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Physico-Chemical Evaluation of Dar Petroleum Crude Oil Blend

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ABSTRACT

Physicochemical analysis of crude oil samples collected from Petrodar Oil fields showed that Dar Blend is a heavy type crude, having API 23.24 and of low Asphaltene content (0.12%). However the Total Acid Number (TAN) was 4.47%. Element composition showed low Sulfur while Mercury and Vanadium were absent.

المستخلص

أظهرت نتائج التحليل الفيزيوكيميائية للعينات التي تم جمعها من حقول بترودار أن هذا المزيج الخام هو من النوع الثقيل، وله كثافة 23.24 (API) ومحتوى منخفض من الاسفلتين (0.12٪). ولكن له نسبة عالية من المحتوى الحمضى 4.47٪ .وأظهرتقدير محتوى العناصر أن الخام يحتوى على قليل من الكبريت مع غياب الفانديوم والزئبق.

KEYWODRS: Crude oil, Dar Blend, Pour Point, Viscosity, Total Acid Number

INTRODUCTION

Crude oil, better known as petroleum, is a complex mixture of thousands (maybe millions) of compounds. While most of these compounds are hydrocarbons, some contain oxygen, nitrogen, or sulfur, and trace amounts of metals, usually present in large molecules called parafins[(1)]. Crude petroleum varies in appearance from a yellow or green mobile liquid to darker and often almost black syrup fluids, sometimes solidifying into a black paste. This great variety in appearance is obviously caused by differences in composition. While some crude oils consist mainly of paraffin, others may be more cyclopraffinic (naphthenic) or aromatic in character. As for molecular size of constituents, here again some oils may be particularly rich in hydrocarbons of low molecular weight, whereas others contain a high percentage of large, complicated molecules[(2)]. Sudanese crude oil is waxy in character, has an average American Petroleum Institute (API) degree of 32 and contains no sulfur or mercury. The paraffinic nature of the crude makes it a good feed stock for lubricating oils and petrochemical industries[(3)]. Petrodar Operating Company Ltd. is an operating company undertaking exploration, development and production of oil in Blocks 3E, 7E and 3D in Sudan. At present Petrodar is producing oil and gas from Blocks 3 and 7.These blocks are situated in the south east of Sudan, between longitudes 31 and 34 and

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latitude 8 and 10 with a total area of about 72,000Km^2 .The oil produced from different wells is blended to constitute DAR Blend which are paraffinic and asphaltinic in nature. The main features of the blend mixture are medium density, low sulfur content (sweet), high pour point (42°C)[4]. In spite of these good qualities Dar Blend does not occupy fore position among crudes produced in Sudan by Greater Nile Petroleum Operating Company (GNPOC) or White Nile Petroleum Operating Company (WNPOC). This study aimed to evaluate Dar blend in comparison with GNPOC, WNPOC and others crude oils produced in the Sudan, using physico-chemical methods.

MATERIALS and METHODS

Materials

Untreated crude oil samples of Foola light, GNPOC, WNPOC and Star Oil were collected from the Field Processing Facility (FPF), in sealed inert containers, and kept at room temperatures till further use.

Experimental Methods

Density, API, specific gravity, wax content, pour point, water content, sulfur content, kinematic viscosity and Asphaltene content of blends were measured using standard methods according to the American Society for Testing and Materials (ASTM) and the American Petroleum Institute (API) [5-11] while cationic composition was determined using Inductively Coupled Plasma Optical Emission Spectrometric (ICP-OES) method [12] .

RESULTS and DISCUSSION

Results of Dar crude analysis are given in Table 1, where density, API, Wax %, pour point, Total Acid Number (TAN) and water content are cited, in comparison with corresponding values of crude oils produced in adjacent oil fields namely Foola light, WNPOC,GNPOC, and Star Oil. The density of the Dar blend was found to be 0. 9136 g/ml, which places it in the second high density value among the five crudes. Consequently Dar crude is classified as heavy type according to API standard. [11]. Usually heavy crudes are of less commercial values compared to light ones if intended for fuel production, as it contains small fractions of low molecular weight component.

Table1: Physicochemical characterization of Dar Blend in comparison with Foola light, WNPOC, GNPOC, and Star Oil crudes.

Sample type	Density at15°C	API	S.G	Wax content %	Pour point	TAN	Water content %	Sulfur content %	k.Viscosity at 50°C	k.Viscosity at 60°C	k.Viscosity at 70°C	Asphaltene content %
PDOC	0.9136	23.24	0.9145	19.28	39	4.47	0.4	0.1272	440.5	233.4	139.8	0.12
Foola light	0.8813	28.91	0.8821	21.68	12	0.35	3.0	0.0813	32.54	21.34	16.06	0.1
WNPOC	0.9278	20.87	0.9286	20.99	12	1.64	0.05	0.1227	499.4	278.7	170.6	0.08
GNPOC	0.8784	29.45	0.8729	29.95	30	0.66	0.20	0.0745	39.03	25.06	17.88	0.14
Star oil	0.8363	37.55	0.8369	36.88	42	0.12	2.8	0.0885	12.97	7.761	6.696	0.04

API values of Dar blend which was found to be 23. 2 also support the characterization of the crude as heavy type, according to the specification of (API) which sets limits of value 25 and below as a measure of heavy crudes. [11] Heavy crudes are more valued in the petrochemical industries where more chemicals might be fractionated or synthesized from the crude. The wax % of Dar blend is low compared to other crudes cited in Table 1. This

may be advantageous in transporting the crude through pipelines where heavy crudes with high wax contents tend to cause many problems in transportation and requires adjustment of viscosity and pumping pressure and maintaining the temperatures of the pipe lines. The low API density reflects low hydrogen/carbon ratio in the Dar blend, and consequently lack of light hydrocarbon fractions. The pour point of Dar blend ranked second among five crude oils produced in Sudan reaching 39° next only to the pour point of Star Oil crude. It is interesting to note that the wax content of Star Oil is 36. 8% which justifies the high pour point. But the wax content of Dar blend is only 19.2%. Hence the high pour point is possibly due to the presence of mercaptants and other aromatic sulfur compounds of medium size. This is further supported by the comparatively high level of sulfur in Dar blend compared to other crudes, as depicted in Table 1. Asphaltene content of Dar blend also ranked second among the five crudes investigated. It is shown in Table 1 along with the kinematic viscosities at different temperatures. The presence of asphaltene contributes to the crystallization of high molecular weight molecules in the crude and, generally, enhances, crystallization of heavy waxes. This consequently raises the pour point. As Dar blend has a low wax content presence of Asphaltene would assist crystallization of aromatics and mercaptants hence raise the viscosity and ultimately the pour point. Table1 shows sulpher content along with values of Aspaltene content of the studied crudes. The sulpher content of Dar blend is comparable with that of WNOPC where as Aspheltine content of Dar blend is almost one and half times higher. It is interesting to note that the reduction in viscosity when temperature was reduced by 10 ^{o}C could be correlated to the crude constituents and their types of aggregations .The ratio of reduction of viscosity with increasing temperature by an increment of 10°C is almost equal in the five crudes. This would suggest a similar mechanism of aggregation of crude constituents, the type of which shall be very decisively, reflected in pour point and viscosity.

Table 2 shows the cationic content of the five crudes[12]. It is interesting to note the high content of sodium in Star Oil crude, and the high calcium content of Dar blend which was the lightest among all crudes. Presence of Ca usually results in formation of some sparingly soluble salts that tend to separate into the solid phase, which enhance the process of crystallization of naphthenic fraction and sulfur containing aromatic fraction by providing seeding mechanism that accelerates the crystallization process. The high value of Total Acid Number (TAN) in Dar blend constitutes its major disadvantage, which manifests itself in corrosion problems that shall be associated with Dar blend processing at the refinaries. Presence of high sulfur content and sulphonic acid functions might be the reason for the high TAN value. Serious corrosion problems that result from high TAN may be mitigated by injection of basic sodium salts to neutralize the acidity and add to increasing the solubility of calcium compounds.

Table 2: Cationic composition of the crude samples studied

cations	Na	Mg	Ca	V	Fe	Ni	Cu	Al	As	Pb
Samples	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
PDOC	11.782	1.198	26.602	1.156	107.956	65.136	‹0.1	0.86	‹0.1	‹0.1
Foola light	27.564	0.926	10.112	0.581	21.533	7.642	‹0.1	5.183	‹0.1	‹0.1
WNPOC	4.467	0.428	4.071	1.13	17.455	24.515	‹0.1	1.506	‹0.1	‹0.1
GNPOC	4.666	0.435	4.927	O.609	3.424	7.611	‹0.1	6.851	‹0.1	‹0.1
Star oil	50.995	0.55	6.124	0.365	26.328	2.34	‹0.1	0.848	‹0.1	‹0.1

CONCLUSIONS

- Dar blend oil is heavy crude based on API value, of low Asphaltene and of high TAN value.
- Optimization of the Dar blend may be achieved by increasing the proportions from low TAN content fields (Gummry and Adar) and decreasing the portions from high TAN content field (Palouge, Moleeta) .

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