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THE STANDARD MODEL OF OIL CHARACTERISTICS OF ZUBAIR RESERVOIR IN LUHAIS FIELD SOUTHERN IRAQ

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ABSTRACT : Many factors play an important role in influencing the properties of oil during the stages it generates in the source rocks and migrating and catching it in reservoirs. Most of the global sands present in the bottom reservoirs are affected by the geochemical factors more than the reservoirs deep depths. Biodegradation is one of the most important factors affecting the oil, which is also affected by the temperature of the subsoil. The objective of this research is to study the properties of oil and its evaluation in Zubair reservoir in Luhais field. The assessment includes calculation of the oil density (API), viscosity, water, salt, chromatic and sulfur content, determination of residual carbon content, as well as calculation of asphalt ratio and other properties. The study of the properties of oil is useful in treatment and it determines the quality of use. Use a Gas Chromatographic device to determines the distribution of normal n-alkane distribution, which allows you to know the type of kerogen, its origin and degree of maturation. The pour point was measured, showing the viability of oil in the reservoir on the movement and flow because the temperature of the reservoir is greater than the pour point. A standard model of oil properties was also prepared to show that the oil of the Zubair reservoir inLuhais field is medium type. This study was based on international standards for determining the quality of oil. These scales were organized with tables and presented in forms to be clearly defined. It recommend a plan that includes the experience of secondary oil recovery methods such as Thermal Injection, because the API is smaller than 27, by injecting steam to reduce oil viscosity.

Key words : Oil, Luhais, kerogen, Zubair, wax, Iraq.

INTRODUCTION

The oil industry is of great importance because of its impact on the economic reality. Therefore, oil studies, especially those that determine the characteristics of oil, are very important in determining the quality of oil, which is affected by the secondary oil content such as wax, salt, water, sulfur and carbon residues, or some oil properties such as viscosity and density. The accuracy of the results depends on the quality of the instruments used in the analysis.

Knowing the characteristics of crude oil is useful in determining the treatments that can be done to improve the nature of oil, as well as determine the degree within the global oil classification to be determined on the oil market within the Organization of the Petroleum Exporting.

The current study deals with the oil characteristics affecting the determination of the quality of oil and the geochemical properties of crude oil, which include density, viscosity and heat effects and linking all these data to global standards for the conclusion and knowledge of the characteristics of oil, which is based on the type of oil and its economic value and methods of treatment and improvement.

Zubair formation has been studied in several oil specialties including the following studies:Abbo and Safar In 1967,They divided Zubair formation in southern Iraq into five members, Al-Qaraghuli *et al* (1970) reported that the upper shale member and upper sand member were due to a shallow water environment, Rohan, in 1975, proved that the Zubair formation deposited in the form of sedimentary deltaic cycles, Najmiddin Abdulhakem (1979), he studied the geology of the Zubair formation in the Luhais field and the composition of Zubair to three main units. Samir Mikhael (1980) studied the physical properties (PVT) of Zubair oil in the field of Luhais, EhabSamy Hassan (2007), studied the main lithology

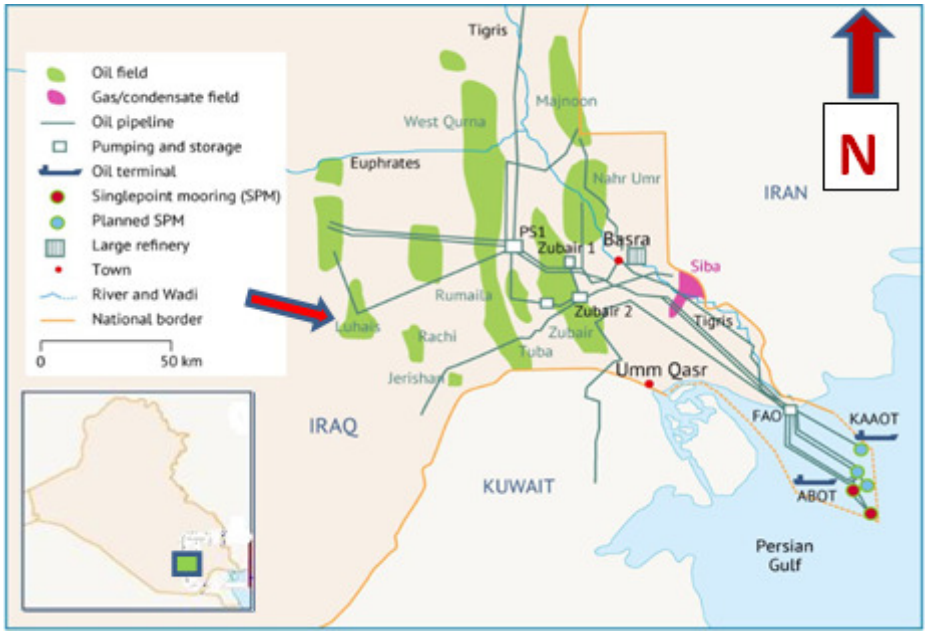

Fig. 1 : Location map of the Luhais field in southern Iraq.

components and textile and the presence of minerals and sedimentary environments. Amin Ibrahim Eliasy (2015), use geophysical logs to study reservoir properties and calculate petrophysical properties and show them in two Dimension models. Al-Khazraji (2016) studied in details the quality of speed in seismic interpretations. Sulaf Razak Khattar Al-Enezi (2017) studied the associated groundwater in Luhais field and its potential for investment.

Geological setting

Luhais field is located between longitude (3340 – 3380) and latitude (660 – 690) in the south of Iraq in semi-Arid zone with elevation of 70 m to sea level about 100 km south east Basrah city. The length of the field is about 20 km and width of about 5 km at the northern part of the field and 10 km in the central and southern part of it.Generally , Luhais field is located in unstable shelf of Zubair- Mesopotamian zone can be considered as stable zone according to (Buday and Jassim, 1987). It is bounded from south west structure Boleh and Archi and Ratawi Field from the east and sabba field from the north and our structure from the west. It is far about 80 km from Rumaila Field to the North East Fig. 1. The Luhais field is structurally a convex fold with a synthetic axes that are oriented towards the general direction (north-sout).

A number of researchers (Ashoor and Al-Muhalhal, 1999) have formed Zubair formation in Luhais field to only three members. The Lower shale member disappears and merges the upper sand member with the Lower sand member to be one member, The division is as follows:

1. Upper Shale Member
2. Upper-Lower Sandstone Member
3. Lower Shale Member

The final geological reports of the excavated wells indicate that the lower part of Zubair formation in Luhais field consists of sandstone alternating with shale, And its middle part consists of sandstone medium-grain isolated by thin layers of clay rocks. The upper part consists of shale rocks as well as sandstone saturated with oil. This part was divided into six units (1A, 1B, 1C, 1D, 1E, 1F) (Abdulhakem, 1979) as in Fig. 2.

Al-Husseni (2000), Al-Fares (1998) and Ibrahim (1983) agreed that the age of the Zubair is "Upper Hauterivian Lower Aptian".

METHODS AND DATA

It is possible to evaluate the Zubair reservoir in the Luhais field through the following data:

1. Using the technique of the gas chromatographic device.

The crude oil models were analyzed in the Varian 7890-Aligent. The operating conditions for the Inlet, Oven and Detector components were programmed from pressure and temperature. The analysis is 50^0C and increases at a rate of 5^0C per minute until it reaches 300^0C at the end of the analysis. The size of the model injected into the fumigation gap is about 1 µL and the flow rate is 4 ml per minute.

2. Calculation of hydrocarbon aggregates in Colum Chromatography, which includes: Saturated group, Aromatic group, Resin group and Asphalt.

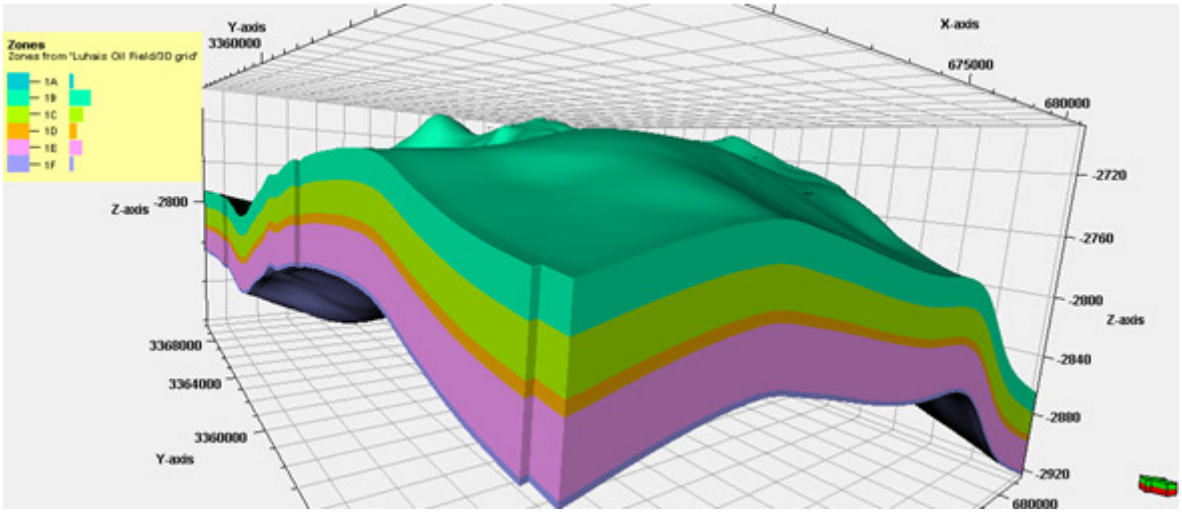

Fig. 2 : Division of Upper Shale Member of Zubair Formation.

3. Calculation of sulfur content by the sulfur measuring device in oil (Sulfur Analysis).

4. Calculation and classification of the specific density of oil by the American Petroleum Institute (API).

The specific density (API) can be extracted from the following equation:

API = (141.5 / SG @ 60 F): 131.5

Where a specific gravity (SG) weight at 60°F.

5. Calculation of Carbon Differentiation Factor (CPI).

The Carbon Differentiation Factor shows the organic maturity of the oil and can be calculated from an equation based on the values of alkanes derived from the Gas Chromatography.

6. Measurement of salt content in method of electrodes, (UOP 46/64).

7. Measurement of wax contentby wax content detector.

RESULTS OF TESTSR

1. Laboratory Tests

Laboratory tests were conducted for samples of crude oil and the results of these tests can be detailed in Table 1.

2. Gas Chromatography Tests

The normal alkane values as shown in Table 2, including Prastane (Pr) and Phytane (Ph) values of (Lu-24) and (Lu-32).

The normal alkanes values in Fig. 3 of the well (Lu-24) and Figure (4) of the well (Lu-32).

3. Carbon Preference Index (CPI)

Carbon Preference Index shows the extent of organic maturity of oil, and can be calculated from the following equation:

$$CPI = (((C_{23}+C_{25}+C_{27}+C_{29}+C_{31}+C_{33})/(C_{24}+C_{26}+C_{28}+C_{30}+C_{32}))+((C_{23}+C_{25}+C_{27}+C_{29}+C_{31}+C_{33})/(C_{22}+C_{24}+C_{26}+C_{28}+C_{30}+C_{32})))$$ (Bray and Evans, 1961).

Table 1 : Characteristics of crude oil in Luhais field of Zubair reservoir.

Characteristic	Results
Specific Gravity @ 60^{0}C	0.8967
A P I Gravity	26.3
Reid Vapour Pressure @ 100°F	8.8
KinemativeViscosity, cSt.60°C@	6.221
Sulphur Content, (wt %)	1.7
Pour point, C Ú	Below - 30
Water Content (Dean and Stark), vol. %	9.2
B.S. and Water (centrifuge), vol. %	11
Carbon Residue wt %	7.8
Salt Content ppm	27384
Wax Content, wt %	4.3

The results showed that the Carbon Preference Index in Zubair reservoir for the Luhais field ranged between (1.1584073 - 1.22405).

4. Relationships of Normal Alkanes to Determine the Oil characteristics

A number of values that can be used in maturity calculations, kerogen type or origin of oil in thereservoir were calculated as in Table 3 (Peter *et al*, 1999).

DISCUSSION AND CONCLUSION

1. Specific Density (API) and Specific Weight (SG)

Based on the API, oil is classified into three categories (light, medium, heavy) (Dickson and Udoessien, 2012) and (Dnr.Louisiana.gov, 1989).

Table 2 : Normal alkane distribution for Zubair reservoir.

Alkanes	Lu-32	Lu-24
C7	-	94332
C8	-	71640
C9	51117.9	62838.8
C10	41612	49994.2
C11	40856.7	46804.6
C12	39056.8	37977.3
C13	35758.9	31686.2
C14	32735.3	22704.3
C15	31236.4	21493.6
C16	30680	20178.3
C17	28238.4	18053.4
Pr	8043.85	2247.3
C18	27126.3	15293.4
Ph	8982.21	2429.6
C19	25909.3	13038.2
C20	24632.1	11567.9
C21	23720.8	9521.44
C22	19934.8	8873.04
C23	18667.2	7831.4
C24	17907.8	7003.1
C25	15130.6	6781.48
C26	11819.4	6374.62
C27	10969.2	4778.91
C28	9540.98	3565.31
C29	7519.22	3132.74
C30	7310.81	2862.22
C31	5656.75	2253.55
C32	3937.27	1733.67
C33	2821.12	1446.5
C34	1783.02	1342.17
C35	1050.65	956.19
C36	472.21	702.33
C37	159.12	271.55
C38	-	177.55

It was found in the tests that the specific weight is 0.8967 and in Table 4, it is found that the oil in Luhais field to Zubair reservoir is of the type (middle). According to the specific gravity derived from the analyzes, it was also found that the specific density (API) is 26.3

It can also be classified as intermediate oil by API (Repsol, 2007) as shown in Table 5.

2. Sulfur content

Sulfur is the most abundant element after carbon, hydrogen and oxygen in oil as a result of the process of biodegradation of the tissues of older organisms. According to the classification of Orr (2001), oil is classified as sulfur based on two types of sweet if the sulfur content is less than 0.5% and Sour (acid) if the sulfur content is greater than 0.5%, Wang and Huang (1992) and Sun *et al* (2009) pointed to this classification.

Table 3 : Relationships of normal alkanes to determine the oil characteristics of Zubair reservoir in Luhais field.

Name	Lu-32	Lu-24
Pr/Ph	0.89532	0.916662
Pr/C17	0.1786167	0.0690895
Ph/C18	0.3311255	0.1588659
CPI	1.22405	1.1584073

Table 4 : Classification of oil by specific weight at temperature 60 F.

Light oil	Middle oil	Heavy oil
Smaller than 0.87	0.87–0.92	Greater than 0.92

Table 5 : Classification of oil by specific density at temperature 60 F.

Type	API
Very light	45<
Light	45-32
Medium	32-25
Heavy	25>

According to the results obtained, the sulfur content of Zubair reservoir in Luhais field is 1.7%, which is Sour (acidic), as well as the middle type according to the classification of the quality of the saplings relative to the sulfur content as in Table 6 (Chang *et al*, 2012).

3. Pour Point

The Pour point is the lowest thermal level in which liquid flow occurs. The lower the Pour point, the less paraffin content will be, (ASTM D5949 – 16). According to the results obtained, it is found that the amount of the Pour point of the Zubair reservoir in Luhais field is 30^0C, which means that this oil is capable of movement and flow, because the Zubair reservoir temperature is equal to 76°C.

4. Salt content

Crude oil contains salt, expressed mainly in sodium chloride (NaCl) and less calcium chloride and magnesium chloride, Erik Fetter Pruneda (2005). If the salts are larger than 0.001 lb / bbl, it is necessary to remove the salt from the crude oil before treatment. If the salt is not removed, the treatment process may face severe corrosion problems. But when treated with auxiliaries, the salt is removed to the desired extent in crude oil (Al-Otaibi, 2003).

The saline content ranges from moderate to a saturation level of approximately 350,000 ppm. According to the results obtained, the saline content of Zubair reservoir in Luhais field is 27384 ppm, So the saline content is relatively low, which is within the limits of moderation and middle.

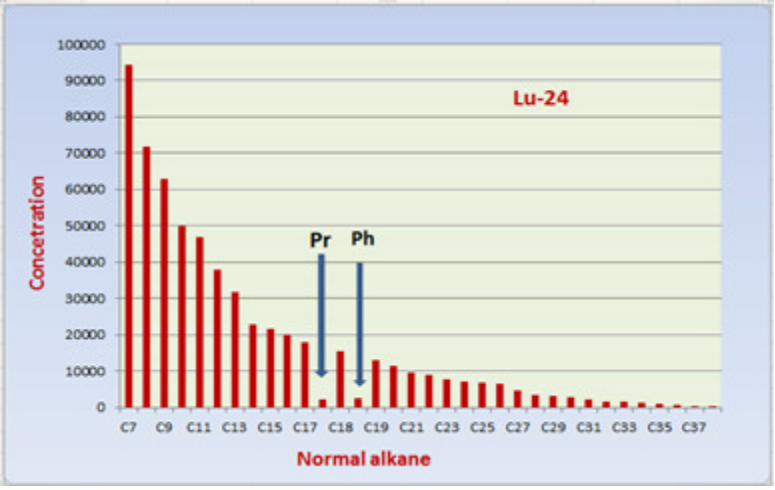

Fig. 3 : Distribution of the normal alkanes in the field of Luhais (Lu-24).

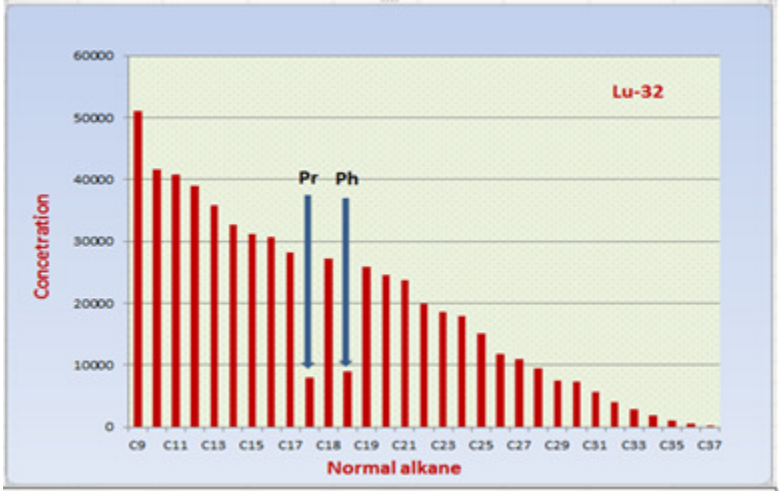

Fig. 4 : Distribution of the normal alkanes in the field of Luhais (Lu-32).

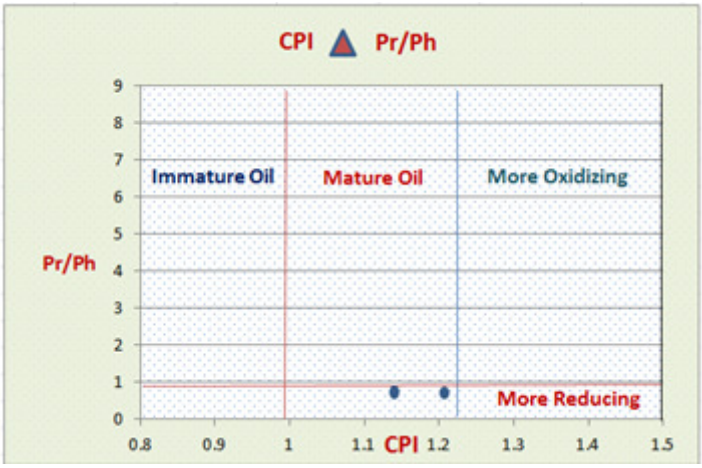

Fig. 5 : Determination of maturity and reduction of relationship (CPI) with (Pr / Ph) (Bray and Evans, 1961).

Kinematic viscosity

The resistance of the liquid to the flow is under the influence of gravity, where this viscosity corresponds to the time that takes the flow of a specific volume of fluid, (Symon, Keith 1971). The high viscosity is indicative of the colloidal nature of oil, but its decrease is indicative of oil runoff and low boiling point (Glenn Elert, 2010).

The global Kinematic of viscosity measurement with temperature changes indicates that the flux can be at temperatures below 40^{0}C (Smits, Alexander, Dussauge, Jean-Paul, 2006). The oil is also heavy if the viscosity is greater than 10 mm^2/s at 60°C and is considered lighter if the viscosity is less than 4 mm^2/s as in Table 7 (ASTM D 2161, 2005).

According to the results obtained from the crude oil tests of Zubair reservoir in Luhais field, the kinematic viscosity is equal to (6.22 mm^2/s) at 60°C and the oil is of medium type.

6. Wax content

That the oil contains a high wax ratio of light oil, but this wax gives negative effects because it will be concentrated in oil derivatives that give a low degree of spill (Nasser, William, 1999). According to the results obtained, it was found that the percentage of wax content in Zubair reservoir in Luhais field is 4.3%, which is very moderate. The natural percentage of wax content is between 2-7%.

7. Residual Carbon

The ratio of carbon to crude oil is one of the most important criteria by which to judge the quality of oil, and the remaining carbon little oil value is better (ASTM D524-15, 2015).

According to the results obtained, the percentage of residual carbon in Zubair reservoir inLuhais field is 7.8%.

8. Water content

The water contained in the oil was classified in the natural waters in the depths, but it is characterized by the fact that the old water from the times of sedimentation and stored and non-renewable was stored in the crude oil after the migration with oil, resulting in significant changes in the composition as a result of mixing with water from other sources, for the chemical exchange between them and the new rocks that have become contact with them. The standard non-effective rate of water content in the oil should not exceed 1%. Yet, it needs treatment. According to the results obtained, it was found that the percentage of water content in Zubair reservoir inLuhais field is 9.2% and therefore it requires surface treatments for insulation.

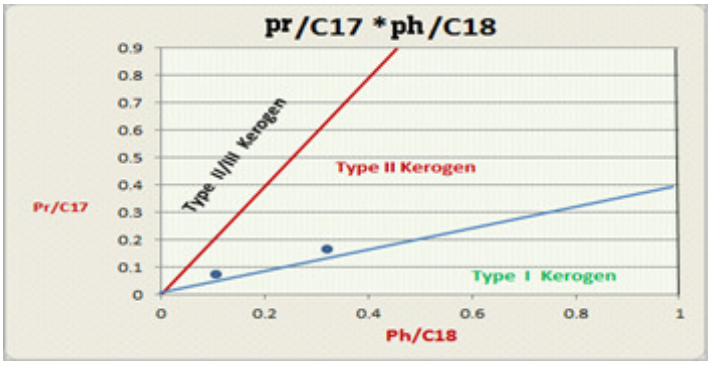

Fig. 6 : Determination of kerogen type through the relationship between (Ph/C18) and (Pr / C17) (Peter and Moldowan, 1999).

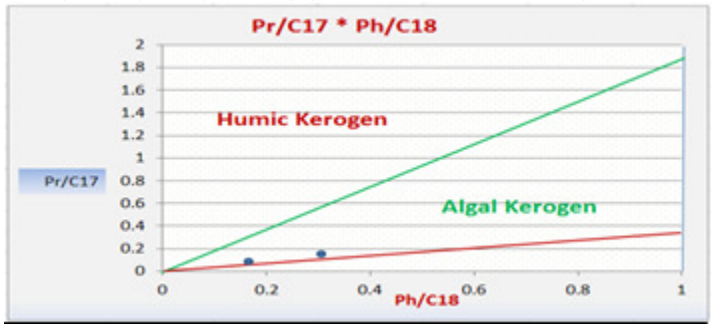

Fig. 7 : Determination of the origin of kerogen from a relationship between (Ph/ C18) and (Pr / C17) (Peter and Moldowan, 1999).

10. The results showed that the coefficient of carbon differentiation in Zubair reservoir in Luhais field ranged between (1.1584073 - 1.22405) and by dividing values (CPI) with (Pr / Ph) values shown in Tables 5-8. It turns out that the oil of the Zubair reservoir in the field of Luhais mature and high-reduction type according to Didyk (1978) and as shown in Fig. 5 (Bray and Evans, 1961)

11. Type of Kerogen

The identification of the normal alkanes, specifically the relationship (Ph / C18) and (Pr / C17), shows that the kerogen type of the Zubair reservoir in the second type (Kerogen II) can be demonstrated by the intersection of the values established in Tables 5 - 8 and can be shown in Fig. 6. It can be sure that this type of kerogen originates from algae by the relationship between (Ph / C18) and (Pr / C17) as shown in Fig. 7.

Standard Model of Oil Properties

A standard model has been prepared for the characteristics of the oil which can determine the type of oil for all fields in terms of degree of maturity,

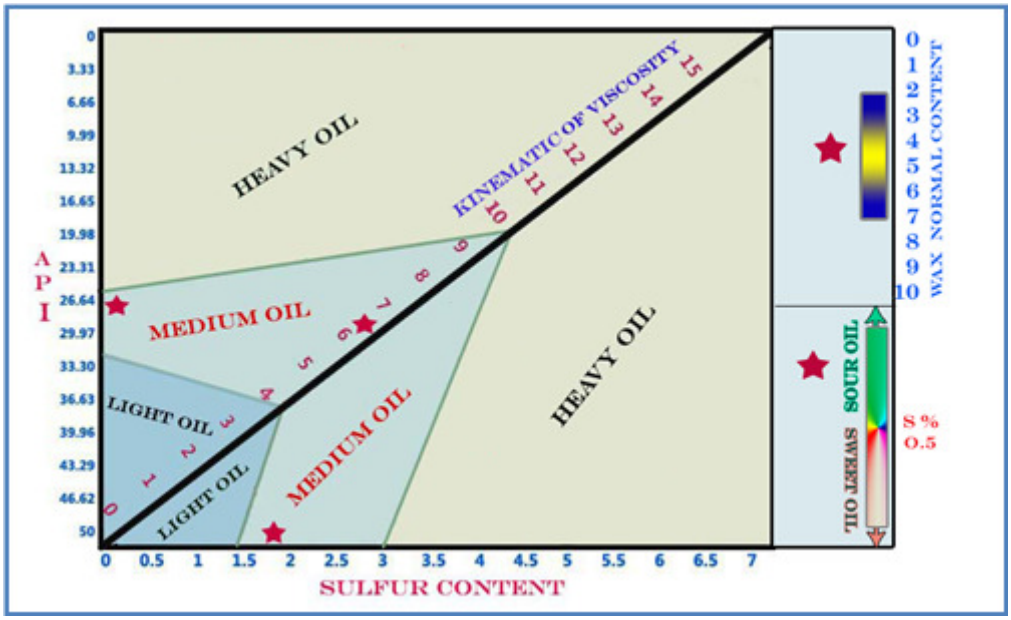

Fig. 8 : Standard model to determine the quality of the oil.

9. Ried Vapor Pressure

It a measure of steam pressure lubricated by oil or light products at 100°F and its usefulness is to know the pressure of the oil vapor to prevent its negative effects when transporting and storing (Ruzicka *et al*, 2010). The reason for this high pressure is that the oil According to the results obtained, the amount of Ried Vapor Pressure in Zubair reservoir of Luhais field is 8.8 PSI, ie bar 0.69. if it is light, medium or heavy, and other characteristics such as the natural content of wax and the quality of oil through the proportion of sulfur, whether sweet or sour. These characteristics included API density as well as kinetic viscosity and sulfur ratio according to the international measurements to determine oil properties.

The values extracted from the Zubair reservoir oil analysis in Luhais field were dropped on the standard

Table 6 : Classification of crude oil by sulfur ratio

Type of oil	äÓÈÉ ÇáßÈÑíÊ
Light	0.5 – 1.4
Medium	1.4 – 3
Heavy	Greater than 3

Table 7 : Kinematic viscosity scale at 60° C.

Type of oil	Unit	Kinematic viscosity
Light	mm^2/s	Less than 4
Medium	mm^2/s	10- 4
Heavy	mm^2/s	Greater than 10

model of the oil characteristics. It was found that the oil of the intermediate type for the occurrence of the specific density values (API) and the sulfur and viscosity ratio within the medium oil type area and that the oil is acidic because it is more than 0.5% And the percentage of wax content within the normal range ranging from (7-2) as in Fig. 8.

Recommendations

1. The study recommends a plan that includes the experience of secondary oil recovery methods such as Thermal Injection, because the API is smaller than 27, by injecting steam to reduce oil viscosity.
2. Take advantage of the produced water (associated) to re-inject it into the same reservoir or injection in adjacent fields, so that we can maintain reservoir pressure.
3. Water content is equal to 9.2% and therefore requires surface treatments for insulation to match the amount of water associated.
4. Mix the oil of Zubair reservoir with the oil of the Nahar Omar formation in Luhais field, which is of a low quality density in order to get a high API.
5. Treatment of high salt content in a (DE saltation) method to deliver it to the acceptable level.
6. Sulfur extraction in the reservoir by hydrodynamic cavity effect method.

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