

**WAX AND GEL CONTROL FOR WAXY CRUDE FROM INFILL WELLS
BY USING POUR POINT DEPRESSANT**

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ABSTRACT

Transportation of Hydrocarbon through pipelines in waxy residue is a challenging task and expensive due mainly to high wax content and gelling formation. The application of Pour Point Depressant (PPD) is one of the mechanisms to improve the flow properties of waxy hydrocarbon at low temperatures which researches has been done worldwide on the thermodynamic changes. This study is done to evaluate the Wax Model for Field REX that is having existing producing wells and new infill wells with fluid characteristics with Pour Point (PP) 30°C, Wax Appearance Temperature (WAT) 31-33°C and Wax content 12-18 % by weight. The fluid properties of this field are from three producing wells that are routed to Compact Manifold Bulk Header at the topside facility, on which two of the producing wells are the infill wells that recently drilled and completed with both dual strings. The current prevention method of wax and gelling formation is by using heat tracers, insulators, mechanical assistance such as Pigging Operations and other chemical injections. By using Standard Methods, analysis lab involves these parameters in evaluating the effectiveness of PPD : Pour Point, Wax Appearance Temperature (WAT), Paraffin Wax Content, Density, Kinematic Viscosity and Fluid Composition. The findings from this project is expected to prove the basis on the thermodynamics modifications on the fluid properties by PPD. Simultaneously, to identify the operation scenario susceptible to wax and gel formation and eliminates the problems by looking at other different way than by using only thermal and mechanical methods.

ABSTRAK

Pengangkutan Hidrokarbon melalui paip minyak yang mengandungi residu wax adalah tugas yang mencabar dan mahal terutamanya jika kandungan wax yang tinggi dan membentuk gel yang cepat. Aplikasi menggunakan bahan kimia Penurun Takat Curah (PPD) adalah salah satu mekanisme yang berpotensi untuk meningkatkan sifat aliran hidrokarbon wax pada suhu rendah. Penelitian serta kajian tentang PPD telah aktif dilakukan di seluruh dunia pada perubahan termodinamika. Dalam kajian ini pula adalah spesifik kepada Pelantar minyak REX yang mempunyai sumur penghasil minyak yang sedia ada dan juga telaga minyak yang baru dengan ciri-ciri bendalir di mana Takat Curah (PP) pada suhu 30°C atau lebih, Suhu Penampilan Wax (WAT) 31-33 ° C dan kandungan Wax 12-18 % mengikut berat. Sifat bendalir Pelantar minyak Rex adalah berasal dari tiga telaga minyak penghasil awal yang diarahkan ke Header Compact Manifold di kemudahan fasiliti, yang kemudian melibatkan dua lagi telaga minyak yang juga menghasilkan lengkap dengan sumur-dual. Kaedah pencegahan pembentukan Wax dan Gel yang terdapat di Pelantar minyak Rex pada asasnya adalah dengan menggunakan haba, penebat, bantuan mekanikal seperti Operasi Pigging dan bahan kimia. Analisis di makmal dilakukan dengan menggunakan Prosedur Standard dalam menilai keberkesanan PPD iaitu merangkumi Takat Curah (PP), Suhu Penampilan Wax (WAT), Kandungan Wax Parafin, Ketumpatan, Kelikatan Kinematik dan Komposisi Cecair. Kajian ini telah membuktikan asas pengubahsuaian termodinamik pada sifat cecair oleh PPD. Pada masa yang sama, PPD dalam kajian ini telah dikenal pasti dapat membantu senario operasi yang pembentukan wax dan gel dengan menggunakan kaedah alternatif dan berbeza daripada kaedah termal dan mekanikal.

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CHAPTER 1

INTRODUCTION

1.0 Background of Study

Infill Wells are well that are drilled into the same reservoir as known producing wells so that oil or natural gas does not have to travel far through the formation, thereby helping to improve or accelerate recovery. This study will looked through infill wells of Field REX that is supported by a four (4) legged substructure with six (6) slots all slated for producing conductors. The existing wellhead system consist of three (3) producing wells at three different slots and one (1) suspended well on another slot. However, the suspended wellhead on this slot has been removed and flanged off.

Two remaining (2) unused slots are the infill wells that recently drilled and completed with both dual strings. The production fluid from the three (3) producing wells are routed to Compact Manifold Bulk Header. At the manifold, the FWS can be diverted to the Test Header for well testing or the Bulk Header (GAY-0020) which then will be directed into the pipeline until reaching mother platform. Well testing facility consist of Test Header and Test Separator are provided on-board REX platform.

One of the problem while producing crude oil is by having a waxy crude. Waxy Crude is a variety of light and intermediate hydrocarbons or heavy organic (non-hydrocarbon) compounds. When the temperature of a waxy crude oil is lowered, first the heavier fractions of

its wax content start to freeze out thus making it difficult to flow when reaching the surface facilities.

Crude oils from China, Australasia and many other parts of the world, containing waxy crude crystals and colloidal asphaltenes, possess distinct non-Newtonian flow properties which depend strongly on the shear and thermal history and result in special difficulties being encountered in all types of viscometers. (Wardhaugh, Boger, Melbourne et.al, 1988).

By adding chemical, specifically Pour Point Depressant (PPD) can help to ensure the flow assurance of waxy crude throughout the topside and surface facilities. PPD is petroleum based mineral oils at lower temperatures. The lowest temperature at which a fuel or oil will pour is called a pour point. High-quality pour point depressants can lower a pour point of an oil additive by as much as 40°C

Paraffin wax deposition at low temperature is one of the serious and long-standing problems in the petroleum industry. At low temperatures, the crystals of wax easily form impermeable cakes, which can block filters and eventually lead to engine failure. Many methods have been attempted for the prevention of the crystals mating together. It has been found that with the addition of the additives, the shape of the wax crystal changes. Many postulated mechanisms have been put forward to explain this phenomenon and to instruct the PPD product design. Among the mechanism theories, adsorption, co-crystallization, nucleation, and improved wax solubility are widely accepted by mechanism researchers (Zhang, Wu, and Wei Li et.al, 2003).

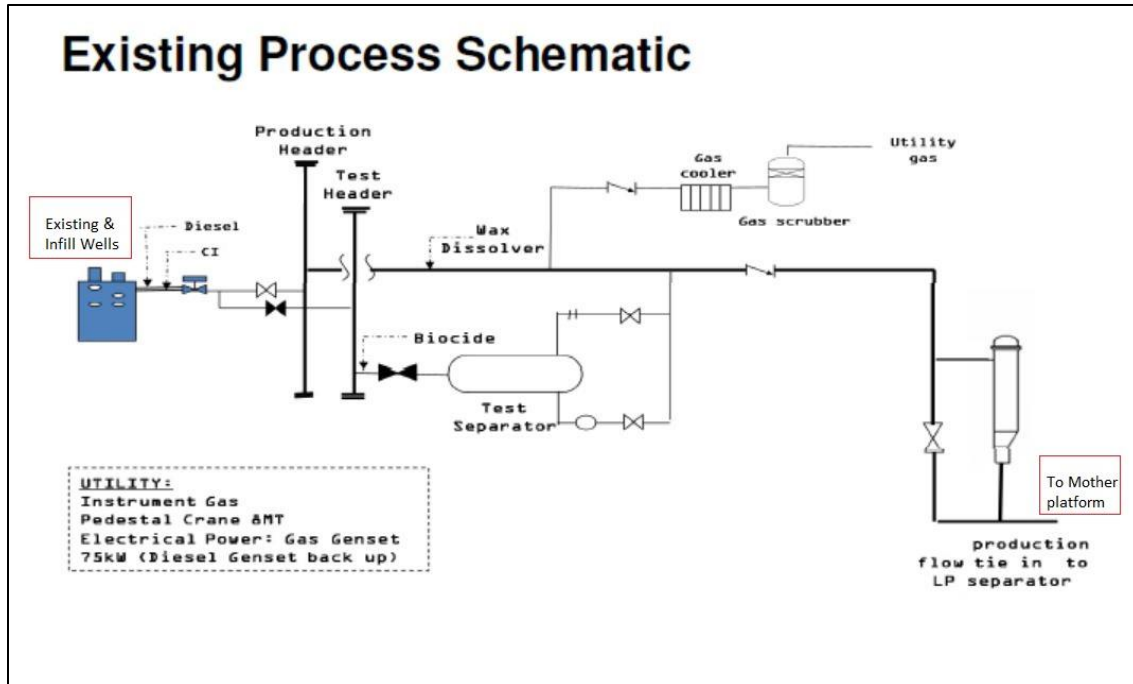


Figure 1.1 - Existing Process Schematic of Field REX

1.1 Existing Wax and Gel Control Philosophy

1.1.1 Wax and Gel Prevention

i) Topside piping

All the existing process piping including the flowlines are equipped with electrical heat tracing together with insulation. The Test Separator, MBD-0100, is also heat traced with insulation. The emergency power generation will continue powering up the heat tracing in the event of topside shutdown except during ESD. This is to continue maintaining the crude temperature above minimum ambient temperature and hence preventing the gelling up of the crude.

ii) Chemicals solution philosophy

Wax dissolver are employed in suppressing the crude gel formation and reducing the wax gel strength respectively. Pour point depressant is injected onto the production header continuously. Wax dissolver is injected into the production header 2 days before pigging operation commenced and also before planned prolong pipeline shutdown.

iii) Normal Operation philosophy

Test Separator is always tie-in to one flowing flow line to prevent wax deposition.

1.1.2 Wax and Gel Removal

i) Pigging philosophy

Pigging of pipeline facility is provided on the D21JT-A for internal cleaning to prevent wax build up in the pipeline. It should be noted that the use of PPD chemical will not completely stop the deposition of the wax on the pipeline inner wall surfaces when the fluid flowing temperature is fall below the crude pour point. Wax build up in the pipeline may pose flow restriction as well as potential risk of pig sticking in the pipeline. Therefore, it is necessary to physically remove the deposited wax by mean of periodic pigging. Pigging can be successful for managing the residual paraffin deposit in pipeline providing that a regular schedule pigging program is initiated upon commissioning.

ii) Unplanned pipeline shutdown

In the event of prolonged shutdown due to delayed start-up, and crude gelling has occurred in the pipeline, the only way to restart the flow in the pipeline is by applying some pressure to break the gel plug. The pressure sources can be from the produced well or external pressure from the Diesel Injection Self Equalization Pump.

1.2 Problem Statement

Field REX produces 2,000 barrels of fluid per day which flows through a 10" diameter pipeline to a mother platform 13 km away. The existing producing wells and infill wells is having the typical fluid characteristics with Pour Point (PP) 30°C, Wax Appearance Temperature (WAT) 31-33°C and Wax content 12-18 % by weight.

Heat tracing, insulators, mechanical assistance and other chemical injections are already in place to prevent wax and gel formation. However, the formation is to be assessed because of the critical nature of the production.

The current gel and wax management are using continuous thermal method and mechanical removal. In the event of shutdown where the crude can start gelling as early gel removal must be carried out to start up the affected line. Another mechanical method is by using Pigging for internal cleaning to prevent wax build up in the pipeline. Chemical such as Wax dissolver is injected at least 2 days prior to pigging for effective wax removal.

1.3 Objectives

- i) To study the performance of PPD towards the fluid properties from combined infill wells.
- ii) To determine the Wax model for Field REX
- iii) To measure the severity of the Wax deposition by Pipeline Deposition Simulation

1.4 Scope of Study

For this project, the scopes will be as follows;

- i) Carrying out a series of wax simulations to estimate the wax appearance temperature of the various fluids as a function of pressure;
- ii) Calculate the amount of wax deposition that could occur during high, medium and low flowrates.
- iii) Identifying operating scenario susceptible to wax and gel formation.
- iv) Compare and determine the effectiveness of PPD into the fluids (combined infill wells) by doing analysis lab.

1.5 Significance of Study

The findings from this project will strengthen the Wax Modelling Study of Waxy Crude Fields in ensuring the flow assurance by providing the basis of Wax and Gelling Management. By having an effective strategy, will potentially improve hydrocarbon production rates, reduce downtime for workovers and improve operational safety.

Other than that, it can also prove the mechanism of Pour Point Depressant in order to provide the basis on the thermodynamics modifications on the fluid properties. Simultaneously, this can also help to identify the operation scenario susceptible to wax and gel formation and eliminates the problems by looking at other different way than by using only thermal and mechanical methods.

CHAPTER 2

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