Removal Of Sulphur From Crude Oil In Zakho District North Iraq

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Abstract— In this study, the sulfur content of crude oil and exported product from Zakho oil fields of Tawke and Qadia, in Kurdistan region of Iraq was studied. The following devices were used; Stanhope-seta (salt in crude oil), centrifuge for Bs&w, Anton par for specific gravity and density, parch method for H2S by nitrogen. Three samples of oil exported abroad were examined and evaluated at a laboratory Institute of fluid dynamics in Germany, for sulfur content and gravity. Several experiments have been conducted to determine the values of sulfur content in oil and some other characteristics related to the above mentioned oils as well as comparing them to global oils and trying to find new and inexpensive ways to reduce and eliminate the sulphur from crude oil.

Index Terms— Crude oil, Sulfur content physical properties, Tawke and Qadia field.

1 INTRODUCTION

A mixture of literally hundreds of hydrocarbon compounds ranging in size from the smallest, methane, with only one carbon atom, to large compounds containing 300 and more carbon atoms is called crude oil as explained in [1]. Nowadays, the conditions that control the transportation of oil have become increasingly important according to the presence of sulfur. As a result, the separation of sulfur from crude oil is one of the central requirements in most refineries and the price of oil is identified by the amount of sulfur as declared in [2]. Sulphur is an element that results in inefficient burning, pollution, and damage to the engine life [3[Sulphur in crude oil is problematic because it results in various problems such as the corrosion of metals. Air pollution is another negative outcome that is a result of burning crude oil which contains a high amount of sulphur. Sulphur compounds poison and expensive refining catalysts pollute the atmosphere in the form of sulfur oxides when burned, making environment problems [4[crude oil is a natural mixture of hydrocarbons, generally, in the liquid state, which may also include compounds of sulfur, nitrogen, oxygen, and metals and other elements [5]. Inorganic sediment and water may also be present. Not all compounds contained in crude oil are hydrocarbons. There are present also as impurities, small quantities of sulfur, nitrogen, and metals [6]. By far the most important and the most common of these impurities is sulfur. This appears in the form of hydrogen sulfide and organic compounds of sulfur. These organic compounds are present through the whole boiling range of the hydrocarbons in the crude [7]. In particular, there is an inverse relationship between sulfur content and maturity, where the sulfur content decreases with increasing maturity [8]. The sulfur content can be used as a source indicator, as oil of marine origin has more than 0.5% sulfur content, the high sulfur content is derived from carbonate source rocks. On the other hand, oil derived from clastic source rock is typically low in sulfur [9[.The most common metal impurities found in crude oils are nickel, vanadium, and sodium cupper and iron [10]. The determination of metal ions in crude oils has environmental and industrial importance. The metal ions like V, Ni, Cu, and Fe, behave as a catalyst poisons during the catalytic cracking process in the refining of crude oil. It is therefore considered necessary to know the concentration of metals in the oils for meaningful impact assessment. Molecular absorption spectroscopy [11[. Petroleum exhibits wide variations in composition and properties, and these occur not only in petroleum from different fields but also in oils taken from different production depths in the same well. Historically, physical properties such as boiling point, density (gravity), and viscosity have been used to describe petroleum, compounds can decompose on heating to produce hydrogen sulfide, which is corrosive and toxic. The importance of this topic, there are several studies and researches are conducted in Iraq and the Kurdistan region where the current investigation mentioned some of them like Hydrotreating of Basra crude oil wide range distillate [12]. In this study, it was concluded that the sulfur content decreased with increasing temperature, and determination of the Total Sulphur Content in Khurmala and Guwayar Oil Fields of Kurdistan Region (14), Iraq it concluded that Kurdish crude oil is of medium-high API gravity and low ratios of specific gravity, that makes the amount of sulphur low (1) 5 crude oil characterization and hydrocarbon affinity of Amarah Oil Field, South Iraq. Bulk properties are characterized by medium API gravity where Mishrif oil sample is ranging between 15.3% -21.0%, and Nahr Umr oil sample is ranging between 16.6% – 30.4% and high sulfur content of Mishrif oil sample is ranging between 4.48% - 4.74%, and Nahr Umr oil sample is ranging between 2.31% – 2.35% while the ratio of vanadium over nickel of Mishrif. There is another evaluation titled. Comparative elemental analysis of the different Kurdistan crude oil fields (16). This study concluded that Tawki crude oil and fuel oils produced from it give higher Vanadium content (10ppm, 36ppm, and 40ppm) for crude oil, fuel oil at 300°C and fuel oil at 350°C respectively.

2 FACILITY

The present study utilized the devices of Stanhope-seta for salt in crude oil analyzer or salt content, centrifuge for BS&W Basic sediment and water to measure certain impurities in crude oil, Anton par for specific gravity and density, sparch method for H2S by nitrogen, sulfur meter device for sulfur content.

3 RESULTS

As shown in Table 1, the specific gravity values for all the selected wells and the oil exported from the Tawke and Qadiya fields are Close together and between values (0.8924 – 0.9150). These values are close to the specifications of Iraqi oil in general, with some variation due to the geological nature of the Zakho region. This is clearly shown in Fig. 1.

TABLE 1
PHYSICAL PROPERTIES AND SULFUR CONTENT OF TAWKE AND QADIA CRUDE OILS

Well – No.	Specific Gravity at (60 °F)	API Gravity (º)	"BS&W (v%)"	H2S (ppm)	SALT/ ppm	WT % SULFUR
T-4	0.9098	24.02	0.8	316.61	10	2.828
T-5A	0.8938	26.81	30	67.39	>430	2.768
T-16	0.8950	26.60	22	64.88	>430	2.479
T-21	0.8928	26.99	14	51.78	>430	2.767
T-27	0.8936	26.84	30	46.64	>430	2.768
T-28	0.8924	27.06	38	181.15	>430	1.693
T-31	0.8940	26.77	40	70	>430	2.327
T-33	0.9150	23.14	26	275.96	>430	3.049
T-35	0.8948	26.63	72	57.08	>430	1.867
T-37	0.9100	23.99	21	263.9	346	3.056
T -ex	0.8945	26.68	0.2	90	18 - 22	3.681
Q -ex	0.8872	27.99	0.2	68	4.4	3.1491

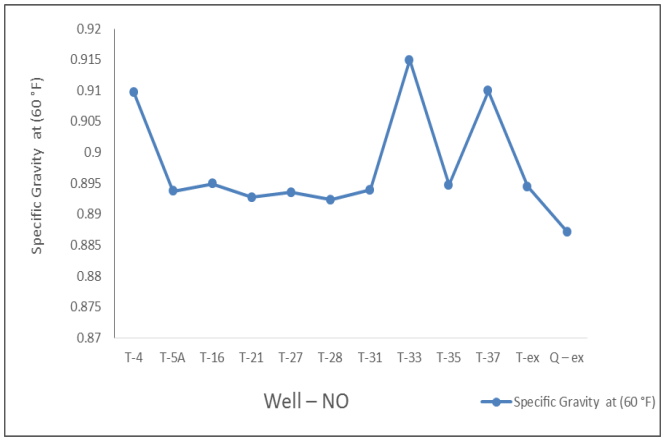

Fig. 1. The specific gravity for different crude oil wells.

Furthermore, the observed values API in Table 1 showed that the values of the oils of these wells lie between 23.14 and 27.99 According to the specifications of the American Oil Institute's scale, good oil has an API value of more than 33, and since the results in Table 1 are all less than 33, it is considered that the Tawke and Qadia oils are generally close to heavy oils and are often called medium oils.

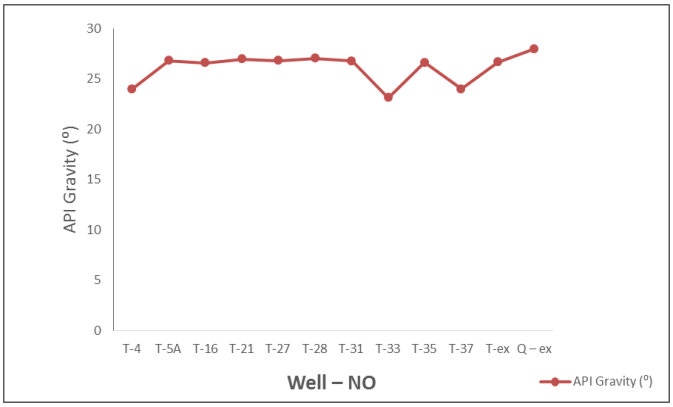

Fig. 2. The API for different crude oil wells.

When the evaluation of the readings in Table 1 is conducted, the variation in the reading values is been noticed, wherein the value of T-ex is 0.2 %v but in the T-35 values is 72. This is due to the fact that in T-ex it is the oil exported abroad after conducting several treatments from it, in which that in the process of removing water, impurities, and sediments by separation processes. Therefore, the amount of water and sediment must be very small quantities because they affect the quality and price of crude oil when exported abroad. While in T-35 it is observed that the amount of water is also large in other wells and this is due to the fact that measurements take place when extracting crude oil directly from the well and this is normally the presence of large quantities of water and sediments with oil extracted due to the nature of the geographical area and the depth of the well. Fig. 3 show.

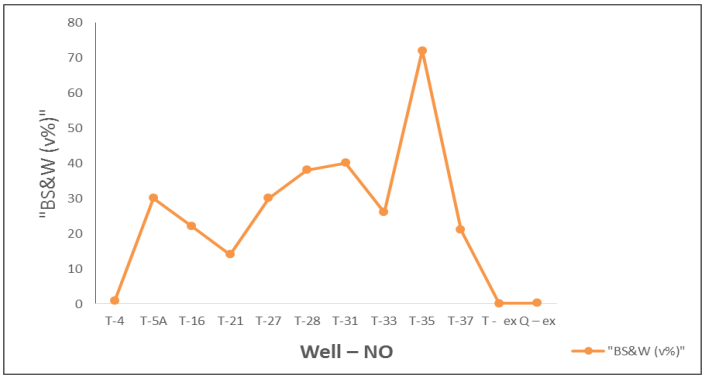

Fig. 3. BS&W Basic sediment and water for different crude oil wells.

The observation of hydrogen sulfide gas values of the present test it had been seen a great difference in the results in T-4 the value is 316.61 ppm and in T-27 the value is 46.64 ppm This is due to the depth of the well, wherein the T-4 well, the depth is close to 400 meters. These wells are characterized by the presence of large quantities of gas, unlike the T-27 well, as it is at a depth of more than 2000 meters that contains less.

One of the important and basic issues in crude oil that affect its quality and good specifications is the amount of sulfur in it. In this research, it has taken several values of Zakho oil, which show in Table 1 that the percentage of the amount of sulfur is large compared to the good global qualities. There is also a difference and variation between the values in the same region. Thus, since the crude oil for which the sulfur content is exported is one of the largest values that are p and this is due to the fact that it is a mixture of many wells present in the

region, some of which we mentioned in the study and some that we did not mention. One of the reasons for the great values of the sulfur content of oil in this region is that its wells are in a mountain chain line that is characterized by the abundance of sulfur, especially the areas near the surface of the earth.

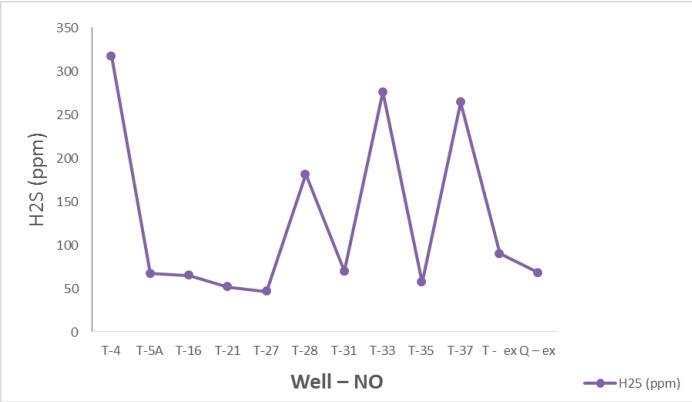

Fig. 4. H2S content for different crude oil wells.

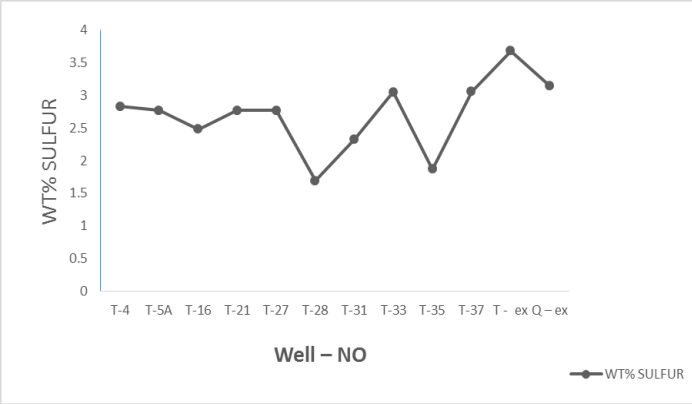

Fig. 5. The sulfur content for different crude oil wells.

And to achieve the results that we obtained in our laboratories and from several places, including the oil laboratory at the Technical Institute in Zakho, We took three samples of the oil exported abroad from Tawke oil and lead and some physical properties and sulfur content were studied as shown in Table 2 we visited with the supervising to Germany - Institution: Helmholtz Zentrum Dresden Rossendorf, Department: Institute of Fluid Dynamics We obtained very close results from the results obtained in our laboratories. With some slight differences that generally result from the time period of oil extraction, human errors and reaction conditions.

TABLE 2
PHYSICAL PROPERTIES OF TAWKE AND QADIA CRUDE OILS

Zakho Oil Analysis Report				
Oil Sample	Specific Gravity	API	Sulfur content (wt%)	BS/w(%)
EQT1	0.8942	26.74	3.135	0.2
EQT2	0.8957	26.48	3.024	0.2
EQT3	0.8963	26.37	2.964	0.2
average	0.895	26.53	3.041	0.2

To increase the information about crude oil in the Zakho region, the results of the Tawke wells 1 and 2 are considered. Of course, after the initial treatment, such as the processes of removing water and sediments, and from observing the physical properties of these wells, it fond that the convergence of values with other wells in the region. In Table 3, there is an increase in some other characteristics, such as information on naphtha, kerosene, and diesel, which are components of crude oil, followed by Table 4, which gives additional information on these components.

TABLE 3
PHYSICAL PROPERTIES OF TAWKE 1,2 WELLS CRUDE OILS

Sample	Sp. G.	°API Gravity	BS&W % wt	Sulfur % wt	Salt (ppm)	H_2S (ppm)	RVP (kPa)	ASTM Distillation Cracking point °C	Naphtha Vol.(%)	Kerosene Vol.(%)	Diesel Vol.(%)	RCR Vol.(%)
Lab#: DT01	0.896	26.40	0.20	3.62	21.00	93	12.97	335	24	13	37	26
Lab#: DT02	0.895	26.60	0.30	3.57	31.00	91	13.83	330	25	15	35	25

TABLE 4
PHYSICAL PROPERTIES OF PRODUCTS.

Lab#: DT01				ASTM D86 IBP °C											ASTM D86 EP °C
Sample	Sp. G.	Flash point (°C)	Sulfur % wt	(5) Vol.%	(10) Vol.%	(20) Vol.%	(30) Vol.%	(40) Vol.%	(50) Vol.%	(60) Vol.%	(70) Vol.%	(80) Vol.%	(90) Vol.%	(95) Vol.%	
Naphtha	0.711	31	0.15	45	63	73	80	83	93	105	117	132	145	151	157
Kerosene	0.781	43	0.76	163	170	183	191	200	212	223	232	250	257	260	268
Diesel	0.837	65	1.54	275	279	285	289	293	295	298	300	303	308	313	317

TABLE 5
Viscosity of Tawke crude oils at different temperatures

	ASTM D445			
Sample	Viscosity (cSt) @ 37.8 °C	Viscosity (cSt) @ 100 °C	Viscosity (cSt) @ 125 °C	Viscosity (cSt) @ 150 °C
Lab#: DT-01	32.53	12.3	8.8	6.63
Lab#: DT-02	30.52	11.1	8.2	6.54

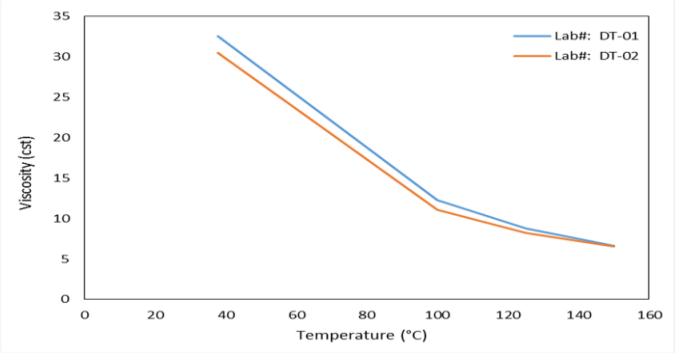

Fig. 6. Effect of temperature on heavy crude oil.

4 Conclusion

Through this study and from the observation and evaluation of the results of sulfur content and physical properties of the wells of Tawke field and the mixture exported from the field and Qadia field, It became clear that the tested oil is of medium type and near heavy oil according to the values of the API, and that because of the high sulfur content in it and the geographical nature of the region in addition to the depth of the oil well. The present study also revealed that the ratio of the presence of water and sediments in the wells is large and this leads to the ratio of salt also be large.

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