

Dedication

To my mother

Acknowledgments

To begin with, I would like to express my deep gratitude to my supervisor, Dr. El- fatih Ahmed Hassan. He gave me the opportunity not only to perform the research that led to this thesis, but also to promote my standing of Crude oil composition wax, Emulsions, and Asphaltenes phenomena. Moreover, I am very grateful for the permanent trust he .granted to me

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Abstract

The Sudanese crude oil is regarded as one of the simplest types of crude in the world as it contains no percentage of sulfur which reacts with water to form sulfuric acid that negatively impact the production facilities and transportation lines due its corrosiveness . How ever it suffers other problems

represented by the high viscosity and high percentage of wax. These characteristics prevail in the crude oil produced by Petrodar company causing some very serious technical problems affectively the transfer of crude which is transported long distances from production fields to the port export terminal a matter that affect directly the cost of production and the quality

A detailed study was made on the system adopted in collecting crude oil from different wells and physical and chemical processing to which crude is subjected through different stages of production and also study of the behaviour of crude in the pipeline during transportation processes

Samples were collected from the fields of production at Adar-yale, Agordeed and Palouge and also samples were collected after the initial and final treatment at CPF

No samples of the recently introduced field such as Gummry, Gasub, Moleeta, were collected, but their specifications were inferred from available data

Physical and chemical properties that have been studies were amount of wax, is in the range 23-31% and asphaltene which was around 0.1%; resin content that ranged from 13-7%, deposits was 0.01%, water cut was 0.05% and the carbon number distribution in the crude which ranged between 7 to 35 carbon atoms. The pour point was found range from 39-42 C; also the boiling point was in the range from 70 °C - 533+ C ° and density specifications according the American Institute of petroleum was 24

Mechanical effects and temperature influence in viscosity were also studied. The composition of the Dar Blend was found to influence the flow characteristics of the crude. Presence of asphalting and resins reduce the deposition of wax crystals and enhance, therefore, the fluidity of the crude

When increasing the rate of shear at a temperature higher than 42C doesn't effect on viscosity, it became constant

The chemical additives effects on pour point and viscosity was studied. It was found that addition of PPD had no effect in altering the viscosity even at a dose .(of 1000-4000 ppm (i.e, ten folds greater than the usual dose

It is either unsuitable additives were used by Dar Company or the additives were expired, which in either case necessitate reevaluations of using such .additives

الخلاصة

يصنف الخام السوداني من ايسط أنواع الخام في العالم لعدم إحتوائه علي نسبة عالية من الكبريت الذي يتفاعل مع الماء ليكون حمض الكبرتيك ذو التأثير السلبي. ولكن هنالك مشاكل إخرى متمثلة في اللزوجة العالية ونسب الشمع المرتفعة فيه وهذه الخصائص تسود في الخام المنتج بواسطة شركة بترودار مما تنتج عنه بعض المشاكل التقنية المتعلقة بنقل الخام وخاصة أن الخام ينقل إلي مسافات بعيدة من مناطق آبار الإنتاج إلي ميناء التصدير مما يؤثر مباشرة علي تكلفة الإنتاج والجودة.

تمت دراسة تفصيلية لكيفية تجميع الخام من الآبار والمعالجات الكيميائية والفيزيائية التي يتعرض لها عبر مراحل الإنتاج المختلفة وأيضاً دراسة لسلوكه داخل خط أنابيب نقل الخام.

تم جمع عينات من حقول إنتاج عداريل وأكورديد وفلج كما تم جمع عينات بعد المعالجات الأولية والنهائية . وهنالك حقول أدخلت حديثة إلى دائرة الإنتاج لم تجمع منها عينات ولكن تم جمع وتحليل بياناتها ومواصفاتها وهي حقول قصب وقمري وموليتا .

الخواص الكيميائية والفيزيائية التي تمت دراساتها وتحليلها للعينات المختلفة هي محتويات الخام من كمية الشمع التي تراوحت بين 23—31% والأسفلتين الذي بلغ حوالي 0.1% والراتنجات التي كانت 7-13% والرواسب التي وجدت 0.01% والماء الذي بلغت نسبته 0.05% و توزيع عدد ذرات الكربون في سلاسل وجزئيات الخام التي تراوحت ما بين 7 إلى 35 ذرة كربون، درجة الإنسكاب حيث تراوحت ما بين 39 و 42 درجة مئوية ، ودرجة الغليان ثم الكثافة ،حسب مواصفات المعهد الأمريكي للبترول، وكانت 24 كما تم قياس اللزوجة وتأثير العوامل الميكانيكية عليها وتأثير التغير في درجة الحرارة وتأثيرات إضافة المواد الكيميائية المخففة لترسيب الشموع علي مدي تخفيض اللزوجة.

وقد بينت الدراسة أن هنالك حقول بها نسب شمع عالية بينما أخرى لها نسبة عالية من الأسفلتين والراتنجات وعند تكوين مزيج دار يكون تأثير الأسفلتين والراتنجات إيجابي إذ أنه يمنع ترسيب جزئيات الشمع بفاعلية عالية ويزيد من سيولة الخام.

زيادة معدل القص عند درجة حرارة أعلى من 42 درجة مئوية لا يؤثر علي اللزوجة، حيث تصبح ثابتة عندئذ في مستوي معين .

كما بينت الدراسة أن حقن المعالج الكيميائي الخافض لدرجة الإنسكاب ليس لديه أي فعالية بالرغم من إضافته بنسب عالية تراوحت من 1000 إلى 4000 جزء من المليون أي ما يصل إلي عشرة أضعاف الكمية المعتادة مما يستوجب إعادة النظر من قبل شركة بترودار في اختيارها للمضافات الكيميائية خافضة درجة الإنسكاب أو التحقق من جودتها وصلاحياتها للإستخدام.

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Notations

Symbols

P pressure

μ Viscosity of fluid

Density of the fluid

Subscripts

API American Petroleum institute

BS&W Basic Sediment and Water

CCR Center Control Room

.CI Corrosion Inhibitor

Cp cent poise

Cs centistokes

.CPF Center processing facilities

ESD Emergency Shutdown

.ESP Electric Submersible Pumps

.FPF Field production facilities

FSF Field Surface Facilities

PDOC Petrodar operating company

.PCP Progressive Cavity Pumps

.PCV pressure control valve

.PPD Pour Point Depressant

PS Pump station

OGM Oil Gathering Manifold

MT Marine Terminal

MPM Multi phase meter
MPP Multiphase Pump
Temp Temperature
.SG Specific Gravity
.SI Scale Inhibitor
RVP Reid Vapor Pressure
.WCA Wax-control additives
.WI Wax Inhibitor