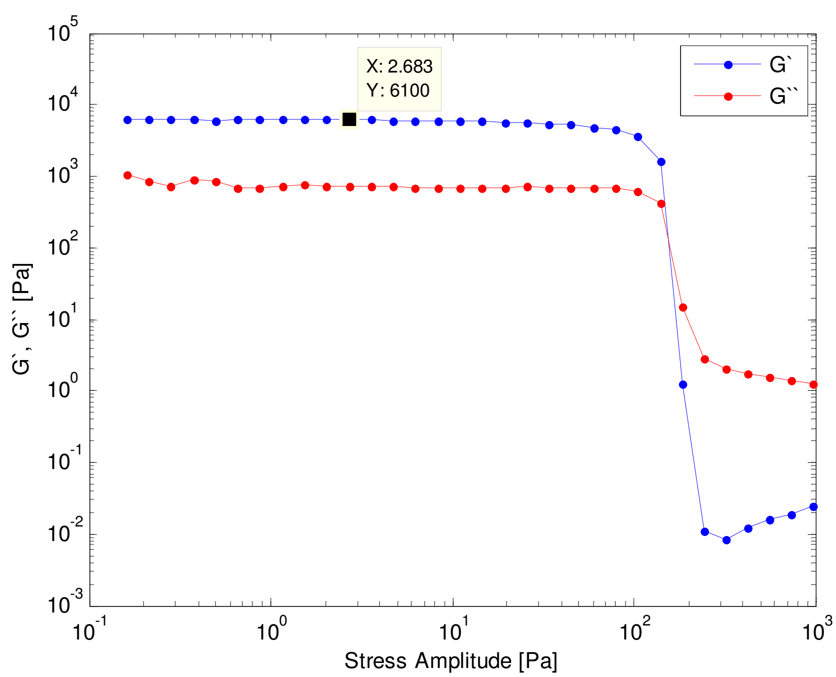

Figure 5.8. Oscillatory Test for Oil 2 and 24 hours of aging time at 5 °C.

Table 5.6. Storage Modulus values for the Oil 2.

Aging time	1 hour	5 hours	24 hours
Test	G_0 [Pa]	G_0 [Pa]	G_0 [Pa]
1	2262	4310	6100

2	1750	4141	8671
3	3000	4328	6792
Mean	2270.7	4259.7	7187.7

The static yield stress is the point where the transition occurs from solid-like to fluid-like. At this point the shear rate is $\dot{\gamma}_{yd}$, already discussed and obtained for both the oils in Table 5.4 and Table 5.5. The value of the stress can be obtained by the oscillatory test, and would be the point B in the Figure 2.11.

Table 5.7. Static yield stress obtained by Luthi (2013) for the Oil 2.

Aging time	1 hour	5 hours	24 hours
Test	τ_y [Pa]	τ_y [Pa]	τ_y [Pa]
1	150.5	121.7	210.1
2	124.2	128.5	158.4
3	91.3	156.0	187.8
Mean	122.0	135.4	185.4

As described by Equation (2.31) to calculate the viscosity when the structure is completely destroyed, the applied frequency, the dynamic shear stress and the plateau of the loss modulus are required. They can be obtained by the experiment shown in Figure 5.8. For 24 hour of Aging time the value of the purely viscosity is: 1.05 Pa.s.

5.1.4.3 Dynamic tests

The dynamic tests were done for both the oils. The Oil 1 was published by Badin (2012) and the Oil 2 was published by Luthi (2013). Figure 5.9 and Figure 5.10 are, respectively, the experimental data for Oil 1 and Oil 2 with one hour of aging time.

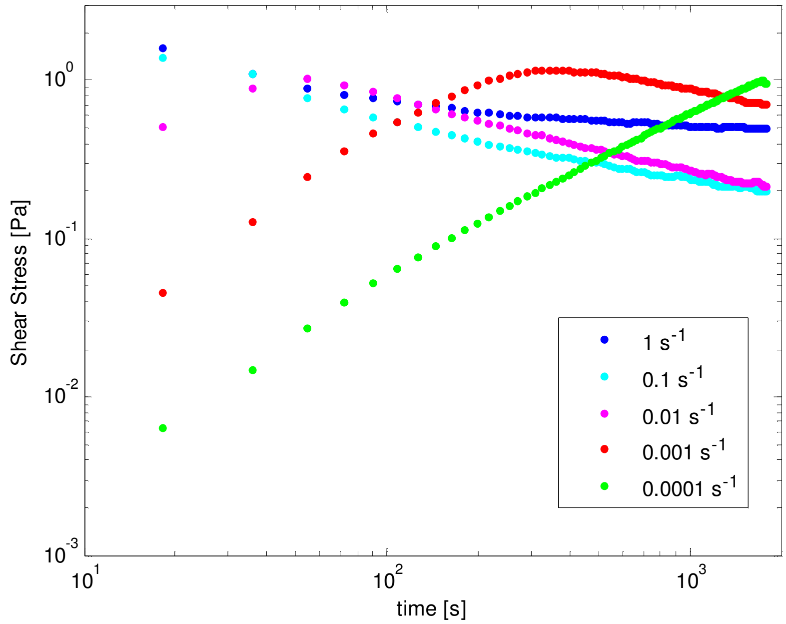

Figure 5.9. Dynamic test at constant shear rate for Oil 1 for 1 hour of aging time (Badin, 2012).

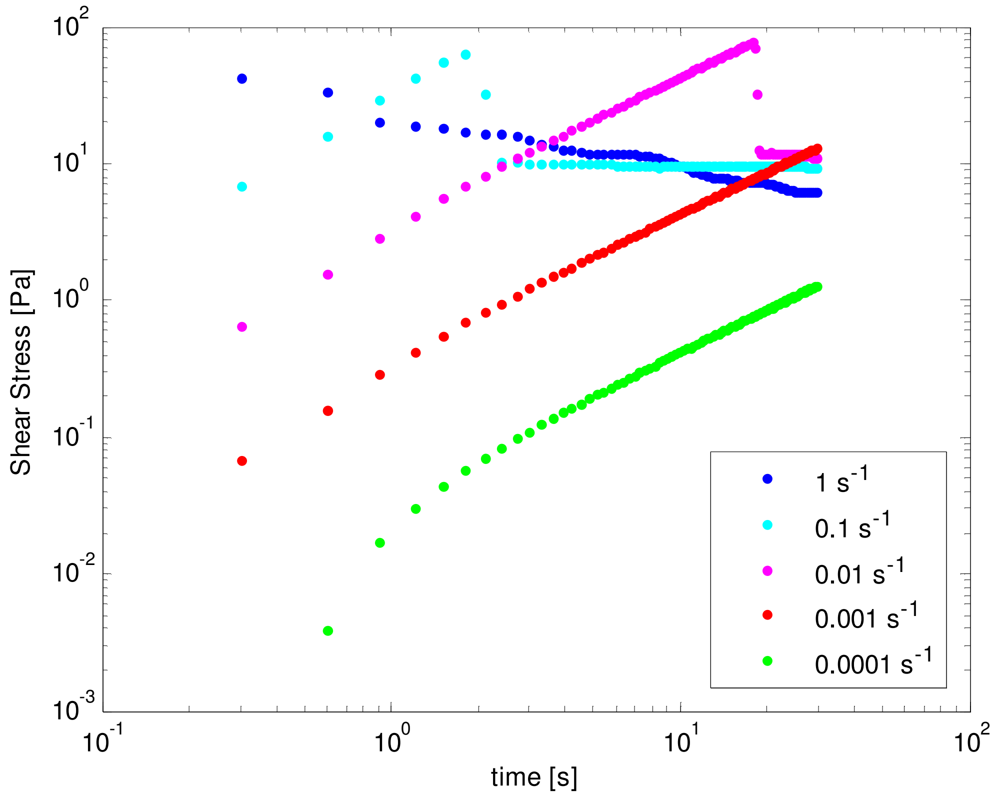

Figure 5.10. Dynamic test at constant shear rate for Oil 2 for 1 hour of aging time (Luthi, 2013).

Dynamic shear stress is the only physical parameter obtained from this procedure. The purely viscous stress is the result obtained when the structure has broken down, and it is represented by the plateau in the end of the experiment. Table 5.8 show the results.

Table 5.8. Purely viscous stress, for Oil 1 and Oil 2.

	Oil 1	Oil 2
τ_{yd} [Pa]	0.2	10

5.1.4.4 Generalization of de Souza Mendes and Thompson model

All the parameters are showed again in the Table 5.9 for the Oil 1 and Oil 2.

Table 5.9. All the physical parameter for Oil 1 and Oil 2 for 1 hour of aging time.

Parameters	Oil 1	Oil 2	Units

η_∞	0.1	1.05	$Pa.s$
τ_y	8	122	Pa
τ_{yd}	0.2	10	Pa
G_0	100	2200	Pa
K	2.069×10^{-2}	0.32×10^{-3}	$Pa.s^n$
n	1.661	1.885	-
η_0	10^5	10^6	$Pa.s$
$\dot{\gamma}_{yd}$	6.10^{-4}	10^{-4}	s^{-1}

With all those physical parameters, the next step is to obtain the values of the empirical ones, which would allow the simulation of the results. The first step after the algorithm was build was to verify if the the results were the same as in the literature. Therefore, simulation was done first with all the data from the literature, the empirical parameters are described in Table 5.10.

Table 5.10. Empirical parameters from the literature (de Souza Mendes, 2012).

Parameters	Values	Units
m	1	–
a	1	–
b	1	–
t_{eq}	100	s

Euler's numerical method was used to solve the differential equations. The simulation was made with the parameters described in de Souza Mendes and Thompson (2013). Figure 5.11 shows the exact behaviour obtained in the literature in the time evolution of the stress for constant shear rates. The continuous line is the simulation for an initial viscosity of $\eta_0 = 10^7\ Pa.s$ while the non-continuous line is for an infinity initial viscosity $\eta_0 = 10^{300}\ Pa.s$. The simulation with a constant shear stress was also made, and the results were the same too.

The axes in Figure 5.11 are dimensionless numbers also presented by de Souza Mendes and Thompson (2013).

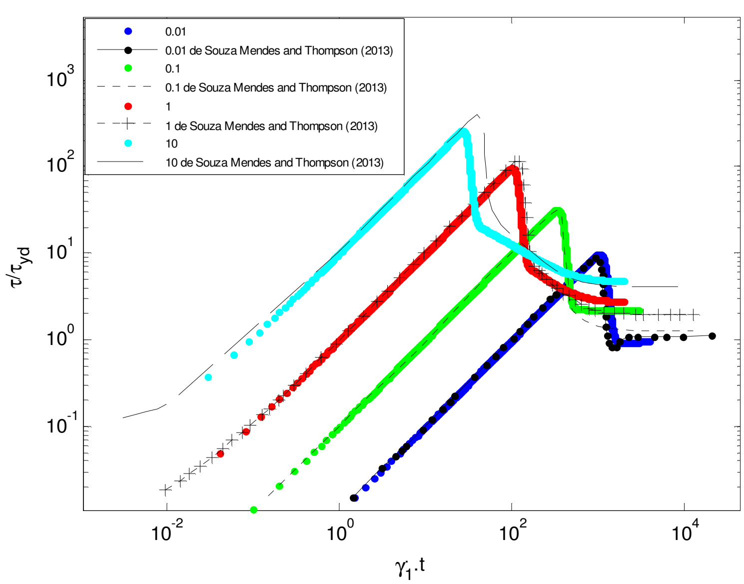

Figure 5.11. Time evolution of the stress for constant shear rate flows, finite and infinite initial viscosity.

After obtaining the same result, we consider the algorithm coherent and used it for all the calculation described from now on. The results with the empirical parameter from the literature can be observed in Figure 5.12. The experimental data does not fit with the simulation results.

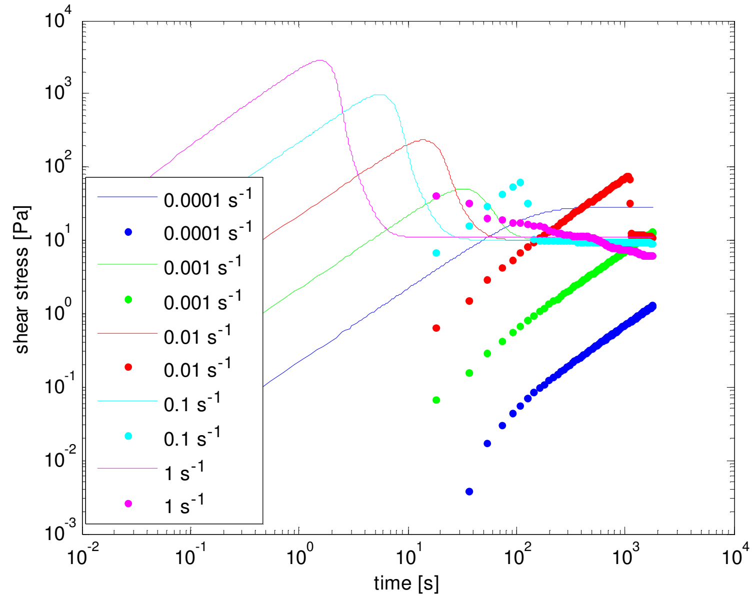

Figure 5.12. Experimental and simulation using the empirical parameters by de Souza Mendes and Thompson (2013) for Oil 2.

To show that the empirical parameters could not predict the experimental data, simulations were done in a big domain for each of the parameters. To allow a visualization of the situation, Figure 5.13, Figure 5.14, Figure 5.15 and Figure 5.16 show the behaviour of the model by changing one parameter at a time while the others were kept constant at each of the value showed in Table 5.10.

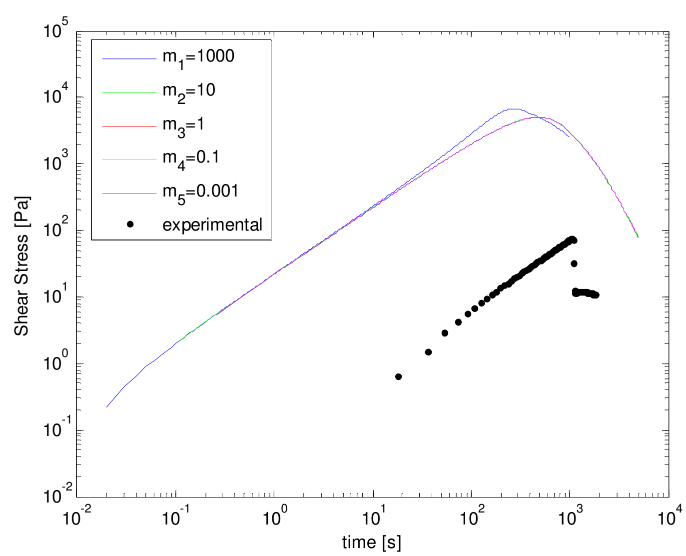

Figure 5.13. Analysis of the influence of the empirical parameter “m”.

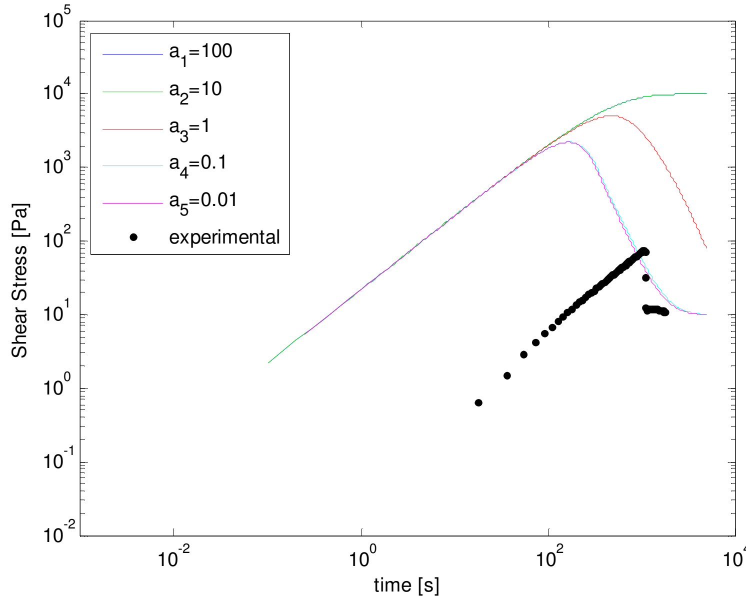

Figure 5.14. Analysis of the influence of the empirical parameter “a”.

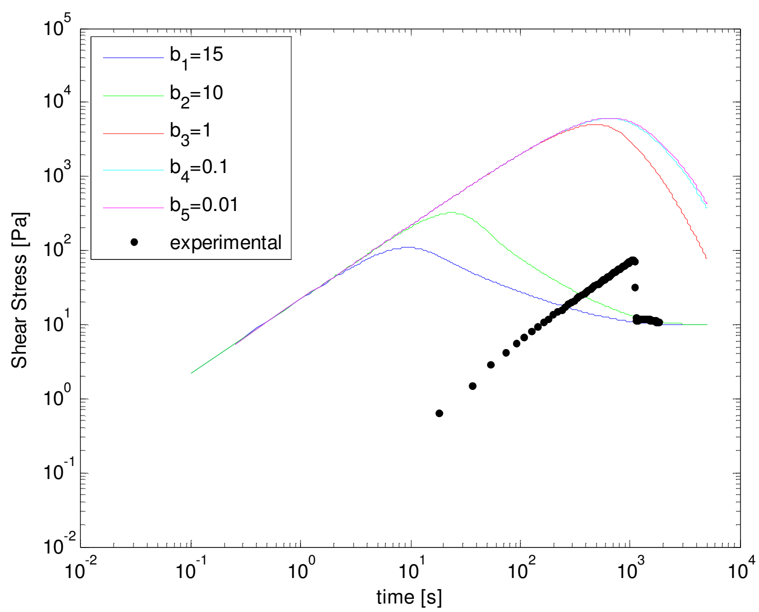

Figure 5.15. Analysis of the influence of the empirical parameter “b”.

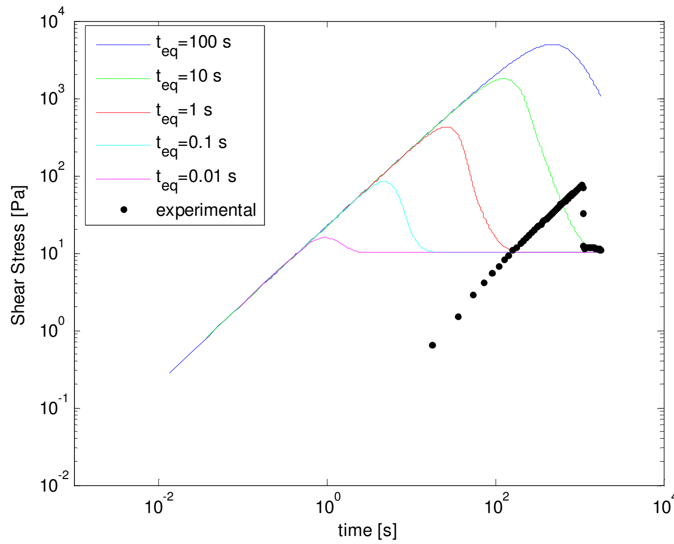

Figure 5.16. Analysis of the influence of the empirical parameter "t_{eq}".

As showed, none of the empirical parameters could delay the whole curve to fit the experimental data. That is because none of them influences the elastic behaviour directly.

Considering that the elastic behaviour is controlled by the storage modulus, which is a physical parameter, one way to influence the model is to add an empirical parameter in the equation of the elastic behaviour. Thus, the whole actual behaviour would be kept and the shear stress slope could also change with time. This is an solution based exclusively in the empirical data of the rheometer, we could not find, yet, an physical explanation for the reason why the storage modulus and the variation of the structure parameter, as has been presented, could not predict the data.

The reason that this generalization does not breaks the physical meaning of the equation is that the elastic behaviour is still directly proportional to the storage modulus, although it is no longer the only parameter. In other words, the spring constant has decreased, and the elastic response to the stress is not as strong, as proposed by de Souza Mendes and Thompson (2013).

The most generic solution would be to add one parameter, and the solution would be as shown in Equation (5.1).

$$G_s = \left(\frac{G_0}{m_{new}}\right) e^{m_{old}\cdot\left(\frac{1}{\lambda}-\frac{1}{\lambda_0}\right)} \tag{5.1}$$

The final equation proposed in the present study is not the Equation (5.1) though, in our case, the influence of parameter "m_{old}" can be held by parameters "a" and "b", as can be seen in Figure 5.13, Figure 5.14 and Figure 5.15.

Hence, we reformulated the Equation (5.1) removing parameter "m_{old}". The final result can be seen in Equation (5.2). This has been done because one of the main comparisons about all the models is how many empirical parameters they have. One of the best aspects about the model proposed by de Souza Mendes and Thompson (2013) is the reduced number of them.

$$\mathrm{G_s} = \left(\frac{\mathrm{G_0}}{\mathrm{m}}\right) \mathrm{e}^{\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)} \tag{5.2}$$

5.1.4.5 Final model, results and errors

All the equations are rewritten here for facility.

$$\frac{\theta_2}{\eta_\infty}\left(\frac{\tau}{\theta_1} + \dot{\tau}\right) = (\dot{\gamma} + \theta_2\ddot{\gamma}) \tag{2.25}$$

$$\theta_1 = \left(1 - \frac{\eta_\infty}{\eta_v(\lambda)}\right)\frac{\eta_v(\lambda)}{G_s(\lambda)} \tag{2.26}$$

$$\theta_2 = \left(1 - \frac{\eta_\infty}{\eta_v(\lambda)}\right)\frac{\eta_\infty}{G_s(\lambda)} \tag{2.27}$$

$$\eta_v(\lambda) = \eta_\infty e^{\lambda} \tag{2.30}$$

$$\lambda_{eq} = \ln\left(\frac{\eta_{eq}}{\eta_\infty}\right) \tag{2.22}$$

$$\eta_{eq}(\dot{\gamma}) = \left(1 - e^{\frac{\eta_0 \cdot \dot{\gamma}}{\tau_y}}\right)\left(\frac{\tau_y - \tau_{yd}}{\dot{\gamma}} e^{-\frac{\dot{\gamma}}{\dot{\gamma}_{yd}}} + \frac{\tau_{yd}}{\dot{\gamma}} + K\,\dot{\gamma}^{n-1}\right) + \eta_\infty \tag{2.24}$$

$$\frac{d\lambda}{dt} = \frac{1}{t_{eq}}\left[\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)^a - \left(\frac{\lambda}{\lambda_{eq}(\tau)}\right)^b \left(\frac{1}{\lambda_{eq}(\tau)} - \frac{1}{\lambda_0}\right)^a\right] \tag{2.33}$$

$$\mathrm{G_s} = \left(\frac{\mathrm{G_0}}{\mathrm{m}}\right) \mathrm{e}^{\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)} \tag{5.2}$$

After solving the algorithm with the new equation, the results are more coherent with the experimental data. Figure 5.17 and Figure 5.18 show that all the elastic behaviour is better predicted by the new model. The steady state shear stress is also predicted. The main point then is the discussion about the maximum stress value, also called overshoot.

The first discussion needed is the sudden break down of the stress, this is considered to be an adhesive failure (Lee, 2008) and not a cohesive failure (breakdown of the structure), which is the basis of the modelling. The point is: regardless the way the breakdown occurs, the model has to predict the restart. In that sense, the results are good. The model does not predict an adhesive failure, but it comes quite close to the results.

The values of the empirical parameters were calculated by a least square method. The final results can be seen in Figure 5.17 and Table 5.11 for Oil 1 and Figure 5.18 and Table 5.12 for Oil 2.

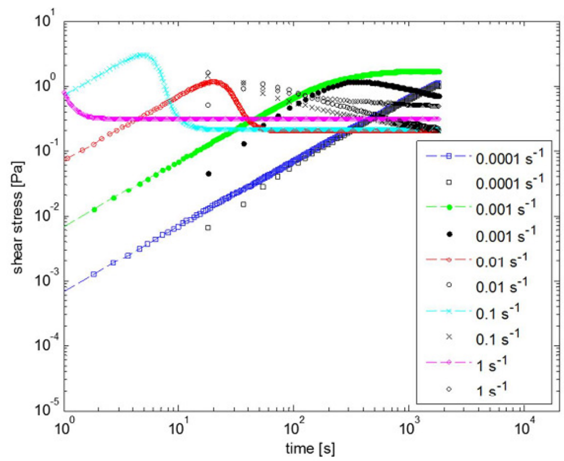

Figure 5.17. Stress evolution, for Oil 1 and 1 hour of aging time, for breakdown experiments.

Table 5.11. Empirical Parameters from the transient experiments for Oil 1 and 1 hour of aging time.

Parameters	Values	Units
m	14.29	–
a	1.2	–

b	1.2	–
t_{eq}	0.41	s

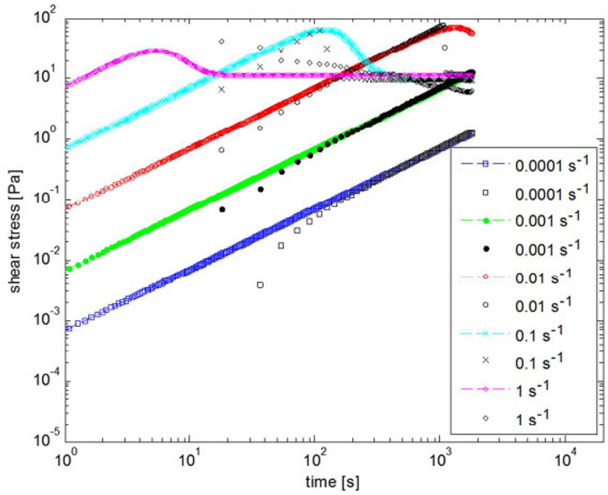

Figure 5.18. Stress evolution, for Oil 2 and 1 hour of aging time, for breakdown experiments.

Table 5.12. Empirical Parameters from the transient experiments for Oil 2 and 1 hour of aging time.

Parameters	Values	Units
m	314.19	–
a	3	–
b	3	–
t_{eq}	0.41	s

After the observation that the elastic and the dynamic shear stress are calculated with good accuracy, the next goal is to see how accurate the model can predict the overshoot point. Table 5.13 shows the error for oil 2.

Table 5.13. Overshoot error comparing the simulation with the experimental data for Oil 2 for 1 hour of aging time.

Shear Rate [s^{-1}]	Experimental [Pa]	Model [Pa]	Error [Pa]	Error %
1	42.11	28.50	13.62	47 %
0.1	63.55	65.40	1.85	2.8 %
0.01	77.13	69.93	7.20	10.3%
0.001	13.08	12.49	0*	0%*
0.0001	1.29	1.25	0*	0%*

Table 5.14 shows the error of the time necessary to reach the maximum stress, where the solid-like behaviour turns to fluid-like.

Table 5.14. Time of Overshoot error comparing the simulation with the experimental data for Oil 2 for 1 hour of aging time.

Shear Rate [s^{-1}]	Experimental [s]	Model [s]	Error [s]	Error %
1	18	15.31	2.69	14.9 %
0.1	108	130.15	22.15	20.5 %
0.01	1062	1334.3	272.35	25.6 %
0.001	1782	1782	0*	0%*
0.0001	1782	1782	0*	0%*

The error goes up as the shear rate increases. However, it may not be a severe problem for restart cases, since the shear rates are small, usually smaller than $\dot{\gamma} = 0.1\ s^{-1}$.

The model's idea is simulate the oils behaviour independently of aging time; hence, once some of the empirical parameters were calculated (“a”, “b”, “t_{eq}”), they were not modified, even if that generates a higher error. The only one that could not be kept constant was “m”, but the ratio of “$G_0.m^{-1}$” was kept constant.

To demonstrate the consequences of keeping the ratio constant, Table 5.15 shows the results of the empirical parameters for 5 hours of aging time for Oil 2. The mean of oscillatory test results, shown in Table 5.6 was $G_{0=}4259.7$ Pa. As can be seen, the only parameter that was varied was *m*. One of the main goals is to solve all the problems with the less variation possible. So, all the others empirical parameters were kept constant.

Table 5.15. Empirical Parameters from the transient experiments for Oil 2 and 5 hour of aging time.

Parameters	Values	Units
m	619	–
a	3	–
b	3	–
t_{eq}	0.41	s

Figure 5.19 shows the result of the simulation and the experimental data for all shear rates.

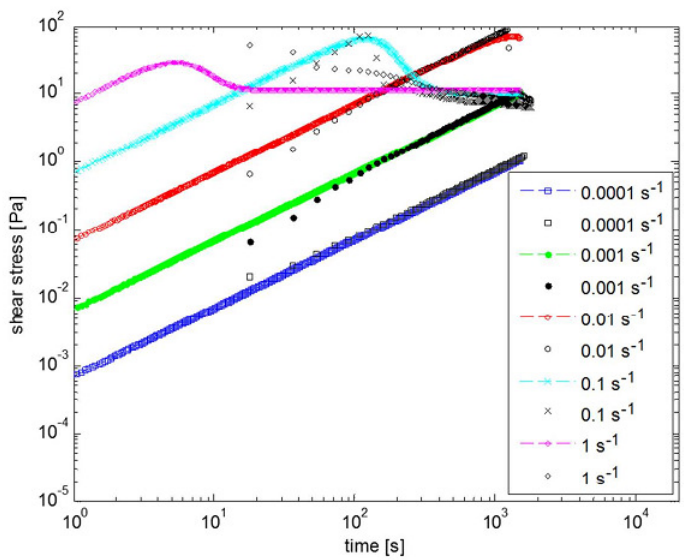

Figure 5.19. Stress evolution, for Oil 2 and 5 hour of aging time, for breakdown experiments.

Table 5.16 and Table 5.17 showo the deviation between the model and the data for 5 hours of aging time.

Table 5.16. Overshoot error comparing the simulation with the experimental data for Oil 2 for 5 hours of aging time.

Shear Rate [s^{-1}]	Experimental [Pa]	Model [Pa]	Error [Pa]	Error %
1	52.96	28.49	24.47	85.9%
0.1	72.11	65.39	6.71	10.3 %
0.01	89.10	69.93	19.17	27.42%
0.001	13.08	12.49	0*	0%*
0.0001	1.29	1.25	0*	0%*

Table 5.17. Time of Overshoot error comparing the simulation with the experimental data for Oil 2 for 5 hour of aging time.

Shear Rate [s^{-1}]	Experimental [s]	Model [s]	Error [s]	Error %
1	18	15.31	2.69	14.9 %
0.1	126	130.15	4.15	3.3 %
0.01	1224	1334.3	110.35	9.0 %
0.001	1782	1782	0*	0%*
0.0001	1782	1782	0*	0%*

* For shear rates of "0.001" and "0.0001" the Overshoot was not reached, neither in the experiment or model.

Finally, for 24 hours of aging time, as shown in Table 5.6, the storage modulus is equal to "$G_0 = 7187.7$ Pa", changing only the parameter m and keeping all the other empirical parameters constants, as shown in Table 5.18.

Table 5.18. Empirical Parameters from the transient experiments for Oil 2 and 24 hour of aging time.

Parameters	Values	Units
m	1020	–
a	3	–
b	3	–
t_{eq}	0.41	s

Figure 5.20 shows the result of the simulation and the experimental data for all the shear rates for 24 hours of aging time.

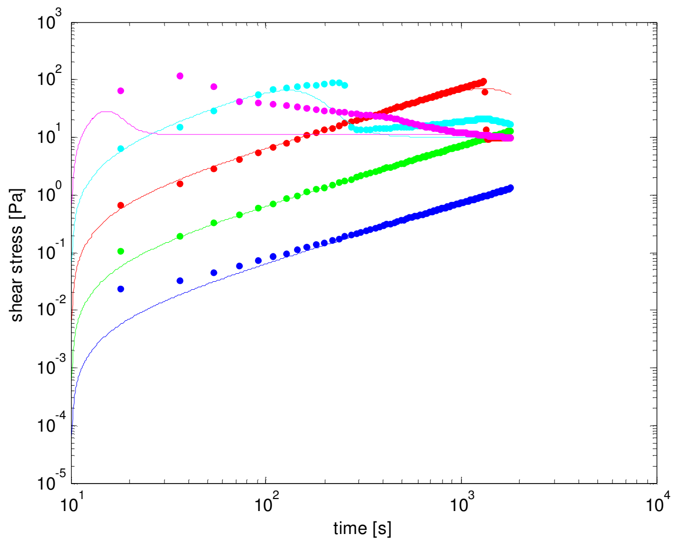

Figure 5.20. Stress evolution, for Oil 2 and 24 hour of aging time, for breakdown experiments.

Table 5.19 and Table 5.20 have the errors of the comparison between the model and the data for Oil 2 and 24 hours of aging time.

Table 5.19. Overshoot error comparing the simulation with the experimental data for Oil 2 for 24 hours of aging time.

Shear Rate [s^{-1}]	Experimental [Pa]	Model [Pa]	Error [Pa]	Error %
1	119.4	28.49	91.0	76.2%
0.1	89.5	65.39	24.4	27.3%
0.01	94.7	69.93	25.1	26.5%
0.001	13.1	12.49	0*	0%*
0.0001	1.3	1.25	0*	0%*

Table 5.20. Time of Overshoot error comparing the simulation with the experimental data for Oil 2 for 24 hour of aging time.

Shear Rate [s^{-1}]	Experimental [s]	Model [s]	Error [s]	Error %
1	36	15.31	20.7	57.5%
0.1	234	130.15	104.4	44.6%
0.01	1296	1334.3	32.5	2.5%
0.001	1782	1782	0*	0%*
0.0001	1782	1782	0*	0%*

5.2 Pipeline

The main objective of this study was to predict how much pressure would be needed to restart a pipeline filled with gelled waxy crude oil. The procedures were done in the order described before for simplicity in the control of the apparatus and to better allow the interpretation.

5.2.1 First Procedure

Figure 5.21 shows the results for the first procedure for the Oil 1 and the aging time was 24 hours. This procedure was the easiest one to execute, because during the whole cooling down and aging time, there was no valve control, since all the valves were open, and consequently the fluids stood at atmospheric pressure. These results were obtained in triplicate with the same behaviour for both oils.

As can be seen in Figure 5.21, the flow restarted with a pressure of approximately $P_{inlet} = 0.015\ bar$, which is a low pressure. The inner tank starts to measure a difference in the oil's level in around $t = 30\ s$. There is no real tendency on the values of the differential pressures, they are practically constant where the $\Delta P_1 = 0.01\ bar$ and $\Delta P_2 = -0.002\ bar$.

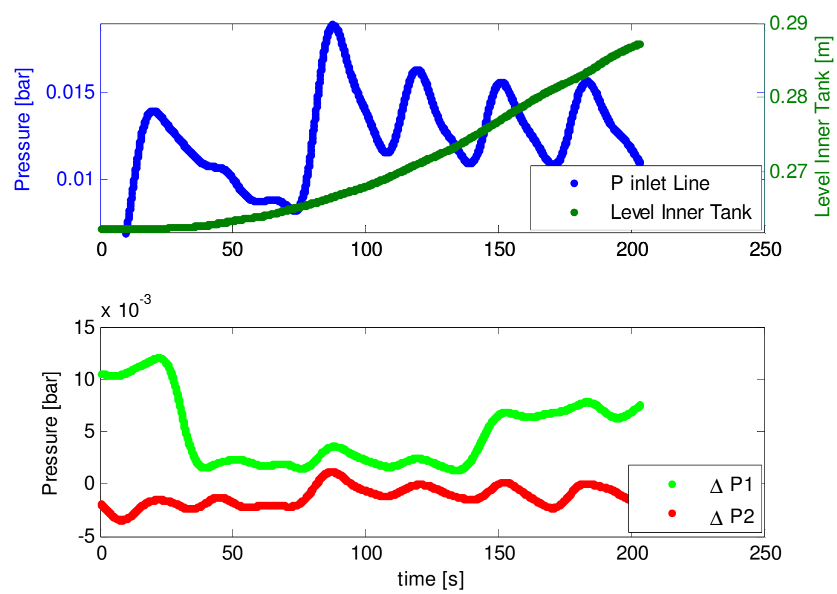

Figure 5.21. Restart Experiment with the oil 1 and Procedure 1

If the fluid had behaved similarly in the pipeline as in the rheometer, a considerably higher pressure would be necessary to restart the pipeline. These experiments show that, the necessary pressure to restart is a lot smaller than the one calculated from the force balance. The first possible explanation is that at atmospheric pressure, the shrinkage might be more relevant than the rheology. Probably, the void in the fluid allows small pressure disturbance in the whole structure and a pressure wave propagate throughout the pipeline until the flow restarts.

To test that possibility the second procedure was done. During both the cooling and aging time the oil in the pipeline was subjected to a pressure, and this would avoid, or at least minimize, the voids throughout the oil or the formation of an empty area in contact with the top of the pipeline.

5.2.2 Second Procedure

After realizing that the rheology is not relevant when the fluid is cooled down under atmospheric pressure, the next idea was to apply a pressure during the process. That is similar to the reality in the field, since there is a hydrostatic pressure in the bottom of the sea when the production stops. So, the procedure is: applying a pressure of $P_{inlet} = 15\ bar$ during the cooling and the aging time, and after that, depressurize and restart.

Figure 5.22 shows the second procedure, for the oil 2. The experiments were also done in triplicate and the results are also the same for both oils. As can be seen, the flow restarted with a pressure of around $P_{inlet} = 0{,}015\ bar$, which is also considerably small pressure. The inner tank starts to measure a difference in the oil's level in approximately $t = 40\ s$. There is no real tendency on the values of the differential pressures, they are practically constant where the $\Delta P_1 = 0{,}01\ bar$ and $\Delta P_2 = -0{,}002\ bar$. The results are practically the same as the procedure 1.

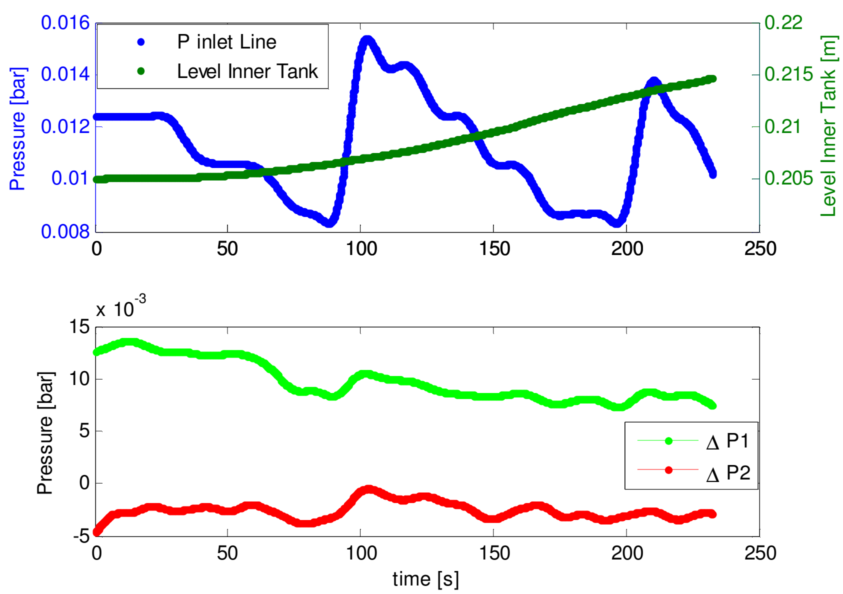

Figure 5.22. Restart Experiment with the oil 2 and Procedure 2

After obtaining the same results of procedure 1, a different phenomenon leads to the next procedure. Since the results were the same with the shrinkage or without it and there is experimental evidence that it occurs, we started to consider that the depressurization of the system could be destroying the structure of the gelled waxy crude.

To better verify the third possibility, all procedure was done with a pressurised system.

5.2.3 Third Procedure

After the second procedure has been analysed, it is possible to see that the results are basically the same that in the first procedure. The rheology effects could not be seen at all, and the results were not close to the ones obtained in the rheometer.

Another possibility was: the compressibility could provoke the destruction of the structure. Before the restart the system was depressurized, hence, if the fluid is compressible it might expand destroying the paraffinic structure. Then, the restart test would look exactly like the first procedure. Even knowing that the oil has a small compressibility, the third procedure was realized to verify that possibility.

This is the hardest control process, because both the tanks should stay at the same pressure during all the process. That is why the test was done with $P_{inlet} = 5\ bar$ and only for 5 hours of aging time. When a longer aging time was tried, there was leaking that could not be controlled, so the test was not validated. Regardless the aging time, the shear stress measured in the rheometer was considerably high. That is why 5 hours of aging time could be considered enough to see the rheological behaviour.

Figure 5.23 shows the result. This time, was applied a ΔP instead of absolute value of pressure (P_{inlet}). A pressure gradient of $\Delta P_{inlet} = 0{,}01$ bar was applied, but as can be seen in Figure 5.23 the inlet pressure was around $P_{inlet} = 4{,}97\ bar$. The flow started after approximately the same time that other procedures, and ΔP_1 and ΔP_2 were basically the same values, exactly like the other procedures.

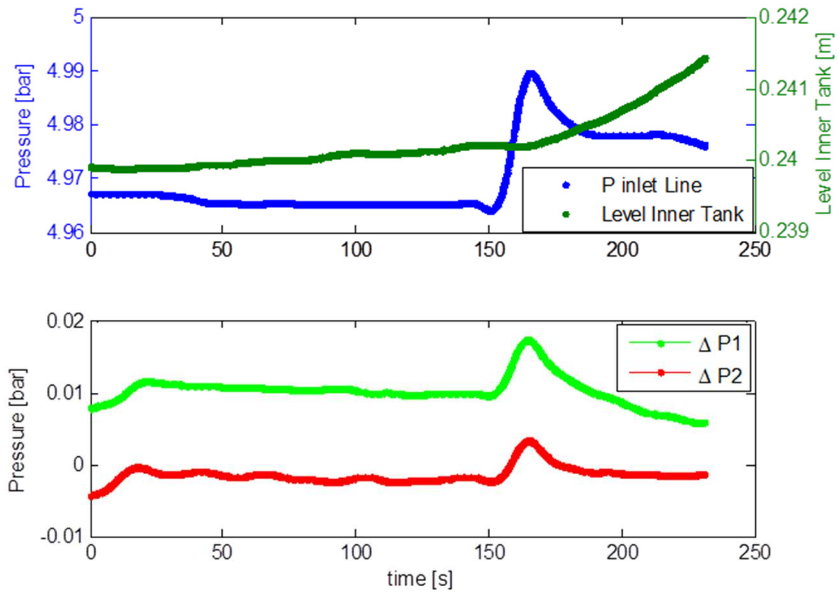

Figure 5.23. Restart Experiment with the oil 2 and Procedure 3

After this discussion, we can see that the restart occurred without any problem again. After all the results, the inner tank started to measure around 40 s after the Pressure was applied in the pipeline, the breaking of the gel could even be a reasonable explanation for the delay. But the rheology could not be seen, hence, it is probably only the low pressure's wave going through the voids and provoking a slowly restart, until it reaches the inner tank.

The peak on the inlet pressure, in all the experiments, is due to the apparatus control, the better control reached was around $P_{inlet} = 0{,}005\ bar$, and that is why the peak occurs, but the point is: the flow had started independent of any peak. Actually, if the fluid had not drained, the pressure in the tank would stay constant, because the structured oil would hold the pressure. Hence, because the pressure dropped the control was applied. Peak of the pressure has nothing to do with the first fluid displacement.

5.2.4 Destructive Test

The last experimental test was done with both oils. The tests were done following the first procedure and the idea was to visualize the consistency of the oil after the restart of the flow. Figure 5.24 show the result for the Oil 1. The idea was to visualize something close to the Figure 2.3.

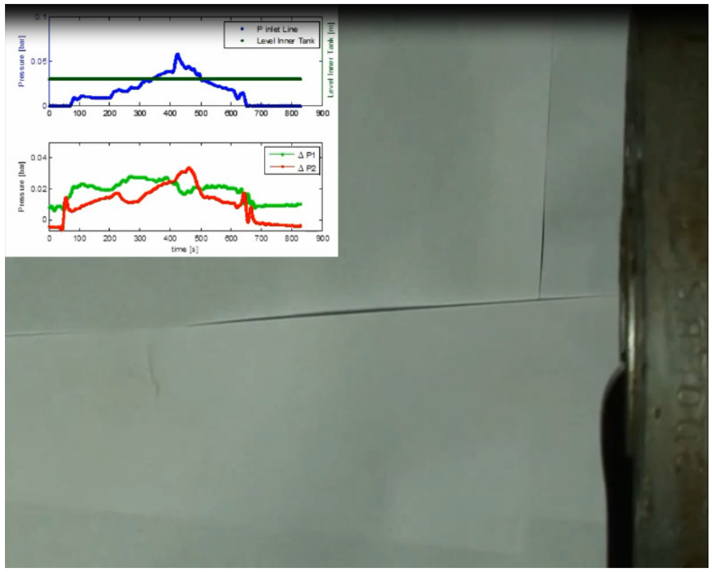

Figure 5.24. Destructive test for Oil 1.

Figure 5.25 show the result of the destructive test for the Oil 2.

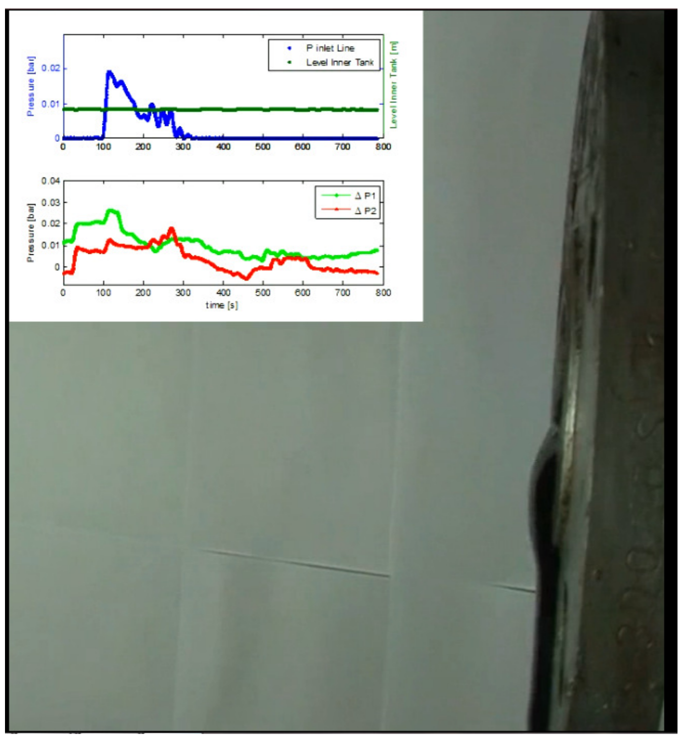

Figure 5.25. Destructive test for Oil 2.

During the restart was possible to see some oscillation while the oil was flowing through the pipeline, probably some structured blocks of paraffin, but there were not a completely structured fluid as the ones discussed in the literature.

5.2.5 Simulation of the Pipeline

The boundary condition are hard to control during the cooling and aging time. Thus, it is not possible to simulate perfectly the model, since the initial condition for the finite difference model is the pressure equal to zero in the whole pipeline, before the restart.

To minimize the error, a few experiments with a slope of pressure were done, the simulation's input were the same values of the inlet measured pressure, to see if the behaviour was reasonably close to the experimental data. The result for the first procedure is shown in Figure 5.26 and Figure 5.27 for the Oil 1 and Oil 2 respectively.

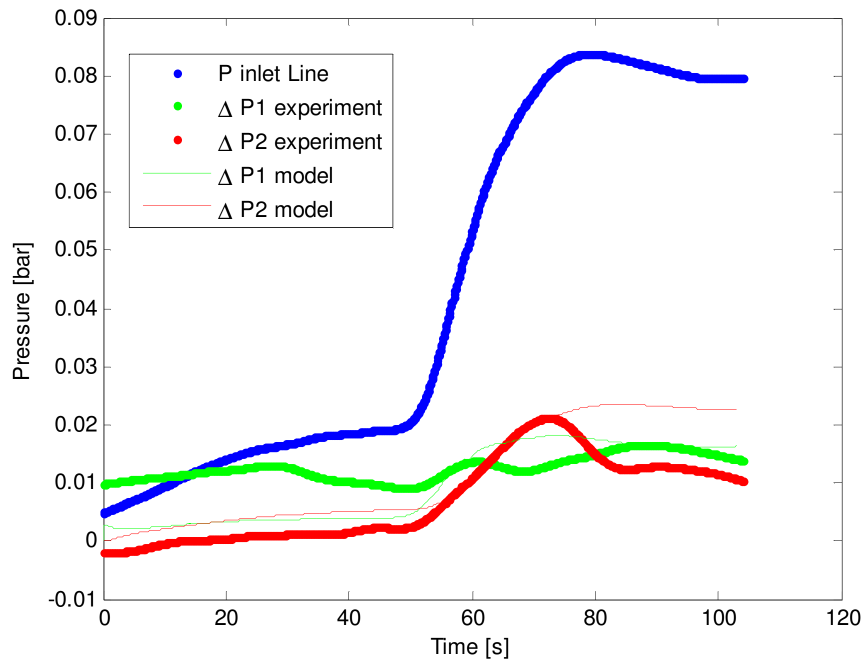

Figure 5.26. First Procedure for oil 1.

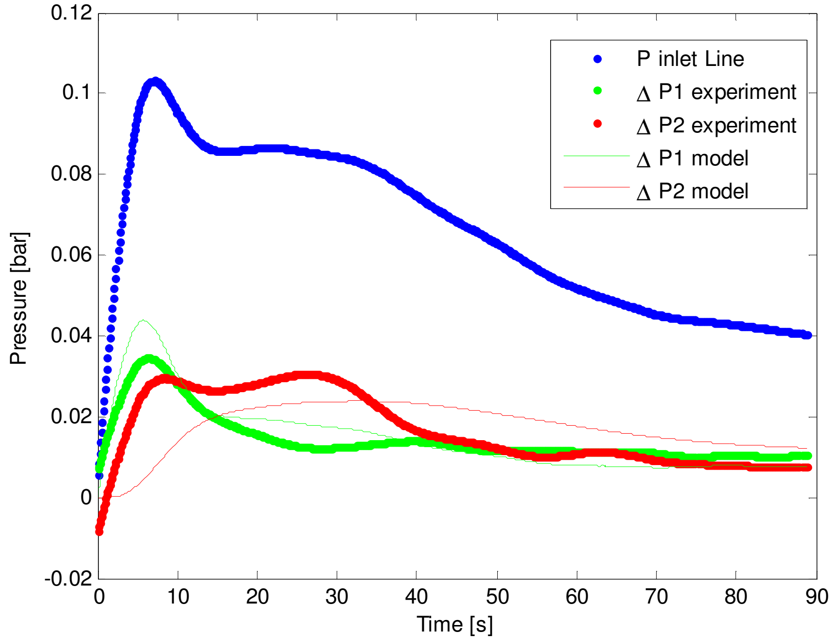

Figure 5.27. First Procedure for oil 2.

The results show that the model present good agreement with the data. It is possible to see that the oil flows almost immediately, and the simulation's error is reasonably small. For the second procedure the result is shown in Figure 5.28.

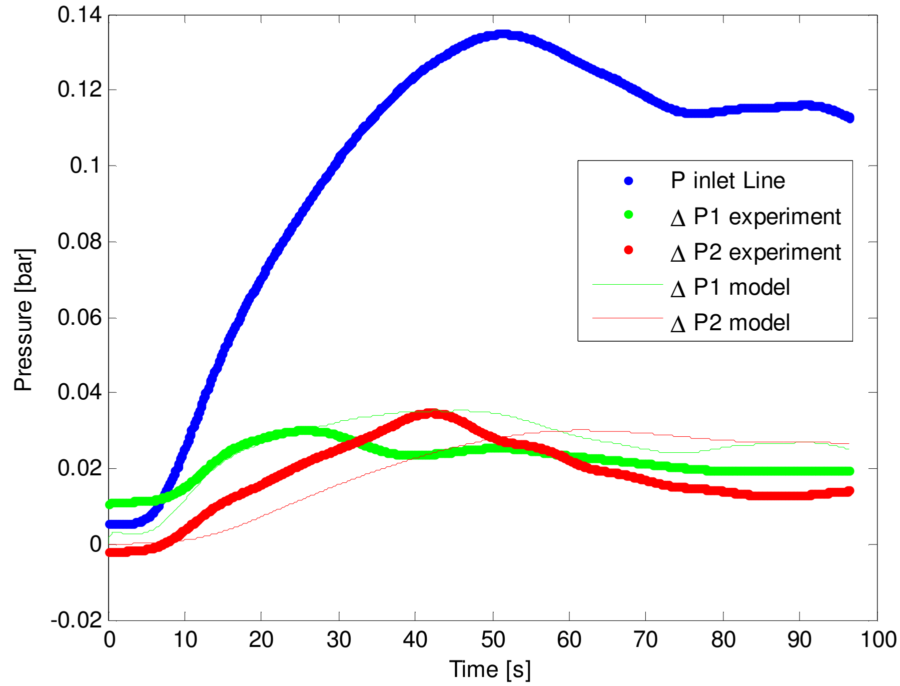

Figure 5.28. Second Procedure for oil 2.

5.2.6 Possible Explanations

There are two different things that are discussible in this point. First: whether the rheology does not perform a part at a pipeline's restart process, which is really hard to believe, since it has been discussed for a while and there is plenty of data that shows the paraffinic structure happening; second: the reason why the structure is not form in this experiment.

To verify the first possibility, a comparison between the volume and the interfacial area was done for the two experiments:

Rheometer:

$$\mathrm{D} \ = \ 60 \ \mathrm{mm} \ \theta = 1° = \frac{\pi}{180}$$

$$A_{int} = 2\pi \frac{D^2}{4}$$

$$V = \theta \frac{D^3}{12}$$

$$\frac{A_{int}}{V} = \frac{6}{\theta D} = 5730\ m^{-1}$$

Pipeline:

$$\mathrm{D} = 25{,}4\ \mathrm{mm}\ ;\ \mathrm{L} = 6\ \mathrm{m}$$

$$A_{int} = \pi D L$$

$$V = \frac{\pi D^2 L}{4}$$

$$\frac{A_{int}}{V} = \frac{4}{D} = 160\ m^{-1}$$

The interfacial area per volume is much smaller in the pipeline, than in the rheometer. This means that, in the rheometer, the oil is subjected to a higher stress at the surface, like shear stress. The pipeline is more subjected to volumetric phenomena, like shrinkage and compressibility. That could explain why it has not been possible to verify the rheology in the pipeline. This is an interesting approach, not completely convincing though, in the real pipelines the problem occurs and they have a bigger diameter, so if this solution was right, there would be no problem in the real subsea apparatus.

The second possibility is investigating our own experiment. The fluid did not really become a structured gel during the aging time, which could be because there is still some liquid in the pipeline during the process. As have been discussed, simplistically, the hydrocarbons from "C_7H_{16}" up to "$C_{15}H_{32}$ " are still in the liquid form at 5°C, that could lead to some kind of convective event when the oil is exchanging heat. To verify, another test was done. During the cooling and aging time, the differential pressure were measured, the result can be seen in Figure 5.29.

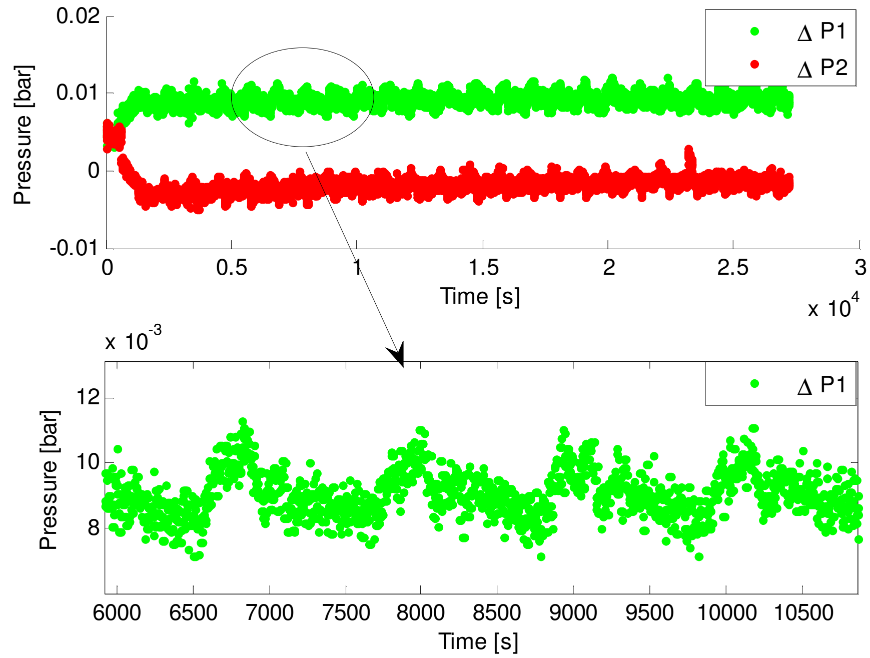

Figure 5.29. Cooling and aging time for the oil 2.

It is important to notice that the precision (by the manufactor) for this sensor is: $\Delta(\Delta P) = 1.10^{-3}$ bar. Pressure variation is around 3 times bigger than the error, which would allow seeing that there is some kind of movement in the fluid during all the aging time. This cooling experiment was done for the three processes and all the results were exactly the same, where the first differential pressure is $\Delta P_1 \approx 0{,}01$ bar, the second is $\Delta P_2 \approx -0{,}003$ bar and it possible to see an oscillatory behaviour in both the sensors.

One of the possibilities for this oscillation might be that the water bath temperature's control. A variation in 2 or 3°C in the water would provoke some oscillation on the temperature of the oil. If consider that the cycle of the differential pressure has the period of approximately 1000 s, and the temperature control cycle of the water is similar, this variation would expand and contract the oil in a small scale, as the one obtained. That movement could destroy the structure. This analysis has the same problem that the first one, if the structure of such paraffinic oil could be destroyed that easily there would be no problem in the real life.

There is also a possibility that the small percentage of water would not allow the crude oil to stick in the wall, if that was the case, it would be possible to see a core flow of paraffinic oil flowing out of the pipeline. The destructive tests show that there is not a complete structuration and therefore the core flow does not happen in our case.

6 FINAL REMARKS

Experimental studies to analyse the thermodynamic and the rheology of two real waxy crude gels were performed to verify their behaviour in the conditions of the bottom of the sea. The study has the goal of predicting the necessary pressure to restart a flow after the shutdown of a pipeline.

Physical models to represent and explain the complex rheological behaviour during yielding are available in the literature. In this study, we did a complex matrix of experiments in order to evaluete the rheology of the gelled waxy crude. The rheological model used in this study was based on de Souza Mendes and Thompson (2013). When the model proposed by de Souza Mendes and Thompson was compared with the data from the rheometer, the results were not accurate, therefore, a modification on the model was proposed. The modification does not influence in the physical analysis of the model proposed by the literature.

The results from the model present small error on predicting the elastic phase of the flow and the final viscous flow. The highest error was found when simulating the value of the shear stress and the time it occurred. The values of the shear stress for shear rates up to "$.1\ s^{-1}$" did not exceed 30% error for neither of the oils, independently of the aging time.

A slight modification of the model allowed finding a constant value that persisted throughout the experiments. The ratio of the storage modulus by the parameter "m", of the new model, was found to be the same for both the oils and all aging times A possible explanation is that there might be a constant related to the paraffins that relates the "spring constant" with the variation of the structural parameter. To generalize this conclusion, more tests are needed using different oil samples, and aging times.

With the good accuracy obtained after analysing the behaviour of real waxy crude oils and the generic rheological modulation, it is possible for the industry to apply this in a generically simulator for the restart problems of flow assurance.

Three procedures for restarting a pipeline filled with waxy crude oil were performed to verify all physical parameters that would influence the flow behaviour. The results were relatively similar. In all of them the flow restarted with a low inlet pressure. The level sensor of the inner tank started to mark a variation after approximately 40 s, and the differential pressure sensors did not show major changes.

We obtained good results in the numerical simulation with 1-D model, disregarding the rheology of the fluid. The restart was simulated considering a weakly compressible Newtonian fluid and the errors were reasonably small, which would allow for disregarding the rheology effect. It is believed that, due to volumetric non-uniformities such as shrinkage, voids may have been generated within the fluid during the cooling phase below the pour point, even with the simultaneous application of constant pressure. The presence of such gas spots would facilitate the breaking down of any structure, and, consequently, the restart happens with a Newtonian fluid behaviour. The effect of the voids in increasing the equivalent compressibility to be used in the numerical model can be suggested, if it is reasonable to assume that the gel is in perfect contact with the pipe wall. Alternatively, the experimentally measured compressibility could be used, but the wet perimeter should be reduced in the numerical model.

7 FUTURE STUDIES

Further experiments are necessary to verify whether the modified elasto visco-plastic thixotropic model can be applied for all materials. Experiments with gelled waxy crudes to verify the constant value that we obtained for this two comercial crudes.

Experiments with the restart apparatus to verify the rheological influence and, the reason why the rheology did not influenced the necessary pressure to restart. One possibility is to use crudes with higher percentage of paraffin molecules.

Implement the modified rheological model in the diffusion-like equation in order to have an mathematical model that can predict the restart when the rheology influence the phenomenon.

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APPENDIX A

In this appendix there is the data of all the graphs shown in this study.

Figure 5.4. Flow curve for Oil 1.		
Shear Stress [Pa]	Shear Rate [s^{-1}]	Viscosity [mPa.s]
5	0.002027	2466000
6.248	0.00009237	67640000
8.683	0.00007578	114600000
11.12	0.00007671	145000000
13.56	0.00007858	172500000
16	0.00008016	199600000
18.43	0.00008289	222400000
20.87	0.00008773	237900000
23.31	0.00009526	244700000
25.75	0.0001012	254500000
28.19	0.0001055	267100000
30.63	0.0001083	282800000
33.06	0.0001147	288400000
35.5	0.0001256	282600000
37.94	0.0001295	292900000
40.38	0.0001331	303300000
42.82	0.0001363	314000000
45.25	0.000138	327900000
47.69	0.0001458	327000000
50.13	0.0001589	315500000
52.57	0.0001677	313500000
55.01	0.0001928	285300000
57.44	0.0002092	274600000
59.88	0.0002223	269400000
62.32	0.0002369	263000000
64.76	0.0002859	226500000
67.2	0.0004035	166500000
69.63	0.0007216	96490000
72.03	0.001959	36760000
74.44	0.02436	3056000

76.85	12.76	6022
79.25	31.41	2523
81.66	39.73	2055
84.07	45.79	1836
86.47	51.05	1694
88.88	55.81	1592
91.29	60.26	1515
93.69	64.46	1454
96.1	68.53	1402
98.5	72.56	1358

Figure 5.5. Flow curve for Oil 2 (Luthi, 2013).		
Shear Stress [Pa]	Shear Rate [s^{-1}]	Viscosity [mPa.s]
0.1	0.000038	2656664.55
2.411783	0.000007	361408281
4.974203	0.000009	547771438
7.529254	0.00001	780852063
10.0955	0.000011	928043750
12.67036	0.000012	1063929875
15.24528	0.000015	1037492875
17.81184	0.000013	1321504500
20.34708	0.000015	1403023875
22.88233	0.000015	1514994500
25.41764	0.000016	1547312250
27.95288	0.000018	1562361375
30.48813	0.000021	1456338000
33.02337	0.000021	1562135250
35.55862	0.000023	1534214000
38.09393	0.000026	1476435250
40.62918	0.00003	1342624125
43.16443	0.000032	1345542375
45.69967	0.000036	1284352000
48.23491	0.00004	1203300625
50.77016	0.000059	866773563
53.30547	0.000507	105051938
55.84072	185.5804	300.897658

58.37596	228.6392	255.319118
60.91121	257.6362	236.423343
63.44652	281.775	225.167319
65.98177	303.8659	217.141047
68.51701	325.423	210.547492
71.05225	346.2604	205.198914
73.5875	367.0021	200.509757
76.12281	387.2927	196.551099
78.65806	406.9619	193.281114
81.19331	426.3703	190.429091
83.72849	445.7624	187.832117
86.26373	465.1747	185.443714
88.79904	485.2201	183.007762
91.33428	505.7844	180.579484
93.86953	526.2464	178.375617
96.40478	546.6954	176.340923
98.94009	564.693	175.210401

Figure 5.8. Oscillatory Test for Oil 2 and 24 hours of aging time at 5 °C.		
Shear Stress [Pa]	G’ [Pa]	G’’[Pa]
0.001	186.5	633.1
0.001326	683.1	446.2
0.001757	220.6	725.4
0.00233	563.4	706.6
0.003089	805.6	1521
0.004095	579.8	1696
0.005429	1785	3837
0.007197	3473	1149
0.009541	3590	4614
0.01265	6343	2774
0.01677	7127	1810
0.02223	9013	2406
0.02947	6352	2289
0.03907	6537	875
0.0518	6482	313.3
0.06867	6196	2107
0.09103	5918	217.4
0.121	6152	556.2

0.16	6313	1083
0.212	6252	835.2
0.281	6143	734.8
0.373	6143	914
0.494	5972	842.3
0.655	6171	670.7
0.869	6193	689.7
1.151	6106	714.7
1.526	6175	743.8
2.024	6142	740.8
2.683	6100	710.1
3.557	6084	721
4.715	6064	712.4
6.251	6027	702.6
8.287	5997	694.8
10.99	5939	702.8
14.56	5858	698.1
19.31	5757	704.1
25.6	5601	708.4
33.93	5410	699.9
44.99	5170	696.9
59.64	4855	698.7
79.07	4480	681.6
104.8	3582	608.4
139	1617	431.6
184.4	1.227	14.8
243.3	0.01086	2.882
321	0.008541	2.078
424	0.01224	1.752
559.9	0.01597	1.544
739.3	0.01867	1.392
975.6	0.02466	1.278

Figure 5.9. Dynamic test at constant shear rate for Oil 1 for 1 hour of aging time (Badin, 2012).

Shear rate $[s^{-1}]$	0.0001	0.001	0.01	0.1	1
Time [s]	Shear Stress [Pa]	Shear Stress [Pa]	Shear Stress [Pa]	Shear Stress [Pa]	Shear Stress [Pa]

18.00048	0.006463	0.046302	0.513007	1.392839	1.60882
36.00144	0.014906	0.128178	0.895933	1.107796	1.112916
54.00144	0.027566	0.247482	1.043563	0.784663	0.902431
72.00048	0.040114	0.361783	0.94844	0.663788	0.824808
90.00144	0.052647	0.464293	0.851135	0.589947	0.773264
108	0.06511	0.550984	0.77373	0.543498	0.739337
126	0.077383	0.639178	0.714603	0.507748	0.714781
144	0.089581	0.725691	0.667341	0.479959	0.696924
162.002	0.101736	0.800098	0.6244	0.458937	0.679416
180	0.113881	0.869744	0.589405	0.435776	0.650544
198.001	0.126021	0.939116	0.561692	0.413888	0.635897
216.001	0.138149	0.998576	0.540372	0.397795	0.626278
234	0.150274	1.040887	0.521505	0.386712	0.616197
252	0.162312	1.077024	0.50085	0.376651	0.60951
270.001	0.174253	1.10946	0.485162	0.369424	0.602256
288	0.186076	1.132267	0.469934	0.360687	0.592053
306.001	0.19787	1.149363	0.459937	0.355104	0.587804
324.001	0.209619	1.164793	0.45156	0.346539	0.584611
342.001	0.22139	1.164386	0.437444	0.337154	0.583743
360	0.23321	1.164829	0.427041	0.331381	0.583618
378.001	0.245007	1.163798	0.41384	0.329561	0.580481
396.001	0.256763	1.151554	0.402984	0.324907	0.572787
414	0.268477	1.143981	0.395311	0.319837	0.56946
432.001	0.280128	1.134589	0.388231	0.316231	0.570598
450	0.291866	1.131908	0.380903	0.31339	0.570309
468	0.303581	1.128185	0.374517	0.307209	0.567096
486.001	0.315265	1.125505	0.369877	0.305371	0.566287
504	0.326958	1.117018	0.366507	0.305026	0.562246
522.001	0.338583	1.107833	0.358652	0.300694	0.557329
540	0.350074	1.095783	0.350731	0.294718	0.55399
558	0.361428	1.083693	0.347285	0.286149	0.552973
576.0001	0.372774	1.071362	0.34662	0.28002	0.549248
594.0001	0.384151	1.058294	0.338685	0.278616	0.545404
612.001	0.395448	1.0483	0.332713	0.276869	0.5424
630.001	0.406586	1.037541	0.325922	0.275707	0.54282
648.001	0.417742	1.033501	0.322357	0.274046	0.546749
666.001	0.428862	1.027537	0.316486	0.268089	0.547694
684.0001	0.43997	1.02117	0.316105	0.2664	0.546435
702.0001	0.451014	1.004209	0.312273	0.26422	0.545235

720.0001	0.462004	0.994901	0.310588	0.260072	0.543559
738.0001	0.472987	0.988758	0.305631	0.256495	0.542306
756.001	0.48392	0.979266	0.304986	0.255882	0.537872
774.001	0.494804	0.97173	0.303116	0.256343	0.533734
792.0001	0.505505	0.961913	0.299546	0.254901	0.530487
810.001	0.516185	0.950273	0.300498	0.252981	0.529007
828.001	0.526852	0.943097	0.295665	0.24973	0.527788
846.001	0.537525	0.941552	0.291297	0.247174	0.52735
864.0001	0.548176	0.931909	0.288436	0.248851	0.526919
882.001	0.558778	0.924964	0.285815	0.249537	0.526802
900.001	0.569325	0.918523	0.282579	0.252493	0.526892
918.0001	0.579843	0.914687	0.2828	0.252697	0.525863
936.001	0.590322	0.909001	0.283986	0.249509	0.524426
954.0001	0.600719	0.903891	0.280348	0.249946	0.522501
972.0001	0.611059	0.899593	0.277997	0.246974	0.518876
990.001	0.621276	0.894862	0.274065	0.240723	0.515589
1008	0.631432	0.891151	0.269303	0.237221	0.513701
1026	0.641675	0.884733	0.26696	0.237212	0.512864
1044	0.652	0.876487	0.263654	0.234266	0.512578
1062.001	0.662347	0.866673	0.261047	0.232135	0.512882
1080	0.672737	0.86174	0.259109	0.23131	0.513931
1098	0.683032	0.859505	0.258373	0.230072	0.515878
1116.001	0.693141	0.855904	0.255549	0.230122	0.51427
1134	0.703287	0.852626	0.257112	0.229479	0.511139
1152.002	0.713283	0.846502	0.257321	0.229665	0.509882
1170.001	0.72319	0.842586	0.256822	0.227689	0.508519
1188	0.733162	0.837828	0.253645	0.222851	0.5077
1206	0.743167	0.833215	0.251903	0.220722	0.506624
1224	0.753311	0.824038	0.249911	0.219306	0.505543
1242.001	0.763587	0.812431	0.248405	0.217456	0.504875
1260	0.773796	0.808499	0.246342	0.215125	0.505086
1278	0.784318	0.803271	0.242251	0.214621	0.506592
1296.001	0.794946	0.800741	0.241456	0.216252	0.50772
1314	0.805441	0.800079	0.239241	0.217311	0.508575
1332	0.815902	0.794551	0.236579	0.216942	0.509148
1350.001	0.826343	0.78809	0.23749	0.216605	0.509475
1368	0.836473	0.780535	0.238023	0.214462	0.509991
1386	0.845653	0.777421	0.231352	0.21335	0.510908
1404	0.854474	0.774985	0.230822	0.214371	0.511134

1422.001	0.863313	0.77032	0.232215	0.213553	0.511132
1440	0.872251	0.764093	0.232293	0.211205	0.51288
1458.001	0.881176	0.7598	0.23068	0.21137	0.514723
1476.001	0.889985	0.753092	0.227103	0.213462	0.512798
1494	0.89888	0.74258	0.225049	0.214028	0.509824
1512	0.90784	0.735143	0.223801	0.215464	0.506019
1530	0.916657	0.733582	0.225824	0.217297	0.502956
1548	0.925399	0.732068	0.224981	0.217513	0.500532
1566	0.934104	0.728468	0.226213	0.214685	0.498579
1584.001	0.942685	0.728655	0.225884	0.212079	0.497521
1602.001	0.950934	0.727903	0.225027	0.209761	0.496081
1620	0.959048	0.726354	0.228879	0.209004	0.495214
1638.001	0.967385	0.724058	0.229709	0.206529	0.494929
1656	0.975518	0.719583	0.229301	0.202697	0.495281
1674	0.983616	0.722246	0.229739	0.201191	0.495427
1692	0.99169	0.72122	0.225016	0.200236	0.49568
1710.001	0.999377	0.718563	0.219011	0.200713	0.496735
1728.002	1.005347	0.717052	0.217215	0.200406	0.49772
1746	0.986757	0.716811	0.219313	0.200201	0.498725
1764.001	0.969827	0.717967	0.217346	0.20006	0.499087
1782	0.968052	0.718486	0.213065	0.200074	0.498555
1800.001	0.967755	0.708825	0.21518	0.199532	0.497679

Figure 5.10. Dynamic test at constant shear rate for Oil 2 for 1 hour of aging time (Luthi, 2013).					
Shear rate $[s^{-1}]$	0.0001	0.001	0.01	0.1	1
Time [s]	Shear Stress [Pa]	Shear Stress [Pa]	Shear Stress [Pa]	Shear Stress [Pa]	Shear Stress [Pa]
18.00048	0.004295	0.075586	1.293909	13.19406	20.02227
36.00144	0.010977	0.208137	2.628482	26.473	17.14722
54.00144	0.017644	0.340801	3.962329	39.51992	16.39537
72.00048	0.024322	0.473288	5.295852	7.260142	16.54554
90.00144	0.030978	0.605646	6.628945	6.436152	17.69227
108	0.040587	0.738103	7.961824	6.147114	18.58415
126	0.053889	0.870469	9.294016	5.886429	18.61994
144	0.067183	1.002852	10.62608	5.626657	17.82732
162.002	0.080465	1.135165	11.95781	5.426285	16.8962
180	0.093731	1.267479	13.28921	5.24327	15.8956
198.001	0.107001	1.399804	14.62049	5.075683	15.1532

216.001	0.120287	1.532153	15.95154	4.933453	14.47198
234	0.133558	1.664489	17.28203	4.831345	13.89241
252	0.146834	1.796831	18.61219	4.718536	13.55948
270.001	0.160104	1.929122	19.94182	4.616825	13.21786
288	0.173369	2.061474	21.27071	4.553091	12.86039
306.001	0.186637	2.193791	22.59673	4.489766	12.75231
324.001	0.199902	2.326148	23.92396	4.436236	12.6135
342.001	0.213157	2.458396	25.25064	4.412603	12.43561
360	0.226408	2.590753	26.5765	4.388238	12.3425
378.001	0.239652	2.723087	27.90193	4.352236	12.02259
396.001	0.252908	2.855344	29.22623	4.330355	11.80575
414	0.266146	2.987617	30.54875	4.339255	11.84236
432.001	0.279374	3.119874	31.86966	4.324343	11.88765
450	0.292609	3.252168	33.18797	4.311404	11.92667
468	0.305833	3.384523	34.50405	4.29613	11.93774
486.001	0.319054	3.516721	35.81797	4.276037	11.80182
504	0.332252	3.648876	37.12989	4.248859	11.67691
522.001	0.345448	3.781022	38.43962	4.233112	11.41299
540	0.358636	3.913159	39.74413	4.248521	11.14924
558	0.371822	4.045299	41.04122	4.27243	10.9316
576.0001	0.385017	4.177564	42.32561	4.285121	10.65136
594.0001	0.398211	4.309711	43.57896	4.295166	10.48617
612.001	0.411416	4.441795	44.72907	4.310327	10.32263
630.001	0.424632	4.573892	9.104077	4.319068	10.14294
648.001	0.437854	4.705947	6.773586	4.326558	9.969768
666.001	0.451056	4.838004	6.847405	4.343754	9.716022
684.0001	0.464251	4.969666	6.94917	4.36363	9.530867
702.0001	0.47745	5.101589	6.885553	4.389353	9.391697
720.0001	0.49065	5.233546	6.721802	4.40429	9.303512
738.0001	0.50384	5.365451	6.421673	4.410599	9.273769
756.001	0.517034	5.497324	6.234188	4.413926	9.230515
774.001	0.530241	5.629158	6.152207	4.421455	9.136596
792.0001	0.543453	5.76092	6.095494	4.441495	9.038539
810.001	0.556666	5.8927	6.031227	4.475728	8.908223
828.001	0.569878	6.024488	5.974609	4.493133	8.831961
846.001	0.583088	6.15617	5.91487	4.49508	8.757938
864.0001	0.596312	6.288153	5.867482	4.49587	8.688612
882.001	0.609526	6.420132	5.834188	4.508986	8.626146
900.001	0.622729	6.552019	5.803596	4.520512	8.631308

918.0001	0.635936	6.683875	5.775712	4.518216	8.62741
936.001	0.649142	6.81569	5.734463	4.53735	8.601871
954.0001	0.662354	6.947478	5.690739	4.580764	8.594472
972.0001	0.675557	7.079313	5.653639	4.606378	8.612006
990.001	0.688776	7.21099	5.627433	4.633378	8.558262
1008	0.701996	7.342672	5.599888	4.663043	8.538986
1026	0.715224	7.474417	5.575965	4.684229	8.491707
1044	0.728447	7.606111	5.551967	4.709739	8.479975
1062.001	0.741674	7.737791	5.52718	4.738807	8.460884
1080	0.75491	7.869443	5.493112	4.760115	8.416276
1098	0.768147	8.001056	5.481205	4.77732	8.391325
1116.001	0.781372	8.132636	5.450668	4.800462	8.34917
1134	0.794595	8.264267	5.452796	4.832492	8.317506
1152.002	0.807821	8.395918	5.442706	4.867587	8.288954
1170.001	0.821041	8.527542	5.421236	4.900412	8.244026
1188	0.834252	8.659105	5.407403	4.933118	8.181894
1206	0.847461	8.790765	5.399861	4.951958	8.141895
1224	0.860681	8.922404	5.393287	4.965638	8.114838
1242.001	0.873891	9.053905	5.372794	4.979301	8.065539
1260	0.887081	9.185426	5.352448	4.999952	8.013354
1278	0.900266	9.317018	5.341405	5.034047	7.976784
1296.001	0.913442	9.448616	5.322173	5.072642	7.920202
1314	0.926613	9.580127	5.305539	5.121823	7.879652
1332	0.939763	9.711597	5.290714	5.184069	7.810787
1350.001	0.952931	9.843195	5.269807	5.232014	7.742197
1368	0.966102	9.974665	5.247527	5.280274	7.695903
1386	0.979284	10.10613	5.222714	5.317535	7.627189
1404	0.99246	10.23761	5.200483	5.340853	7.575706
1422.001	1.005641	10.36901	5.151252	5.365361	7.521746
1440	1.01882	10.50036	5.163801	5.393507	7.460174
1458.001	1.031987	10.63157	5.158487	5.424417	7.418091
1476.001	1.045153	10.76275	5.140459	5.445728	7.361704
1494	1.058313	10.89389	5.123847	5.462953	7.323537
1512	1.071486	11.02493	5.0951	5.496539	7.285207
1530	1.08467	11.15589	5.089609	5.586092	7.255968
1548	1.097855	11.28667	5.074034	5.650514	7.228891
1566	1.11104	11.41743	5.053236	5.699792	7.185071
1584.001	1.124233	11.54796	5.040447	5.745642	7.167592
1602.001	1.137425	11.67838	5.023937	5.796516	7.137607

1620	1.150615	11.80867	5.003603	5.840807	7.101388
1638.001	1.163797	11.93891	4.988612	5.867535	7.084786
1656	1.176987	12.06886	4.972348	5.886998	7.050222
1674	1.190166	12.19866	4.955953	5.907182	7.030486
1692	1.203338	12.32829	4.93531	5.911447	7.001992
1710.001	1.216514	12.45801	4.910957	5.929772	6.962798
1728.002	1.229688	12.58771	4.893528	5.931897	6.940026
1746	1.242858	12.71734	4.877669	5.917189	6.911539
1764.001	1.256025	12.84683	4.841944	5.929317	6.887988
1782	1.269185	12.97616	4.843664	5.875315	6.860348
1800.001	1.28234	13.10566	4.832711	5.907828	6.840336

Figure 5.21. Restart Experiment with the oil 1 and Procedure 1

Tempo Total	Pressão Linha	Delta P 1	Delta P 2	Nivel Externo
0	0.005106	0.010765	-0.00221	0.270234
0.110006	0.005106	0.010765	-0.00221	0.270234
0.219013	0.005106	0.010765	-0.00221	0.270234
0.327019	0.005106	0.010765	-0.00221	0.270234
0.451026	0.005106	0.010497	-0.00221	0.270234
0.607035	0.005106	0.010497	-0.00221	0.270234
0.716041	0.005117	0.010497	-0.00221	0.270234
0.859049	0.005117	0.010497	-0.00221	0.270234
0.969056	0.005117	0.010497	-0.00221	0.270234
1.078062	0.005117	0.010497	-0.00221	0.270234
1.209069	0.005117	0.010497	-0.00221	0.270234
1.319076	0.005117	0.010497	-0.00221	0.270234
1.428082	0.005117	0.010497	-0.00221	0.270234
1.539088	0.005117	0.010497	-0.00221	0.270234
1.652094	0.005117	0.010497	-0.00221	0.270234
1.808104	0.005117	0.010497	-0.00221	0.270234
1.91611	0.005117	0.010497	-0.00221	0.270234
2.026116	0.005117	0.010497	-0.00221	0.270234
2.135122	0.005117	0.010497	-0.00221	0.270234
2.244128	0.005117	0.010497	-0.00221	0.270234
2.353135	0.005117	0.010497	-0.00221	0.270234
2.463141	0.005117	0.010497	-0.00221	0.270234
2.573147	0.005087	0.010497	-0.00221	0.270234
2.681153	0.005087	0.010497	-0.00221	0.270234
2.79116	0.005087	0.010497	-0.00221	0.270234

2.899166	0.005087	0.010497	-0.00221	0.270234
3.008172	0.005087	0.010497	-0.00221	0.270234
3.118178	0.005087	0.010497	-0.00221	0.27023
3.248186	0.005087	0.010497	-0.00221	0.27023
3.359192	0.005087	0.010497	-0.00221	0.27023
3.468198	0.005087	0.010497	-0.00221	0.27023
3.578205	0.005087	0.010497	-0.00221	0.27023
3.687211	0.005087	0.010497	-0.00221	0.27023
3.802217	0.005087	0.010497	-0.00287	0.27023
3.912224	0.005087	0.010497	-0.00287	0.27023
4.02123	0.005087	0.010497	-0.00287	0.27023
4.133236	0.005087	0.010497	-0.00287	0.27023
4.242243	0.005087	0.010497	-0.00287	0.27023
4.384251	0.005078	0.010453	-0.00287	0.27023
4.539259	0.005078	0.010453	-0.00287	0.27023
4.670267	0.005078	0.010453	-0.00287	0.27023
4.809275	0.005078	0.010453	-0.00287	0.27023
4.919281	0.005078	0.010453	-0.00287	0.27023
5.028288	0.005078	0.010453	-0.00287	0.27023
5.138294	0.005078	0.010453	-0.00287	0.27023
5.2483	0.005078	0.010453	-0.00287	0.27023
5.356307	0.005078	0.010453	-0.00287	0.27023
5.465312	0.005078	0.010453	-0.00287	0.27023
5.575319	0.005078	0.010453	-0.00287	0.27023
5.711327	0.005078	0.010453	-0.00287	0.27023
5.821333	0.005078	0.010453	-0.00287	0.27023
5.929339	0.005078	0.010453	-0.00287	0.27023
6.038345	0.005078	0.010453	-0.00287	0.27023
6.148352	0.005078	0.010453	-0.00287	0.27023
6.366364	0.005106	0.010453	-0.00287	0.27023
6.47637	0.005106	0.010453	-0.00287	0.27023
6.587377	0.005106	0.010453	-0.00287	0.27023
6.719384	0.005106	0.010453	-0.00404	0.27023
6.829391	0.005106	0.010453	-0.00404	0.27023
6.939397	0.005106	0.010453	-0.00404	0.27023
7.047403	0.005106	0.010453	-0.00404	0.27023
7.156409	0.005106	0.010453	-0.00404	0.27023
7.266416	0.005106	0.010453	-0.00404	0.27023
7.376422	0.005106	0.010453	-0.00404	0.27023
7.485428	0.005106	0.010453	-0.00404	0.27023
7.596435	0.005106	0.010453	-0.00404	0.27023

7.706441	0.005106	0.010453	-0.00404	0.27023
7.815447	0.005106	0.010453	-0.00404	0.27023
7.923453	0.005106	0.010453	-0.00404	0.27023
8.031459	0.005106	0.010453	-0.00404	0.27023
8.139465	0.005105	0.010165	-0.00404	0.27023
8.286474	0.005105	0.010165	-0.00404	0.27023
8.39648	0.005105	0.010165	-0.00404	0.27023
8.57149	0.005105	0.010165	-0.00404	0.27023
8.680497	0.005105	0.010165	-0.00404	0.27023
8.789503	0.005105	0.010165	-0.00404	0.27023
8.899509	0.005105	0.010165	-0.00404	0.27023
9.072519	0.005105	0.010165	-0.00404	0.27023
9.180525	0.005105	0.010165	-0.00404	0.27023
9.289531	0.005105	0.010165	-0.00404	0.27023
9.397538	0.005105	0.010165	-0.00404	0.27023
9.591548	0.005105	0.010165	-0.00404	0.27024
9.702555	0.005105	0.010165	-0.00404	0.27024
9.812561	0.005105	0.010165	-0.00404	0.27024
9.922567	0.005105	0.010165	-0.00404	0.27024
10.033574	0.005106	0.010165	-0.00404	0.27024
10.14358	0.005106	0.010165	-0.00404	0.27024
10.253586	0.005106	0.010165	-0.00404	0.27024
10.362593	0.005106	0.010165	-0.00404	0.27024
10.471599	0.005106	0.010165	-0.00404	0.27024
10.581605	0.005106	0.010165	-0.00404	0.27024
10.692612	0.005106	0.010165	-0.00404	0.27024
10.802618	0.005106	0.010165	-0.00404	0.27024
10.910624	0.005106	0.010165	-0.00404	0.27024
11.01963	0.005106	0.010165	-0.00404	0.27024
11.130637	0.005106	0.010165	-0.002252	0.27024
11.251644	0.005106	0.010165	-0.002252	0.27024
11.36165	0.005106	0.010165	-0.002252	0.27024
11.471656	0.005106	0.010165	-0.002252	0.27024
11.581663	0.005106	0.010165	-0.002252	0.27024
11.689669	0.005106	0.010165	-0.002252	0.27024
11.800675	0.005106	0.010165	-0.002252	0.27024
11.910681	0.013281	0.010165	-0.002252	0.27024
12.076691	0.013281	0.011973	-0.002252	0.27024
12.186697	0.013281	0.011973	-0.002252	0.27024
12.296703	0.013281	0.011973	-0.002252	0.27024
12.42271	0.013281	0.011973	-0.002252	0.27024

12.531717	0.013281	0.011973	-0.002252	0.27024
12.639723	0.013281	0.011973	-0.002252	0.27024
12.77273	0.013281	0.011973	-0.002252	0.27024
12.889737	0.013281	0.011973	-0.002252	0.27024
13.000744	0.013281	0.011973	-0.002252	0.27024
13.11075	0.013281	0.011973	-0.002252	0.27024
13.220756	0.013281	0.011973	-0.002252	0.27024
13.330762	0.013281	0.011973	-0.002252	0.27024
13.440769	0.013281	0.011973	-0.002252	0.27024
13.552775	0.013281	0.011973	-0.002252	0.27024
13.660781	0.013281	0.011973	-0.002252	0.27024
13.772788	0.013281	0.011973	-0.002252	0.27024
13.882794	0.013939	0.011973	-0.002252	0.27024
14.003801	0.013939	0.011973	-0.002252	0.27024
14.112807	0.013939	0.011973	-0.002252	0.27024
14.222814	0.013939	0.011973	-0.002252	0.27024
14.33282	0.013939	0.011973	-0.002252	0.27024
14.440826	0.013939	0.011973	-0.002252	0.27024
14.548832	0.013939	0.011973	-0.002252	0.27024
14.656838	0.013939	0.011973	-0.002252	0.27024
14.764844	0.013939	0.011973	-0.002252	0.27024
14.873851	0.013939	0.011973	-0.002252	0.27024
14.982857	0.013939	0.011973	-0.002252	0.27024
15.097864	0.013939	0.011973	-0.001586	0.27024
15.20787	0.013939	0.011973	-0.001586	0.27024
15.318876	0.013939	0.011973	-0.001586	0.27024
15.435883	0.013939	0.011973	-0.001586	0.27024
15.545889	0.013939	0.011973	-0.001586	0.27024
15.653895	0.013939	0.011973	-0.001586	0.27024
15.762902	0.013394	0.011973	-0.001586	0.27024
15.946912	0.013394	0.011205	-0.001586	0.27024
16.055918	0.013394	0.011205	-0.001586	0.27024
16.223928	0.013394	0.011205	-0.001586	0.27024
16.333934	0.013394	0.011205	-0.001586	0.27024
16.443941	0.013394	0.011205	-0.001586	0.27024
16.553947	0.013394	0.011205	-0.001586	0.27024
16.661953	0.013394	0.011205	-0.001586	0.27024
16.834963	0.013394	0.011205	-0.001586	0.27024
16.943969	0.013394	0.011205	-0.001586	0.27024
17.052975	0.013394	0.011205	-0.001586	0.27024
17.160982	0.013394	0.011205	-0.001586	0.27024

17.270988	0.013394	0.011205	-0.001586	0.27024
17.380994	0.013394	0.011205	-0.001586	0.27024
17.49	0.013394	0.011205	-0.001586	0.27024
17.600007	0.013394	0.011205	-0.001586	0.27024
17.708013	0.012551	0.011205	-0.001586	0.27024
17.817019	0.012551	0.011205	-0.001586	0.27024
17.926025	0.012551	0.011205	-0.001586	0.27024
18.035031	0.012551	0.011205	-0.001586	0.27024
18.145038	0.012551	0.011205	-0.001586	0.27024
18.256044	0.012551	0.011205	-0.001586	0.27024
18.366051	0.012551	0.011205	-0.001586	0.27024
18.475057	0.012551	0.011205	-0.001586	0.270253
18.628066	0.012551	0.011205	-0.001586	0.270253
18.736072	0.012551	0.011205	-0.001586	0.270253
18.88808	0.012551	0.011205	-0.001804	0.270253
18.998086	0.012551	0.011205	-0.001804	0.270253
19.108093	0.012551	0.011205	-0.001804	0.270253
19.218099	0.012551	0.011205	-0.001804	0.270253
19.328105	0.012551	0.011205	-0.001804	0.270253
19.438112	0.012551	0.011205	-0.001804	0.270253
19.550118	0.014026	0.011205	-0.001804	0.270253
19.658124	0.014026	0.011205	-0.001804	0.270253
19.769131	0.014026	0.011205	-0.001804	0.270253
19.879137	0.014026	0.011205	-0.001804	0.270253
19.988143	0.014026	0.011205	-0.001804	0.270253
20.10015	0.014026	0.011205	-0.001804	0.270253
20.210156	0.014026	0.011205	-0.001804	0.270253
20.319162	0.014026	0.011205	-0.001804	0.270253
20.428168	0.014026	0.011205	-0.001804	0.270253
20.562176	0.014026	0.011205	-0.001804	0.270253
20.671182	0.014026	0.011205	-0.001804	0.270253
20.779189	0.014026	0.011205	-0.001804	0.270253
20.890195	0.014026	0.011205	-0.001804	0.270253
21.019202	0.014026	0.011205	-0.001804	0.270253
21.170211	0.014026	0.012117	-0.001804	0.270253
21.279217	0.014026	0.012117	-0.001804	0.270253
21.391223	0.014026	0.012117	-0.001804	0.270253
21.50123	0.014358	0.012117	-0.001804	0.270253
21.611236	0.014358	0.012117	-0.001804	0.270253
21.744244	0.014358	0.012117	-0.001804	0.270253
21.85425	0.014358	0.012117	-0.001804	0.270253

21.963256	0.014358	0.012117	-0.001804	0.270253
22.073263	0.014358	0.012117	-0.001804	0.270253
22.182269	0.014358	0.012117	-0.001804	0.270253
22.344278	0.014358	0.012117	-0.001804	0.270253
22.454284	0.014358	0.012117	-0.001804	0.270253
22.564291	0.014358	0.012117	-0.001804	0.270253
22.672297	0.014358	0.012117	-0.001331	0.270253
22.780303	0.014358	0.012117	-0.001331	0.270253
22.889309	0.014358	0.012117	-0.001331	0.270253
23.025317	0.014358	0.012117	-0.001331	0.270253
23.137323	0.014358	0.012117	-0.001331	0.270253
23.24733	0.014358	0.012117	-0.001331	0.270253
23.357336	0.013112	0.012117	-0.001331	0.270253
23.467342	0.013112	0.012117	-0.001331	0.270253
23.578349	0.013112	0.012117	-0.001331	0.270253
23.687355	0.013112	0.012117	-0.001331	0.270253
23.797361	0.013112	0.012117	-0.001331	0.270253
23.907367	0.013112	0.012117	-0.001331	0.270253
24.017374	0.013112	0.012117	-0.001331	0.270253
24.12738	0.013112	0.012117	-0.001331	0.270253
24.237386	0.013112	0.012117	-0.001331	0.270253
24.378394	0.013112	0.012117	-0.001331	0.270253
24.489401	0.013112	0.012117	-0.001331	0.270253
24.600407	0.013112	0.012117	-0.001331	0.270253
24.708413	0.013112	0.012117	-0.001331	0.270253
24.937427	0.013112	0.01176	-0.001331	0.270253
25.045433	0.013112	0.01176	-0.001331	0.270253
25.158439	0.013112	0.01176	-0.001331	0.270253
25.268445	0.012542	0.01176	-0.001331	0.270253
25.378451	0.012542	0.01176	-0.001331	0.270253
25.496459	0.012542	0.01176	-0.001331	0.270253
25.606465	0.012542	0.01176	-0.001331	0.270253
25.714471	0.012542	0.01176	-0.001331	0.270253
25.824477	0.012542	0.01176	-0.001331	0.270253
25.931483	0.012542	0.01176	-0.001331	0.270253
26.039489	0.012542	0.01176	-0.001331	0.270253
26.180498	0.012542	0.01176	-0.001331	0.270253
26.293504	0.012542	0.01176	-0.001331	0.270253
26.40351	0.012542	0.01176	-0.001331	0.270253
26.559519	0.012542	0.01176	-0.001331	0.270253
26.670526	0.012542	0.01176	-0.00183	0.270253

26.778532	0.012542	0.01176	-0.00183	0.270253
26.886538	0.012542	0.01176	-0.00183	0.270253
26.995544	0.012542	0.01176	-0.00183	0.270253
27.10355	0.012542	0.01176	-0.00183	0.270084
27.213557	0.012559	0.01176	-0.00183	0.270084
27.322563	0.012559	0.01176	-0.00183	0.270084
27.432569	0.012559	0.01176	-0.00183	0.270084
27.543575	0.012559	0.01176	-0.00183	0.270084
27.652582	0.012559	0.01176	-0.00183	0.270084
27.761588	0.012559	0.01176	-0.00183	0.270084
27.869594	0.012559	0.01176	-0.00183	0.270084
27.978601	0.012559	0.01176	-0.00183	0.270084
28.086607	0.012559	0.01176	-0.00183	0.270084
28.271617	0.012559	0.01176	-0.00183	0.270084
28.379623	0.012559	0.01176	-0.00183	0.270084
28.487629	0.012559	0.01176	-0.00183	0.270084
28.595635	0.012559	0.01176	-0.00183	0.270084
28.719643	0.012559	0.0065	-0.00183	0.270084
28.882652	0.012559	0.0065	-0.00183	0.270084
29.006659	0.012575	0.0065	-0.00183	0.270084
29.115665	0.012575	0.0065	-0.00183	0.270084
29.224671	0.012575	0.0065	-0.00183	0.270084
29.337678	0.012575	0.0065	-0.00183	0.270084
29.461685	0.012575	0.0065	-0.00183	0.270084
29.572691	0.012575	0.0065	-0.00183	0.270084
29.680697	0.012575	0.0065	-0.00183	0.270084
29.793704	0.012575	0.0065	-0.00183	0.270084
29.901711	0.012575	0.0065	-0.00183	0.270084
30.011716	0.012575	0.0065	-0.00183	0.270084
30.121723	0.012575	0.0065	-0.00183	0.270084
30.231729	0.012575	0.0065	-0.00183	0.270084
30.340735	0.012575	0.0065	-0.00183	0.270084
30.449742	0.012575	0.0065	-0.002408	0.270084
30.558748	0.012575	0.0065	-0.002408	0.270084
30.667754	0.012575	0.0065	-0.002408	0.270084
30.783761	0.012575	0.0065	-0.002408	0.270084
30.893767	0.012575	0.0065	-0.002408	0.270084
31.003773	0.011849	0.0065	-0.002408	0.270084
31.11378	0.011849	0.0065	-0.002408	0.270084
31.221786	0.011849	0.0065	-0.002408	0.270084
31.335793	0.011849	0.0065	-0.002408	0.270084

31.447799	0.011849	0.0065	-0.002408	0.270084
31.557805	0.011849	0.0065	-0.002408	0.270084
31.669811	0.011849	0.0065	-0.002408	0.270084
31.780818	0.011849	0.0065	-0.002408	0.270084
31.896824	0.011849	0.0065	-0.002408	0.270084
32.013831	0.011849	0.0065	-0.002408	0.270084
32.123837	0.011849	0.0065	-0.002408	0.270084
32.232844	0.011849	0.0065	-0.002408	0.270084
32.34185	0.011849	0.0065	-0.002408	0.270084
32.448856	0.011849	0.002018	-0.002408	0.270084
32.568863	0.011849	0.002018	-0.002408	0.270084
32.679869	0.011849	0.002018	-0.002408	0.270084
32.943884	0.011943	0.002018	-0.002408	0.270084
33.05189	0.011943	0.002018	-0.002408	0.270084
33.163897	0.011943	0.002018	-0.002408	0.270084
33.271903	0.011943	0.002018	-0.002408	0.270084
33.39291	0.011943	0.002018	-0.002408	0.270084
33.503916	0.011943	0.002018	-0.002408	0.270084
33.612923	0.011943	0.002018	-0.002408	0.270084
33.723929	0.011943	0.002018	-0.002408	0.270084
33.91994	0.011943	0.002018	-0.002408	0.269809
34.029946	0.011943	0.002018	-0.002408	0.269809
34.137953	0.011943	0.002018	-0.002408	0.269809
34.249959	0.011943	0.002018	-0.002408	0.269809
34.359965	0.011943	0.002018	-0.002408	0.269809
34.469972	0.011943	0.002018	-0.002408	0.269809
34.580978	0.011943	0.002018	-0.002408	0.269809
34.728986	0.011362	0.002018	-0.002408	0.269809
34.835992	0.011362	0.002018	-0.002408	0.269809
34.946999	0.011362	0.002018	-0.002408	0.269809
35.056005	0.011362	0.002018	-0.002408	0.269809
35.166011	0.011362	0.002018	-0.002408	0.269809
35.276018	0.011362	0.002018	-0.002408	0.269809
35.386024	0.011362	0.002018	-0.002356	0.269809
35.579035	0.011362	0.002018	-0.002356	0.269809
35.723043	0.011362	0.002018	-0.002356	0.269809
35.83605	0.011362	0.002018	-0.002356	0.269809
35.945056	0.011362	0.002018	-0.002356	0.269809
36.065063	0.011362	0.002018	-0.002356	0.269809
36.174069	0.011362	0.002018	-0.002356	0.269809
36.285076	0.011362	0.002018	-0.002356	0.269809

36.434084	0.011362	0.001766	-0.002356	0.269809
36.54509	0.011362	0.001766	-0.002356	0.269809
36.654097	0.010759	0.001766	-0.002356	0.269809
36.826107	0.010759	0.001766	-0.002356	0.269809
36.935112	0.010759	0.001766	-0.002356	0.269809
37.045119	0.010759	0.001766	-0.002356	0.269809
37.155125	0.010759	0.001766	-0.002356	0.269809
37.266131	0.010759	0.001766	-0.002356	0.269809
37.376138	0.010759	0.001766	-0.002356	0.269809
37.486144	0.010759	0.001766	-0.002356	0.269809
37.59615	0.010759	0.001766	-0.002356	0.269809
37.704156	0.010759	0.001766	-0.002356	0.269809
37.812163	0.010759	0.001766	-0.002356	0.269809
37.920169	0.010759	0.001766	-0.002356	0.269809
38.029175	0.010759	0.001766	-0.002356	0.269809
38.137181	0.010759	0.001766	-0.002356	0.269809
38.246188	0.010759	0.001766	-0.002356	0.269809
38.453199	0.010759	0.001766	-0.002356	0.269809
38.573206	0.010744	0.001766	-0.002356	0.269809
38.681212	0.010744	0.001766	-0.002356	0.269809
38.790219	0.010744	0.001766	-0.002356	0.269809
38.899225	0.010744	0.001766	-0.002356	0.269809
39.009231	0.010744	0.001766	-0.002356	0.269809
39.118237	0.010744	0.001766	-0.002356	0.269809
39.228244	0.010744	0.001766	-0.002356	0.269809
39.407254	0.010744	0.001766	-0.001315	0.269809
39.51826	0.010744	0.001766	-0.001315	0.269809
39.627266	0.010744	0.001766	-0.001315	0.269809
39.735273	0.010744	0.001766	-0.001315	0.269809
39.847279	0.010744	0.001766	-0.001315	0.269809
39.957285	0.010744	0.001766	-0.001315	0.269809
40.066292	0.010744	0.001766	-0.001315	0.269809
40.232301	0.010744	0.002088	-0.001315	0.269809
40.341308	0.010744	0.002088	-0.001315	0.269809
40.451314	0.010762	0.002088	-0.001315	0.269809
40.576321	0.010762	0.002088	-0.001315	0.269809
40.684327	0.010762	0.002088	-0.001315	0.269809
40.814334	0.010762	0.002088	-0.001315	0.269809
40.922341	0.010762	0.002088	-0.001315	0.269809
41.052348	0.010762	0.002088	-0.001315	0.269809
41.161355	0.010762	0.002088	-0.001315	0.269809

41.27036	0.010762	0.002088	-0.001315	0.269809
41.379367	0.010762	0.002088	-0.001315	0.269809
41.566378	0.010762	0.002088	-0.001315	0.269356
41.674384	0.010762	0.002088	-0.001315	0.269356
41.78439	0.010762	0.002088	-0.001315	0.269356
41.898396	0.010762	0.002088	-0.001315	0.269356
42.008403	0.010762	0.002088	-0.001315	0.269356
42.119409	0.010762	0.002088	-0.001315	0.269356
42.260417	0.010762	0.002088	-0.001315	0.269356
42.372424	0.010741	0.002088	-0.001315	0.269356
42.48443	0.010741	0.002088	-0.001144	0.269356
42.608437	0.010741	0.002088	-0.001144	0.269356
42.715443	0.010741	0.002088	-0.001144	0.269356
42.825449	0.010741	0.002088	-0.001144	0.269356
42.935456	0.010741	0.002088	-0.001144	0.269356
43.044462	0.010741	0.002088	-0.001144	0.269356
43.154469	0.010741	0.002088	-0.001144	0.269356
43.265475	0.010741	0.002088	-0.001144	0.269356
43.375481	0.010741	0.002088	-0.001144	0.269356
43.485487	0.010741	0.002088	-0.001144	0.269356
43.593493	0.010741	0.002088	-0.001144	0.269356
43.701499	0.010741	0.002088	-0.001144	0.269356
43.810506	0.010741	0.002088	-0.001144	0.269356
43.920512	0.010741	0.002088	-0.001144	0.269356
44.066521	0.010741	0.002201	-0.001144	0.269356
44.175527	0.010741	0.002201	-0.001144	0.269356
44.285533	0.010732	0.002201	-0.001144	0.269356
44.40154	0.010732	0.002201	-0.001144	0.269356
44.516546	0.010732	0.002201	-0.001144	0.269356
44.627553	0.010732	0.002201	-0.001144	0.269356
44.870566	0.010732	0.002201	-0.001144	0.269356
44.990573	0.010732	0.002201	-0.001144	0.269356
45.11358	0.010732	0.002201	-0.001144	0.269356
45.264589	0.010732	0.002201	-0.001144	0.269356
45.441599	0.010732	0.002201	-0.001144	0.269356
45.552606	0.010732	0.002201	-0.001144	0.269356
45.665612	0.010732	0.002201	-0.001144	0.269356
45.773618	0.010732	0.002201	-0.001144	0.269356
45.884624	0.010732	0.002201	-0.001144	0.269356
45.995631	0.010732	0.002201	-0.001144	0.269356
46.105637	0.010732	0.002201	-0.001144	0.269356

46.218644	0.010765	0.002201	-0.001144	0.269356
46.32865	0.010765	0.002201	-0.001144	0.269356
46.441657	0.010765	0.002201	-0.001144	0.269356
46.551662	0.010765	0.002201	-0.001144	0.269356
46.68267	0.010765	0.002201	-0.001144	0.269356
46.798677	0.010765	0.002201	-0.001144	0.269356
46.906683	0.010765	0.002201	-0.001144	0.269356
47.03069	0.010765	0.002201	-0.001383	0.269356
47.139696	0.010765	0.002201	-0.001383	0.269356
47.247703	0.010765	0.002201	-0.001383	0.269356
47.362709	0.010765	0.002201	-0.001383	0.269356
47.481716	0.010765	0.002201	-0.001383	0.269356
47.600723	0.010765	0.002201	-0.001383	0.269356
47.709729	0.010765	0.002201	-0.001383	0.269356
47.817735	0.010765	0.002201	-0.001383	0.269356
47.926741	0.010765	0.002201	-0.001383	0.269356
48.040748	0.01042	0.002201	-0.001383	0.269356
48.150754	0.01042	0.002201	-0.001383	0.269356
48.25976	0.01042	0.002201	-0.001383	0.269356
48.368767	0.01042	0.002201	-0.001383	0.269356
48.478773	0.01042	0.002201	-0.001383	0.269356
48.587779	0.01042	0.002201	-0.001383	0.269356
48.717787	0.01042	0.002201	-0.001383	0.269356
48.839794	0.01042	0.002201	-0.001383	0.269356
48.961801	0.01042	0.002201	-0.001383	0.269356
49.070807	0.01042	0.002201	-0.001383	0.269356
49.186813	0.01042	0.002256	-0.001383	0.269356
49.29582	0.01042	0.002256	-0.001383	0.269356
49.405826	0.01042	0.002256	-0.001383	0.269356
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49.734845	0.01042	0.002256	-0.001383	0.269356
49.843851	0.01042	0.002256	-0.001383	0.269356
49.952857	0.010404	0.002256	-0.001383	0.269356
50.060863	0.010404	0.002256	-0.001383	0.269356
50.16787	0.010404	0.002256	-0.001383	0.269356
50.275876	0.010404	0.002256	-0.001383	0.269356
50.382882	0.010404	0.002256	-0.001383	0.269356
50.490888	0.010404	0.002256	-0.001383	0.269356
50.598894	0.010404	0.002256	-0.001383	0.269356
50.7069	0.010404	0.002256	-0.001383	0.269356

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50.923913	0.010404	0.002256	-0.002553	0.269356
51.032919	0.010404	0.002256	-0.002553	0.269356
51.144925	0.010404	0.002256	-0.002553	0.269356
51.253932	0.010404	0.002256	-0.002553	0.269356
51.371938	0.010404	0.002256	-0.002553	0.269356
51.481945	0.010404	0.002256	-0.002553	0.269356
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51.700957	0.010404	0.002256	-0.002553	0.269356
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51.964972	0.008829	0.002256	-0.002553	0.268778
52.074978	0.008829	0.002256	-0.002553	0.268778
52.183985	0.008829	0.002256	-0.002553	0.268778
52.295991	0.008829	0.002256	-0.002553	0.268778
52.405997	0.008829	0.002256	-0.002553	0.268778
52.570007	0.008829	0.002256	-0.002553	0.268778
52.679013	0.008829	0.002256	-0.002553	0.268778
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53.85408	0.008827	0.002539	-0.002553	0.268778
53.962087	0.008827	0.002539	-0.002553	0.268778
54.071093	0.008827	0.002539	-0.002553	0.268778
54.182099	0.008827	0.002539	-0.002553	0.268778
54.344109	0.008827	0.002539	-0.002553	0.268778
54.455115	0.008827	0.002539	-0.002553	0.268778
54.564121	0.008827	0.002539	-0.002553	0.268778
54.737131	0.008827	0.002539	-0.001923	0.268778
54.845137	0.008827	0.002539	-0.001923	0.268778
54.955143	0.008827	0.002539	-0.001923	0.268778
55.06515	0.008827	0.002539	-0.001923	0.268778
55.177156	0.008827	0.002539	-0.001923	0.268778
55.287162	0.008827	0.002539	-0.001923	0.268778
55.398169	0.008827	0.002539	-0.001923	0.268778
55.509175	0.008827	0.002539	-0.001923	0.268778

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55.726187	0.008822	0.002539	-0.001923	0.268778
55.836194	0.008822	0.002539	-0.001923	0.268778
55.9462	0.008822	0.002539	-0.001923	0.268778
56.055206	0.008822	0.002539	-0.001923	0.268778
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56.273219	0.008822	0.002539	-0.001923	0.268778
56.426228	0.008822	0.002539	-0.001923	0.268778
56.559235	0.008822	0.002539	-0.001923	0.268778
56.667241	0.008822	0.002539	-0.001923	0.268778
56.904255	0.008822	0.001785	-0.001923	0.268778
57.019261	0.008822	0.001785	-0.001923	0.268778
57.196271	0.008822	0.001785	-0.001923	0.268778
57.312278	0.008822	0.001785	-0.001923	0.268778
57.422284	0.008822	0.001785	-0.001923	0.268778
57.541291	0.009049	0.001785	-0.001923	0.268778
57.662298	0.009049	0.001785	-0.001923	0.268778
57.770304	0.009049	0.001785	-0.001923	0.268778
57.913312	0.009049	0.001785	-0.001923	0.268099
58.023319	0.009049	0.001785	-0.001923	0.268099
58.134325	0.009049	0.001785	-0.001923	0.268099
58.242331	0.009049	0.001785	-0.001923	0.268099
58.353338	0.009049	0.001785	-0.001923	0.268099
58.465344	0.009049	0.001785	-0.002033	0.268099
58.610353	0.009049	0.001785	-0.002033	0.268099
58.720359	0.009049	0.001785	-0.002033	0.268099
58.828365	0.009049	0.001785	-0.002033	0.268099
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59.152383	0.009049	0.001785	-0.002033	0.268099
59.26139	0.009049	0.001785	-0.002033	0.268099
59.373396	0.009049	0.001785	-0.002033	0.268099
59.483402	0.008827	0.001785	-0.002033	0.268099
59.593409	0.008827	0.001785	-0.002033	0.268099
59.706415	0.008827	0.001785	-0.002033	0.268099
59.816422	0.008827	0.001785	-0.002033	0.268099
59.926428	0.008827	0.001785	-0.002033	0.268099
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60.170442	0.008827	0.001785	-0.002033	0.268099
60.282448	0.008827	0.001785	-0.002033	0.268099
60.391454	0.008827	0.001785	-0.002033	0.268099

60.501461	0.008827	0.001785	-0.002033	0.268099
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60.717473	0.008827	0.001785	-0.002033	0.268099
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61.219501	0.008827	0.001429	-0.002033	0.268099
61.377511	0.008819	0.001429	-0.002033	0.268099
61.487517	0.008819	0.001429	-0.002033	0.268099
61.596523	0.008819	0.001429	-0.002033	0.268099
61.704529	0.008819	0.001429	-0.002033	0.268099
61.813536	0.008819	0.001429	-0.002033	0.268099
61.922542	0.008819	0.001429	-0.002033	0.268099
62.032548	0.008819	0.001429	-0.002033	0.268099
62.142554	0.008819	0.001429	-0.002033	0.268099
62.253561	0.008819	0.001429	-0.002033	0.268099
62.446572	0.008819	0.001429	-0.002002	0.268099
62.557578	0.008819	0.001429	-0.002002	0.268099
62.667584	0.008819	0.001429	-0.002002	0.268099
62.77559	0.008819	0.001429	-0.002002	0.268099
62.883597	0.008819	0.001429	-0.002002	0.268099
62.991603	0.008819	0.001429	-0.002002	0.268099
63.125611	0.008819	0.001429	-0.002002	0.268099
63.233617	0.008847	0.001429	-0.002002	0.268099
63.341623	0.008847	0.001429	-0.002002	0.268099
63.449629	0.008847	0.001429	-0.002002	0.268099
63.558635	0.008847	0.001429	-0.002002	0.268099
63.667642	0.008847	0.001429	-0.002002	0.268099
63.777648	0.008847	0.001429	-0.002002	0.268099
63.921656	0.008847	0.001429	-0.002002	0.268099
64.031662	0.008847	0.001429	-0.002002	0.268099
64.152669	0.008847	0.001429	-0.002002	0.268099
64.261675	0.008847	0.001429	-0.002002	0.268099
64.372682	0.008847	0.001429	-0.002002	0.268099
64.481688	0.008847	0.002107	-0.002002	0.268099
64.597695	0.008847	0.002107	-0.002002	0.268099
64.705701	0.008847	0.002107	-0.002002	0.268099
64.930714	0.008847	0.002107	-0.002002	0.268099
65.04072	0.008847	0.002107	-0.002002	0.268099
65.194729	0.008818	0.002107	-0.002002	0.268099
65.331737	0.008818	0.002107	-0.002002	0.268099

65.443743	0.008818	0.002107	-0.002002	0.268099
65.554749	0.008818	0.002107	-0.002002	0.268099
65.662756	0.008818	0.002107	-0.002002	0.268099
65.837766	0.008818	0.002107	-0.002002	0.268099
65.947772	0.008818	0.002107	-0.002002	0.267487
66.058778	0.008818	0.002107	-0.002002	0.267487
66.169785	0.008818	0.002107	-0.002002	0.267487
66.279791	0.008818	0.002107	-0.002002	0.267487
66.388797	0.008818	0.002107	-0.002002	0.267487
66.499804	0.008818	0.002107	-0.002002	0.267487
66.61181	0.008818	0.002107	-0.002002	0.267487
66.719816	0.008818	0.002107	-0.002002	0.267487
66.827822	0.008818	0.002107	-0.002002	0.267487
66.936829	0.008818	0.002107	-0.002002	0.267487
67.044835	0.008851	0.002107	-0.002002	0.267487
67.155841	0.008851	0.002107	-0.002002	0.267487
67.263847	0.008851	0.002107	-0.002002	0.267487
67.372854	0.008851	0.002107	-0.002002	0.267487
67.560864	0.008851	0.002107	-0.001965	0.267487
67.675871	0.008851	0.002107	-0.001965	0.267487
67.784877	0.008851	0.002107	-0.001965	0.267487
67.892883	0.008851	0.002107	-0.001965	0.267487
68.00289	0.008851	0.002107	-0.001965	0.267487
68.113896	0.008851	0.002107	-0.001965	0.267487
68.274905	0.008851	0.002192	-0.001965	0.267487
68.399912	0.008851	0.002192	-0.001965	0.267487
68.509919	0.008851	0.002192	-0.001965	0.267487
68.620925	0.008851	0.002192	-0.001965	0.267487
68.750932	0.008851	0.002192	-0.001965	0.267487
68.863939	0.008851	0.002192	-0.001965	0.267487
68.978945	0.008829	0.002192	-0.001965	0.267487
69.088952	0.008829	0.002192	-0.001965	0.267487
69.208959	0.008829	0.002192	-0.001965	0.267487
69.321965	0.008829	0.002192	-0.001965	0.267487
69.429971	0.008829	0.002192	-0.001965	0.267487
69.544978	0.008829	0.002192	-0.001965	0.267487
69.653984	0.008829	0.002192	-0.001965	0.267487
69.766991	0.008829	0.002192	-0.001965	0.267487
69.883997	0.008829	0.002192	-0.001965	0.267487
69.997004	0.008829	0.002192	-0.001965	0.267487
70.10801	0.008829	0.002192	-0.001965	0.267487

70.218016	0.008829	0.002192	-0.001965	0.267487
70.334023	0.008829	0.002192	-0.001965	0.267487
70.444029	0.008829	0.002192	-0.001965	0.267487
70.561036	0.008829	0.002192	-0.001965	0.267487
70.673042	0.008829	0.002192	-0.001965	0.267487
70.786049	0.008829	0.002192	-0.001965	0.267487
70.895055	0.008825	0.002192	-0.001965	0.267487
71.013062	0.008825	0.002192	-0.001965	0.267487
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71.232074	0.008825	0.002192	-0.001965	0.267487
71.455087	0.008825	0.002192	-0.002032	0.267487
71.565094	0.008825	0.002192	-0.002032	0.267487
71.674099	0.008825	0.002192	-0.002032	0.267487
71.782106	0.008825	0.002192	-0.002032	0.267487
71.896112	0.008825	0.002192	-0.002032	0.267487
72.007119	0.008825	0.002192	-0.002032	0.267487
72.117125	0.008825	0.002192	-0.002032	0.267487
72.252133	0.008825	0.001518	-0.002032	0.267487
72.362139	0.008825	0.001518	-0.002032	0.267487
72.472145	0.008825	0.001518	-0.002032	0.267487
72.600152	0.008825	0.001518	-0.002032	0.267487
72.709159	0.008825	0.001518	-0.002032	0.267487
72.820165	0.008516	0.001518	-0.002032	0.267487
72.930171	0.008516	0.001518	-0.002032	0.267487
73.040178	0.008516	0.001518	-0.002032	0.267487
73.149184	0.008516	0.001518	-0.002032	0.267487
73.25819	0.008516	0.001518	-0.002032	0.267487
73.366196	0.008516	0.001518	-0.002032	0.267487
73.557207	0.008516	0.001518	-0.002032	0.267487
73.665214	0.008516	0.001518	-0.002032	0.267487
73.77322	0.008516	0.001518	-0.002032	0.267487
73.884226	0.008516	0.001518	-0.002032	0.267487
73.993232	0.008516	0.001518	-0.002032	0.267487
74.103239	0.008516	0.001518	-0.002032	0.267487
74.213245	0.008516	0.001518	-0.002032	0.267487
74.322251	0.008516	0.001518	-0.002032	0.267487
74.430257	0.008516	0.001518	-0.002032	0.267487
74.538263	0.008516	0.001518	-0.002032	0.267487
74.646269	0.008697	0.001518	-0.002032	0.267487
74.755276	0.008697	0.001518	-0.002032	0.266583
74.864282	0.008697	0.001518	-0.002032	0.266583

74.973288	0.008697	0.001518	-0.002032	0.266583
75.081295	0.008697	0.001518	-0.002032	0.266583
75.189301	0.008697	0.001518	-0.002032	0.266583
75.298307	0.008697	0.001518	-0.002032	0.266583
75.406313	0.008697	0.001518	-0.002032	0.266583
75.517319	0.008697	0.001518	-0.002032	0.266583
75.636326	0.008697	0.001518	-0.002032	0.266583
75.783335	0.008697	0.001518	-0.002032	0.266583
75.899341	0.008697	0.001518	-0.002032	0.266583
76.029349	0.008697	0.001191	-0.002032	0.266583
76.143355	0.008697	0.001191	-0.001732	0.266583
76.253361	0.008697	0.001191	-0.001732	0.266583
76.369368	0.008697	0.001191	-0.001732	0.266583
76.479374	0.008764	0.001191	-0.001732	0.266583
76.590381	0.008764	0.001191	-0.001732	0.266583
76.701387	0.008764	0.001191	-0.001732	0.266583
76.811393	0.008764	0.001191	-0.001732	0.266583
76.9224	0.008764	0.001191	-0.001732	0.266583
77.035406	0.008764	0.001191	-0.001732	0.266583
77.146412	0.008764	0.001191	-0.001732	0.266583
77.254419	0.008764	0.001191	-0.001732	0.266583
77.366425	0.008764	0.001191	-0.001732	0.266583
77.474432	0.008764	0.001191	-0.001732	0.266583
77.583437	0.008764	0.001191	-0.001732	0.266583
77.691444	0.008764	0.001191	-0.001732	0.266583
77.80145	0.008764	0.001191	-0.001732	0.266583
77.911457	0.008764	0.001191	-0.001732	0.266583
78.042464	0.008764	0.001191	-0.001732	0.266583
78.15347	0.008764	0.001191	-0.001732	0.266583
78.263476	0.008764	0.001191	-0.001732	0.266583
78.386484	0.00966	0.001191	-0.000306	0.266583
78.49649	0.00966	0.001191	-0.000306	0.266583
78.606496	0.00966	0.001191	-0.000306	0.266583
78.713502	0.00966	0.001191	-0.000306	0.266583
78.821508	0.00966	0.001191	-0.000306	0.266583
78.929514	0.00966	0.001191	-0.000306	0.266583
79.038521	0.00966	0.001191	-0.000306	0.266583
79.147527	0.00966	0.001191	-0.000306	0.266583
79.259533	0.00966	0.001191	-0.000306	0.266583
79.367539	0.00966	0.001191	-0.000306	0.266583
79.475546	0.00966	0.001191	-0.000306	0.266583

79.585552	0.00966	0.001191	-0.000306	0.266583
79.693558	0.00966	0.001191	-0.000306	0.266583
79.801564	0.00966	0.002845	-0.000306	0.266583
79.945573	0.00966	0.002845	-0.000306	0.266583
80.055579	0.00966	0.002845	-0.000306	0.266583
80.220588	0.013963	0.002845	-0.000306	0.266583
80.329595	0.013963	0.002845	-0.000306	0.266583
80.442601	0.013963	0.002845	-0.000306	0.266583
80.552608	0.013963	0.002845	-0.000306	0.266583
80.708616	0.013963	0.002845	-0.000306	0.266583
80.828623	0.013963	0.002845	-0.000306	0.266583
80.936629	0.013963	0.002845	-0.000306	0.266583
81.046636	0.013963	0.002845	-0.000306	0.266583
81.158642	0.013963	0.002845	-0.000306	0.266583
81.275649	0.013963	0.002845	-0.000306	0.266583
81.386655	0.013963	0.002845	-0.000306	0.266583
81.496661	0.013963	0.002845	-0.000306	0.266583
81.606668	0.013963	0.002845	-0.000306	0.266583
81.714674	0.013963	0.002845	-0.000306	0.266583
81.861682	0.013963	0.002845	-0.000306	0.266583
81.971689	0.013963	0.002845	-0.000306	0.266583
82.082695	0.013963	0.002845	-0.000306	0.266583
82.192701	0.017677	0.002845	-0.000306	0.266583
82.302708	0.017677	0.002845	-0.000306	0.266583
82.411714	0.017677	0.002845	-0.000306	0.26567
82.542721	0.017677	0.002845	-0.000306	0.26567
82.650727	0.017677	0.002845	-0.000306	0.26567
82.758734	0.017677	0.002845	0.001379	0.26567
82.911742	0.017677	0.002845	0.001379	0.26567
83.021749	0.017677	0.002845	0.001379	0.26567
83.130755	0.017677	0.002845	0.001379	0.26567
83.239761	0.017677	0.002845	0.001379	0.26567
83.350768	0.017677	0.002845	0.001379	0.26567
83.469774	0.017677	0.002845	0.001379	0.26567
83.580781	0.017677	0.002845	0.001379	0.26567
83.688787	0.017677	0.002845	0.001379	0.26567
83.819794	0.017677	0.002845	0.001379	0.26567
83.9308	0.017677	0.002845	0.001379	0.26567
84.064808	0.020019	0.002845	0.001379	0.26567
84.174815	0.020019	0.002845	0.001379	0.26567
84.285821	0.020019	0.002845	0.001379	0.26567

84.395827	0.020019	0.002845	0.001379	0.26567
84.518834	0.020019	0.002845	0.001379	0.26567
84.626841	0.020019	0.002845	0.001379	0.26567
84.820851	0.020019	0.002845	0.001379	0.26567
84.928858	0.020019	0.002845	0.001379	0.26567
85.036864	0.020019	0.003984	0.001379	0.26567
85.14987	0.020019	0.003984	0.001379	0.26567
85.259877	0.020019	0.003984	0.001379	0.26567
85.369883	0.020019	0.003984	0.001379	0.26567
85.479889	0.020019	0.003984	0.001379	0.26567
85.589895	0.020019	0.003984	0.001379	0.26567
85.762905	0.020019	0.003984	0.001379	0.26567
85.870912	0.020019	0.003984	0.001379	0.26567
85.980918	0.019606	0.003984	0.001379	0.26567
86.089924	0.019606	0.003984	0.001379	0.26567
86.19993	0.019606	0.003984	0.001379	0.26567
86.322937	0.019606	0.003984	0.001379	0.26567
86.432944	0.019606	0.003984	0.001379	0.26567
86.54295	0.019606	0.003984	0.001379	0.26567
86.650956	0.019606	0.003984	0.001264	0.26567
86.758962	0.019606	0.003984	0.001264	0.26567
86.867969	0.019606	0.003984	0.001264	0.26567
86.974975	0.019606	0.003984	0.001264	0.26567
87.084981	0.019606	0.003984	0.001264	0.26567
87.195987	0.019606	0.003984	0.001264	0.26567
87.305994	0.019606	0.003984	0.001264	0.26567
87.419	0.019606	0.003984	0.001264	0.26567
87.529006	0.019606	0.003984	0.001264	0.26567
87.637012	0.019606	0.003984	0.001264	0.26567
87.746019	0.019606	0.003984	0.001264	0.26567
87.855025	0.018216	0.003984	0.001264	0.26567
87.964031	0.018216	0.003984	0.001264	0.26567
88.072037	0.018216	0.003984	0.001264	0.26567
88.180044	0.018216	0.003984	0.001264	0.26567
88.28905	0.018216	0.003984	0.001264	0.26567
88.399056	0.018216	0.003984	0.001264	0.26567
88.510063	0.018216	0.003984	0.001264	0.26567
88.620069	0.018216	0.00337	0.001264	0.26567
88.918086	0.018216	0.00337	0.001264	0.26567
89.026092	0.018216	0.00337	0.001264	0.26567
89.138098	0.018216	0.00337	0.001264	0.26567

89.247105	0.018216	0.00337	0.001264	0.26567
89.360111	0.018216	0.00337	0.001264	0.26567
89.468117	0.018216	0.00337	0.001264	0.26567
89.579123	0.018216	0.00337	0.001264	0.26567
89.68813	0.018216	0.00337	0.001264	0.26567
89.814137	0.017547	0.00337	0.001264	0.26567
89.927144	0.017547	0.00337	0.001264	0.26567
90.03715	0.017547	0.00337	0.001264	0.26567
90.146156	0.017547	0.00337	0.001264	0.264817
90.259162	0.017547	0.00337	0.001264	0.264817
90.368169	0.017547	0.00337	0.001264	0.264817
90.477175	0.017547	0.00337	0.000375	0.264817
90.606183	0.017547	0.00337	0.000375	0.264817
90.719189	0.017547	0.00337	0.000375	0.264817
90.830195	0.017547	0.00337	0.000375	0.264817
90.942202	0.017547	0.00337	0.000375	0.264817
91.059208	0.017547	0.00337	0.000375	0.264817
91.189216	0.017547	0.00337	0.000375	0.264817
91.298222	0.017547	0.00337	0.000375	0.264817
91.408228	0.017547	0.00337	0.000375	0.264817
91.519235	0.017547	0.00337	0.000375	0.264817
91.629241	0.016298	0.00337	0.000375	0.264817
91.739247	0.016298	0.00337	0.000375	0.264817
91.847253	0.016298	0.00337	0.000375	0.264817
91.95626	0.016298	0.00337	0.000375	0.264817
92.067266	0.016298	0.00337	0.000375	0.264817
92.205274	0.016298	0.00337	0.000375	0.264817
92.31628	0.016298	0.00337	0.000375	0.264817
92.426287	0.016298	0.00337	0.000375	0.264817
92.538293	0.016298	0.00337	0.000375	0.264817
92.684301	0.016298	0.002786	0.000375	0.264817
92.796308	0.016298	0.002786	0.000375	0.264817
92.909314	0.016298	0.002786	0.000375	0.264817
93.018321	0.016298	0.002786	0.000375	0.264817
93.129327	0.016298	0.002786	0.000375	0.264817
93.261334	0.016298	0.002786	0.000375	0.264817
93.406343	0.016298	0.002786	0.000375	0.264817
93.515349	0.016253	0.002786	0.000375	0.264817
93.626355	0.016253	0.002786	0.000375	0.264817
93.735362	0.016253	0.002786	0.000375	0.264817
93.843368	0.016253	0.002786	0.000375	0.264817

94.025378	0.016253	0.002786	0.000375	0.264817
94.136384	0.016253	0.002786	0.000375	0.264817
94.246391	0.016253	0.002786	0.000375	0.264817
94.4184	0.016253	0.002786	-0.000498	0.264817
94.526407	0.016253	0.002786	-0.000498	0.264817
94.635413	0.016253	0.002786	-0.000498	0.264817
94.76642	0.016253	0.002786	-0.000498	0.264817
94.877427	0.016253	0.002786	-0.000498	0.264817
94.987433	0.016253	0.002786	-0.000498	0.264817
95.097439	0.016253	0.002786	-0.000498	0.264817
95.209445	0.016253	0.002786	-0.000498	0.264817
95.319452	0.016253	0.002786	-0.000498	0.264817
95.430459	0.014551	0.002786	-0.000498	0.264817
95.540465	0.014551	0.002786	-0.000498	0.264817
95.648471	0.014551	0.002786	-0.000498	0.264817
95.756477	0.014551	0.002786	-0.000498	0.264817
95.866483	0.014551	0.002786	-0.000498	0.264817
95.97649	0.014551	0.002786	-0.000498	0.264817
96.086496	0.014551	0.002786	-0.000498	0.264817
96.197502	0.014551	0.002786	-0.000498	0.264817
96.306509	0.014551	0.002786	-0.000498	0.264817
96.416515	0.014551	0.002786	-0.000498	0.264817
96.547522	0.014551	0.002524	-0.000498	0.264817
96.783536	0.014551	0.002524	-0.000498	0.264817
96.892542	0.014551	0.002524	-0.000498	0.264817
97.002548	0.014551	0.002524	-0.000498	0.264817
97.111555	0.014551	0.002524	-0.000498	0.264817
97.220561	0.014551	0.002524	-0.000498	0.264817
97.329567	0.014467	0.002524	-0.000498	0.264817
97.441573	0.014467	0.002524	-0.000498	0.264817
97.55058	0.014467	0.002524	-0.000498	0.264817
97.660586	0.014467	0.002524	-0.000498	0.264817
97.808594	0.014467	0.002524	-0.000498	0.264817
97.918601	0.014467	0.002524	-0.000498	0.264817
98.029607	0.014467	0.002524	-0.000498	0.264817
98.139613	0.014467	0.002524	-0.000498	0.264817
98.249619	0.014467	0.002524	-0.000498	0.264817
98.359626	0.014467	0.002524	-0.000498	0.264817
98.470632	0.014467	0.002524	-0.000498	0.264817
98.579638	0.014467	0.002524	-0.000498	0.264817
98.689645	0.014467	0.002524	-0.000498	0.264817

98.799651	0.014467	0.002524	-0.000545	0.264817
98.914658	0.014467	0.002524	-0.000545	0.264817
99.024664	0.014467	0.002524	-0.000545	0.264817
99.13467	0.014467	0.002524	-0.000545	0.264817
99.244677	0.014491	0.002524	-0.000545	0.264817
99.354683	0.014491	0.002524	-0.000545	0.264817
99.464689	0.014491	0.002524	-0.000545	0.263719
99.573695	0.014491	0.002524	-0.000545	0.263719
99.682702	0.014491	0.002524	-0.000545	0.263719
99.790708	0.014491	0.002524	-0.000545	0.263719
99.900714	0.014491	0.002524	-0.000545	0.263719
100.01072	0.014491	0.002524	-0.000545	0.263719
100.120727	0.014491	0.002524	-0.000545	0.263719
100.253734	0.014491	0.002524	-0.000545	0.263719
100.384742	0.014491	0.002073	-0.000545	0.263719
100.494748	0.014491	0.002073	-0.000545	0.263719
100.603754	0.014491	0.002073	-0.000545	0.263719
100.71276	0.014491	0.002073	-0.000545	0.263719
100.87277	0.014491	0.002073	-0.000545	0.263719
100.980776	0.014491	0.002073	-0.000545	0.263719
101.090782	0.014491	0.002073	-0.000545	0.263719
101.203789	0.01311	0.002073	-0.000545	0.263719
101.314795	0.01311	0.002073	-0.000545	0.263719
101.423801	0.01311	0.002073	-0.000545	0.263719
101.533807	0.01311	0.002073	-0.000545	0.263719
101.655815	0.01311	0.002073	-0.000545	0.263719
101.763821	0.01311	0.002073	-0.000545	0.263719
101.873827	0.01311	0.002073	-0.000545	0.263719
101.984833	0.01311	0.002073	-0.000545	0.263719
102.09384	0.01311	0.002073	-0.000545	0.263719
102.203846	0.01311	0.002073	-0.000545	0.263719
102.378856	0.01311	0.002073	-0.000545	0.263719
102.488862	0.01311	0.002073	-0.000545	0.263719
102.598868	0.01311	0.002073	-0.000545	0.263719
102.706874	0.01311	0.002073	-0.000545	0.263719
102.81388	0.01311	0.002073	-0.000545	0.263719
102.921887	0.01311	0.002073	-0.000545	0.263719
103.029893	0.012558	0.002073	-0.000545	0.263719
103.137899	0.012558	0.002073	-0.000545	0.263719
103.246905	0.012558	0.002073	-0.000951	0.263719
103.385913	0.012558	0.002073	-0.000951	0.263719

103.49592	0.012558	0.002073	-0.000951	0.263719
103.605926	0.012558	0.002073	-0.000951	0.263719
103.713932	0.012558	0.002073	-0.000951	0.263719
103.824938	0.012558	0.002073	-0.000951	0.263719
103.934945	0.012558	0.002073	-0.000951	0.263719
104.044951	0.012558	0.002073	-0.000951	0.263719
104.220961	0.012558	0.001904	-0.000951	0.263719
104.330967	0.012558	0.001904	-0.000951	0.263719
104.440974	0.012558	0.001904	-0.000951	0.263719
104.619984	0.012558	0.001904	-0.000951	0.263719
104.773993	0.012558	0.001904	-0.000951	0.263719
104.883999	0.012558	0.001904	-0.000951	0.263719
105.021007	0.01252	0.001904	-0.000951	0.263719
105.131013	0.01252	0.001904	-0.000951	0.263719
105.24902	0.01252	0.001904	-0.000951	0.263719
105.362026	0.01252	0.001904	-0.000951	0.263719
105.477033	0.01252	0.001904	-0.000951	0.263719
105.587039	0.01252	0.001904	-0.000951	0.263719
105.700046	0.01252	0.001904	-0.000951	0.263719
105.810052	0.01252	0.001904	-0.000951	0.263719
105.923059	0.01252	0.001904	-0.000951	0.262468
106.052066	0.01252	0.001904	-0.000951	0.262468
106.193074	0.01252	0.001904	-0.000951	0.262468
106.309081	0.01252	0.001904	-0.000951	0.262468
106.428087	0.01252	0.001904	-0.000951	0.262468
106.558095	0.01252	0.001904	-0.000951	0.262468
106.671101	0.01252	0.001904	-0.000951	0.262468
106.800108	0.01252	0.001904	-0.000951	0.262468
106.909115	0.011457	0.001904	-0.000951	0.262468
107.020121	0.011457	0.001904	-0.000951	0.262468
107.140128	0.011457	0.001904	-0.001539	0.262468
107.260135	0.011457	0.001904	-0.001539	0.262468
107.369141	0.011457	0.001904	-0.001539	0.262468
107.477148	0.011457	0.001904	-0.001539	0.262468
107.587153	0.011457	0.001904	-0.001539	0.262468
107.70216	0.011457	0.001904	-0.001539	0.262468
107.813167	0.011457	0.001904	-0.001539	0.262468
107.936173	0.011457	0.001904	-0.001539	0.262468
108.04718	0.011457	0.001548	-0.001539	0.262468
108.157186	0.011457	0.001548	-0.001539	0.262468
108.268193	0.011457	0.001548	-0.001539	0.262468

108.3982	0.011457	0.001548	-0.001539	0.262468
108.530208	0.011457	0.001548	-0.001539	0.262468
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108.75022	0.010744	0.001548	-0.001539	0.262468
108.859226	0.010744	0.001548	-0.001539	0.262468
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110.101297	0.010744	0.001548	-0.001539	0.262468
110.210304	0.010744	0.001548	-0.001539	0.262468
110.32031	0.010744	0.001548	-0.001539	0.262468
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110.537323	0.010744	0.001548	-0.001539	0.262468
110.649329	0.010774	0.001548	-0.001539	0.262468
110.759335	0.010774	0.001548	-0.001539	0.262468
110.873342	0.010774	0.001548	-0.001539	0.262468
111.02335	0.010774	0.001548	-0.000353	0.262468
111.132357	0.010774	0.001548	-0.000353	0.262468
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111.353369	0.010774	0.001548	-0.000353	0.262468
111.463376	0.010774	0.001548	-0.000353	0.262468
111.573381	0.010774	0.001548	-0.000353	0.262468
111.682388	0.010774	0.001548	-0.000353	0.262468
111.794394	0.010774	0.001548	-0.000353	0.262468
111.956404	0.010774	0.001548	-0.000353	0.262468
112.06741	0.010774	0.001548	-0.000353	0.262468
112.220418	0.010774	0.001548	-0.000353	0.262468
112.328425	0.010774	0.001548	-0.000353	0.262468
112.437431	0.010774	0.001548	-0.000353	0.262468
112.548438	0.014506	0.001548	-0.000353	0.262468
112.712447	0.014506	0.001548	-0.000353	0.262468
112.831454	0.014506	0.001548	-0.000353	0.262468
112.964461	0.014506	0.001548	-0.000353	0.262468
113.073467	0.014506	0.001548	-0.000353	0.262468

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113.403486	0.014506	0.002286	-0.000353	0.262468
113.513493	0.014506	0.002286	-0.000353	0.262468
113.664501	0.014506	0.002286	-0.000353	0.262468
113.783508	0.014506	0.002286	-0.000353	0.262468
113.894515	0.014506	0.002286	-0.000353	0.262468
114.00352	0.014506	0.002286	-0.000353	0.262468
114.120527	0.014506	0.002286	-0.000353	0.262468
114.248535	0.014506	0.002286	-0.000353	0.262468
114.357541	0.016287	0.002286	-0.000353	0.261265
114.593554	0.016287	0.002286	-0.000353	0.261265
114.70156	0.016287	0.002286	-0.000353	0.261265
114.809567	0.016287	0.002286	-0.000187	0.261265
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115.134585	0.016287	0.002286	-0.000187	0.261265
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115.353598	0.016287	0.002286	-0.000187	0.261265
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115.57361	0.016287	0.002286	-0.000187	0.261265
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115.91563	0.016287	0.002286	-0.000187	0.261265
116.059638	0.016287	0.002286	-0.000187	0.261265
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116.281651	0.017345	0.002286	-0.000187	0.261265
116.395658	0.017345	0.002286	-0.000187	0.261265
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117.152701	0.017345	0.002741	-0.000187	0.261265
117.260707	0.017345	0.002741	-0.000187	0.261265
117.368713	0.017345	0.002741	-0.000187	0.261265
117.478719	0.017345	0.002741	-0.000187	0.261265
117.588726	0.017345	0.002741	-0.000187	0.261265
117.698732	0.017345	0.002741	-0.000187	0.261265
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117.929745	0.017345	0.002741	-0.000187	0.261265

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118.145758	0.016333	0.002741	-0.000187	0.261265
118.323768	0.016333	0.002741	-0.000187	0.261265
118.432774	0.016333	0.002741	-0.000187	0.261265
118.54178	0.016333	0.002741	-0.000187	0.261265
118.742792	0.016333	0.002741	-4.02E-05	0.261265
118.851798	0.016333	0.002741	-4.02E-05	0.261265
118.959804	0.016333	0.002741	-4.02E-05	0.261265
119.067811	0.016333	0.002741	-4.02E-05	0.261265
119.175817	0.016333	0.002741	-4.02E-05	0.261265
119.283823	0.016333	0.002741	-4.02E-05	0.261265
119.393829	0.016333	0.002741	-4.02E-05	0.261265
119.503835	0.016333	0.002741	-4.02E-05	0.261265
119.612842	0.016333	0.002741	-4.02E-05	0.261265
119.724848	0.016333	0.002741	-4.02E-05	0.261265
119.854856	0.016333	0.002741	-4.02E-05	0.261265
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120.071868	0.016286	0.002741	-4.02E-05	0.261265
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120.29488	0.016286	0.002741	-4.02E-05	0.261265
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120.521894	0.016286	0.002741	-4.02E-05	0.261265
120.6329	0.016286	0.002741	-4.02E-05	0.261265
120.825911	0.016286	0.002251	-4.02E-05	0.261265
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121.040923	0.016286	0.002251	-4.02E-05	0.261265
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121.554953	0.016286	0.002251	-4.02E-05	0.261265
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121.772965	0.016286	0.002251	-4.02E-05	0.261265
121.881971	0.016286	0.002251	-4.02E-05	0.261265
121.990978	0.014858	0.002251	-4.02E-05	0.261265
122.198989	0.014858	0.002251	-4.02E-05	0.259858
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123.573068	0.014858	0.002251	-8.21E-05	0.259858
123.683074	0.014858	0.002251	-8.21E-05	0.259858
123.79208	0.014498	0.002251	-8.21E-05	0.259858
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124.014093	0.014498	0.002251	-8.21E-05	0.259858
124.1241	0.014498	0.002251	-8.21E-05	0.259858
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124.570125	0.014498	0.002251	-8.21E-05	0.259858
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125.031151	0.014498	0.001741	-8.21E-05	0.259858
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125.696189	0.013535	0.001741	-8.21E-05	0.259858
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126.001207	0.013535	0.001741	-8.21E-05	0.259858
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126.518237	0.013535	0.001741	-0.000784	0.259858
126.628243	0.013535	0.001741	-0.000784	0.259858
126.736249	0.013535	0.001741	-0.000784	0.259858
126.845255	0.013535	0.001741	-0.000784	0.259858
126.954261	0.013535	0.001741	-0.000784	0.259858
127.062268	0.013535	0.001741	-0.000784	0.259858
127.170274	0.013535	0.001741	-0.000784	0.259858
127.27828	0.013535	0.001741	-0.000784	0.259858
127.386286	0.013535	0.001741	-0.000784	0.259858
127.495292	0.013535	0.001741	-0.000784	0.259858
127.604299	0.012698	0.001741	-0.000784	0.259858

127.712305	0.012698	0.001741	-0.000784	0.259858
127.824311	0.012698	0.001741	-0.000784	0.259858
127.933317	0.012698	0.001741	-0.000784	0.259858
128.041324	0.012698	0.001741	-0.000784	0.259858
128.236335	0.012698	0.001741	-0.000784	0.259858
128.345341	0.012698	0.001741	-0.000784	0.259858
128.454347	0.012698	0.001741	-0.000784	0.259858
128.564353	0.012698	0.001841	-0.000784	0.259858
128.706362	0.012698	0.001841	-0.000784	0.259858
128.816368	0.012698	0.001841	-0.000784	0.259858
128.934375	0.012698	0.001841	-0.000784	0.259858
129.044381	0.012698	0.001841	-0.000784	0.259858
129.154387	0.012698	0.001841	-0.000784	0.259858
129.264393	0.012698	0.001841	-0.000784	0.259858
129.3734	0.012698	0.001841	-0.000784	0.259858
129.484406	0.012543	0.001841	-0.000784	0.259858
129.594412	0.012543	0.001841	-0.000784	0.259858
129.712419	0.012543	0.001841	-0.000784	0.259858
129.839427	0.012543	0.001841	-0.000784	0.259858
129.947433	0.012543	0.001841	-0.000784	0.259858
130.059439	0.012543	0.001841	-0.000784	0.259858
130.170445	0.012543	0.001841	-0.000784	0.259858
130.293452	0.012543	0.001841	-0.000784	0.259858
130.401459	0.012543	0.001841	-0.000784	0.259858
130.509465	0.012543	0.001841	-0.000784	0.259858
130.642472	0.012543	0.001841	-0.000784	0.259858
130.760479	0.012543	0.001841	-0.000784	0.259858
130.877486	0.012543	0.001841	-0.000784	0.259858
130.987492	0.012543	0.001841	-0.000784	0.259858
131.096498	0.012543	0.001841	-0.000784	0.258362
131.224505	0.012543	0.001841	-0.000784	0.258362
131.334512	0.012557	0.001841	-0.000784	0.258362
131.532523	0.012557	0.001841	-0.001107	0.258362
131.64153	0.012557	0.001841	-0.001107	0.258362
131.751536	0.012557	0.001841	-0.001107	0.258362
131.859542	0.012557	0.001841	-0.001107	0.258362
131.969548	0.012557	0.001841	-0.001107	0.258362
132.080554	0.012557	0.001841	-0.001107	0.258362
132.191561	0.012557	0.001841	-0.001107	0.258362
132.378572	0.012557	0.00129	-0.001107	0.258362
132.488578	0.012557	0.00129	-0.001107	0.258362

132.602584	0.012557	0.00129	-0.001107	0.258362
132.731592	0.012557	0.00129	-0.001107	0.258362
132.839598	0.012557	0.00129	-0.001107	0.258362
132.949605	0.012557	0.00129	-0.001107	0.258362
133.05961	0.012557	0.00129	-0.001107	0.258362
133.170617	0.012557	0.00129	-0.001107	0.258362
133.286623	0.01233	0.00129	-0.001107	0.258362
133.39663	0.01233	0.00129	-0.001107	0.258362
133.511636	0.01233	0.00129	-0.001107	0.258362
133.635643	0.01233	0.00129	-0.001107	0.258362
133.74865	0.01233	0.00129	-0.001107	0.258362
133.860656	0.01233	0.00129	-0.001107	0.258362
133.978663	0.01233	0.00129	-0.001107	0.258362
134.09067	0.01233	0.00129	-0.001107	0.258362
134.202676	0.01233	0.00129	-0.001107	0.258362
134.372686	0.01233	0.00129	-0.001107	0.258362
134.480692	0.01233	0.00129	-0.001107	0.258362
134.588698	0.01233	0.00129	-0.001107	0.258362
134.702704	0.01233	0.00129	-0.001409	0.258362
134.813711	0.01233	0.00129	-0.001409	0.258362
134.927718	0.01233	0.00129	-0.001409	0.258362
135.040724	0.01233	0.00129	-0.001409	0.258362
135.14973	0.012063	0.00129	-0.001409	0.258362
135.259737	0.012063	0.00129	-0.001409	0.258362
135.369743	0.012063	0.00129	-0.001409	0.258362
135.478749	0.012063	0.00129	-0.001409	0.258362
135.588755	0.012063	0.00129	-0.001409	0.258362
135.698761	0.012063	0.00129	-0.001409	0.258362
135.806768	0.012063	0.00129	-0.001409	0.258362
135.917774	0.012063	0.00129	-0.001409	0.258362
136.02678	0.012063	0.00129	-0.001409	0.258362
136.139787	0.012063	0.001564	-0.001409	0.258362
136.254793	0.012063	0.001564	-0.001409	0.258362
136.364799	0.012063	0.001564	-0.001409	0.258362
136.536809	0.012063	0.001564	-0.001409	0.258362
136.644815	0.012063	0.001564	-0.001409	0.258362
136.777823	0.012063	0.001564	-0.001409	0.258362
136.88883	0.012063	0.001564	-0.001409	0.258362
136.998836	0.012063	0.001564	-0.001409	0.258362
137.108842	0.010746	0.001564	-0.001409	0.258362
137.218848	0.010746	0.001564	-0.001409	0.258362

137.331855	0.010746	0.001564	-0.001409	0.258362
137.549868	0.010746	0.001564	-0.001409	0.256663
137.666874	0.010746	0.001564	-0.001409	0.256663
137.777881	0.010746	0.001564	-0.001409	0.256663
137.897887	0.010746	0.001564	-0.001409	0.256663
138.007894	0.010746	0.001564	-0.001409	0.256663
138.1169	0.010746	0.001564	-0.001409	0.256663
138.226906	0.010746	0.001564	-0.001409	0.256663
138.335912	0.010746	0.001564	-0.001409	0.256663
138.444919	0.010746	0.001564	-0.001409	0.256663
138.554925	0.010746	0.001564	-0.001409	0.256663
138.664931	0.010746	0.001564	-0.001409	0.256663
138.773937	0.010746	0.001564	-0.001409	0.256663
138.883944	0.010746	0.001564	-0.001409	0.256663
138.99395	0.010757	0.001564	-0.001409	0.256663
139.104956	0.010757	0.001564	-0.001128	0.256663
139.220963	0.010757	0.001564	-0.001128	0.256663
139.330969	0.010757	0.001564	-0.001128	0.256663
139.441976	0.010757	0.001564	-0.001128	0.256663
139.551982	0.010757	0.001564	-0.001128	0.256663
139.662988	0.010757	0.001564	-0.001128	0.256663
139.770995	0.010757	0.001564	-0.001128	0.256663
139.879001	0.010757	0.001564	-0.001128	0.256663
140.009008	0.010757	0.003178	-0.001128	0.256663
140.118014	0.010757	0.003178	-0.001128	0.256663
140.230021	0.010757	0.003178	-0.001128	0.256663
140.39003	0.010757	0.003178	-0.001128	0.256663
140.501036	0.010757	0.003178	-0.001128	0.256663
140.611042	0.010757	0.003178	-0.001128	0.256663
140.74305	0.010757	0.003178	-0.001128	0.256663
140.903059	0.010747	0.003178	-0.001128	0.256663
141.014066	0.010747	0.003178	-0.001128	0.256663
141.122072	0.010747	0.003178	-0.001128	0.256663
141.245079	0.010747	0.003178	-0.001128	0.256663
141.380086	0.010747	0.003178	-0.001128	0.256663
141.501093	0.010747	0.003178	-0.001128	0.256663
141.6111	0.010747	0.003178	-0.001128	0.256663
141.719106	0.010747	0.003178	-0.001128	0.256663
141.827112	0.010747	0.003178	-0.001128	0.256663
141.942119	0.010747	0.003178	-0.001128	0.256663
142.093127	0.010747	0.003178	-0.001128	0.256663

142.212134	0.010747	0.003178	-0.001128	0.256663
142.32114	0.010747	0.003178	-0.001128	0.256663
142.430147	0.010747	0.003178	-0.001128	0.256663
142.539153	0.010747	0.003178	-0.001128	0.256663
142.647159	0.010747	0.003178	-0.001128	0.256663
142.760166	0.01091	0.003178	-0.001128	0.256663
142.868172	0.01091	0.003178	-0.001128	0.256663
143.01918	0.01091	0.003178	-0.001621	0.256663
143.128186	0.01091	0.003178	-0.001621	0.256663
143.242193	0.01091	0.003178	-0.001621	0.256663
143.352199	0.01091	0.003178	-0.001621	0.256663
143.463206	0.01091	0.003178	-0.001621	0.256663
143.573212	0.01091	0.003178	-0.001621	0.256663
143.697219	0.01091	0.003178	-0.001621	0.256663
143.806225	0.01091	0.005654	-0.001621	0.256663
143.930233	0.01091	0.005654	-0.001621	0.256663
144.040239	0.01091	0.005654	-0.001621	0.256663
144.150245	0.01091	0.005654	-0.001621	0.256663
144.260251	0.01091	0.005654	-0.001621	0.256663
144.370257	0.01091	0.005654	-0.001621	0.256663
144.480264	0.01091	0.005654	-0.001621	0.256663
144.59127	0.01091	0.005654	-0.001621	0.256663
144.700276	0.014104	0.005654	-0.001621	0.256663
144.810283	0.014104	0.005654	-0.001621	0.256663
144.919289	0.014104	0.005654	-0.001621	0.256663
145.028295	0.014104	0.005654	-0.001621	0.256663
145.136302	0.014104	0.005654	-0.001621	0.256663
145.245307	0.014104	0.005654	-0.001621	0.256663
145.354314	0.014104	0.005654	-0.001621	0.256663
145.46232	0.014104	0.005654	-0.001621	0.256663
145.570326	0.014104	0.005654	-0.001621	0.256663
145.678332	0.014104	0.005654	-0.001621	0.256663
145.788339	0.014104	0.005654	-0.001621	0.256663
145.897345	0.014104	0.005654	-0.001621	0.256663
146.007351	0.014104	0.005654	-0.001621	0.256663
146.120358	0.014104	0.005654	-0.001621	0.256663
146.230364	0.014104	0.005654	-0.001621	0.256663
146.34037	0.014104	0.005654	-0.001621	0.256663
146.548382	0.016169	0.005654	-0.001621	0.254894
146.656388	0.016169	0.005654	-0.001621	0.254894
146.764394	0.016169	0.005654	-0.001621	0.254894

146.874401	0.016169	0.005654	0.000418	0.254894
146.982407	0.016169	0.005654	0.000418	0.254894
147.090413	0.016169	0.005654	0.000418	0.254894
147.198419	0.016169	0.005654	0.000418	0.254894
147.308425	0.016169	0.005654	0.000418	0.254894
147.416432	0.016169	0.005654	0.000418	0.254894
147.524438	0.016169	0.005654	0.000418	0.254894
147.632444	0.016169	0.005654	0.000418	0.254894
147.74045	0.016169	0.005654	0.000418	0.254894
147.848456	0.016169	0.005654	0.000418	0.254894
147.955462	0.016169	0.005654	0.000418	0.254894
148.068469	0.016169	0.005654	0.000418	0.254894
148.179475	0.016169	0.005654	0.000418	0.254894
148.287482	0.016169	0.005654	0.000418	0.254894
148.397488	0.016169	0.005654	0.000418	0.254894
148.526495	0.016272	0.005654	0.000418	0.254894
148.634501	0.016272	0.005654	0.000418	0.254894
148.806511	0.016272	0.005654	0.000418	0.254894
148.914517	0.016272	0.005654	0.000418	0.254894
149.025524	0.016272	0.007169	0.000418	0.254894
149.145531	0.016272	0.007169	0.000418	0.254894
149.254537	0.016272	0.007169	0.000418	0.254894
149.366543	0.016272	0.007169	0.000418	0.254894
149.474549	0.016272	0.007169	0.000418	0.254894
149.691562	0.016272	0.007169	0.000418	0.254894
149.800568	0.016272	0.007169	0.000418	0.254894
149.908575	0.016272	0.007169	0.000418	0.254894
150.017581	0.016272	0.007169	0.000418	0.254894
150.127587	0.016272	0.007169	0.000418	0.254894
150.237593	0.016272	0.007169	0.000418	0.254894
150.348599	0.015871	0.007169	0.000418	0.254894
150.458606	0.015871	0.007169	0.000418	0.254894
150.568612	0.015871	0.007169	0.000418	0.254894
150.732622	0.015871	0.007169	0.000272	0.254894
150.840628	0.015871	0.007169	0.000272	0.254894
150.948634	0.015871	0.007169	0.000272	0.254894
151.117643	0.015871	0.007169	0.000272	0.254894
151.22765	0.015871	0.007169	0.000272	0.254894
151.336656	0.015871	0.007169	0.000272	0.254894
151.446662	0.015871	0.007169	0.000272	0.254894
151.556669	0.015871	0.007169	0.000272	0.254894

151.666675	0.015871	0.007169	0.000272	0.254894
151.775681	0.015871	0.007169	0.000272	0.254894
151.883687	0.015871	0.007169	0.000272	0.254894
151.993693	0.015871	0.007169	0.000272	0.254894
152.1047	0.015871	0.007169	0.000272	0.254894
152.214706	0.014522	0.007169	0.000272	0.254894
152.389716	0.014522	0.007169	0.000272	0.254894
152.498723	0.014522	0.007169	0.000272	0.254894
152.609729	0.014522	0.007169	0.000272	0.254894
152.746737	0.014522	0.007169	0.000272	0.254894
152.865744	0.014522	0.007169	0.000272	0.254894
152.97575	0.014522	0.007169	0.000272	0.254894
153.084756	0.014522	0.007169	0.000272	0.254894
153.201763	0.014522	0.006684	0.000272	0.254894
153.311769	0.014522	0.006684	0.000272	0.254894
153.450777	0.014522	0.006684	0.000272	0.254894
153.560783	0.014522	0.006684	0.000272	0.254894
153.668789	0.014522	0.006684	0.000272	0.254894
153.776795	0.014522	0.006684	0.000272	0.254894
153.884802	0.014522	0.006684	0.000272	0.254894
153.994808	0.014522	0.006684	0.000272	0.254894
154.104815	0.014522	0.006684	0.000272	0.254894
154.224821	0.014467	0.006684	0.000272	0.25324
154.334827	0.014467	0.006684	0.000272	0.25324
154.445834	0.014467	0.006684	0.000272	0.25324
154.55584	0.014467	0.006684	-0.000222	0.25324
154.664846	0.014467	0.006684	-0.000222	0.25324
154.774853	0.014467	0.006684	-0.000222	0.25324
154.885859	0.014467	0.006684	-0.000222	0.25324
154.995865	0.014467	0.006684	-0.000222	0.25324
155.105872	0.014467	0.006684	-0.000222	0.25324
155.215878	0.014467	0.006684	-0.000222	0.25324
155.326884	0.014467	0.006684	-0.000222	0.25324
155.436891	0.014467	0.006684	-0.000222	0.25324
155.546897	0.014467	0.006684	-0.000222	0.25324
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155.764909	0.014467	0.006684	-0.000222	0.25324
155.874916	0.014467	0.006684	-0.000222	0.25324
155.982922	0.014467	0.006684	-0.000222	0.25324
156.090928	0.014215	0.006684	-0.000222	0.25324
156.250937	0.014215	0.006684	-0.000222	0.25324

156.358943	0.014215	0.006684	-0.000222	0.25324
156.466949	0.014215	0.006684	-0.000222	0.25324
156.574955	0.014215	0.006223	-0.000222	0.25324
156.987979	0.014215	0.006223	-0.000222	0.25324
157.099986	0.014215	0.006223	-0.000222	0.25324
157.207992	0.014215	0.006223	-0.000222	0.25324
157.35	0.014215	0.006223	-0.000222	0.25324
157.460006	0.014215	0.006223	-0.000222	0.25324
157.570013	0.014215	0.006223	-0.000222	0.25324
157.679019	0.014215	0.006223	-0.000222	0.25324
157.790025	0.014215	0.006223	-0.000222	0.25324
157.899031	0.014215	0.006223	-0.000222	0.25324
158.009037	0.013	0.006223	-0.000222	0.25324
158.119044	0.013	0.006223	-0.000222	0.25324
158.239051	0.013	0.006223	-0.000222	0.25324
158.377059	0.013	0.006223	-0.001252	0.25324
158.487065	0.013	0.006223	-0.001252	0.25324
158.598072	0.013	0.006223	-0.001252	0.25324
158.707078	0.013	0.006223	-0.001252	0.25324
158.816084	0.013	0.006223	-0.001252	0.25324
158.92609	0.013	0.006223	-0.001252	0.25324
159.036097	0.013	0.006223	-0.001252	0.25324
159.147103	0.013	0.006223	-0.001252	0.25324
159.27711	0.013	0.006223	-0.001252	0.25324
159.387116	0.013	0.006223	-0.001252	0.25324
159.496123	0.013	0.006223	-0.001252	0.25324
159.608129	0.013	0.006223	-0.001252	0.25324
159.716135	0.013	0.006223	-0.001252	0.25324
159.825141	0.012574	0.006223	-0.001252	0.25324
159.935148	0.012574	0.006223	-0.001252	0.25324
160.047154	0.012574	0.006223	-0.001252	0.25324
160.15616	0.012574	0.006223	-0.001252	0.25324
160.266167	0.012574	0.006223	-0.001252	0.25324
160.402174	0.012574	0.006223	-0.001252	0.25324
160.517181	0.012574	0.006897	-0.001252	0.25324
160.627187	0.012574	0.006897	-0.001252	0.25324
160.743194	0.012574	0.006897	-0.001252	0.25324
160.857201	0.012574	0.006897	-0.001252	0.25324
160.966207	0.012574	0.006897	-0.001252	0.25324
161.076213	0.012574	0.006897	-0.001252	0.25324
161.185219	0.012574	0.006897	-0.001252	0.25324

161.295226	0.012574	0.006897	-0.001252	0.25324
161.405232	0.012574	0.006897	-0.001252	0.25324
161.514238	0.012574	0.006897	-0.001252	0.25324
161.623244	0.012574	0.006897	-0.001252	0.25324
161.732251	0.01257	0.006897	-0.001252	0.25324
161.850257	0.01257	0.006897	-0.001252	0.251738
161.960264	0.01257	0.006897	-0.001252	0.251738
162.06927	0.01257	0.006897	-0.001252	0.251738
162.179276	0.01257	0.006897	-0.001252	0.251738
162.290282	0.01257	0.006897	-0.001252	0.251738
162.400289	0.01257	0.006897	-0.001252	0.251738
162.510295	0.01257	0.006897	-0.001252	0.251738
162.621302	0.01257	0.006897	-0.001252	0.251738
162.729308	0.01257	0.006897	-0.001252	0.251738
162.839314	0.01257	0.006897	-0.001252	0.251738
162.94832	0.01257	0.006897	-0.001252	0.251738
163.058326	0.01257	0.006897	-0.001252	0.251738
163.168333	0.01257	0.006897	-0.001252	0.251738
163.28734	0.01257	0.006897	-0.001252	0.251738
163.398346	0.01257	0.006897	-0.001507	0.251738
163.547354	0.01257	0.006897	-0.001507	0.251738
163.657361	0.012575	0.006897	-0.001507	0.251738
163.766367	0.012575	0.006897	-0.001507	0.251738
163.875373	0.012575	0.006897	-0.001507	0.251738
163.983379	0.012575	0.006897	-0.001507	0.251738
164.092386	0.012575	0.006897	-0.001507	0.251738
164.200392	0.012575	0.006897	-0.001507	0.251738
164.3494	0.012575	0.005966	-0.001507	0.251738
164.459406	0.012575	0.005966	-0.001507	0.251738
164.568413	0.012575	0.005966	-0.001507	0.251738
164.680419	0.012575	0.005966	-0.001507	0.251738
164.834428	0.012575	0.005966	-0.001507	0.251738
164.945435	0.012575	0.005966	-0.001507	0.251738
165.079442	0.012575	0.005966	-0.001507	0.251738
165.189448	0.012575	0.005966	-0.001507	0.251738
165.307455	0.012575	0.005966	-0.001507	0.251738
165.417461	0.012575	0.005966	-0.001507	0.251738
165.525467	0.012218	0.005966	-0.001507	0.251738
165.672476	0.012218	0.005966	-0.001507	0.251738
165.781482	0.012218	0.005966	-0.001507	0.251738
165.890489	0.012218	0.005966	-0.001507	0.251738

166.008495	0.012218	0.005966	-0.001507	0.251738
166.121501	0.012218	0.005966	-0.001507	0.251738
166.233508	0.012218	0.005966	-0.001507	0.251738
166.344514	0.012218	0.005966	-0.001507	0.251738
166.454521	0.012218	0.005966	-0.001507	0.251738
166.566527	0.012218	0.005966	-0.001507	0.251738
166.674533	0.012218	0.005966	-0.001507	0.251738
166.78554	0.012218	0.005966	-0.001507	0.251738
166.893546	0.012218	0.005966	-0.001507	0.251738
167.002552	0.012218	0.005966	-0.001507	0.251738
167.117558	0.012218	0.005966	-0.001507	0.251738
167.225565	0.012218	0.005966	-0.001507	0.251738
167.333571	0.012218	0.005966	-0.001507	0.251738
167.442577	0.010798	0.005966	-0.001507	0.251738
167.646589	0.010798	0.005966	-0.002215	0.251738
167.754595	0.010798	0.005966	-0.002215	0.251738
167.863601	0.010798	0.005966	-0.002215	0.251738
167.975608	0.010798	0.005966	-0.002215	0.251738
168.085614	0.010798	0.007565	-0.002215	0.251738
168.218622	0.010798	0.007565	-0.002215	0.251738
168.35763	0.010798	0.007565	-0.002215	0.251738
168.480637	0.010798	0.007565	-0.002215	0.251738
168.589643	0.010798	0.007565	-0.002215	0.251738
168.697649	0.010798	0.007565	-0.002215	0.251738
168.805655	0.010798	0.007565	-0.002215	0.251738
168.913661	0.010798	0.007565	-0.002215	0.251738
169.023668	0.010798	0.007565	-0.002215	0.251738
169.131674	0.010798	0.007565	-0.002215	0.251738
169.24068	0.010798	0.007565	-0.002215	0.251738
169.398689	0.010745	0.007565	-0.002215	0.251738
169.567699	0.010745	0.007565	-0.002215	0.251738
169.679705	0.010745	0.007565	-0.002215	0.251738
169.787711	0.010745	0.007565	-0.002215	0.251738
169.907718	0.010745	0.007565	-0.002215	0.251738
170.015724	0.010745	0.007565	-0.002215	0.251738
170.125731	0.010745	0.007565	-0.002215	0.251738
170.246737	0.010745	0.007565	-0.002215	0.251738
170.370745	0.010745	0.007565	-0.002215	0.251738
170.514753	0.010745	0.007565	-0.002215	0.250148
170.624759	0.010745	0.007565	-0.002215	0.250148
170.737766	0.010745	0.007565	-0.002215	0.250148

170.887774	0.010745	0.007565	-0.002215	0.250148
170.998781	0.010745	0.007565	-0.002215	0.250148
171.108787	0.010745	0.007565	-0.002656	0.250148
171.230794	0.01079	0.007565	-0.002656	0.250148
171.360801	0.01079	0.007565	-0.002656	0.250148
171.470808	0.01079	0.007565	-0.002656	0.250148
171.587814	0.01079	0.007565	-0.002656	0.250148
171.700821	0.01079	0.007565	-0.002656	0.250148
171.819828	0.01079	0.007565	-0.002656	0.250148
171.967836	0.01079	0.006674	-0.002656	0.250148
172.108844	0.01079	0.006674	-0.002656	0.250148
172.21785	0.01079	0.006674	-0.002656	0.250148
172.38186	0.01079	0.006674	-0.002656	0.250148
172.504867	0.01079	0.006674	-0.002656	0.250148
172.620873	0.01079	0.006674	-0.002656	0.250148
172.863887	0.01079	0.006674	-0.002656	0.250148
172.974894	0.01079	0.006674	-0.002656	0.250148
173.105901	0.01079	0.006674	-0.002656	0.250148
173.238909	0.010757	0.006674	-0.002656	0.250148
173.349915	0.010757	0.006674	-0.002656	0.250148
173.459921	0.010757	0.006674	-0.002656	0.250148
173.569928	0.010757	0.006674	-0.002656	0.250148
173.689935	0.010757	0.006674	-0.002656	0.250148
173.798941	0.010757	0.006674	-0.002656	0.250148
173.910947	0.010757	0.006674	-0.002656	0.250148
174.070956	0.010757	0.006674	-0.002656	0.250148
174.178962	0.010757	0.006674	-0.002656	0.250148
174.286969	0.010757	0.006674	-0.002656	0.250148
174.397975	0.010757	0.006674	-0.002656	0.250148
174.508981	0.010757	0.006674	-0.002656	0.250148
174.619988	0.010757	0.006674	-0.002656	0.250148
174.727994	0.010757	0.006674	-0.002656	0.250148
174.856001	0.010757	0.006674	-0.000951	0.250148
175.061013	0.011491	0.006674	-0.000951	0.250148
175.172019	0.011491	0.006674	-0.000951	0.250148
175.283026	0.011491	0.006674	-0.000951	0.250148
175.419034	0.011491	0.006674	-0.000951	0.250148
175.53004	0.011491	0.006674	-0.000951	0.250148
175.643046	0.011491	0.006674	-0.000951	0.250148
175.752052	0.011491	0.006674	-0.000951	0.250148
175.868059	0.011491	0.006674	-0.000951	0.250148

175.979065	0.011491	0.006674	-0.000951	0.250148
176.087071	0.011491	0.006674	-0.000951	0.250148
176.262082	0.011491	0.006674	-0.000951	0.250148
176.371088	0.011491	0.006674	-0.000951	0.250148
176.482094	0.011491	0.006674	-0.000951	0.250148
176.592101	0.011491	0.006674	-0.000951	0.250148
176.702107	0.011491	0.006674	-0.000951	0.250148
176.812113	0.011491	0.006674	-0.000951	0.250148
176.92712	0.01434	0.006674	-0.000951	0.250148
177.036126	0.01434	0.006674	-0.000951	0.250148
177.163133	0.01434	0.007546	-0.000951	0.250148
177.273139	0.01434	0.007546	-0.000951	0.250148
177.384146	0.01434	0.007546	-0.000951	0.250148
177.494152	0.01434	0.007546	-0.000951	0.250148
177.605158	0.01434	0.007546	-0.000951	0.250148
177.713165	0.01434	0.007546	-0.000951	0.250148
177.821171	0.01434	0.007546	-0.000951	0.250148
177.929177	0.01434	0.007546	-0.000951	0.250148
178.037183	0.01434	0.007546	-0.000951	0.250148
178.145189	0.01434	0.007546	-0.000951	0.250148
178.254196	0.01434	0.007546	-0.000951	0.250148
178.361202	0.01434	0.007546	-0.000951	0.248653
178.583214	0.01434	0.007546	-0.000951	0.248653
178.691221	0.01434	0.007546	-0.000951	0.248653
178.799227	0.01434	0.007546	-0.000951	0.248653
178.941235	0.016067	0.007546	0.000954	0.248653
179.049241	0.016067	0.007546	0.000954	0.248653
179.158247	0.016067	0.007546	0.000954	0.248653
179.266253	0.016067	0.007546	0.000954	0.248653
179.37526	0.016067	0.007546	0.000954	0.248653
179.485266	0.016067	0.007546	0.000954	0.248653
179.595272	0.016067	0.007546	0.000954	0.248653
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179.813285	0.016067	0.007546	0.000954	0.248653
179.923291	0.016067	0.007546	0.000954	0.248653
180.062299	0.016067	0.007546	0.000954	0.248653
180.172305	0.016067	0.007546	0.000954	0.248653
180.282311	0.016067	0.007546	0.000954	0.248653
180.392318	0.016067	0.007546	0.000954	0.248653
180.502324	0.016067	0.007546	0.000954	0.248653
180.611331	0.016067	0.007546	0.000954	0.248653

180.906347	0.016289	0.00811	0.000954	0.248653
181.048356	0.016289	0.00811	0.000954	0.248653
181.156362	0.016289	0.00811	0.000954	0.248653
181.268368	0.016289	0.00811	0.000954	0.248653
181.376374	0.016289	0.00811	0.000954	0.248653
181.48538	0.016289	0.00811	0.000954	0.248653
181.594387	0.016289	0.00811	0.000954	0.248653
181.704393	0.016289	0.00811	0.000954	0.248653
181.8274	0.016289	0.00811	0.000954	0.248653
181.935406	0.016289	0.00811	0.000954	0.248653
182.044412	0.016289	0.00811	0.000954	0.248653
182.155419	0.016289	0.00811	0.000954	0.248653
182.265425	0.016289	0.00811	0.000954	0.248653
182.376431	0.016289	0.00811	0.000954	0.248653
182.487438	0.016289	0.00811	0.000954	0.248653
182.596444	0.016289	0.00811	0.000954	0.248653
182.70445	0.015971	0.00811	-0.000659	0.248653
182.813457	0.015971	0.00811	-0.000659	0.248653
182.951464	0.015971	0.00811	-0.000659	0.248653
183.059471	0.015971	0.00811	-0.000659	0.248653
183.169477	0.015971	0.00811	-0.000659	0.248653
183.277483	0.015971	0.00811	-0.000659	0.248653
183.387489	0.015971	0.00811	-0.000659	0.248653
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183.608502	0.015971	0.00811	-0.000659	0.248653
183.716508	0.015971	0.00811	-0.000659	0.248653
183.824514	0.015971	0.00811	-0.000659	0.248653
183.93252	0.015971	0.00811	-0.000659	0.248653
184.040526	0.015971	0.00811	-0.000659	0.248653
184.150533	0.015971	0.00811	-0.000659	0.248653
184.259539	0.015971	0.00811	-0.000659	0.248653
184.385546	0.015971	0.00811	-0.000659	0.248653
184.494553	0.015971	0.00811	-0.000659	0.248653
184.609559	0.014503	0.00811	-0.000659	0.248653
184.740567	0.014503	0.00811	-0.000659	0.248653
184.855573	0.014503	0.00811	-0.000659	0.248653
184.967579	0.014503	0.007555	-0.000659	0.248653
185.077586	0.014503	0.007555	-0.000659	0.248653
185.187592	0.014503	0.007555	-0.000659	0.248653
185.297598	0.014503	0.007555	-0.000659	0.248653
185.407605	0.014503	0.007555	-0.000659	0.248653

185.516611	0.014503	0.007555	-0.000659	0.248653
185.626617	0.014503	0.007555	-0.000659	0.248653
185.734623	0.014503	0.007555	-0.000659	0.248653
185.84363	0.014503	0.007555	-0.000659	0.248653
185.953636	0.014503	0.007555	-0.000659	0.248653
186.187649	0.014503	0.007555	-0.000659	0.247195
186.296656	0.014503	0.007555	-0.000659	0.247195
186.406662	0.014503	0.007555	-0.000659	0.247195
186.528669	0.014499	0.007555	-0.000227	0.247195
186.636675	0.014499	0.007555	-0.000227	0.247195
186.745681	0.014499	0.007555	-0.000227	0.247195
186.854688	0.014499	0.007555	-0.000227	0.247195
186.962694	0.014499	0.007555	-0.000227	0.247195
187.0707	0.014499	0.007555	-0.000227	0.247195
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187.405719	0.014499	0.007555	-0.000227	0.247195
187.515725	0.014499	0.007555	-0.000227	0.247195
187.625731	0.014499	0.007555	-0.000227	0.247195
187.736738	0.014499	0.007555	-0.000227	0.247195
187.846744	0.014499	0.007555	-0.000227	0.247195
187.95775	0.014499	0.007555	-0.000227	0.247195
188.069757	0.014499	0.007555	-0.000227	0.247195
188.218766	0.014499	0.007555	-0.000227	0.247195
188.327772	0.014359	0.007555	-0.000227	0.247195
188.437778	0.014359	0.007555	-0.000227	0.247195
188.546784	0.014359	0.007555	-0.000227	0.247195
188.687792	0.014359	0.006837	-0.000227	0.247195
188.798799	0.014359	0.006837	-0.000227	0.247195
188.908805	0.014359	0.006837	-0.000227	0.247195
189.018811	0.014359	0.006837	-0.000227	0.247195
189.128818	0.014359	0.006837	-0.000227	0.247195
189.238824	0.014359	0.006837	-0.000227	0.247195
189.371831	0.014359	0.006837	-0.000227	0.247195
189.481838	0.014359	0.006837	-0.000227	0.247195
189.591844	0.014359	0.006837	-0.000227	0.247195
189.69985	0.014359	0.006837	-0.000227	0.247195
189.810856	0.014359	0.006837	-0.000227	0.247195
189.938864	0.014359	0.006837	-0.000227	0.247195
190.05087	0.014359	0.006837	-0.000227	0.247195
190.160877	0.014359	0.006837	-0.000227	0.247195

190.270883	0.013318	0.006837	-0.000227	0.247195
190.39189	0.013318	0.006837	-0.000165	0.247195
190.501896	0.013318	0.006837	-0.000165	0.247195
190.611902	0.013318	0.006837	-0.000165	0.247195
190.720909	0.013318	0.006837	-0.000165	0.247195
190.828915	0.013318	0.006837	-0.000165	0.247195
190.936921	0.013318	0.006837	-0.000165	0.247195
191.045927	0.013318	0.006837	-0.000165	0.247195
191.155933	0.013318	0.006837	-0.000165	0.247195
191.26594	0.013318	0.006837	-0.000165	0.247195
191.375946	0.013318	0.006837	-0.000165	0.247195
191.485952	0.013318	0.006837	-0.000165	0.247195
191.595959	0.013318	0.006837	-0.000165	0.247195
191.703965	0.013318	0.006837	-0.000165	0.247195
191.812971	0.013318	0.006837	-0.000165	0.247195
191.922977	0.013318	0.006837	-0.000165	0.247195
192.031984	0.013318	0.006837	-0.000165	0.247195
192.14099	0.012551	0.006837	-0.000165	0.247195
192.248996	0.012551	0.006837	-0.000165	0.247195
192.357002	0.012551	0.006837	-0.000165	0.247195
192.508011	0.012551	0.006074	-0.000165	0.247195
192.618017	0.012551	0.006074	-0.000165	0.247195
192.738024	0.012551	0.006074	-0.000165	0.247195
192.893033	0.012551	0.006074	-0.000165	0.247195
193.003039	0.012551	0.006074	-0.000165	0.247195
193.113046	0.012551	0.006074	-0.000165	0.247195
193.221052	0.012551	0.006074	-0.000165	0.247195
193.344059	0.012551	0.006074	-0.000165	0.247195
193.452065	0.012551	0.006074	-0.000165	0.247195
193.562071	0.012551	0.006074	-0.000165	0.247195
193.671077	0.012551	0.006074	-0.000165	0.247195
193.860088	0.012551	0.006074	-0.000165	0.245733
193.969094	0.012551	0.006074	-0.000165	0.245733
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194.185107	0.012555	0.006074	-0.000165	0.245733
194.294113	0.012555	0.006074	-0.000165	0.245733
194.403119	0.012555	0.006074	-0.000165	0.245733
194.511126	0.012555	0.006074	-0.000165	0.245733
194.620131	0.012555	0.006074	-0.000165	0.245733
194.728138	0.012555	0.006074	-0.000165	0.245733
194.836144	0.012555	0.006074	-0.000165	0.245733

194.94515	0.012555	0.006074	-0.000165	0.245733
195.053156	0.012555	0.006074	-0.000165	0.245733
195.163163	0.012555	0.006074	-0.000165	0.245733
195.274169	0.012555	0.006074	-0.000165	0.245733
195.385175	0.012555	0.006074	-0.001777	0.245733
195.532184	0.012555	0.006074	-0.001777	0.245733
195.64119	0.012555	0.006074	-0.001777	0.245733
195.750196	0.012555	0.006074	-0.001777	0.245733
195.858202	0.012555	0.006074	-0.001777	0.245733
195.967209	0.012575	0.006074	-0.001777	0.245733
196.076215	0.012575	0.006074	-0.001777	0.245733
196.184221	0.012575	0.006074	-0.001777	0.245733
196.370232	0.012575	0.006719	-0.001777	0.245733
196.478238	0.012575	0.006719	-0.001777	0.245733
196.586244	0.012575	0.006719	-0.001777	0.245733
196.708251	0.012575	0.006719	-0.001777	0.245733
196.900262	0.012575	0.006719	-0.001777	0.245733
197.048271	0.012575	0.006719	-0.001777	0.245733
197.180278	0.012575	0.006719	-0.001777	0.245733
197.290284	0.012575	0.006719	-0.001777	0.245733
197.401291	0.012575	0.006719	-0.001777	0.245733
197.511297	0.012575	0.006719	-0.001777	0.245733
197.640305	0.012575	0.006719	-0.001777	0.245733
197.748311	0.012575	0.006719	-0.001777	0.245733
197.859317	0.012568	0.006719	-0.001777	0.245733
197.969323	0.012568	0.006719	-0.001777	0.245733
198.08133	0.012568	0.006719	-0.001777	0.245733
198.191336	0.012568	0.006719	-0.001777	0.245733
198.301342	0.012568	0.006719	-0.001777	0.245733
198.411348	0.012568	0.006719	-0.001777	0.245733
198.522355	0.012568	0.006719	-0.001777	0.245733
198.630361	0.012568	0.006719	-0.001777	0.245733
198.738367	0.012568	0.006719	-0.001777	0.245733
198.846374	0.012568	0.006719	-0.001777	0.245733
198.95438	0.012568	0.006719	-0.001777	0.245733
199.063386	0.012568	0.006719	-0.001777	0.245733
199.172392	0.012568	0.006719	-0.001777	0.245733
199.357403	0.012568	0.006719	-0.001496	0.245733
199.468409	0.012568	0.006719	-0.001496	0.245733
199.581416	0.012568	0.006719	-0.001496	0.245733
199.689422	0.012568	0.006719	-0.001496	0.245733

199.798428	0.011652	0.006719	-0.001496	0.245733
199.917435	0.011652	0.006719	-0.001496	0.245733
200.025441	0.011652	0.006719	-0.001496	0.245733
200.134447	0.011652	0.007412	-0.001496	0.245733
200.242453	0.011652	0.007412	-0.001496	0.245733
200.35046	0.011652	0.007412	-0.001496	0.245733
200.494468	0.011652	0.007412	-0.001496	0.245733
200.602474	0.011652	0.007412	-0.001496	0.245733
200.779484	0.011652	0.007412	-0.001496	0.245733
200.88949	0.011652	0.007412	-0.001496	0.245733
201.001497	0.011652	0.007412	-0.001496	0.245733
201.112503	0.011652	0.007412	-0.001496	0.245733
201.222509	0.011652	0.007412	-0.001496	0.245733
201.333516	0.011652	0.007412	-0.001496	0.245733
201.443522	0.011652	0.007412	-0.001496	0.245733
201.57553	0.011652	0.007412	-0.001496	0.245733
201.685536	0.010777	0.007412	-0.001496	0.245733
201.793542	0.010777	0.007412	-0.001496	0.245733
201.903548	0.010777	0.007412	-0.001496	0.245733
202.013555	0.010777	0.007412	-0.001496	0.245733
202.123561	0.010777	0.007412	-0.001496	0.245733
202.27957	0.010777	0.007412	-0.001496	0.245733
202.399577	0.010777	0.007412	-0.001496	0.245733
202.509583	0.010777	0.007412	-0.001496	0.245733
202.618589	0.010777	0.007412	-0.001496	0.245733
202.726595	0.010777	0.007412	-0.001496	0.244396
202.851603	0.010777	0.007412	-0.001496	0.244396
202.959609	0.010777	0.007412	-0.001496	0.244396
203.067615	0.010777	0.007412	-0.001382	0.244396
203.212623	0.010777	0.007412	-0.001382	0.244396

Figure 5.22. Restart Experiment with the oil 2 and Procedure 2			
Tempo Total	Pressão Linha	Delta P 1	Delta P 2
0	0.012396	0.012759	-0.006144
0.211012	0.012396	0.012759	-0.006144
0.374022	0.012396	0.012759	-0.006144

0.491028	0.012396	0.012759	-0.006144
0.606035	0.012396	0.012759	-0.006144
0.725041	0.012396	0.012759	-0.006144
0.844048	0.012396	0.012759	-0.006144
0.954054	0.012396	0.012759	-0.006144
1.062061	0.012396	0.012759	-0.006144
1.179067	0.012396	0.012759	-0.006144
1.299074	0.012381	0.012759	-0.006144
1.418081	0.012381	0.012759	-0.006144
1.535088	0.012381	0.012759	-0.006144
1.642094	0.012381	0.012759	-0.002552
1.886108	0.012381	0.012759	-0.002552
1.995114	0.012381	0.012759	-0.002552
2.10912	0.012381	0.012759	-0.002552
2.232128	0.012381	0.012759	-0.002552
2.342134	0.012381	0.012759	-0.002552
2.45314	0.012381	0.012759	-0.002552
2.575147	0.012381	0.012759	-0.002552
2.685153	0.012381	0.012759	-0.002552
2.793159	0.012381	0.012759	-0.002552
2.908166	0.012381	0.012759	-0.002552
3.035173	0.012381	0.012759	-0.002552
3.14518	0.012381	0.012759	-0.002552
3.332191	0.012416	0.013022	-0.002552

3.440197	0.012416	0.013022	-0.002552
3.550203	0.012416	0.013022	-0.002552
3.660209	0.012416	0.013022	-0.002552
3.771215	0.012416	0.013022	-0.002552
3.880222	0.012416	0.013022	-0.002552
3.989228	0.012416	0.013022	-0.002552
4.099235	0.012416	0.013022	-0.002552
4.20924	0.012416	0.013022	-0.002552
4.332248	0.012416	0.013022	-0.002552
4.440254	0.012416	0.013022	-0.002552
4.54826	0.012416	0.013022	-0.002552
4.657266	0.012416	0.013022	-0.002552
4.765273	0.012416	0.013022	-0.002552
4.874279	0.012416	0.013022	-0.002552
4.982285	0.012416	0.013022	-0.002552
5.104292	0.012395	0.013022	-0.002552
5.212298	0.012395	0.013022	-0.002552
5.322304	0.012395	0.013022	-0.002552
5.430311	0.012395	0.013022	-0.002552
5.539317	0.012395	0.013022	-0.002552
5.649323	0.012395	0.013022	-0.002552
5.759329	0.012395	0.013022	-0.002552
5.869336	0.012395	0.013022	-0.002552

5.978342	0.012395	0.013022	-0.002552
6.088348	0.012395	0.013022	-0.002552
6.197354	0.012395	0.013022	-0.003228
6.307361	0.012395	0.013022	-0.003228
6.416367	0.012395	0.013022	-0.003228
6.524373	0.012395	0.013022	-0.003228
6.633379	0.012395	0.013022	-0.003228
6.742385	0.012395	0.013022	-0.003228
6.891394	0.012395	0.013022	-0.003228
7.0014	0.012414	0.013022	-0.003228
7.154409	0.012414	0.013473	-0.003228
7.263415	0.012414	0.013473	-0.003228
7.372422	0.012414	0.013473	-0.003228
7.480428	0.012414	0.013473	-0.003228
7.589434	0.012414	0.013473	-0.003228
7.69744	0.012414	0.013473	-0.003228
7.806447	0.012414	0.013473	-0.003228
7.915452	0.012414	0.013473	-0.003228
8.024459	0.012414	0.013473	-0.003228
8.140466	0.012414	0.013473	-0.003228
8.262473	0.012414	0.013473	-0.003228
8.410481	0.012414	0.013473	-0.003228
8.520487	0.012414	0.013473	-0.003228

8.628493	0.012414	0.013473	-0.003228
8.7395	0.012414	0.013473	-0.003228
8.849506	0.012413	0.013473	-0.003228
8.960513	0.012413	0.013473	-0.003228
9.070519	0.012413	0.013473	-0.003228
9.180525	0.012413	0.013473	-0.003228
9.293531	0.012413	0.013473	-0.003228
9.401537	0.012413	0.013473	-0.003228
9.511544	0.012413	0.013473	-0.003228
9.61955	0.012413	0.013473	-0.003228
9.78756	0.012413	0.013473	-0.003228
9.937568	0.012413	0.013473	-0.003228
10.047575	0.012413	0.013473	-0.003228
10.172582	0.012413	0.013473	-0.003228
10.285588	0.012413	0.013473	-0.003228
10.400595	0.012413	0.013473	-0.003228
10.509601	0.012413	0.013473	-0.003228
10.623608	0.012413	0.013473	-0.002754
10.767616	0.012426	0.013473	-0.002754
10.875622	0.012426	0.013473	-0.002754
11.001629	0.012426	0.013756	-0.002754
11.112636	0.012426	0.013756	-0.002754
11.222642	0.012426	0.013756	-0.002754

11.333648	0.012426	0.013756	-0.002754
11.448655	0.012426	0.013756	-0.002754
11.558661	0.012426	0.013756	-0.002754
11.674668	0.012426	0.013756	-0.002754
11.786674	0.012426	0.013756	-0.002754
11.89568	0.012426	0.013756	-0.002754
12.06369	0.012426	0.013756	-0.002754
12.185697	0.012426	0.013756	-0.002754
12.391709	0.012426	0.013756	-0.002754
12.514716	0.012426	0.013756	-0.002754
12.626722	0.012401	0.013756	-0.002754
12.735728	0.012401	0.013756	-0.002754
12.845735	0.012401	0.013756	-0.002754
12.953741	0.012401	0.013756	-0.002754
13.062747	0.012401	0.013756	-0.002754
13.173753	0.012401	0.013756	-0.002754
13.341763	0.012401	0.013756	-0.002754
13.450769	0.012401	0.013756	-0.002754
13.566776	0.012401	0.013756	-0.002754
13.676782	0.012401	0.013756	-0.002754
13.788788	0.012401	0.013756	-0.002754
13.896795	0.012401	0.013756	-0.002754
14.005801	0.012401	0.013756	-0.002754

14.113807	0.012401	0.013756	-0.002754
14.222814	0.012401	0.013756	-0.002754
14.33182	0.012401	0.013756	-0.002754
14.439826	0.012401	0.013756	-0.002754
14.620836	0.012401	0.013756	-0.002582
14.729843	0.012401	0.013756	-0.002582
14.932854	0.012401	0.013756	-0.002582
15.04486	0.012401	0.013756	-0.002582
15.153867	0.012401	0.013756	-0.002582
15.262873	0.012401	0.013756	-0.002582
15.371879	0.012401	0.013756	-0.002582
15.488886	0.012401	0.013756	-0.002582
15.598892	0.012401	0.013756	-0.002582
15.707898	0.012401	0.013756	-0.002582
15.818905	0.012401	0.013756	-0.002582
15.925911	0.012401	0.013756	-0.002582
16.034917	0.012401	0.01317	-0.002582
16.153924	0.012401	0.01317	-0.002582
16.26293	0.012401	0.01317	-0.002582
16.399938	0.012395	0.01317	-0.002582
16.509944	0.012395	0.01317	-0.002582
16.619951	0.012395	0.01317	-0.002582
16.728957	0.012395	0.01317	-0.002582

16.838963	0.012395	0.01317	-0.002582
16.948969	0.012395	0.01317	-0.002582
17.058976	0.012395	0.01317	-0.002582
17.169982	0.012395	0.01317	-0.002582
17.279988	0.012395	0.01317	-0.002582
17.388995	0.012395	0.01317	-0.002582
17.499001	0.012395	0.01317	-0.002582
17.619008	0.012395	0.01317	-0.002582
17.734014	0.012395	0.01317	-0.002582
17.84402	0.012395	0.01317	-0.002582
17.954027	0.012395	0.01317	-0.002582
18.064033	0.012395	0.01317	-0.002582
18.174039	0.012395	0.01317	-0.002582
18.283046	0.012395	0.01317	-0.002582
18.449055	0.012415	0.01317	-0.002056
18.559062	0.012415	0.01317	-0.002056
18.722071	0.012415	0.01317	-0.002056
18.830077	0.012415	0.01317	-0.002056
18.940083	0.012415	0.01317	-0.002056
19.050089	0.012415	0.01317	-0.002056
19.160096	0.012415	0.01317	-0.002056
19.269102	0.012415	0.01317	-0.002056
19.382109	0.012415	0.01317	-0.002056

19.491115	0.012415	0.01317	-0.002056
19.601121	0.012415	0.01317	-0.002056
19.710127	0.012415	0.01317	-0.002056
19.823134	0.012415	0.01317	-0.002056
19.976142	0.012415	0.012918	-0.002056
20.086149	0.012415	0.012918	-0.002056
20.195155	0.012415	0.012918	-0.002056
20.340163	0.012425	0.012918	-0.002056
20.45017	0.012425	0.012918	-0.002056
20.561176	0.012425	0.012918	-0.002056
20.670182	0.012425	0.012918	-0.002056
20.779189	0.012425	0.012918	-0.002056
20.891195	0.012425	0.012918	-0.002056
21.000201	0.012425	0.012918	-0.002056
21.110208	0.012425	0.012918	-0.002056
21.294218	0.012425	0.012918	-0.002056
21.403224	0.012425	0.012918	-0.002056
21.51323	0.012425	0.012918	-0.002056
21.622237	0.012425	0.012918	-0.002056
21.732243	0.012425	0.012918	-0.002056
21.841249	0.012425	0.012918	-0.002056
21.950255	0.012425	0.012918	-0.002056
22.060262	0.012425	0.012918	-0.002056

22.169268	0.012413	0.012918	-0.001869
22.38428	0.012413	0.012918	-0.001869
22.505287	0.012413	0.012918	-0.001869
22.622294	0.012413	0.012918	-0.001869
22.7373	0.012413	0.012918	-0.001869
22.847307	0.012413	0.012918	-0.001869
22.961313	0.012413	0.012918	-0.001869
23.069319	0.012413	0.012918	-0.001869
23.179326	0.012413	0.012918	-0.001869
23.289332	0.012413	0.012918	-0.001869
23.397338	0.012413	0.012918	-0.001869
23.507344	0.012413	0.012918	-0.001869
23.619351	0.012413	0.012918	-0.001869
23.78036	0.012413	0.012575	-0.001869
23.892366	0.012413	0.012575	-0.001869
24.009373	0.012401	0.012575	-0.001869
24.11938	0.012401	0.012575	-0.001869
24.230386	0.012401	0.012575	-0.001869
24.382395	0.012401	0.012575	-0.001869
24.489401	0.012401	0.012575	-0.001869
24.600407	0.012401	0.012575	-0.001869
24.708413	0.012401	0.012575	-0.001869
24.861422	0.012401	0.012575	-0.001869

24.971428	0.012401	0.012575	-0.001869
25.082435	0.012401	0.012575	-0.001869
25.191441	0.012401	0.012575	-0.001869
25.301447	0.012401	0.012575	-0.001869
25.410453	0.012401	0.012575	-0.001869
25.534461	0.012401	0.012575	-0.001869
25.642467	0.012401	0.012575	-0.001869
25.792475	0.012401	0.012575	-0.001869
25.922482	0.012412	0.012575	-0.001869
26.029489	0.012412	0.012575	-0.001869
26.147495	0.012412	0.012575	-0.003149
26.256502	0.012412	0.012575	-0.003149
26.376509	0.012412	0.012575	-0.003149
26.485515	0.012412	0.012575	-0.003149
26.595521	0.012412	0.012575	-0.003149
26.705527	0.012412	0.012575	-0.003149
26.814534	0.012412	0.012575	-0.003149
26.92354	0.012412	0.012575	-0.003149
27.032546	0.012412	0.012575	-0.003149
27.146553	0.012412	0.012575	-0.003149
27.257559	0.012412	0.012575	-0.003149
27.428569	0.012412	0.012575	-0.003149
27.537575	0.012412	0.012481	-0.003149

27.663582	0.012412	0.012481	-0.003149
27.772588	0.012412	0.012481	-0.003149
27.881595	0.01219	0.012481	-0.003149
27.990601	0.01219	0.012481	-0.003149
28.101607	0.01219	0.012481	-0.003149
28.220614	0.01219	0.012481	-0.003149
28.374623	0.01219	0.012481	-0.003149
28.514631	0.01219	0.012481	-0.003149
28.623637	0.01219	0.012481	-0.003149
28.737644	0.01219	0.012481	-0.003149
28.85065	0.01219	0.012481	-0.003149
28.957656	0.01219	0.012481	-0.003149
29.069663	0.01219	0.012481	-0.003149
29.181669	0.01219	0.012481	-0.003149
29.289675	0.01219	0.012481	-0.003149
29.401681	0.01219	0.012481	-0.003149
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29.616694	0.01219	0.012481	-0.003149
29.7267	0.012188	0.012481	-0.003149
29.835706	0.012188	0.012481	-0.003149
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70.475031	0.009225	0.010399	-0.002659
70.583037	0.009225	0.010399	-0.002659
70.690043	0.009225	0.010399	-0.002659
70.798049	0.009225	0.010399	-0.002659
70.906055	0.009225	0.010399	-0.002659
71.016062	0.009225	0.010399	-0.002659

71.213073	0.009225	0.008956	-0.003189
71.32408	0.009225	0.008956	-0.003189
71.433085	0.009225	0.008956	-0.003189
71.556093	0.009041	0.008956	-0.003189
71.663099	0.009041	0.008956	-0.003189
71.771105	0.009041	0.008956	-0.003189
71.879111	0.009041	0.008956	-0.003189
71.987117	0.009041	0.008956	-0.003189
72.095124	0.009041	0.008956	-0.003189
72.20713	0.009041	0.008956	-0.003189
72.39114	0.009041	0.008956	-0.003189
72.500147	0.009041	0.008956	-0.003189
72.608153	0.009041	0.008956	-0.003189
72.716159	0.009041	0.008956	-0.003189
72.828166	0.009041	0.008956	-0.003189
72.936172	0.009041	0.008956	-0.003189
73.048178	0.009041	0.008956	-0.003189
73.156184	0.009041	0.008956	-0.003189
73.26419	0.009041	0.008956	-0.003189
73.372197	0.009041	0.008956	-0.003189
73.501204	0.009265	0.008956	-0.003189
73.60921	0.009265	0.008956	-0.003189
73.759219	0.009265	0.008956	-0.003189

73.935229	0.009265	0.008956	-0.003189
74.051235	0.009265	0.008956	-0.004064
74.160242	0.009265	0.008956	-0.004064
74.270248	0.009265	0.008956	-0.004064
74.377254	0.009265	0.008956	-0.004064
74.48526	0.009265	0.008956	-0.004064
74.601267	0.009265	0.008956	-0.004064
74.708273	0.009265	0.008956	-0.004064
74.817279	0.009265	0.008956	-0.004064
74.979289	0.009265	0.008718	-0.004064
75.101295	0.009265	0.008718	-0.004064
75.211302	0.009265	0.008718	-0.004064
75.322308	0.008751	0.008718	-0.004064
75.430314	0.008751	0.008718	-0.004064
75.538321	0.008751	0.008718	-0.004064
75.645327	0.008751	0.008718	-0.004064
75.757333	0.008751	0.008718	-0.004064
75.87434	0.008751	0.008718	-0.004064
76.040349	0.008751	0.008718	-0.004064
76.148355	0.008751	0.008718	-0.004064
76.268362	0.008751	0.008718	-0.004064
76.376369	0.008751	0.008718	-0.004064
76.483375	0.008751	0.008718	-0.004064

76.592381	0.008751	0.008718	-0.004064
76.700387	0.008751	0.008718	-0.004064
76.808393	0.008751	0.008718	-0.004064
76.916399	0.008751	0.008718	-0.004064
77.024405	0.008751	0.008718	-0.004064
77.154413	0.008751	0.008718	-0.004064
77.342423	0.008676	0.008718	-0.004064
77.466431	0.008676	0.008718	-0.004064
77.646441	0.008676	0.008718	-0.004064
77.754447	0.008676	0.008718	-0.004064
77.862453	0.008676	0.008718	-0.003617
77.97146	0.008676	0.008718	-0.003617
78.080466	0.008676	0.008718	-0.003617
78.189472	0.008676	0.008718	-0.003617
78.299479	0.008676	0.008718	-0.003617
78.409485	0.008676	0.008718	-0.003617
78.524491	0.008676	0.008718	-0.003617
78.634498	0.008676	0.008718	-0.003617
78.751504	0.008676	0.008718	-0.003617
78.888512	0.008676	0.008718	-0.003617
79.010519	0.008676	0.008718	-0.003617
79.120525	0.008675	0.008718	-0.003617
79.229532	0.008675	0.008718	-0.003617

79.338538	0.008675	0.008718	-0.003617
79.446544	0.008675	0.008718	-0.003617
79.56355	0.008675	0.008718	-0.003617
79.671557	0.008675	0.008718	-0.003617
79.779563	0.008675	0.008718	-0.003617
79.889569	0.008675	0.008718	-0.003617
80.003576	0.008675	0.009224	-0.003617
80.155584	0.008675	0.009224	-0.003617
80.264591	0.008675	0.009224	-0.003617
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81.055636	0.008677	0.009224	-0.003617
81.168643	0.008677	0.009224	-0.003617
81.286649	0.008677	0.009224	-0.003617
81.454659	0.008677	0.009224	-0.003617
81.610668	0.008677	0.009224	-0.003617
81.720674	0.008677	0.009224	-0.003617
81.843681	0.008677	0.009224	-0.003617
81.955688	0.008677	0.009224	-0.003617

82.063694	0.008677	0.009224	-0.003617
82.1737	0.008677	0.009224	-0.003617
82.281706	0.008677	0.009224	-0.003617
82.432715	0.008677	0.009224	-0.003757
82.553722	0.008677	0.009224	-0.003757
82.714731	0.008677	0.009224	-0.003757
82.824737	0.008677	0.009224	-0.003757
82.934743	0.008683	0.009224	-0.003757
83.05475	0.008683	0.009224	-0.003757
83.176757	0.008683	0.009224	-0.003757
83.284763	0.008683	0.009224	-0.003757
83.39477	0.008683	0.009224	-0.003757
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83.614782	0.008683	0.008713	-0.003757
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83.834795	0.008683	0.008713	-0.003757
83.944801	0.008683	0.008713	-0.003757
84.063808	0.008683	0.008713	-0.003757
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84.324823	0.008683	0.008713	-0.003757
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84.870854	0.008679	0.008713	-0.003757
84.981861	0.008679	0.008713	-0.003757
85.091867	0.008679	0.008713	-0.003757
85.200873	0.008679	0.008713	-0.003757
85.308879	0.008679	0.008713	-0.003757
85.419886	0.008679	0.008713	-0.003757
85.529892	0.008679	0.008713	-0.003757
85.641898	0.008679	0.008713	-0.003757
85.753905	0.008679	0.008713	-0.003757
85.870912	0.008679	0.008713	-0.003757
85.981918	0.008679	0.008713	-0.003757
86.091924	0.008679	0.008713	-0.003757
86.20093	0.008679	0.008713	-0.003757
86.314937	0.008679	0.008713	-0.002819
86.424943	0.008679	0.008713	-0.002819
86.54095	0.008679	0.008713	-0.002819
86.651956	0.008679	0.008713	-0.002819
86.763963	0.008682	0.008713	-0.002819
86.871969	0.008682	0.008713	-0.002819
86.978975	0.008682	0.008713	-0.002819
87.091981	0.008682	0.008713	-0.002819
87.199987	0.008682	0.008713	-0.002819

87.308994	0.008682	0.008713	-0.002819
87.419	0.008682	0.008713	-0.002819
87.530006	0.008682	0.008713	-0.002819
87.640013	0.008682	0.008713	-0.002819
87.809022	0.008682	0.008257	-0.002819
87.919029	0.008682	0.008257	-0.002819
88.028035	0.008682	0.008257	-0.002819
88.139041	0.008682	0.008257	-0.002819
88.250048	0.008682	0.008257	-0.002819
88.369054	0.008682	0.008257	-0.002819
88.480061	0.008682	0.008257	-0.002819
88.588067	0.008682	0.008257	-0.002819
88.697073	0.00866	0.008257	-0.002819
88.806079	0.00866	0.008257	-0.002819
88.915086	0.00866	0.008257	-0.002819
89.025092	0.00866	0.008257	-0.002819
89.134098	0.00866	0.008257	-0.002819
89.244104	0.00866	0.008257	-0.002819
89.354111	0.00866	0.008257	-0.002819
89.462117	0.00866	0.008257	-0.002819
89.570123	0.00866	0.008257	-0.002819
89.678129	0.00866	0.008257	-0.002819
89.804136	0.00866	0.008257	-0.002819

89.916143	0.00866	0.008257	-0.002819
90.028149	0.00866	0.008257	-0.003152
90.183158	0.00866	0.008257	-0.003152
90.291164	0.00866	0.008257	-0.003152
90.39917	0.00866	0.008257	-0.003152
90.525177	0.008672	0.008257	-0.003152
90.634184	0.008672	0.008257	-0.003152
90.74219	0.008672	0.008257	-0.003152
90.851196	0.008672	0.008257	-0.003152
90.960203	0.008672	0.008257	-0.003152
91.068209	0.008672	0.008257	-0.003152
91.192216	0.008672	0.008257	-0.003152
91.301222	0.008672	0.008257	-0.003152
91.409228	0.008672	0.008257	-0.003152
91.517234	0.008672	0.008236	-0.003152
91.663243	0.008672	0.008236	-0.003152
91.771249	0.008672	0.008236	-0.003152
91.879255	0.008672	0.008236	-0.003152
91.988261	0.008672	0.008236	-0.003152
92.097268	0.008672	0.008236	-0.003152
92.211274	0.008672	0.008236	-0.003152
92.383284	0.008672	0.008236	-0.003152
92.49229	0.008665	0.008236	-0.003152

92.601296	0.008665	0.008236	-0.003152
92.709302	0.008665	0.008236	-0.003152
92.819309	0.008665	0.008236	-0.003152
92.998319	0.008665	0.008236	-0.003152
93.108325	0.008665	0.008236	-0.003152
93.225332	0.008665	0.008236	-0.003152
93.333338	0.008665	0.008236	-0.003152
93.441344	0.008665	0.008236	-0.003152
93.552351	0.008665	0.008236	-0.003152
93.662357	0.008665	0.008236	-0.003152
93.772363	0.008665	0.008236	-0.003152
93.88137	0.008665	0.008236	-0.00221
94.034379	0.008665	0.008236	-0.00221
94.144385	0.008665	0.008236	-0.00221
94.263391	0.008665	0.008236	-0.00221
94.374398	0.010479	0.008236	-0.00221
94.484404	0.010479	0.008236	-0.00221
94.623412	0.010479	0.008236	-0.00221
94.754419	0.010479	0.008236	-0.00221
94.875426	0.010479	0.008236	-0.00221
94.989433	0.010479	0.008236	-0.00221
95.10044	0.010479	0.008236	-0.00221
95.226447	0.010479	0.008236	-0.00221

95.341453	0.010479	0.008236	-0.00221
95.44946	0.010479	0.011063	-0.00221
95.561466	0.010479	0.011063	-0.00221
95.673472	0.010479	0.011063	-0.00221
95.790479	0.010479	0.011063	-0.00221
95.907485	0.010479	0.011063	-0.00221
96.017492	0.010479	0.011063	-0.00221
96.128498	0.010479	0.011063	-0.00221
96.247505	0.014385	0.011063	-0.00221
96.368512	0.014385	0.011063	-0.00221
96.541522	0.014385	0.011063	-0.00221
96.651528	0.014385	0.011063	-0.00221
96.761534	0.014385	0.011063	-0.00221
96.871541	0.014385	0.011063	-0.00221
96.981547	0.014385	0.011063	-0.00221
97.091553	0.014385	0.011063	-0.00221
97.20156	0.014385	0.011063	-0.00221
97.319566	0.014385	0.011063	-0.00221
97.431572	0.014385	0.011063	-0.00221
97.540579	0.014385	0.011063	-0.00221
97.650585	0.014385	0.011063	-0.00221
97.758591	0.014385	0.011063	-0.00221
97.866598	0.014385	0.011063	4.39E-05

97.977604	0.014385	0.011063	4.39E-05
98.08761	0.014385	0.011063	4.39E-05
98.200617	0.016142	0.011063	4.39E-05
98.312623	0.016142	0.011063	4.39E-05
98.43163	0.016142	0.011063	4.39E-05
98.541636	0.016142	0.011063	4.39E-05
98.658643	0.016142	0.011063	4.39E-05
98.770649	0.016142	0.011063	4.39E-05
98.883656	0.016142	0.011063	4.39E-05
98.993662	0.016142	0.011063	4.39E-05
99.109669	0.016142	0.011063	4.39E-05
99.219675	0.016142	0.011063	4.39E-05
99.330681	0.016142	0.010082	4.39E-05
99.450688	0.016142	0.010082	4.39E-05
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100.016721	0.016155	0.010082	4.39E-05
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101.3968	0.016155	0.010082	4.39E-05
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102.827881	0.014955	0.010082	-0.001085
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103.390913	0.014955	0.010493	-0.001085
103.50792	0.014955	0.010493	-0.001085
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104.057951	0.014342	0.010493	-0.001085
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106.150071	0.014321	0.010493	-0.001085
106.260077	0.014321	0.010493	-0.001085
106.368084	0.014321	0.010493	-0.001085
106.47609	0.014321	0.010493	-0.001085
106.584096	0.014321	0.010493	-0.001085
106.777107	0.014321	0.010493	-0.000862
106.886114	0.014321	0.010493	-0.000862
106.99812	0.014321	0.010003	-0.000862
107.108126	0.014321	0.010003	-0.000862
107.218132	0.014321	0.010003	-0.000862
107.328139	0.014321	0.010003	-0.000862
107.437145	0.014321	0.010003	-0.000862
107.561152	0.014321	0.010003	-0.000862
107.671158	0.014338	0.010003	-0.000862
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107.900171	0.014338	0.010003	-0.000862
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112.014407	0.014335	0.009918	-0.001194
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112.384428	0.014335	0.009918	-0.001194
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112.605441	0.014335	0.009918	-0.001194
112.715447	0.014335	0.009918	-0.001194
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112.94446	0.014335	0.009918	-0.001194
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113.166472	0.014335	0.009918	-0.001194
113.308481	0.014322	0.009918	-0.001194
113.432488	0.014322	0.009918	-0.001194
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113.867513	0.014322	0.009918	-0.001194

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115.556609	0.014356	0.009918	-0.001887
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115.804624	0.014356	0.009918	-0.001887
115.91363	0.014356	0.009764	-0.001887
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117.447718	0.014329	0.009764	-0.001887
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124.034094	0.013674	0.009105	-0.000986
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151.047639	0.010597	0.008529	-0.003323
151.155645	0.010597	0.008529	-0.003323
151.268652	0.010597	0.008529	-0.003323
151.378658	0.010595	0.008529	-0.003323
151.568669	0.010595	0.008529	-0.003323

151.702677	0.010595	0.008529	-0.003323
151.824684	0.010595	0.008316	-0.003323
151.939691	0.010595	0.008316	-0.003323
152.055697	0.010595	0.008316	-0.003323
152.218706	0.010595	0.008316	-0.003323
152.332713	0.010595	0.008316	-0.003323
152.440719	0.010595	0.008316	-0.003323
152.550725	0.010595	0.008316	-0.003323
152.659731	0.010595	0.008316	-0.003323
152.769738	0.010595	0.008316	-0.003323
152.880744	0.010595	0.008316	-0.003323
153.000751	0.010595	0.008316	-0.003323
153.111757	0.010595	0.008316	-0.003323
153.228764	0.0106	0.008316	-0.003323
153.341771	0.0106	0.008316	-0.003323
153.450777	0.0106	0.008316	-0.003323
153.558783	0.0106	0.008316	-0.003323
153.668789	0.0106	0.008316	-0.003323
153.776795	0.0106	0.008316	-0.003323
153.887802	0.0106	0.008316	-0.003323
153.997808	0.0106	0.008316	-0.00262
154.163817	0.0106	0.008316	-0.00262
154.273824	0.0106	0.008316	-0.00262

154.38183	0.0106	0.008316	-0.00262
154.489836	0.0106	0.008316	-0.00262
154.633844	0.0106	0.008316	-0.00262
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154.863858	0.0106	0.008316	-0.00262
154.973864	0.0106	0.008316	-0.00262
155.093871	0.0106	0.008316	-0.00262
155.203877	0.010615	0.008316	-0.00262
155.463892	0.010615	0.00856	-0.00262
155.572898	0.010615	0.00856	-0.00262
155.681904	0.010615	0.00856	-0.00262
155.78991	0.010615	0.00856	-0.00262
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156.980979	0.010615	0.00856	-0.00262
157.090985	0.010606	0.00856	-0.00262

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157.310997	0.010606	0.00856	-0.00262
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157.653017	0.010606	0.00856	-0.00262
157.773024	0.010606	0.00856	-0.00262
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158.152046	0.010606	0.00856	-0.002235
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158.814084	0.010606	0.00856	-0.002235
158.93109	0.010269	0.00856	-0.002235
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159.149103	0.010269	0.00856	-0.002235
159.259109	0.010269	0.00856	-0.002235
159.369115	0.010269	0.008812	-0.002235
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192.692021	0.008677	0.007593	-0.003358
192.805028	0.008677	0.007593	-0.003358
192.914034	0.008677	0.007593	-0.003358
193.02504	0.008677	0.007593	-0.003358
193.134047	0.008692	0.007593	-0.003358
193.244053	0.008692	0.007593	-0.003358
193.356059	0.008692	0.007593	-0.003358
193.464066	0.008692	0.007593	-0.003358
193.572072	0.008692	0.007593	-0.003358
193.680078	0.008692	0.007593	-0.003358
193.828086	0.008692	0.007593	-0.003374
193.936092	0.008692	0.007593	-0.003374
194.054099	0.008692	0.007593	-0.003374
194.204108	0.008692	0.007593	-0.003374
194.314114	0.008692	0.007593	-0.003374
194.42512	0.008692	0.007593	-0.003374
194.535127	0.008692	0.007593	-0.003374
194.643133	0.008692	0.007593	-0.003374
194.755139	0.008692	0.007593	-0.003374
194.865146	0.008692	0.007593	-0.003374
194.974152	0.008692	0.007593	-0.003374
195.084158	0.008678	0.007593	-0.003374
195.195165	0.008678	0.007593	-0.003374

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195.413177	0.008678	0.007206	-0.003374
195.521183	0.008678	0.007206	-0.003374
195.630189	0.008678	0.007206	-0.003374
195.738195	0.008678	0.007206	-0.003374
195.846201	0.008678	0.007206	-0.003374
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196.199222	0.008678	0.007206	-0.003374
196.364232	0.008678	0.007206	-0.003374
196.473238	0.008678	0.007206	-0.003374
196.582244	0.008678	0.007206	-0.003374
196.69125	0.008678	0.007206	-0.003374
196.814257	0.008678	0.007206	-0.003374
196.922263	0.008662	0.007206	-0.003374
197.029269	0.008662	0.007206	-0.003374
197.138276	0.008662	0.007206	-0.003374
197.252282	0.008662	0.007206	-0.003374
197.361289	0.008662	0.007206	-0.003374
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198.162334	0.008662	0.007206	-0.003374
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198.888376	0.008393	0.007206	-0.002599
198.999382	0.008393	0.007206	-0.002599
199.111389	0.008393	0.00726	-0.002599
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201.593531	0.008347	0.00726	-0.002599
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203.085616	0.010004	0.009031	-0.003223
203.195622	0.010004	0.009031	-0.003223
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203.528641	0.010004	0.009031	-0.003223
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211.02707	0.013887	0.008773	-0.002562
211.136076	0.013887	0.008773	-0.002562
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211.948123	0.013887	0.008153	-0.002562
212.057129	0.013887	0.008153	-0.002562
212.167135	0.012596	0.008153	-0.002562
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234.407407	0.010587	0.007647	-0.003072
234.517414	0.010587	0.007647	-0.003072
234.62842	0.010587	0.007647	-0.003072
234.742426	0.010587	0.007647	-0.003072
234.858433	0.010587	0.007647	-0.003072
234.992441	0.010257	0.007791	-0.004259
235.103447	0.010257	0.007791	-0.004259
235.213453	0.010257	0.007791	-0.004259
235.32346	0.010257	0.007791	-0.004259
235.431466	0.010257	0.007791	-0.004259
235.539472	0.010257	0.007791	-0.004259
235.647478	0.010257	0.007791	-0.004259
235.755485	0.010257	0.007791	-0.004259
235.869491	0.010257	0.007791	-0.004259
235.977497	0.010257	0.007791	-0.004259
236.086503	0.010257	0.007791	-0.004259
236.196509	0.010257	0.007791	-0.004259

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236.475525	0.010257	0.007791	-0.004259
236.583532	0.010257	0.007791	-0.004259
236.691538	0.010257	0.007791	-0.004259
236.800544	0.010597	0.007791	-0.004259
236.90855	0.010597	0.007791	-0.004259
237.017557	0.010597	0.007791	-0.004259
237.124563	0.010597	0.007791	-0.004259
237.267571	0.010597	0.007791	-0.004259
237.382577	0.010597	0.007791	-0.004259
237.490583	0.010597	0.007791	-0.004259
237.620591	0.010597	0.007791	-0.004259
237.729597	0.010597	0.007791	-0.004259
237.838603	0.010597	0.007791	-0.004123
237.946609	0.010597	0.007791	-0.004123
238.056616	0.010597	0.007791	-0.004123
238.167623	0.010597	0.007791	-0.004123
238.276628	0.010597	0.007791	-0.004123
238.396636	0.010597	0.007791	-0.004123
238.504642	0.010597	0.007791	-0.004123
238.612648	0.010597	0.007791	-0.004123
238.720654	0.010613	0.007791	-0.004123
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239.049673	0.010613	0.007791	-0.004123
239.157679	0.010613	0.007791	-0.004123
239.265685	0.010613	0.007791	-0.004123
239.373692	0.010613	0.007791	-0.004123
239.481698	0.010613	0.007791	-0.004123
239.589704	0.010613	0.007791	-0.004123
239.69771	0.010613	0.007791	-0.004123
239.805716	0.010613	0.007791	-0.004123
239.930723	0.010613	0.007791	-0.004123
240.101733	0.010613	0.008093	-0.004123
240.212739	0.010613	0.008093	-0.004123
240.345747	0.010613	0.008093	-0.004123
240.453753	0.010613	0.008093	-0.004123
240.562759	0.010613	0.008093	-0.004123
240.670765	0.010592	0.008093	-0.004123
240.800773	0.010592	0.008093	-0.004123
240.92078	0.010592	0.008093	-0.004123
241.028786	0.010592	0.008093	-0.004123
241.136792	0.010592	0.008093	-0.004123
241.261799	0.010592	0.008093	-0.004123
241.373806	0.010592	0.008093	-0.004123
241.481812	0.010592	0.008093	-0.004123

241.589818	0.010592	0.008093	-0.004123
241.739827	0.010592	0.008093	-0.004357
241.846833	0.010592	0.008093	-0.004357
241.962839	0.010592	0.008093	-0.004357
242.072845	0.010592	0.008093	-0.004357
242.182852	0.010592	0.008093	-0.004357
242.292858	0.010592	0.008093	-0.004357
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242.509871	0.010498	0.008093	-0.004357
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247.082132	0.009717	0.007761	-0.003248
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247.302145	0.009717	0.007761	-0.003248
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247.526157	0.009717	0.007811	-0.003248
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248.664223	0.009958	0.007811	-0.003248
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249.112248	0.009958	0.007811	-0.003248
249.221254	0.009958	0.007811	-0.003248
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253.042473	0.009388	0.007429	-0.003783
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253.583504	0.009388	0.007429	-0.003783
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254.952582	0.008686	0.007429	-0.003904
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257.795745	0.008682	0.007519	-0.00471
257.905751	0.008682	0.007519	-0.00471
258.014758	0.008682	0.007519	-0.00471
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258.463783	0.008682	0.007519	-0.00471
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258.681796	0.008682	0.007519	-0.00471
258.791802	0.008682	0.007519	-0.00471
258.900808	0.008682	0.007519	-0.00471
259.010815	0.008682	0.007519	-0.00471
259.122821	0.008682	0.007519	-0.00471
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261.282945	0.008652	0.00737	-0.00471
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262.254	0.008684	0.00737	-0.003809
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274.272687	0.008685	0.007186	-0.003877
274.419696	0.008685	0.007186	-0.004596
274.528702	0.008685	0.007186	-0.004596
274.759715	0.008685	0.007186	-0.004596
274.881722	0.008682	0.007186	-0.004596
275.01473	0.008682	0.007186	-0.004596
275.129736	0.008682	0.007186	-0.004596
275.239743	0.008682	0.007186	-0.004596
275.351749	0.008682	0.007186	-0.004596
275.462756	0.008682	0.007186	-0.004596
275.572762	0.008682	0.007186	-0.004596
275.681768	0.008682	0.007186	-0.004596
275.791774	0.008682	0.007186	-0.004596
275.936782	0.008682	0.00673	-0.004596
276.045789	0.008682	0.00673	-0.004596
276.167796	0.008682	0.00673	-0.004596
276.288803	0.008682	0.00673	-0.004596

276.400809	0.008682	0.00673	-0.004596
276.513815	0.008682	0.00673	-0.004596
276.634822	0.008682	0.00673	-0.004596
276.747829	0.008662	0.00673	-0.004596
276.863836	0.008662	0.00673	-0.004596
276.981843	0.008662	0.00673	-0.004596
277.093849	0.008662	0.00673	-0.004596
277.213856	0.008662	0.00673	-0.004596
277.336863	0.008662	0.00673	-0.004596
277.445869	0.008662	0.00673	-0.004596
277.557875	0.008662	0.00673	-0.004596
277.671882	0.008662	0.00673	-0.004596
277.780888	0.008662	0.00673	-0.004596
277.890894	0.008662	0.00673	-0.004596
278.003901	0.008662	0.00673	-0.004596
278.115907	0.008662	0.00673	-0.004596
278.239914	0.008662	0.00673	-0.003575
278.349921	0.008662	0.00673	-0.003575
278.458927	0.008662	0.00673	-0.003575
278.568933	0.008662	0.00673	-0.003575
278.679939	0.00868	0.00673	-0.003575
278.795946	0.00868	0.00673	-0.003575
278.905952	0.00868	0.00673	-0.003575

279.014959	0.00868	0.00673	-0.003575
279.124965	0.00868	0.00673	-0.003575
279.236971	0.00868	0.00673	-0.003575
279.348978	0.00868	0.00673	-0.003575
279.469985	0.00868	0.00673	-0.003575
279.578991	0.00868	0.00673	-0.003575
279.688997	0.00868	0.007474	-0.003575
279.799004	0.00868	0.007474	-0.003575
279.90801	0.00868	0.007474	-0.003575
280.018016	0.00868	0.007474	-0.003575
280.128022	0.00868	0.007474	-0.003575
280.238029	0.00868	0.007474	-0.003575
280.349035	0.00868	0.007474	-0.003575
280.461041	0.00868	0.007474	-0.003575
280.569047	0.00865	0.007474	-0.003575
280.679054	0.00865	0.007474	-0.003575
280.822062	0.00865	0.007474	-0.003575
280.931068	0.00865	0.007474	-0.003575
281.041075	0.00865	0.007474	-0.003575
281.152081	0.00865	0.007474	-0.003575
281.30409	0.00865	0.007474	-0.003575
281.412096	0.00865	0.007474	-0.003575
281.519102	0.00865	0.007474	-0.003575

281.630108	0.00865	0.007474	-0.003575
281.759116	0.00865	0.007474	-0.003575
281.946126	0.00865	0.007474	-0.003575
282.080134	0.00865	0.007474	-0.00318
282.19014	0.00865	0.007474	-0.00318
282.299147	0.00865	0.007474	-0.00318
282.420154	0.00833	0.007474	-0.00318
282.52816	0.00833	0.007474	-0.00318
282.636166	0.00833	0.007474	-0.00318
282.746172	0.00833	0.007474	-0.00318
282.855178	0.00833	0.007474	-0.00318
282.969185	0.00833	0.007474	-0.00318
283.077191	0.00833	0.007474	-0.00318
283.187197	0.00833	0.007474	-0.00318
283.343206	0.00833	0.007474	-0.00318
283.451212	0.00833	0.007474	-0.00318
283.605221	0.00833	0.006998	-0.00318
283.713227	0.00833	0.006998	-0.00318
283.822234	0.00833	0.006998	-0.00318
283.93524	0.00833	0.006998	-0.00318
284.049247	0.00833	0.006998	-0.00318
284.157253	0.00833	0.006998	-0.00318
284.27726	0.00833	0.006998	-0.00318

284.418268	0.008106	0.006998	-0.00318
284.539275	0.008106	0.006998	-0.00318
284.647281	0.008106	0.006998	-0.00318
284.755287	0.008106	0.006998	-0.00318
284.951298	0.008106	0.006998	-0.00318
285.065305	0.008106	0.006998	-0.00318
285.175311	0.008106	0.006998	-0.00318
285.284317	0.008106	0.006998	-0.00318
285.392323	0.008106	0.006998	-0.00318
285.500329	0.008106	0.006998	-0.00318
285.608336	0.008106	0.006998	-0.00318
285.716342	0.008106	0.006998	-0.00318
285.825348	0.008106	0.006998	-0.003258
286.03236	0.008106	0.006998	-0.003258
286.145367	0.008106	0.006998	-0.003258
286.255373	0.007109	0.006998	-0.003258
286.363379	0.007109	0.006998	-0.003258
286.471385	0.007109	0.006998	-0.003258
286.578391	0.007109	0.006998	-0.003258
286.687397	0.007109	0.006998	-0.003258
286.796404	0.007109	0.006998	-0.003258
286.90841	0.007109	0.006998	-0.003258
287.019416	0.007109	0.006998	-0.003258

287.129423	0.007109	0.006998	-0.003258
287.239429	0.007109	0.006998	-0.003258
287.350435	0.007109	0.007003	-0.003258
287.471442	0.007109	0.007003	-0.003258
287.584449	0.007109	0.007003	-0.003258
287.692455	0.007109	0.007003	-0.003258
287.801461	0.007109	0.007003	-0.003258
287.909467	0.007109	0.007003	-0.003258
288.017474	0.007109	0.007003	-0.003258
288.12548	0.007106	0.007003	-0.003258
288.252487	0.007106	0.007003	-0.003258
288.362494	0.007106	0.007003	-0.003258
288.4815	0.007106	0.007003	-0.003258
288.597507	0.007106	0.007003	-0.003258
288.775517	0.007106	0.007003	-0.003258
288.884523	0.007106	0.007003	-0.003258
288.994529	0.007106	0.007003	-0.003258
289.117537	0.007106	0.007003	-0.003258
289.229543	0.007106	0.007003	-0.003258
289.338549	0.007106	0.007003	-0.003258
289.446555	0.007106	0.007003	-0.003258
289.554562	0.007106	0.007003	-0.003258
289.663568	0.007106	0.007003	-0.003258

289.819577	0.007106	0.007003	-0.003258
289.930583	0.007106	0.007003	-0.003664
290.045589	0.007674	0.007003	-0.003664
290.188598	0.007674	0.007003	-0.003664
290.298604	0.007674	0.007003	-0.003664
290.40761	0.007674	0.007003	-0.003664
290.515616	0.007674	0.007003	-0.003664
290.628623	0.007674	0.007003	-0.003664
290.736629	0.007674	0.007003	-0.003664
290.844635	0.007674	0.007003	-0.003664
290.952641	0.007674	0.007003	-0.003664
291.060647	0.007674	0.007003	-0.003664
291.167654	0.007674	0.007003	-0.003664
291.300662	0.007674	0.007499	-0.003664
291.407668	0.007674	0.007499	-0.003664
291.518674	0.007674	0.007499	-0.003664
291.639681	0.007674	0.007499	-0.003664
291.749687	0.007674	0.007499	-0.003664
291.859694	0.007674	0.007499	-0.003664
291.9707	0.010931	0.007499	-0.003664
292.080706	0.010931	0.007499	-0.003664
292.189712	0.010931	0.007499	-0.003664
292.368722	0.010931	0.007499	-0.003664

292.476728	0.010931	0.007499	-0.003664
292.603736	0.010931	0.007499	-0.003664
292.711742	0.010931	0.007499	-0.003664
292.819748	0.010931	0.007499	-0.003664
292.927754	0.010931	0.007499	-0.003664
293.036761	0.010931	0.007499	-0.003664
293.148767	0.010931	0.007499	-0.003664
293.296775	0.010931	0.007499	-0.003664
293.405782	0.010931	0.007499	-0.003664
293.520788	0.010931	0.007499	-0.003664
293.632795	0.010931	0.007499	-0.003664
293.741801	0.010931	0.007499	-0.003664
293.860808	0.012419	0.007499	-0.003664
293.974814	0.012419	0.007499	-0.003664
294.084821	0.012419	0.007499	-0.003664
294.194827	0.012419	0.007499	-0.003664
294.304833	0.012419	0.007499	-0.003664
294.41684	0.012419	0.007499	-0.003664
294.531846	0.012419	0.007499	-0.003664
294.642853	0.012419	0.007499	-0.003664
294.752859	0.012419	0.007499	-0.003664
294.880866	0.012419	0.007499	-0.003664
294.990872	0.012419	0.007499	-0.003664

295.102879	0.012419	0.008169	-0.003664
295.211885	0.012419	0.008169	-0.003664
295.321891	0.012419	0.008169	-0.003664
295.429898	0.012419	0.008169	-0.003664
295.557905	0.012419	0.008169	-0.003664
295.665911	0.012419	0.008169	-0.003664
295.773917	0.012401	0.008169	-0.003664
295.881923	0.012401	0.008169	-0.003664
295.98993	0.012401	0.008169	-0.003664
296.097936	0.012401	0.008169	-0.003664
296.211942	0.012401	0.008169	-0.003664
296.331949	0.012401	0.008169	-0.003664
296.551962	0.012401	0.008169	-0.003664
296.658968	0.012401	0.008169	-0.002606
296.766974	0.012401	0.008169	-0.002606
296.87598	0.012401	0.008169	-0.002606
296.983986	0.012401	0.008169	-0.002606
297.094993	0.012401	0.008169	-0.002606
297.204999	0.012401	0.008169	-0.002606
297.313005	0.012401	0.008169	-0.002606
297.453013	0.012401	0.008169	-0.002606
297.56802	0.012401	0.008169	-0.002606
297.75003	0.012422	0.008169	-0.002606

297.861037	0.012422	0.008169	-0.002606
297.971043	0.012422	0.008169	-0.002606
298.081049	0.012422	0.008169	-0.002606
298.192056	0.012422	0.008169	-0.002606
298.301062	0.012422	0.008169	-0.002606
298.409068	0.012422	0.008169	-0.002606
298.518074	0.012422	0.008169	-0.002606
298.626081	0.012422	0.008169	-0.003642
298.741087	0.012422	0.008169	-0.003642
298.849093	0.012422	0.008169	-0.003642
298.960099	0.012422	0.00797	-0.003642
299.070106	0.012422	0.00797	-0.003642
299.181112	0.012422	0.00797	-0.003642
299.290118	0.012422	0.00797	-0.003642
299.399125	0.012422	0.00797	-0.003642
299.513131	0.012419	0.00797	-0.003642
299.623137	0.012419	0.00797	-0.003642
299.735144	0.012419	0.00797	-0.003642
299.84515	0.012419	0.00797	-0.003642
300.011159	0.012419	0.00797	-0.003642
300.122166	0.012419	0.00797	-0.003642
300.290175	0.012419	0.00797	-0.003642
300.400182	0.012419	0.00797	-0.003642

300.508188	0.012419	0.00797	-0.003642
300.616194	0.012419	0.00797	-0.003642
300.7242	0.012419	0.00797	-0.003642
300.833207	0.012419	0.00797	-0.003642
300.943213	0.012419	0.00797	-0.003642
301.054219	0.012419	0.00797	-0.003642
301.164226	0.012419	0.00797	-0.003642
301.378238	0.012419	0.00797	-0.003642
301.486244	0.012408	0.00797	-0.003642
301.608251	0.012408	0.00797	-0.003642
301.717257	0.012408	0.00797	-0.003642
301.826263	0.012408	0.00797	-0.003642
301.93627	0.012408	0.00797	-0.003642
302.046276	0.012408	0.00797	-0.003642
302.156282	0.012408	0.00797	-0.003642
302.265288	0.012408	0.00797	-0.003642
302.373295	0.012408	0.00797	-0.003642
302.551305	0.012408	0.00797	-0.003793
302.661311	0.012408	0.00797	-0.003793
302.771317	0.012408	0.00797	-0.003793
302.881324	0.012408	0.00797	-0.003793
302.99133	0.012408	0.00797	-0.003793
303.102336	0.012408	0.00797	-0.003793

303.213343	0.012408	0.00797	-0.003793
303.322349	0.010969	0.00797	-0.003793
303.430355	0.010969	0.00797	-0.003793
303.538362	0.010969	0.00797	-0.003793
303.646368	0.010969	0.00797	-0.003793
303.754374	0.010969	0.00797	-0.003793
303.86238	0.010969	0.00797	-0.003793
303.971386	0.010969	0.00789	-0.003793
304.099393	0.010969	0.00789	-0.003793
304.2084	0.010969	0.00789	-0.003793

Figure 5.23. Restart Experiment with the oil 2 and Procedure 3

Tempo Total	Pressão Linha	Delta P 1	Delta P 2
0	4.96713	0.007527	-0.003954
0.110006	4.96713	0.007527	-0.003954
0.220013	4.96713	0.007527	-0.003954
0.410024	4.96713	0.007527	-0.003954
0.51803	4.96713	0.007527	-0.003954
0.628036	4.96713	0.007527	-0.003954
0.737042	4.96713	0.007527	-0.003954
0.939054	4.967139	0.007527	-0.004012
1.04806	4.967139	0.007527	-0.004012
1.172067	4.967139	0.007527	-0.004012
1.346077	4.967139	0.007527	-0.004012

1.456083	4.967139	0.007527	-0.004012
1.56709	4.967139	0.007527	-0.004012
1.690097	4.967139	0.007527	-0.004012
1.872107	4.967139	0.008444	-0.004012
1.980114	4.967139	0.008444	-0.004012
2.08812	4.967139	0.008444	-0.004012
2.196126	4.967139	0.008444	-0.004012
2.383136	4.967139	0.008444	-0.004012
2.493143	4.967139	0.008444	-0.004012
2.603149	4.967139	0.008444	-0.004012
2.714155	4.967139	0.008444	-0.004012
2.822162	4.967149	0.008444	-0.004012
2.958169	4.967149	0.008444	-0.004012
3.067175	4.967149	0.008444	-0.004012
3.176182	4.967149	0.008444	-0.004012
3.286188	4.967149	0.008444	-0.004012
3.396194	4.967149	0.008444	-0.004012
3.538202	4.967149	0.008444	-0.004012
3.648209	4.967149	0.008444	-0.004012
3.759215	4.967149	0.008444	-0.004012
3.867221	4.967149	0.008444	-0.004012
3.977228	4.967149	0.008444	-0.004012
4.087234	4.967149	0.008444	-0.004012

4.239243	4.967149	0.008444	-0.004012
4.349249	4.967149	0.008444	-0.004012
4.460255	4.967149	0.008444	-0.004012
4.571261	4.967149	0.008444	-0.004012
4.681268	4.967173	0.008444	-0.004012
4.825276	4.967173	0.008444	-0.003637
4.934282	4.967173	0.008444	-0.003637
5.044289	4.967173	0.008444	-0.003637
5.159295	4.967173	0.008444	-0.003637
5.268301	4.967173	0.008444	-0.003637
5.379308	4.967173	0.008444	-0.003637
5.489314	4.967173	0.008444	-0.003637
5.59932	4.967173	0.008642	-0.003637
5.710327	4.967173	0.008642	-0.003637
5.818333	4.967173	0.008642	-0.003637
5.927339	4.967173	0.008642	-0.003637
6.039345	4.967173	0.008642	-0.003637
6.150352	4.967173	0.008642	-0.003637
6.259358	4.967173	0.008642	-0.003637
6.369364	4.967173	0.008642	-0.003637
6.480371	4.967173	0.008642	-0.003637
6.590377	4.967171	0.008642	-0.003637
6.701383	4.967171	0.008642	-0.003637

6.80939	4.967171	0.008642	-0.003637
6.918396	4.967171	0.008642	-0.003637
7.026402	4.967171	0.008642	-0.003637
7.136408	4.967171	0.008642	-0.003637
7.249415	4.967171	0.008642	-0.003637
7.388422	4.967171	0.008642	-0.003637
7.500429	4.967171	0.008642	-0.003637
7.619436	4.967171	0.008642	-0.003637
7.729442	4.967171	0.008642	-0.003637
7.838449	4.967171	0.008642	-0.003637
7.946455	4.967171	0.008642	-0.003637
8.054461	4.967171	0.008642	-0.003637
8.164467	4.967171	0.008642	-0.003637
8.274473	4.967171	0.008642	-0.003637
8.38248	4.967171	0.008642	-0.003637
8.490486	4.967173	0.008642	-0.003637
8.599492	4.967173	0.008642	-0.001773
8.707498	4.967173	0.008642	-0.001773
8.815504	4.967173	0.008642	-0.001773
8.92551	4.967173	0.008642	-0.001773
9.036517	4.967173	0.008642	-0.001773
9.145523	4.967173	0.008642	-0.001773
9.255529	4.967173	0.008642	-0.001773

9.365536	4.967173	0.008642	-0.001773
9.555547	4.967173	0.008741	-0.001773
9.665553	4.967173	0.008741	-0.001773
9.774559	4.967173	0.008741	-0.001773
9.897566	4.967173	0.008741	-0.001773
10.007572	4.967173	0.008741	-0.001773
10.115579	4.967173	0.008741	-0.001773
10.224585	4.967173	0.008741	-0.001773
10.333591	4.967173	0.008741	-0.001773
10.442597	4.967185	0.008741	-0.001773
10.552604	4.967185	0.008741	-0.001773
10.66061	4.967185	0.008741	-0.001773
10.776617	4.967185	0.008741	-0.001773
10.886623	4.967185	0.008741	-0.001773
11.039631	4.967185	0.008741	-0.001773
11.231643	4.967185	0.008741	-0.001773
11.341649	4.967185	0.008741	-0.001773
11.450655	4.967185	0.008741	-0.001773
11.559661	4.967185	0.008741	-0.001773
11.670668	4.967185	0.008741	-0.001773
11.788674	4.967185	0.008741	-0.001773
11.909681	4.967185	0.008741	-0.001773
12.018688	4.967185	0.008741	-0.001773

12.127694	4.967185	0.008741	-0.001773
12.2367	4.967185	0.008741	-0.001773
12.347706	4.967164	0.008741	-0.001773
12.527717	4.967164	0.008741	-0.001773
12.638723	4.967164	0.008741	-0.001773
12.748729	4.967164	0.008741	-0.001773
12.857736	4.967164	0.008741	-0.001773
12.966742	4.967164	0.008741	-0.001773
13.076748	4.967164	0.008741	-0.001773
13.185754	4.967164	0.008741	-0.001773
13.295761	4.967164	0.008741	-0.001773
13.405767	4.967164	0.008741	-0.001773
13.515773	4.967164	0.008741	-0.001773
13.62578	4.967164	0.008741	-0.000202
13.738786	4.967164	0.008741	-0.000202
13.847792	4.967164	0.008741	-0.000202
14.030803	4.967164	0.011497	-0.000202
14.140809	4.967164	0.011497	-0.000202
14.251815	4.967169	0.011497	-0.000202
14.361822	4.967169	0.011497	-0.000202
14.471828	4.967169	0.011497	-0.000202
14.582834	4.967169	0.011497	-0.000202
14.693841	4.967169	0.011497	-0.000202

14.813847	4.967169	0.011497	-0.000202
14.922853	4.967169	0.011497	-0.000202
15.099864	4.967169	0.011497	-0.000202
15.20887	4.967169	0.011497	-0.000202
15.318876	4.967169	0.011497	-0.000202
15.428883	4.967169	0.011497	-0.000202
15.539889	4.967169	0.011497	-0.000202
15.649895	4.967169	0.011497	-0.000202
15.769902	4.967169	0.011497	-0.000202
15.878908	4.967169	0.011497	-0.000202
15.989914	4.967169	0.011497	-0.000202
16.100921	4.967135	0.011497	-0.000202
16.209927	4.967135	0.011497	-0.000202
16.319933	4.967135	0.011497	-0.000202
16.42894	4.967135	0.011497	-0.000202
16.561947	4.967135	0.011497	-0.000202
16.672954	4.967135	0.011497	-0.000202
16.78196	4.967135	0.011497	-0.000202
16.945969	4.967135	0.011497	-0.000405
17.054976	4.967135	0.011497	-0.000405
17.164982	4.967135	0.011497	-0.000405
17.275988	4.967135	0.011497	-0.000405
17.385994	4.967135	0.011497	-0.000405

17.496001	4.967135	0.011497	-0.000405
17.606007	4.967135	0.011497	-0.000405
17.738015	4.967135	0.011497	-0.000405
17.847021	4.967135	0.011497	-0.000405
17.956027	4.967135	0.011497	-0.000405
18.064033	4.967135	0.011497	-0.000405
18.173039	4.967135	0.011497	-0.000405
18.282046	4.967135	0.011497	-0.000405
18.391052	4.967135	0.011497	-0.000405
18.500058	4.967135	0.011354	-0.000405
18.611064	4.967135	0.011354	-0.000405
18.721071	4.967135	0.011354	-0.000405
18.852078	4.967135	0.011354	-0.000405
18.984086	4.967135	0.011354	-0.000405
19.094092	4.967135	0.011354	-0.000405
19.203098	4.967135	0.011354	-0.000405
19.322105	4.967135	0.011354	-0.000405
19.433112	4.967135	0.011354	-0.000405
19.542118	4.967135	0.011354	-0.000405
19.655124	4.967135	0.011354	-0.000405
19.76613	4.967135	0.011354	-0.000405
19.881137	4.967149	0.011354	-0.000405
19.990143	4.967149	0.011354	-0.000405

20.10215	4.967149	0.011354	-0.000405
20.216156	4.967149	0.011354	-0.000405
20.327163	4.967149	0.011354	-0.000405
20.440169	4.967149	0.011354	-0.000405
20.562176	4.967149	0.011354	-0.000405
20.672183	4.967149	0.011354	-0.000405
20.780189	4.967149	0.011354	-0.000405
20.888195	4.967149	0.011354	-0.000405
20.997201	4.967149	0.011354	-0.000405
21.116208	4.967149	0.011354	-0.000405
21.224214	4.967149	0.011354	-0.000405
21.352221	4.967149	0.011354	-0.001113
21.462228	4.967149	0.011354	-0.001113
21.573234	4.967149	0.011354	-0.001113
21.68224	4.967149	0.011354	-0.001113
21.792246	4.967186	0.011354	-0.001113
21.900253	4.967186	0.011354	-0.001113
22.009259	4.967186	0.011354	-0.001113
22.118265	4.967186	0.011354	-0.001113
22.228271	4.967186	0.011354	-0.001113
22.339278	4.967186	0.011354	-0.001113
22.449284	4.967186	0.011354	-0.001113
22.55929	4.967186	0.011354	-0.001113

22.677297	4.967186	0.011448	-0.001113
22.788303	4.967186	0.011448	-0.001113
22.89831	4.967186	0.011448	-0.001113
23.009316	4.967186	0.011448	-0.001113
23.119322	4.967186	0.011448	-0.001113
23.228329	4.967186	0.011448	-0.001113
23.338335	4.967186	0.011448	-0.001113
23.449341	4.967186	0.011448	-0.001113
23.560348	4.967186	0.011448	-0.001113
23.672354	4.967176	0.011448	-0.001113
23.78136	4.967176	0.011448	-0.001113
23.901367	4.967176	0.011448	-0.001113
24.009373	4.967176	0.011448	-0.001113
24.11838	4.967176	0.011448	-0.001113
24.227386	4.967176	0.011448	-0.001113
24.338392	4.967176	0.011448	-0.001113
24.448399	4.967176	0.011448	-0.001113
24.565405	4.967176	0.011448	-0.001113
24.674411	4.967176	0.011448	-0.001113
24.783418	4.967176	0.011448	-0.001113
24.892424	4.967176	0.011448	-0.001113
25.00243	4.967176	0.011448	-0.001113
25.113437	4.967176	0.011448	-0.001382

25.258445	4.967176	0.011448	-0.001382
25.497458	4.967176	0.011448	-0.001382
25.638466	4.967183	0.011448	-0.001382
25.750473	4.967183	0.011448	-0.001382
25.857479	4.967183	0.011448	-0.001382
25.973485	4.967183	0.011448	-0.001382
26.087492	4.967183	0.011448	-0.001382
26.198499	4.967183	0.011255	-0.001382
26.309505	4.967183	0.011255	-0.001382
26.420511	4.967183	0.011255	-0.001382
26.529517	4.967183	0.011255	-0.001382
26.640524	4.967183	0.011255	-0.001382
26.74853	4.967183	0.011255	-0.001382
26.856536	4.967183	0.011255	-0.001382
27.038547	4.967183	0.011255	-0.001382
27.147553	4.967183	0.011255	-0.001382
27.255559	4.967183	0.011255	-0.001382
27.364565	4.967183	0.011255	-0.001382
27.473571	4.967177	0.011255	-0.001382
27.581578	4.967177	0.011255	-0.001382
27.689584	4.967177	0.011255	-0.001382
27.834592	4.967177	0.011255	-0.001382
27.943598	4.967177	0.011255	-0.001382

28.052605	4.967177	0.011255	-0.001382
28.161611	4.967177	0.011255	-0.001382
28.269617	4.967177	0.011255	-0.001382
28.377623	4.967177	0.011255	-0.001382
28.485629	4.967177	0.011255	-0.001382
28.593636	4.967177	0.011255	-0.001382
28.701642	4.967177	0.011255	-0.001382
28.810648	4.967177	0.011255	-0.001382
28.920654	4.967177	0.011255	-0.001382
29.079663	4.967177	0.011255	-0.001243
29.18967	4.967177	0.011255	-0.001243
29.299676	4.967177	0.011255	-0.001243
29.410682	4.966793	0.011255	-0.001243
29.520689	4.966793	0.011255	-0.001243
29.630695	4.966793	0.011255	-0.001243
29.741701	4.966793	0.011255	-0.001243
29.849708	4.966793	0.011255	-0.001243
30.004716	4.966793	0.011026	-0.001243
30.112722	4.966793	0.011026	-0.001243
30.221729	4.966793	0.011026	-0.001243
30.359736	4.966793	0.011026	-0.001243
30.468743	4.966793	0.011026	-0.001243
30.578749	4.966793	0.011026	-0.001243

30.688756	4.966793	0.011026	-0.001243
30.798761	4.966793	0.011026	-0.001243
30.906768	4.966793	0.011026	-0.001243
31.015774	4.966793	0.011026	-0.001243
31.12378	4.966793	0.011026	-0.001243
31.231786	4.966793	0.011026	-0.001243
31.341793	4.966335	0.011026	-0.001243
31.450799	4.966335	0.011026	-0.001243
31.559805	4.966335	0.011026	-0.001243
31.694813	4.966335	0.011026	-0.001243
31.805819	4.966335	0.011026	-0.001243
31.913826	4.966335	0.011026	-0.001243
32.022831	4.966335	0.011026	-0.001243
32.132838	4.966335	0.011026	-0.001243
32.242844	4.966335	0.011026	-0.001243
32.384852	4.966335	0.011026	-0.001243
32.494859	4.966335	0.011026	-0.001243
32.604865	4.966335	0.011026	-0.001243
32.714871	4.966335	0.011026	-0.001243
32.822877	4.966335	0.011026	-0.001653
32.930883	4.966335	0.011026	-0.001653
33.03889	4.966335	0.011026	-0.001653
33.146896	4.966335	0.011026	-0.001653

33.317906	4.966542	0.011026	-0.001653
33.427912	4.966542	0.011026	-0.001653
33.537918	4.966542	0.011026	-0.001653
33.648925	4.966542	0.011026	-0.001653
33.759931	4.966542	0.011081	-0.001653
33.867937	4.966542	0.011081	-0.001653
33.975944	4.966542	0.011081	-0.001653
34.08395	4.966542	0.011081	-0.001653
34.191956	4.966542	0.011081	-0.001653
34.343965	4.966542	0.011081	-0.001653
34.453971	4.966542	0.011081	-0.001653
34.563977	4.966542	0.011081	-0.001653
34.673983	4.966542	0.011081	-0.001653
34.783989	4.966542	0.011081	-0.001653
34.891996	4.966542	0.011081	-0.001653
35.025003	4.966542	0.011081	-0.001653
35.13601	4.966981	0.011081	-0.001653
35.246016	4.966981	0.011081	-0.001653
35.359023	4.966981	0.011081	-0.001653
35.48403	4.966981	0.011081	-0.001653
35.611037	4.966981	0.011081	-0.001653
35.769046	4.966981	0.011081	-0.001653
35.881052	4.966981	0.011081	-0.001653

35.996059	4.966981	0.011081	-0.001653
36.264074	4.966981	0.011081	-0.001653
36.380081	4.966981	0.011081	-0.001653
36.491087	4.966981	0.011081	-0.001653
36.602094	4.966981	0.011081	-0.001653
36.728101	4.966981	0.011081	-0.001653
36.837107	4.966981	0.011081	-0.0008
36.948113	4.966981	0.011081	-0.0008
37.074121	4.966661	0.011081	-0.0008
37.206128	4.966661	0.011081	-0.0008
37.328135	4.966661	0.011081	-0.0008
37.448142	4.966661	0.011081	-0.0008
37.557148	4.966661	0.011081	-0.0008
37.676155	4.966661	0.011081	-0.0008
37.787161	4.966661	0.011081	-0.0008
37.907168	4.966661	0.011081	-0.0008
38.020175	4.966661	0.011081	-0.0008
38.138181	4.966661	0.011081	-0.0008
38.247188	4.966661	0.011081	-0.0008
38.357194	4.966661	0.011081	-0.0008
38.4662	4.966661	0.011081	-0.0008
38.582207	4.966661	0.011081	-0.0008
38.720215	4.966661	0.011081	-0.0008

38.828221	4.966661	0.011081	-0.0008
38.944228	4.966034	0.011081	-0.0008
39.074235	4.966034	0.011081	-0.0008
39.183241	4.966034	0.011081	-0.0008
39.297248	4.966034	0.011081	-0.0008
39.408254	4.966034	0.011081	-0.0008
39.51726	4.966034	0.011081	-0.0008
39.640267	4.966034	0.011081	-0.0008
39.754274	4.966034	0.011081	-0.0008
39.86528	4.966034	0.011081	-0.0008
39.976286	4.966034	0.011081	-0.0008
40.093293	4.966034	0.011081	-0.0008
40.2053	4.966034	0.011081	-0.0008
40.315306	4.966034	0.011081	-0.0008
40.426312	4.966034	0.011081	-0.0008
40.615323	4.966034	0.011081	-0.000982
40.724329	4.966034	0.011081	-0.000982
40.833335	4.965516	0.011081	-0.000982
41.007346	4.965516	0.011081	-0.000982
41.164354	4.965516	0.011081	-0.000982
41.275361	4.965516	0.011081	-0.000982
41.386367	4.965516	0.011081	-0.000982
41.534376	4.965516	0.010918	-0.000982

41.644382	4.965516	0.010918	-0.000982
41.754388	4.965516	0.010918	-0.000982
41.862394	4.965516	0.010918	-0.000982
42.058405	4.965516	0.010918	-0.000982
42.167412	4.965516	0.010918	-0.000982
42.276418	4.965516	0.010918	-0.000982
42.385425	4.965516	0.010918	-0.000982
42.49543	4.965516	0.010918	-0.000982
42.604437	4.965516	0.010918	-0.000982
42.714443	4.965369	0.010918	-0.000982
42.822449	4.965369	0.010918	-0.000982
42.944456	4.965369	0.010918	-0.000982
43.055463	4.965369	0.010918	-0.000982
43.195471	4.965369	0.010918	-0.000982
43.304477	4.965369	0.010918	-0.000982
43.416483	4.965369	0.010918	-0.000982
43.52749	4.965369	0.010918	-0.000982
43.636496	4.965369	0.010918	-0.000982
43.746502	4.965369	0.010918	-0.000982
43.917512	4.965369	0.010918	-0.000982
44.025518	4.965369	0.010918	-0.000982
44.133524	4.965369	0.010918	-0.000982
44.243531	4.965369	0.010918	-0.000982

44.352537	4.965369	0.010918	-0.000982
44.460543	4.965369	0.010918	-0.000982
44.570549	4.96538	0.010918	-0.000982
44.679555	4.96538	0.010918	-0.000982
44.787562	4.96538	0.010918	-0.000982
44.897568	4.96538	0.010918	-0.000982
45.005574	4.96538	0.010918	-0.000982
45.11358	4.96538	0.010918	-0.000982
45.221587	4.96538	0.010918	-0.000982
45.330593	4.96538	0.010918	-0.000982
45.441599	4.96538	0.010918	-0.000982
45.550605	4.96538	0.010918	-0.001424
45.795619	4.96538	0.010918	-0.001424
45.903625	4.96538	0.010918	-0.001424
46.012632	4.96538	0.010918	-0.001424
46.141639	4.96538	0.010918	-0.001424
46.252645	4.96538	0.010918	-0.001424
46.362652	4.96538	0.010918	-0.001424
46.472658	4.965346	0.010918	-0.001424
46.659669	4.965346	0.011052	-0.001424
46.767675	4.965346	0.011052	-0.001424
46.876681	4.965346	0.011052	-0.001424
47.045691	4.965346	0.011052	-0.001424

47.155697	4.965346	0.011052	-0.001424
47.267704	4.965346	0.011052	-0.001424
47.37771	4.965346	0.011052	-0.001424
47.487716	4.965346	0.011052	-0.001424
47.596723	4.965346	0.011052	-0.001424
47.73873	4.965346	0.011052	-0.001424
47.846737	4.965346	0.011052	-0.001424
47.955743	4.965346	0.011052	-0.001424
48.064749	4.965346	0.011052	-0.001424
48.174756	4.965346	0.011052	-0.001424
48.284762	4.965346	0.011052	-0.001424
48.393768	4.966453	0.011052	-0.001424
48.502774	4.966453	0.011052	-0.001424
48.612781	4.966453	0.011052	-0.001424
48.730787	4.966453	0.011052	-0.001424
48.838793	4.966453	0.011052	-0.001424
48.9478	4.966453	0.011052	-0.001424
49.057806	4.966453	0.011052	-0.001424
49.167812	4.966453	0.011052	-0.001424
49.342822	4.966453	0.011052	-0.001424
49.452828	4.966453	0.011052	-0.001534
49.562835	4.966453	0.011052	-0.001534
49.699843	4.966453	0.011052	-0.001534

49.820849	4.966453	0.011052	-0.001534
49.928856	4.966453	0.011052	-0.001534
50.036862	4.966453	0.011052	-0.001534
50.145868	4.966453	0.011052	-0.001534
50.253874	4.965352	0.011052	-0.001534
50.361881	4.965352	0.01061	-0.001534
50.505889	4.965352	0.01061	-0.001534
50.615895	4.965352	0.01061	-0.001534
50.728901	4.965352	0.01061	-0.001534
50.87791	4.965352	0.01061	-0.001534
51.033919	4.965352	0.01061	-0.001534
51.143925	4.965352	0.01061	-0.001534
51.258932	4.965352	0.01061	-0.001534
51.368938	4.965352	0.01061	-0.001534
51.479945	4.965352	0.01061	-0.001534
51.588951	4.965352	0.01061	-0.001534
51.696957	4.965352	0.01061	-0.001534
51.804963	4.965352	0.01061	-0.001534
51.915969	4.965352	0.01061	-0.001534
52.024976	4.965352	0.01061	-0.001534
52.134982	4.965352	0.01061	-0.001534
52.245988	4.965353	0.01061	-0.001534
52.355995	4.965353	0.01061	-0.001534

52.465001	4.965353	0.01061	-0.001534
52.576007	4.965353	0.01061	-0.001534
52.686014	4.965353	0.01061	-0.001534
52.871024	4.965353	0.01061	-0.001534
52.97903	4.965353	0.01061	-0.001534
53.087037	4.965353	0.01061	-0.001534
53.195043	4.965353	0.01061	-0.001534
53.304049	4.965353	0.01061	-0.001903
53.456058	4.965353	0.01061	-0.001903
53.566064	4.965353	0.01061	-0.001903
53.67707	4.965353	0.01061	-0.001903
53.822079	4.965353	0.01061	-0.001903
53.931085	4.965353	0.01061	-0.001903
54.041091	4.965353	0.01061	-0.001903
54.153098	4.965328	0.01061	-0.001903
54.302106	4.965328	0.010556	-0.001903
54.410112	4.965328	0.010556	-0.001903
54.520118	4.965328	0.010556	-0.001903
54.631125	4.965328	0.010556	-0.001903
54.742131	4.965328	0.010556	-0.001903
54.851138	4.965328	0.010556	-0.001903
55.040148	4.965328	0.010556	-0.001903
55.148154	4.965328	0.010556	-0.001903

55.256161	4.965328	0.010556	-0.001903
55.41717	4.965328	0.010556	-0.001903
55.525176	4.965328	0.010556	-0.001903
55.634182	4.965328	0.010556	-0.001903
55.742188	4.965328	0.010556	-0.001903
55.851194	4.965328	0.010556	-0.001903
55.960201	4.965349	0.010556	-0.001903
56.070207	4.965349	0.010556	-0.001903
56.181213	4.965349	0.010556	-0.001903
56.30222	4.965349	0.010556	-0.001903
56.411227	4.965349	0.010556	-0.001903
56.520233	4.965349	0.010556	-0.001888
56.630239	4.965349	0.010556	-0.001888
56.741245	4.965349	0.010556	-0.001888
56.850252	4.965349	0.010556	-0.001888
56.958258	4.965349	0.010556	-0.001888
57.066264	4.965349	0.010556	-0.001888
57.17527	4.965349	0.010556	-0.001888
57.284276	4.965349	0.010556	-0.001888
57.418284	4.965349	0.010556	-0.001888
57.52829	4.965349	0.010556	-0.001888
57.651298	4.965349	0.010556	-0.001888
57.761304	4.965349	0.010556	-0.001888

57.87231	4.965355	0.010556	-0.001888
57.981317	4.965355	0.010556	-0.001888
58.128325	4.965355	0.010749	-0.001888
58.238331	4.965355	0.010749	-0.001888
58.360338	4.965355	0.010749	-0.001888
58.471344	4.965355	0.010749	-0.001888
58.582351	4.965355	0.010749	-0.001888
58.693357	4.965355	0.010749	-0.001888
58.802363	4.965355	0.010749	-0.001888
58.932371	4.965355	0.010749	-0.001888
59.051378	4.965355	0.010749	-0.001888
59.250389	4.965355	0.010749	-0.001888
59.382397	4.965355	0.010749	-0.001888
59.495403	4.965355	0.010749	-0.001888
59.605409	4.965355	0.010749	-0.001888
59.713416	4.965355	0.010749	-0.001888
59.821422	4.965363	0.010749	-0.001888
59.930428	4.965363	0.010749	-0.001888
60.040434	4.965363	0.010749	-0.001888
60.150441	4.965363	0.010749	-0.001888
60.260447	4.965363	0.010749	-0.001888
60.369453	4.965363	0.010749	-0.001888
60.479459	4.965363	0.010749	-0.001888

60.589466	4.965363	0.010749	-0.001888
60.698472	4.965363	0.010749	-0.001888
60.806478	4.965363	0.010749	-0.001888
60.917484	4.965363	0.010749	-0.001888
61.075493	4.965363	0.010749	-0.000997
61.1865	4.965363	0.010749	-0.000997
61.296506	4.965363	0.010749	-0.000997
61.505518	4.965363	0.010749	-0.000997
61.616524	4.965363	0.010749	-0.000997
61.728531	4.965305	0.010749	-0.000997
61.836537	4.965305	0.010749	-0.000997
62.013547	4.965305	0.010893	-0.000997
62.123553	4.965305	0.010893	-0.000997
62.23456	4.965305	0.010893	-0.000997
62.346566	4.965305	0.010893	-0.000997
62.458572	4.965305	0.010893	-0.000997
62.569579	4.965305	0.010893	-0.000997
62.680585	4.965305	0.010893	-0.000997
62.790592	4.965305	0.010893	-0.000997
62.898598	4.965305	0.010893	-0.000997
63.052607	4.965305	0.010893	-0.000997
63.162613	4.965305	0.010893	-0.000997
63.273619	4.965305	0.010893	-0.000997

63.383626	4.965305	0.010893	-0.000997
63.495632	4.965305	0.010893	-0.000997
63.687643	4.965348	0.010893	-0.000997
63.795649	4.965348	0.010893	-0.000997
63.903655	4.965348	0.010893	-0.000997
64.013661	4.965348	0.010893	-0.000997
64.122668	4.965348	0.010893	-0.000997
64.230674	4.965348	0.010893	-0.000997
64.382682	4.965348	0.010893	-0.000997
64.491689	4.965348	0.010893	-0.000997
64.599695	4.965348	0.010893	-0.000997
64.707701	4.965348	0.010893	-0.000997
64.816707	4.965348	0.010893	-0.001435
64.928714	4.965348	0.010893	-0.001435
65.03972	4.965348	0.010893	-0.001435
65.150726	4.965348	0.010893	-0.001435
65.331737	4.965348	0.010893	-0.001435
65.442743	4.965348	0.010893	-0.001435
65.55375	4.965345	0.010893	-0.001435
65.663756	4.965345	0.010893	-0.001435
65.772762	4.965345	0.010322	-0.001435
65.880768	4.965345	0.010322	-0.001435
65.988774	4.965345	0.010322	-0.001435

66.096781	4.965345	0.010322	-0.001435
66.207787	4.965345	0.010322	-0.001435
66.379797	4.965345	0.010322	-0.001435
66.487803	4.965345	0.010322	-0.001435
66.596809	4.965345	0.010322	-0.001435
66.706816	4.965345	0.010322	-0.001435
66.872825	4.965345	0.010322	-0.001435
67.048835	4.965345	0.010322	-0.001435
67.158841	4.965345	0.010322	-0.001435
67.269848	4.965345	0.010322	-0.001435
67.378854	4.96534	0.010322	-0.001435
67.48786	4.96534	0.010322	-0.001435
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67.816879	4.96534	0.010322	-0.001435
67.924885	4.96534	0.010322	-0.001435
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68.162899	4.96534	0.010322	-0.001435
68.271905	4.96534	0.010322	-0.001435
68.379911	4.96534	0.010322	-0.001435
68.487917	4.96534	0.010322	-0.001435
68.597924	4.96534	0.010322	-0.001435
68.70793	4.96534	0.010322	-0.001544

68.816936	4.96534	0.010322	-0.001544
68.927942	4.96534	0.010322	-0.001544
69.035949	4.96534	0.010322	-0.001544
69.144955	4.96534	0.010322	-0.001544
69.253961	4.96534	0.010322	-0.001544
69.362967	4.965837	0.010322	-0.001544
69.471973	4.965837	0.010322	-0.001544
69.589981	4.965837	0.010422	-0.001544
69.697987	4.965837	0.010422	-0.001544
69.805993	4.965837	0.010422	-0.001544
69.914999	4.965837	0.010422	-0.001544
70.025005	4.965837	0.010422	-0.001544
70.135012	4.965837	0.010422	-0.001544
70.245018	4.965837	0.010422	-0.001544
70.355024	4.965837	0.010422	-0.001544
70.46303	4.965837	0.010422	-0.001544
70.572036	4.965837	0.010422	-0.001544
70.722045	4.965837	0.010422	-0.001544
70.832051	4.965837	0.010422	-0.001544
70.948058	4.965837	0.010422	-0.001544
71.059064	4.965837	0.010422	-0.001544
71.16707	4.965364	0.010422	-0.001544
71.279077	4.965364	0.010422	-0.001544

71.387083	4.965364	0.010422	-0.001544
71.49509	4.965364	0.010422	-0.001544
71.610096	4.965364	0.010422	-0.001544
71.718102	4.965364	0.010422	-0.001544
71.827108	4.965364	0.010422	-0.001544
71.935114	4.965364	0.010422	-0.001544
72.078123	4.965364	0.010422	-0.001544
72.186129	4.965364	0.010422	-0.001544
72.295135	4.965364	0.010422	-0.001544
72.402141	4.965364	0.010422	-0.001544
72.582151	4.965364	0.010422	-0.001544
72.714159	4.965364	0.010422	-0.002039
72.823165	4.965364	0.010422	-0.002039
72.965173	4.965364	0.010422	-0.002039
73.07618	4.965337	0.010422	-0.002039
73.187186	4.965337	0.010422	-0.002039
73.296192	4.965337	0.010422	-0.002039
73.405199	4.965337	0.010422	-0.002039
73.531206	4.965337	0.010586	-0.002039
73.641212	4.965337	0.010586	-0.002039
73.751218	4.965337	0.010586	-0.002039
73.860225	4.965337	0.010586	-0.002039
74.026234	4.965337	0.010586	-0.002039

74.13424	4.965337	0.010586	-0.002039
74.245246	4.965337	0.010586	-0.002039
74.356253	4.965337	0.010586	-0.002039
74.465259	4.965337	0.010586	-0.002039
74.574265	4.965337	0.010586	-0.002039
74.683272	4.965337	0.010586	-0.002039
74.791278	4.965337	0.010586	-0.002039
74.899284	4.965337	0.010586	-0.002039
75.00829	4.965389	0.010586	-0.002039
75.191301	4.965389	0.010586	-0.002039
75.300307	4.965389	0.010586	-0.002039
75.409313	4.965389	0.010586	-0.002039
75.51932	4.965389	0.010586	-0.002039
75.630326	4.965389	0.010586	-0.002039
75.739332	4.965389	0.010586	-0.002039
75.909342	4.965389	0.010586	-0.002039
76.018348	4.965389	0.010586	-0.002039
76.131354	4.965389	0.010586	-0.002039
76.241361	4.965389	0.010586	-0.002039
76.350367	4.965389	0.010586	-0.002039
76.470374	4.965389	0.010586	-0.002039
76.57938	4.965389	0.010586	-0.002039
76.690386	4.965389	0.010586	-0.002039

76.799393	4.965389	0.010586	-0.002039
76.907399	4.965366	0.010586	-0.002039
77.10941	4.965366	0.010586	-0.001992
77.217417	4.965366	0.010586	-0.001992
77.325423	4.965366	0.010586	-0.001992
77.433429	4.965366	0.010586	-0.001992
77.542435	4.965366	0.010586	-0.001992
77.652442	4.965366	0.010586	-0.001992
77.763448	4.965366	0.010586	-0.001992
77.871454	4.965366	0.010586	-0.001992
77.98046	4.965366	0.010586	-0.001992
78.13947	4.965366	0.010586	-0.001992
78.248476	4.965366	0.010586	-0.001992
78.358482	4.965366	0.010586	-0.001992
78.469488	4.965366	0.010586	-0.001992
78.6675	4.965366	0.010085	-0.001992
78.777506	4.965378	0.010085	-0.001992
78.884512	4.965378	0.010085	-0.001992
79.120525	4.965378	0.010085	-0.001992
79.229532	4.965378	0.010085	-0.001992
79.342538	4.965378	0.010085	-0.001992
79.452545	4.965378	0.010085	-0.001992
79.563551	4.965378	0.010085	-0.001992

79.741561	4.965378	0.010085	-0.001992
79.850567	4.965378	0.010085	-0.001992
79.958573	4.965378	0.010085	-0.001992
80.06758	4.965378	0.010085	-0.001992
80.178586	4.965378	0.010085	-0.001992
80.287592	4.965378	0.010085	-0.001992
80.398599	4.965378	0.010085	-0.001992
80.507605	4.965378	0.010085	-0.001992
80.617611	4.965378	0.010085	-0.001992
80.725617	4.965372	0.010085	-0.001992
80.833623	4.965372	0.010085	-0.001992
80.94463	4.965372	0.010085	-0.001992
81.054636	4.965372	0.010085	-0.001992
81.164642	4.965372	0.010085	-0.001992
81.275649	4.965372	0.010085	-0.001992
81.385655	4.965372	0.010085	-0.001992
81.567666	4.965372	0.010085	-0.002148
81.676672	4.965372	0.010085	-0.002148
81.788678	4.965372	0.010085	-0.002148
81.896684	4.965372	0.010085	-0.002148
82.005691	4.965372	0.010085	-0.002148
82.116697	4.965372	0.010085	-0.002148
82.225703	4.965372	0.010085	-0.002148

82.336709	4.965372	0.010085	-0.002148
82.506719	4.965372	0.010283	-0.002148
82.617725	4.965373	0.010283	-0.002148
82.728732	4.965373	0.010283	-0.002148
82.899742	4.965373	0.010283	-0.002148
83.065751	4.965373	0.010283	-0.002148
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83.287764	4.965373	0.010283	-0.002148
83.401771	4.965373	0.010283	-0.002148
83.520777	4.965373	0.010283	-0.002148
83.631783	4.965373	0.010283	-0.002148
83.74279	4.965373	0.010283	-0.002148
83.850796	4.965373	0.010283	-0.002148
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84.118812	4.965373	0.010283	-0.002148
84.229818	4.965373	0.010283	-0.002148
84.340824	4.965373	0.010283	-0.002148
84.45083	4.965373	0.010283	-0.002148
84.561837	4.965359	0.010283	-0.002148
84.671843	4.965359	0.010283	-0.002148
84.780849	4.965359	0.010283	-0.002148
84.890855	4.965359	0.010283	-0.002148
85.001862	4.965359	0.010283	-0.002148

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85.222875	4.965359	0.010283	-0.002148
85.389884	4.965359	0.010283	-0.002018
85.509891	4.965359	0.010283	-0.002018
85.662899	4.965359	0.010481	-0.002018
85.774906	4.965359	0.010481	-0.002018
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85.992918	4.965359	0.010481	-0.002018
86.100924	4.965359	0.010481	-0.002018
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86.426943	4.965354	0.010481	-0.002018
86.53695	4.965354	0.010481	-0.002018
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86.946973	4.965354	0.010481	-0.002018
87.055979	4.965354	0.010481	-0.002018
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87.417	4.965354	0.010481	-0.002018
87.527006	4.965354	0.010481	-0.002018
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88.527063	4.965352	0.010481	-0.002637
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88.861083	4.965352	0.010481	-0.002637
88.970089	4.965352	0.010481	-0.002637
89.078095	4.965352	0.010481	-0.002637
89.187101	4.965352	0.010481	-0.002637
89.401114	4.965352	0.010481	-0.002637
89.50912	4.965352	0.010481	-0.002637
89.619126	4.965352	0.010481	-0.002637
89.728132	4.965352	0.010481	-0.002637
89.836138	4.965352	0.010481	-0.002637
89.943144	4.965352	0.010481	-0.002637
90.054151	4.965352	0.010481	-0.002637
90.164157	4.965354	0.010566	-0.002637
90.274163	4.965354	0.010566	-0.002637
90.38417	4.965354	0.010566	-0.002637

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90.820195	4.965354	0.010566	-0.002637
90.954202	4.965354	0.010566	-0.002637
91.062209	4.965354	0.010566	-0.002637
91.196216	4.965354	0.010566	-0.002637
91.304222	4.965354	0.010566	-0.002637
91.414228	4.965354	0.010566	-0.002637
91.524235	4.965354	0.010566	-0.002637
91.633241	4.965354	0.010566	-0.002637
91.743248	4.965354	0.010566	-0.002637
91.851254	4.965354	0.010566	-0.002637
91.96026	4.965354	0.010566	-0.002637
92.071266	4.96538	0.010566	-0.002637
92.181273	4.96538	0.010566	-0.002637
92.291279	4.96538	0.010566	-0.002637
92.402285	4.96538	0.010566	-0.002637
92.568295	4.96538	0.010566	-0.002637
92.679301	4.96538	0.010566	-0.002637
92.788307	4.96538	0.010566	-0.002637
92.896313	4.96538	0.010566	-0.002637
93.085324	4.96538	0.010566	-0.002215

93.196331	4.96538	0.010566	-0.002215
93.307337	4.96538	0.010566	-0.002215
93.488348	4.96538	0.010566	-0.002215
93.598353	4.96538	0.010566	-0.002215
93.70936	4.96538	0.010566	-0.002215
93.818366	4.96538	0.010566	-0.002215
93.927372	4.96538	0.010566	-0.002215
94.038379	4.965347	0.010566	-0.002215
94.149385	4.965347	0.010566	-0.002215
94.258391	4.965347	0.010695	-0.002215
94.367398	4.965347	0.010695	-0.002215
94.476404	4.965347	0.010695	-0.002215
94.58541	4.965347	0.010695	-0.002215
94.694417	4.965347	0.010695	-0.002215
94.808423	4.965347	0.010695	-0.002215
95.007434	4.965347	0.010695	-0.002215
95.11544	4.965347	0.010695	-0.002215
95.232447	4.965347	0.010695	-0.002215
95.343453	4.965347	0.010695	-0.002215
95.46046	4.965347	0.010695	-0.002215
95.570467	4.965347	0.010695	-0.002215
95.682473	4.965347	0.010695	-0.002215
95.790479	4.965347	0.010695	-0.002215

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96.115498	4.965341	0.010695	-0.002215
96.223504	4.965341	0.010695	-0.002215
96.33351	4.965341	0.010695	-0.002215
96.454517	4.965341	0.010695	-0.002215
96.562523	4.965341	0.010695	-0.002215
96.676529	4.965341	0.010695	-0.002215
96.784536	4.965341	0.010695	-0.002215
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97.074553	4.965341	0.010695	-0.001923
97.183558	4.965341	0.010695	-0.001923
97.335567	4.965341	0.010695	-0.001923
97.450574	4.965341	0.010695	-0.001923
97.56158	4.965341	0.010695	-0.001923
97.72959	4.965341	0.010695	-0.001923
97.855597	4.965354	0.010303	-0.001923
97.981604	4.965354	0.010303	-0.001923
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98.213617	4.965354	0.010303	-0.001923
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98.43563	4.965354	0.010303	-0.001923
98.544637	4.965354	0.010303	-0.001923

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98.764649	4.965354	0.010303	-0.001923
98.878655	4.965354	0.010303	-0.001923
98.989662	4.965354	0.010303	-0.001923
99.103669	4.965354	0.010303	-0.001923
99.220675	4.965354	0.010303	-0.001923
99.331682	4.965354	0.010303	-0.001923
99.527693	4.965354	0.010303	-0.001923
99.6447	4.965354	0.010303	-0.001923
99.756706	4.965383	0.010303	-0.001923
99.864712	4.965383	0.010303	-0.001923
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100.083724	4.965383	0.010303	-0.001923
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100.302737	4.965383	0.010303	-0.001923
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102.656872	4.965349	0.009911	-0.001934
102.765878	4.965349	0.009911	-0.001934
102.873884	4.965349	0.009911	-0.001934
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105.105011	4.965356	0.009911	-0.00133
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105.42903	4.965356	0.009882	-0.00133
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107.302137	4.965362	0.009882	-0.00133
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110.1363	4.965366	0.009882	-0.002543
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111.106355	4.965335	0.010169	-0.002543
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118.687788	4.965342	0.009475	-0.002189
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130.836483	4.965377	0.009777	-0.002006
131.009493	4.965377	0.009777	-0.002006
131.1195	4.965377	0.009777	-0.002006

131.232506	4.965377	0.009777	-0.002006
131.342513	4.965377	0.009777	-0.002006
131.452518	4.965377	0.009777	-0.002006
131.564525	4.965377	0.009777	-0.002006
131.673532	4.965377	0.009777	-0.002006
131.784538	4.965377	0.009777	-0.002006
131.893544	4.965377	0.009777	-0.002006
132.00455	4.965351	0.009777	-0.002006
132.115557	4.965351	0.009777	-0.002006
132.233563	4.965351	0.009777	-0.002006
132.34457	4.965351	0.009777	-0.002006
132.455576	4.965351	0.009777	-0.002006
132.579583	4.965351	0.009777	-0.002006
132.745593	4.965351	0.009777	-0.002167
132.853599	4.965351	0.009777	-0.002167
132.961605	4.965351	0.009777	-0.002167
133.101613	4.965351	0.009777	-0.002167
133.22462	4.965351	0.009777	-0.002167
133.333626	4.965351	0.009777	-0.002167
133.442633	4.965351	0.009777	-0.002167
133.551639	4.965351	0.009777	-0.002167
133.663645	4.965351	0.009887	-0.002167
133.772651	4.965351	0.009887	-0.002167

133.880658	4.96536	0.009887	-0.002167
133.989664	4.96536	0.009887	-0.002167
134.09867	4.96536	0.009887	-0.002167
134.206676	4.96536	0.009887	-0.002167
134.315682	4.96536	0.009887	-0.002167
134.425689	4.96536	0.009887	-0.002167
134.566697	4.96536	0.009887	-0.002167
134.675703	4.96536	0.009887	-0.002167
134.784709	4.96536	0.009887	-0.002167
134.893715	4.96536	0.009887	-0.002167
135.008722	4.96536	0.009887	-0.002167
135.116728	4.96536	0.009887	-0.002167
135.225735	4.96536	0.009887	-0.002167
135.334741	4.96536	0.009887	-0.002167
135.442747	4.96536	0.009887	-0.002167
135.551753	4.96536	0.009887	-0.002167
135.661759	4.96536	0.009887	-0.002167
135.774766	4.965377	0.009887	-0.002167
135.884772	4.965377	□317317317 317317317î	317317317317 317317317317 z
136.053782	4.965377	0.009887	-0.002167
136.164788	4.965377	0.009887	-0.002167
136.274795	4.965377	0.009887	-0.002167

136.3848 01	4.965377	0.009887	- 0.002167	+136.495 807 4.96 5377	0.009887	- 0.002167 318	
318318 318318 玲 318318 318318 318	4.96537 7	0.00988 7	318玲 318318 318318 318318t	318136. 71482	4.96537 7	0.00988 7	- 0.00174 6
136.824826	4.965377	0.009887	-0.001746				
136.983835	4.965377	0.009887	-0.001746				
137.091841	4.965377	0.009887	-0.001746				
137.202847	4.965377	0.009887	-0.001746				
318318t318 318318318318 ▯318	318318318318 î318318318	0.009887	-0.001746				
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137.544867	4.965377	0.009921	-0.001746				
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137.880887	4.965345	0.009921	-0.001746				
137.988 893	4.96534 5	0.00992 1	318318 318318▯ 318318 318318	318138. 097899	4.96534 5	0.00992 1	- 0.00174 6
138.208905	4.965345	0.009921	-0.001746				
138.318912	4.965345	0.009921	-0.001746				
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138.549924	4.965345	0.009921	-0.001746				

138.683932	4.965345	0.009921	-0.001746				
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139.293967	4.965345	0.009921	-0.001746				
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139.51498	4.965345	0.009921	-0.001746				
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142.606157	4.965372	0.009916	-0.00169
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145.160303	4.965345	0.009916	-0.00169
145.268309	4.965331	0.009916	-0.00169
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145.799339	4.965331	0.009916	-0.002032
145.933347	4.965331	0.009916	-0.002032
146.043353	4.965331	0.009916	-0.002032
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146.8604	4.965331	0.010119	-0.002032
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148.452491	4.965336	0.010119	-0.002032
148.583498	4.965336	0.010119	-0.002032
148.697505	4.965336	0.010119	-0.002032
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149.046525	4.965336	0.010119	-0.002162
149.156531	4.965348	0.010119	-0.002162
149.267538	4.965348	0.010119	-0.002162

149.377544	4.965348	0.010119	-0.002162
149.48655	4.965348	0.010119	-0.002162
149.596557	4.965348	0.010119	-0.002162
149.705563	4.965348	0.010119	-0.002162
149.813569	4.965348	0.010119	-0.002162
149.921575	4.965348	0.010119	-0.002162
150.029581	4.965348	0.010119	-0.002162
150.139587	4.965348	0.010119	-0.002162
150.321598	4.965348	0.009431	-0.002162
150.432604	4.965348	0.009431	-0.002162
150.54061	4.965348	0.009431	-0.002162
150.676618	4.965348	0.009431	-0.002162
150.787625	4.965348	0.009431	-0.002162
150.896631	4.965348	0.009431	-0.002162
151.007637	4.965359	0.009431	-0.002162
151.116643	4.965359	0.009431	-0.002162
151.22665	4.965359	0.009431	-0.002162
151.41066	4.965359	0.009431	-0.002162
151.519667	4.965359	0.009431	-0.002162
151.629673	4.965359	0.009431	-0.002162
151.740679	4.965359	0.009431	-0.002162
151.851686	4.965359	0.009431	-0.002162
151.961692	4.965359	0.009431	-0.002162

152.071698	4.965359	0.009431	-0.002162
152.181705	4.965359	0.009431	-0.002162
152.29171	4.965359	0.009431	-0.002162
152.401717	4.965359	0.009431	-0.002162
152.511723	4.965359	0.009431	-0.002162
152.621729	4.965359	0.009431	-0.002162
152.731736	4.965359	0.009431	-0.002162
152.841742	4.965359	0.009431	-0.002162
152.950748	4.965374	0.009431	-0.002162
153.059754	4.965374	0.009431	-0.002162
153.345771	4.965374	0.009431	-0.002157
153.455777	4.965374	0.009431	-0.002157
153.565784	4.965374	0.009431	-0.002157
153.685791	4.965374	0.009431	-0.002157
153.796797	4.965374	0.009431	-0.002157
153.907803	4.965374	0.009431	-0.002157
154.018809	4.965374	0.010655	-0.002157
154.173818	4.965374	0.010655	-0.002157
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154.393831	4.965374	0.010655	-0.002157
154.568841	4.965374	0.010655	-0.002157
154.688848	4.965374	0.010655	-0.002157
154.796854	4.965354	0.010655	-0.002157

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155.105872	4.965354	0.010655	-0.002157
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155.507895	4.965354	0.010655	-0.002157
155.635902	4.965354	0.010655	-0.002157
155.751908	4.965354	0.010655	-0.002157
155.961921	4.965354	0.010655	-0.002157
156.076927	4.965354	0.010655	-0.002157
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156.429947	4.965354	0.010655	-0.002157
156.564955	4.965354	0.010655	-0.002157
156.672961	4.965867	0.010655	-0.002157
156.788968	4.965867	0.010655	-0.002157
156.896974	4.965867	0.010655	-0.002157
157.00598	4.965867	0.010655	-0.000403
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157.223993	4.965867	0.010655	-0.000403
157.348	4.965867	0.010655	-0.000403
157.495008	4.965867	0.010655	-0.000403
157.605014	4.965867	0.010655	-0.000403
157.727022	4.965867	0.010655	-0.000403

157.836028	4.965867	0.010655	-0.000403
158.015038	4.965867	0.015433	-0.000403
158.139045	4.965867	0.015433	-0.000403
158.249052	4.965867	0.015433	-0.000403
158.360058	4.965867	0.015433	-0.000403
158.470064	4.965867	0.015433	-0.000403
158.58007	4.979572	0.015433	-0.000403
158.699077	4.979572	0.015433	-0.000403
158.809083	4.979572	0.015433	-0.000403
158.944091	4.979572	0.015433	-0.000403
159.054097	4.979572	0.015433	-0.000403
159.169104	4.979572	0.015433	-0.000403
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159.856143	4.979572	0.015433	-0.000403
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211.055072	4.978147	0.007003	-0.001377
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211.271084	4.978147	0.007003	-0.001377
211.38109	4.978147	0.007003	-0.001377
211.563101	4.978147	0.007003	-0.001377
211.674107	4.978147	0.007003	-0.001377
211.784113	4.97813	0.007003	-0.001377
211.892119	4.97813	0.007003	-0.001377
212.003126	4.97813	0.007003	-0.001377
212.113132	4.97813	0.007003	-0.001377
212.223138	4.97813	0.007003	-0.001377
212.333145	4.97813	0.007003	-0.001377
212.443151	4.97813	0.007003	-0.001377
212.556158	4.97813	0.007003	-0.001377
212.667164	4.97813	0.007003	-0.001377
212.77717	4.97813	0.007003	-0.001377
212.887177	4.97813	0.007003	-0.001377
212.995183	4.97813	0.007003	-0.001377
213.157192	4.97813	0.007003	-0.001377
213.267198	4.97813	0.007003	-0.001377
213.377204	4.97813	0.007003	-0.0016
213.488211	4.97813	0.007003	-0.0016
213.598217	4.97813	0.007003	-0.0016
213.709223	4.978133	0.007003	-0.0016
213.81723	4.978133	0.007003	-0.0016

213.925236	4.978133	0.007003	-0.0016
214.033242	4.978133	0.007003	-0.0016
214.144248	4.978133	0.007003	-0.0016
214.311258	4.978133	0.007003	-0.0016
214.421264	4.978133	0.007003	-0.0016
214.531271	4.978133	0.007003	-0.0016
214.690279	4.978133	0.007003	-0.0016
214.800286	4.978133	0.007003	-0.0016
215.003297	4.978133	0.007003	-0.0016
215.112304	4.978133	0.007003	-0.0016
215.228311	4.978133	0.007003	-0.0016
215.340317	4.978133	0.007003	-0.0016
215.448323	4.978133	0.007003	-0.0016
215.55933	4.978112	0.007003	-0.0016
215.690337	4.978112	0.007003	-0.0016
215.803343	4.978112	0.007003	-0.0016
215.934351	4.978112	0.007003	-0.0016
216.045357	4.978112	0.007003	-0.0016
216.156363	4.978112	0.007003	-0.0016
216.26737	4.978112	0.007003	-0.0016
216.378376	4.978112	0.007003	-0.0016
216.493383	4.978112	0.007003	-0.0016
216.61839	4.978112	0.007003	-0.0016

216.729396	4.978112	0.007003	-0.0016
216.837402	4.978112	0.007003	-0.0016
216.954409	4.978112	0.007003	-0.0016
217.064415	4.978112	0.007003	-0.0016
217.32043	4.978112	0.007003	-0.001579
217.437437	4.978112	0.007003	-0.001579
217.580445	4.978089	0.007003	-0.001579
217.713452	4.978089	0.007003	-0.001579
217.834459	4.978089	0.007003	-0.001579
217.946466	4.978089	0.007003	-0.001579
218.057472	4.978089	0.0067	-0.001579
218.174479	4.978089	0.0067	-0.001579
218.287486	4.978089	0.0067	-0.001579
218.398492	4.978089	0.0067	-0.001579
218.510498	4.978089	0.0067	-0.001579
218.618505	4.978089	0.0067	-0.001579
218.729511	4.978089	0.0067	-0.001579
218.838517	4.978089	0.0067	-0.001579
218.947523	4.978089	0.0067	-0.001579
219.058529	4.978089	0.0067	-0.001579
219.177536	4.978089	0.0067	-0.001579
219.287543	4.978089	0.0067	-0.001579
219.397549	4.978133	0.0067	-0.001579

219.508555	4.978133	0.0067	-0.001579
219.617561	4.978133	0.0067	-0.001579
219.824574	4.978133	0.0067	-0.001579
219.93258	4.978133	0.0067	-0.001579
220.041586	4.978133	0.0067	-0.001579
220.149592	4.978133	0.0067	-0.001579
220.259598	4.978133	0.0067	-0.001579
220.374605	4.978133	0.0067	-0.001688
220.483611	4.978133	0.0067	-0.001688
220.593617	4.978133	0.0067	-0.001688
220.703624	4.978133	0.0067	-0.001688
220.81363	4.978133	0.0067	-0.001688
220.925636	4.978133	0.0067	-0.001688
221.036643	4.978133	0.0067	-0.001688
221.147649	4.978133	0.0067	-0.001688
221.259655	4.977588	0.0067	-0.001688
221.369662	4.977588	0.0067	-0.001688
221.483668	4.977588	0.0067	-0.001688
221.602675	4.977588	0.0067	-0.001688
221.711681	4.977588	0.0067	-0.001688
221.819687	4.977588	0.0067	-0.001688
221.995697	4.977588	0.006007	-0.001688
222.104704	4.977588	0.006007	-0.001688

222.21271	4.977588	0.006007	-0.001688
222.323716	4.977588	0.006007	-0.001688
222.434722	4.977588	0.006007	-0.001688
222.545729	4.977588	0.006007	-0.001688
222.655735	4.977588	0.006007	-0.001688
222.764741	4.977588	0.006007	-0.001688
222.872747	4.977588	0.006007	-0.001688
223.08076	4.977588	0.006007	-0.001688
223.188766	4.977181	0.006007	-0.001688
223.305772	4.977181	0.006007	-0.001688
223.416779	4.977181	0.006007	-0.001688
223.527785	4.977181	0.006007	-0.001688
223.637792	4.977181	0.006007	-0.001688
223.748798	4.977181	0.006007	-0.001688
223.857804	4.977181	0.006007	-0.001688
223.96881	4.977181	0.006007	-0.001688
224.084817	4.977181	0.006007	-0.001688
224.201824	4.977181	0.006007	-0.001688
224.31283	4.977181	0.006007	-0.001688
224.422836	4.977181	0.006007	-0.001688
224.536843	4.977181	0.006007	-0.001688
224.647849	4.977181	0.006007	-0.001688
224.760856	4.977181	0.006007	-0.001688

224.868862	4.977181	0.006007	-0.001433
224.978868	4.977181	0.006007	-0.001433
225.088874	4.976608	0.006007	-0.001433
225.199881	4.976608	0.006007	-0.001433
225.310887	4.976608	0.006007	-0.001433
225.419893	4.976608	0.006007	-0.001433
225.5299	4.976608	0.006007	-0.001433
225.643906	4.976608	0.006007	-0.001433
225.774914	4.976608	0.005893	-0.001433
225.88492	4.976608	0.005893	-0.001433
225.994926	4.976608	0.005893	-0.001433
226.104932	4.976608	0.005893	-0.001433
226.214939	4.976608	0.005893	-0.001433
226.344946	4.976608	0.005893	-0.001433
226.455953	4.976608	0.005893	-0.001433
226.565959	4.976608	0.005893	-0.001433
226.675965	4.976608	0.005893	-0.001433
226.786972	4.976608	0.005893	-0.001433
226.913979	4.976608	0.005893	-0.001433
227.024985	4.977237	0.005893	-0.001433
227.134991	4.977237	0.005893	-0.001433
227.248998	4.977237	0.005893	-0.001433
227.359004	4.977237	0.005893	-0.001433

227.510013	4.977237	0.005893	-0.001433
227.620019	4.977237	0.005893	-0.001433
227.731026	4.977237	0.005893	-0.001433
227.839032	4.977237	0.005893	-0.001433
227.951038	4.977237	0.005893	-0.001433
228.061044	4.977237	0.005893	-0.001433
228.190052	4.977237	0.005893	-0.001433
228.299058	4.977237	0.005893	-0.001433
228.408064	4.977237	0.005893	-0.001433
228.518071	4.977237	0.005893	-0.001433
228.627077	4.977237	0.005893	-0.00149
228.754084	4.977237	0.005893	-0.00149
228.86209	4.976203	0.005893	-0.00149
228.971097	4.976203	0.005893	-0.00149
229.131105	4.976203	0.005893	-0.00149
229.239112	4.976203	0.005893	-0.00149
229.348118	4.976203	0.005893	-0.00149
229.458124	4.976203	0.005893	-0.00149
229.56813	4.976203	0.005893	-0.00149
229.683137	4.976203	0.005853	-0.00149
229.791143	4.976203	0.005853	-0.00149
229.899149	4.976203	0.005853	-0.00149
230.007156	4.976203	0.005853	-0.00149

230.115162	4.976203	0.005853	-0.00149
230.225168	4.976203	0.005853	-0.00149
230.340175	4.976203	0.005853	-0.00149
230.451181	4.976203	0.005853	-0.00149
230.561187	4.976203	0.005853	-0.00149
230.687195	4.976203	0.005853	-0.00149
230.797201	4.976218	0.005853	-0.00149
230.914207	4.976218	0.005853	-0.00149
231.065216	4.976218	0.005853	-0.00149

Figure 5.27. First Procedure for oil 2.

Tempo Total	Pressão Linha	Delta P 1	Delta P 2
0	0	0.01	0
0.11	0	0.01	0
0.22	0	0.01	0
0.33	0	0.01	0
0.44	0	0.01	0
0.55	0	0.01	0
0.67	0	0.01	0
0.77	0	0.01	0
0.89	0	0.01	0
1	0	0.01	0
1.11	0	0.01	0
1.22	0	0.01	0
1.38	0	0.01	0
1.48	0	0.01	0
1.59	0	0.01	0
1.7	0	0.01	0
1.81	0	0.01	0
1.93	0.09	0.01	0
2.04	0.09	0.01	0

2.15	0.09	0.01	0
2.26	0.09	0.01	0
2.5	0.09	0.01	0
2.62	0.09	0.04	0
2.73	0.09	0.04	0
2.84	0.09	0.04	0
2.97	0.09	0.04	0
3.08	0.09	0.04	0
3.19	0.09	0.04	0
3.39	0.09	0.04	0.03
3.5	0.09	0.04	0.03
3.61	0.09	0.04	0.03
3.72	0.1	0.04	0.03
3.83	0.1	0.04	0.03
3.95	0.1	0.04	0.03
4.06	0.1	0.04	0.03
4.17	0.1	0.04	0.03
4.28	0.1	0.04	0.03
4.4	0.1	0.04	0.03
4.51	0.1	0.04	0.03
4.62	0.1	0.04	0.03
4.73	0.1	0.04	0.03
4.84	0.1	0.04	0.03
4.95	0.1	0.04	0.03
5.06	0.1	0.04	0.03
5.17	0.1	0.04	0.03
5.28	0.1	0.04	0.03
5.39	0.1	0.04	0.03
5.51	0.1	0.04	0.03
5.61	0.1	0.04	0.03
5.72	0.1	0.04	0.03
5.84	0.1	0.04	0.03
5.95	0.1	0.04	0.03
6.06	0.1	0.04	0.03
6.18	0.1	0.04	0.03
6.29	0.1	0.04	0.03
6.4	0.1	0.03	0.03
6.53	0.1	0.03	0.03
6.64	0.1	0.03	0.03
6.75	0.1	0.03	0.03

6.86	0.1	0.03	0.03
7.06	0.1	0.03	0.03
7.21	0.1	0.03	0.03
7.32	0.1	0.03	0.03
7.43	0.1	0.03	0.03
7.54	0.1	0.03	0.03
7.65	0.1	0.03	0.03
7.75	0.1	0.03	0.03
7.86	0.1	0.03	0.03
7.97	0.1	0.03	0.03
8.08	0.1	0.03	0.03
8.19	0.1	0.03	0.03
8.3	0.1	0.03	0.03
8.43	0.1	0.03	2.74E-02
8.56	0.1	0.03	2.74E-02
8.67	0.1	0.03	2.74E-02
8.78	0.1	0.03	2.74E-02
8.89	0.1	0.03	2.74E-02
9	0.1	0.03	2.74E-02
9.11	0.1	0.03	2.74E-02
9.22	0.1	0.03	2.74E-02
9.33	0.1	0.03	2.74E-02
9.44	0.09	0.03	2.74E-02
9.55	0.09	0.03	2.74E-02
9.73	0.09	0.03	2.74E-02
9.84	0.09	0.03	2.74E-02
9.95	0.09	0.03	2.74E-02
10.2	0.09	0.03	2.74E-02
10.31	0.09	0.02	2.74E-02
10.42	0.09	0.02	2.74E-02
10.53	0.09	0.02	2.74E-02
10.64	0.09	0.02	2.74E-02
10.76	0.09	0.02	2.74E-02
10.88	0.09	0.02	2.74E-02
11.04	0.09	0.02	2.71E-02
11.15	0.09	0.02	2.71E-02
11.27	0.09	0.02	2.71E-02
11.38	0.09	0.02	2.71E-02
11.49	0.09	0.02	2.71E-02
11.6	0.09	0.02	2.71E-02

11.71	0.09	0.02	2.71E-02
11.82	0.09	0.02	2.71E-02
11.93	0.09	0.02	2.71E-02
12.04	0.09	0.02	2.71E-02
12.15	0.09	0.02	2.71E-02
12.32	0.09	0.02	2.71E-02
12.43	0.09	0.02	2.71E-02
12.54	0.09	0.02	2.71E-02
12.65	0.09	0.02	2.71E-02
12.76	0.09	0.02	2.71E-02
12.87	0.09	0.02	2.71E-02
12.98	0.09	0.02	2.71E-02
13.16	0.09	0.02	2.71E-02
13.27	0.09	0.02	2.71E-02
13.38	0.09	0.02	2.71E-02
13.5	0.09	0.02	2.71E-02
13.61	0.09	0.02	2.71E-02
13.72	0.09	0.02	2.71E-02
13.83	0.09	0.02	2.71E-02
13.94	0.09	0.02	2.71E-02
14.05	0.09	0.02	2.71E-02
14.28	0.09	0.02	2.71E-02
14.39	0.09	0.02	2.71E-02
14.51	0.09	0.02	2.71E-02
14.62	0.09	0.02	2.71E-02
14.73	0.09	0.02	2.71E-02
14.83	0.09	0.02	2.67E-02
15	0.09	0.02	2.67E-02
15.11	0.09	0.02	2.67E-02
15.22	0.08	0.02	2.67E-02
15.33	0.08	0.02	2.67E-02
15.43	0.08	0.02	2.67E-02
15.54	0.08	0.02	2.67E-02
15.65	0.08	0.02	2.67E-02
15.76	0.08	0.02	2.67E-02
15.87	0.08	0.02	2.67E-02
15.98	0.08	0.02	2.67E-02
16.14	0.08	0.02	2.67E-02
16.24	0.08	0.02	2.67E-02
16.36	0.08	0.02	2.67E-02

16.46	0.08	0.02	2.67E-02
16.57	0.08	0.02	2.67E-02
16.68	0.08	0.02	2.67E-02
16.79	0.08	0.02	2.67E-02
16.9	0.08	0.02	2.67E-02
17.01	0.08	0.02	2.67E-02
17.12	0.09	0.02	2.67E-02
17.23	0.09	0.02	2.67E-02
17.34	0.09	0.02	2.67E-02
17.45	0.09	0.02	2.67E-02
17.55	0.09	0.02	2.67E-02
17.66	0.09	0.02	0.03
17.79	0.09	0.02	0.03
17.9	0.09	0.02	0.03
18.04	0.09	0.02	0.03
18.14	0.09	0.02	0.03
18.25	0.09	0.02	0.03
18.36	0.09	0.02	0.03
18.47	0.09	0.02	0.03
18.58	0.09	0.02	0.03
18.78	0.09	0.02	0.03
18.89	0.09	0.02	0.03
19.12	0.09	0.02	0.03
19.3	0.09	0.01	0.03
19.41	0.09	0.01	0.03
19.53	0.09	0.01	0.03
19.65	0.09	0.01	0.03
19.79	0.09	0.01	0.03
19.98	0.09	0.01	0.03
20.11	0.09	0.01	0.03
20.22	0.09	0.01	0.03
20.33	0.09	0.01	0.03
20.44	0.09	0.01	0.03
20.55	0.09	0.01	0.03
20.66	0.09	0.01	0.03
20.77	0.09	0.01	0.03
20.89	0.09	0.01	0.03
21.01	0.09	0.01	0.03
21.13	0.09	0.01	0.03
21.24	0.09	0.01	0.03

21.35	0.09	0.01	0.03
21.46	0.09	0.01	0.03
21.59	0.09	0.01	0.03
21.71	0.09	0.01	0.03
21.87	0.09	0.01	0.03
21.98	0.09	0.01	0.03
22.09	0.09	0.01	0.03
22.2	0.09	0.01	0.03
22.32	0.09	0.01	0.03
22.43	0.09	0.01	0.03
22.62	0.09	0.01	0.03
22.73	0.09	0.01	0.03
22.84	0.09	0.01	0.03
22.98	0.09	0.01	0.03
23.1	0.09	0.01	0.03
23.21	0.09	0.01	0.03
23.32	0.09	0.01	0.03
23.43	0.09	0.01	0.03
23.54	0.09	0.01	0.03
23.65	0.09	0.01	0.03
23.76	0.09	0.01	0.03
23.87	0.09	0.01	0.03
23.98	0.09	0.01	0.03
24.09	0.09	0.01	0.03
24.2	0.09	0.01	0.03
24.31	0.09	0.01	0.03
24.42	0.09	0.01	0.03
24.53	0.09	0.01	0.03
24.64	0.09	0.01	0.03
24.75	0.09	0.01	0.03
24.86	0.09	0.01	0.03
24.97	0.09	0.01	0.03
25.08	0.09	0.01	0.03
25.19	0.09	0.01	0.03
25.3	0.09	0.01	0.03
25.44	0.09	0.01	0.03
25.55	0.09	0.01	0.03
25.66	0.09	0.01	0.03
25.78	0.09	0.01	0.03
25.89	0.09	0.01	0.03

26	0.09	0.01	0.03
26.11	0.09	0.01	0.03
26.22	0.09	0.01	0.03
26.33	0.09	0.01	0.03
26.46	0.09	0.01	0.03
26.58	0.08	0.01	0.03
26.75	0.08	0.01	0.03
26.85	0.08	0.01	0.03
27.02	0.08	0.01	0.03
27.13	0.08	0.01	0.03
27.23	0.08	0.01	0.03
27.34	0.08	0.01	0.03
27.45	0.08	0.01	0.03
27.56	0.08	0.01	0.03
27.67	0.08	0.01	0.03
27.78	0.08	0.01	0.03
27.89	0.08	0.01	0.03
28	0.08	0.01	0.03
28.12	0.08	0.01	0.03
28.23	0.08	0.01	0.03
28.34	0.08	0.01	0.03
28.45	0.08	0.01	0.03
28.56	0.08	0.01	0.03
28.67	0.08	0.01	0.03
28.77	0.08	0.01	0.03
28.88	0.08	0.01	0.03
28.99	0.08	0.01	0.03
29.1	0.08	0.01	0.03
29.21	0.08	0.01	0.03
29.32	0.08	0.01	0.03
29.43	0.08	0.01	0.03
29.54	0.08	0.01	0.03
29.65	0.08	0.01	0.03
29.77	0.08	0.01	0.03
29.89	0.08	0.01	0.03
30	0.08	0.01	0.03
30.11	0.08	0.01	0.03
30.22	0.08	0.01	0.03
30.33	0.08	0.01	0.03
30.44	0.08	0.01	0.03

30.59	0.08	0.01	0.03
30.7	0.08	0.01	0.03
30.81	0.08	0.01	0.03
30.92	0.08	0.01	0.03
31.15	0.08	0.01	0.03
31.26	0.08	0.01	0.03
31.37	0.08	0.01	0.03
31.51	0.08	0.01	0.03
31.62	0.08	0.01	0.03
31.73	0.08	0.01	0.03
31.83	0.08	0.01	0.03
31.94	0.08	0.01	0.03
32.05	0.08	0.01	0.03
32.16	0.08	0.01	0.03
32.27	0.08	0.01	0.03
32.38	0.08	0.01	0.03
32.49	0.08	0.01	0.03
32.6	0.08	0.01	0.03
32.71	0.08	0.01	0.03
32.82	0.08	0.01	0.03
32.93	0.08	0.01	0.03
33.04	0.08	0.01	0.03
33.15	0.08	0.01	0.03
33.26	0.08	0.01	0.03
33.39	0.08	0.01	0.03
33.5	0.08	0.01	0.03
33.61	0.08	0.01	0.03
33.72	0.08	0.01	0.03
33.83	0.08	0.01	0.03
33.94	0.08	0.01	0.03
34.05	0.08	0.01	0.03
34.16	0.08	0.01	0.03
34.27	0.08	0.01	0.03
34.44	0.08	0.01	0.03
34.55	0.08	0.01	0.03
34.67	0.08	0.01	0.03
34.78	0.08	0.01	0.03
34.89	0.08	0.01	0.03
35.04	0.08	0.01	0.03
35.15	0.08	0.01	0.03

35.36	0.08	0.01	0.02
35.47	0.08	0.01	0.02
35.58	0.08	0.01	0.02
35.69	0.08	0.01	0.02
35.79	0.08	0.01	0.02
35.9	0.08	0.01	0.02
36.01	0.08	0.01	0.02
36.14	0.08	0.01	0.02
36.25	0.08	0.01	0.02
36.36	0.08	0.01	0.02
36.47	0.08	0.01	0.02
36.58	0.08	0.01	0.02
36.69	0.08	0.01	0.02
36.8	0.08	0.01	0.02
36.91	0.08	0.01	0.02
37.02	0.08	0.01	0.02
37.13	0.08	0.01	0.02
37.24	0.08	0.01	0.02
37.35	0.08	0.01	0.02
37.46	0.08	0.01	0.02
37.56	0.08	0.01	0.02
37.67	0.08	0.01	0.02
37.78	0.08	0.01	0.02
37.89	0.08	0.01	0.02
38	0.08	0.01	0.02
38.11	0.08	0.01	0.02
38.24	0.08	0.01	0.02
38.35	0.08	0.01	0.02
38.55	0.08	0.01	0.02
38.66	0.08	0.01	0.02
38.77	0.08	0.01	0.02
38.88	0.08	0.01	0.02
39.02	0.08	0.01	0.02
39.13	0.08	0.01	0.02
39.26	0.08	0.01	0.02
39.37	0.08	0.01	0.02
39.48	0.08	0.01	0.02
39.59	0.08	0.01	0.02
39.7	0.08	0.01	0.02
39.81	0.07	0.01	0.02

39.92	0.07	0.01	0.02
40.03	0.07	0.01	0.02
40.14	0.07	0.01	0.02
40.25	0.07	0.01	0.02
40.36	0.07	0.01	0.02
40.47	0.07	0.01	0.02
40.58	0.07	0.01	0.02
40.69	0.07	0.01	0.02
40.8	0.07	0.01	0.02
40.91	0.07	0.01	0.02
41.02	0.07	0.01	0.02
41.13	0.07	0.01	0.02
41.24	0.07	0.01	0.02
41.34	0.07	0.01	0.02
41.45	0.07	0.01	0.02
41.56	0.07	0.01	0.02
41.67	0.07	0.01	0.02
41.79	0.07	0.01	0.02
41.9	0.07	0.01	0.02
42.01	0.07	0.01	0.02
42.22	0.07	0.01	0.02
42.37	0.07	0.01	0.02
42.48	0.07	0.01	0.01
42.59	0.07	0.01	0.01
42.7	0.07	0.01	0.01
42.81	0.07	0.01	0.01
42.92	0.07	0.01	0.01
43.03	0.07	0.01	0.01
43.14	0.07	0.01	0.01
43.25	0.07	0.01	0.01
43.36	0.07	0.01	0.01
43.47	0.07	0.01	0.01
43.58	0.07	0.01	0.01
43.69	0.07	0.01	0.01
43.81	0.07	0.01	0.01
43.92	0.07	0.01	0.01
44.03	0.07	0.01	0.01
44.14	0.07	0.01	0.01
44.32	0.07	0.01	0.01
44.42	0.07	0.01	0.01

44.53	0.07	0.01	0.01
44.64	0.07	0.01	0.01
44.75	0.07	0.01	0.01
44.86	0.07	0.01	0.01
44.97	0.07	0.01	1.45E-02
45.15	0.07	0.01	1.45E-02
45.27	0.07	0.01	1.45E-02
45.38	0.07	0.01	1.45E-02
45.49	0.07	0.01	1.45E-02
45.6	0.07	0.01	1.45E-02
45.71	0.07	0.01	1.45E-02
45.83	0.07	0.01	1.45E-02
45.94	0.07	0.01	1.45E-02
46.05	0.07	0.01	1.45E-02
46.29	0.07	0.01	1.45E-02
46.4	0.07	0.01	1.45E-02
46.51	0.07	0.01	1.45E-02
46.61	0.07	0.01	1.45E-02
46.72	0.07	0.01	1.45E-02
46.88	0.07	0.01	1.30E-02
47.05	0.07	0.01	1.30E-02
47.2	0.07	0.01	1.30E-02
47.31	0.07	0.01	1.30E-02
47.42	0.06	0.01	1.30E-02
47.53	0.06	0.01	1.30E-02
47.64	0.06	0.01	1.30E-02
47.75	0.06	0.01	1.30E-02
47.86	0.06	0.01	1.30E-02
47.97	0.06	0.01	1.30E-02
48.15	0.06	0.01	1.30E-02
48.26	0.06	0.01	1.30E-02
48.37	0.06	0.01	1.30E-02
48.48	0.06	0.01	1.30E-02
48.59	0.06	0.01	1.30E-02
48.7	0.06	0.01	1.30E-02
48.81	0.06	0.01	1.30E-02
48.92	0.06	0.01	0.01
49.03	0.06	0.01	0.01
49.14	0.06	0.01	0.01
49.25	0.06	0.01	0.01

49.36	0.06	0.01	0.01
49.47	0.06	0.01	0.01
49.58	0.06	0.01	0.01
49.78	0.06	0.01	0.01
49.89	0.06	0.01	0.01
50	0.06	0.01	0.01
50.11	0.06	0.01	0.01
50.22	0.06	0.01	0.01
50.4	0.06	0.01	0.01
50.52	0.06	0.01	0.01
50.63	0.06	0.01	0.01
50.74	0.06	0.01	0.01
50.85	0.06	0.01	0.01
50.97	0.06	0.01	0.01
51.07	0.06	0.01	0.01
51.18	0.06	0.01	0.01
51.29	0.06	0.01	0.01
51.4	0.06	0.01	0.01
51.51	0.06	0.01	0.01
51.62	0.06	0.01	0.01
51.73	0.06	0.01	0.01
51.84	0.06	0.01	0.01
51.99	0.06	0.01	0.01
52.1	0.06	0.01	0.01
52.21	0.06	0.01	0.01
52.32	0.06	0.01	0.01
52.43	0.06	0.01	0.01
52.54	0.06	0.01	0.01
52.65	0.06	0.01	0.01
52.79	0.06	0.01	0.01
52.9	0.06	0.01	0.01
53.01	0.06	0.01	0.01
53.12	0.06	0.01	0.01
53.23	0.06	0.01	0.01
53.34	0.06	0.01	0.01
53.45	0.06	0.01	0.01
53.56	0.06	0.01	0.01
53.67	0.06	0.01	0.01
53.87	0.06	0.01	0.01
53.98	0.06	0.01	0.01

54.09	0.06	0.01	0.01
54.2	0.06	0.01	0.01
54.31	0.06	0.01	0.01
54.43	0.06	0.01	0.01
54.55	0.06	0.01	0.01
54.66	0.06	0.01	0.01
54.77	0.06	0.01	0.01
54.88	0.06	0.01	0.01
54.99	0.06	0.01	0.01
55.1	0.06	0.01	0.01
55.2	0.06	0.01	0.01
55.31	0.06	0.01	0.01
55.42	0.06	0.01	0.01
55.53	0.06	0.01	0.01
55.64	0.06	0.01	0.01
55.83	0.06	0.01	0.01
55.94	0.06	0.01	0.01
56.05	0.06	0.01	0.01
56.16	0.06	0.01	0.01
56.27	0.06	0.01	0.01
56.38	0.06	0.01	9.54E-03
56.49	0.06	0.01	9.54E-03
56.6	0.06	0.01	9.54E-03
56.71	0.06	0.01	9.54E-03
56.82	0.06	0.01	9.54E-03
56.95	0.05	0.01	9.54E-03
57.06	0.05	0.01	9.54E-03
57.17	0.05	0.01	9.54E-03
57.29	0.05	0.01	9.54E-03
57.46	0.05	0.01	9.54E-03
57.57	0.05	0.01	9.54E-03
57.68	0.05	0.01	9.54E-03
57.79	0.05	0.01	9.54E-03
57.9	0.05	0.01	9.54E-03
58.01	0.05	0.01	9.54E-03
58.12	0.05	0.01	9.54E-03
58.23	0.05	0.01	9.54E-03
58.34	0.05	0.01	1.14E-02
58.46	0.05	0.01	1.14E-02
58.57	0.05	0.01	1.14E-02

58.83	0.05	0.01	1.14E-02
59	0.05	0.01	1.14E-02
59.11	0.05	0.01	1.14E-02
59.22	0.05	0.01	1.14E-02
59.33	0.05	0.01	1.14E-02
59.44	0.05	0.01	1.14E-02
59.55	0.05	0.01	1.14E-02
59.66	0.05	0.01	1.14E-02
59.77	0.05	0.01	1.14E-02
59.89	0.05	0.01	1.14E-02
60	0.05	0.01	1.14E-02
60.11	0.05	0.01	1.14E-02
60.22	0.05	0.01	1.14E-02
60.34	0.05	0.01	1.14E-02
60.45	0.05	0.01	1.14E-02
60.57	0.05	0.01	1.14E-02
60.68	0.05	0.01	1.14E-02
60.8	0.05	0.01	1.14E-02
60.91	0.05	0.01	1.14E-02
61.02	0.05	0.01	1.14E-02
61.15	0.05	0.01	1.14E-02
61.26	0.05	0.01	1.14E-02
61.37	0.05	0.01	1.14E-02
61.48	0.05	0.01	1.14E-02
61.62	0.05	0.01	0.01
61.73	0.05	0.01	0.01
61.84	0.05	0.01	0.01
61.94	0.05	0.01	0.01
62.06	0.05	0.01	0.01
62.19	0.05	0.01	0.01
62.3	0.05	0.01	0.01
62.41	0.05	0.01	0.01
62.52	0.05	0.01	0.01
62.63	0.05	0.01	0.01
62.73	0.05	0.01	0.01
62.84	0.05	0.01	0.01
63.07	0.05	0.01	0.01
63.18	0.05	0.01	0.01
63.29	0.05	0.01	0.01
63.4	0.05	0.01	0.01

63.53	0.05	0.01	0.01
63.64	0.05	0.01	0.01
63.74	0.05	0.01	0.01
63.85	0.05	0.01	0.01
63.96	0.05	0.01	0.01
64.07	0.05	0.01	0.01
64.18	0.05	0.01	0.01
64.29	0.05	0.01	0.01
64.4	0.05	0.01	0.01
64.55	0.05	0.01	0.01
64.66	0.05	0.01	0.01
64.76	0.05	0.01	0.01
64.87	0.05	0.01	0.01
64.98	0.05	0.01	0.01
65.12	0.05	0.01	0.01
65.23	0.05	0.01	0.01
65.36	0.05	0.01	0.01
65.47	0.05	0.01	0.01
65.58	0.05	0.01	0.01
65.69	0.05	0.01	0.01
65.8	0.05	0.01	0.01
65.91	0.05	0.01	0.01
66.02	0.05	0.01	0.01
66.13	0.05	0.01	0.01
66.24	0.05	0.01	0.01
66.51	0.05	0.01	0.01
66.61	0.05	0.01	0.01
66.72	0.05	0.01	0.01
66.83	0.05	0.01	0.01
66.99	0.05	0.01	0.01
67.1	0.05	0.01	0.01
67.21	0.05	0.01	0.01
67.34	0.05	0.01	0.01
67.45	0.05	0.01	0.01
67.56	0.05	0.01	0.01
67.67	0.05	0.01	0.01
67.77	0.05	0.01	0.01
67.89	0.05	0.01	0.01
68	0.05	0.01	0.01
68.11	0.05	0.01	0.01

68.22	0.05	0.01	0.01
68.33	0.05	0.01	0.01
68.44	0.05	0.01	0.01
68.55	0.05	0.01	0.01
68.66	0.05	0.01	0.01
68.77	0.05	0.01	0.01
68.88	0.05	0.01	0.01
68.99	0.05	0.01	0.01
69.1	0.05	0.01	0.01
69.21	0.05	0.01	0.01
69.32	0.05	0.01	0.01
69.43	0.05	0.01	0.01
69.55	0.05	0.01	0.01
69.65	0.05	0.01	0.01
69.76	0.05	0.01	0.01
69.87	0.05	0.01	0.01
69.99	0.05	0.01	0.01
70.11	0.05	0.01	0.01
70.26	0.04	0.01	0.01
70.37	0.04	0.01	0.01
70.52	0.04	0.01	0.01
70.63	0.04	0.01	0.01
70.74	0.04	0.01	0.01
70.85	0.04	0.01	0.01
70.98	0.04	0.01	0.01
71.1	0.04	0.01	0.01
71.24	0.04	0.01	0.01
71.35	0.04	0.01	0.01
71.46	0.04	0.01	0.01
71.58	0.04	0.01	0.01
71.69	0.04	0.01	0.01
71.8	0.04	0.01	0.01
71.96	0.04	0.01	0.01
72.08	0.04	0.01	0.01
72.19	0.04	0.01	0.01
72.3	0.04	0.01	0.01
72.41	0.04	0.01	0.01
72.52	0.04	0.01	0.01
72.63	0.04	0.01	0.01
72.74	0.04	0.01	0.01

72.85	0.04	0.01	0.01
72.96	0.04	0.01	0.01
73.08	0.04	0.01	0.01
73.19	0.04	0.01	0.01
73.3	0.04	0.01	0.01
73.41	0.04	0.01	0.01
73.52	0.04	0.01	0.01
73.62	0.04	0.01	0.01
73.73	0.04	0.01	0.01
73.85	0.04	0.01	0.01
73.96	0.04	0.01	0.01
74.1	0.04	0.01	0.01
74.21	0.04	0.01	0.01
74.37	0.04	0.01	0.01
74.5	0.04	0.01	0.01
74.61	0.04	0.01	0.01
74.72	0.04	0.01	0.01
74.83	0.04	0.01	0.01
75.22	0.04	0.01	0.01
75.33	0.04	0.01	0.01
75.44	0.04	0.01	0.01
75.55	0.04	0.01	0.01
75.67	0.04	0.01	0.01
75.78	0.04	0.01	0.01
75.89	0.04	0.01	0.01
76	0.04	0.01	0.01
76.11	0.04	0.01	0.01
76.25	0.04	0.01	0.01
76.36	0.04	0.01	0.01
76.47	0.04	0.01	0.01
76.64	0.04	0.01	0.01
76.75	0.04	0.01	0.01
76.89	0.04	0.01	0.01
77	0.04	0.01	0.01
77.11	0.04	0.01	0.01
77.22	0.04	0.01	0.01
77.33	0.04	0.01	0.01
77.44	0.04	0.01	0.01
77.55	0.04	0.01	0.01
77.66	0.04	0.01	0.01

77.77	0.04	0.01	0.01
77.93	0.04	0.01	0.01
78.04	0.04	0.01	0.01
78.15	0.04	0.01	0.01
78.26	0.04	0.01	0.01
78.37	0.04	0.01	0.01
78.48	0.04	0.01	0.01
78.59	0.04	0.01	0.01
78.7	0.04	0.01	0.01
78.81	0.04	0.01	0.01
78.92	0.04	0.01	0.01
79.03	0.04	0.01	0.01
79.15	0.04	0.01	0.01
79.26	0.04	0.01	0.01
79.37	0.04	0.01	0.01
79.54	0.04	0.01	0.01
79.66	0.04	0.01	0.01
79.78	0.04	0.01	0.01
79.91	0.04	0.01	0.01
80.02	0.04	0.01	0.01
80.17	0.04	0.01	0.01
80.27	0.04	0.01	0.01
80.38	0.04	0.01	0.01
80.5	0.04	0.01	0.01
80.61	0.04	0.01	0.01
80.72	0.04	0.01	0.01
80.83	0.04	0.01	0.01
80.97	0.04	0.01	0.01
81.08	0.04	0.01	0.01
81.19	0.04	0.01	0.01
81.33	0.04	0.01	0.01
81.44	0.04	0.01	0.01
81.55	0.04	0.01	0.01
81.65	0.04	0.01	0.01
81.79	0.04	0.01	0.01
81.9	0.04	0.01	0.01
82.01	0.04	0.01	0.01
82.12	0.04	0.01	0.01
82.24	0.04	0.01	0.01
82.35	0.04	0.01	0.01

82.47	0.04	0.01	0.01
82.6	0.04	0.01	0.01
82.75	0.04	0.01	0.01
82.87	0.04	0.01	0.01
83.01	0.04	0.01	0.01
83.12	0.04	0.01	0.01
83.23	0.04	0.01	0.01
83.36	0.04	0.01	0.01
83.47	0.04	0.01	0.01
83.58	0.04	0.01	0.01
83.69	0.04	0.01	0.01
83.8	0.04	0.01	0.01
83.95	0.04	0.01	0.01
84.06	0.04	0.01	0.01
84.17	0.04	0.01	0.01
84.28	0.04	0.01	0.01
84.39	0.04	0.01	0.01
84.5	0.04	0.01	0.01
84.61	0.04	0.01	0.01
84.78	0.04	0.01	0.01
84.89	0.04	0.01	0.01
85	0.04	0.01	0.01
85.11	0.04	0.01	0.01
85.22	0.04	0.01	0.01
85.33	0.04	0.01	0.01
85.44	0.04	0.01	0.01
85.59	0.04	0.01	0.01
85.69	0.04	0.01	0.01
85.86	0.04	0.01	0.01
86.19	0.04	0.01	0.01
86.3	0.04	0.01	0.01
86.41	0.04	0.01	0.01
86.61	0.04	0.01	0.01
86.71	0.04	0.01	0.01
86.87	0.04	0.01	0.01
87.08	0.04	0.01	0.01
87.19	0.04	0.01	0.01
87.3	0.04	0.01	0.01
87.41	0.04	0.01	0.01
87.52	0.04	0.01	0.01

87.63	0.04	0.01	0.01
87.81	0.04	0.01	0.01
88.2	0.04	0.01	0.01
88.31	0.04	0.01	0.01
88.42	0.04	0.01	0.01
88.52	0.04	0.01	0.01
88.63	0.04	0.01	0.01
88.74	0.04	0.01	0.01
88.85	0.04	0.01	0.01
88.96	0.04	0.01	0.01