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Preparation of Clay Catalyst from Natural Clay and its uses in Desulfurization of Crude Oil

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ABSTRACT:*This study explores the utilization of red soil and Kaolin clay in abstracting sulfur from the crude oil extracted from Qadia and Tawke fields in the Kurdistan Region of Iraq. It uses the following devices to study/analyze the chemical composition of red soil in various locations in our region and a sample of kaolin clay for the town of Hillah in central Iraq: PH. meter, Flash photometer, Atomic Absorption, Spectrophotometer, conductivity meter, sulfur meter devise for sulfur content. To determine the impact of red soil and kaolin in reducing the sulfur content in crude oil, numerous experiments were conducted depending on the phenomenon of adsorption by treating red soil and kaolin with crude oil. It is found that the soil reduced the sulfur content and these percentage increments with the increasing of the temperature*.

KEYWORDS: *Red Soil, Kaolin, Crude Oil, Sulfur Content, Chemical Properties.*

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I. INTRODUCTION

Sulphur is permanently present in crude oil and for this; it needs raw materials to get rid of its bad effects in the process of refining [1]. The amount of sulphur compounds in oil and its derivations is different according to the diversity of its sources and the areas of its existence [2].

There are many different ways to get rid of the sulphur problem in crude oil and its derivations.

Ionizing radiation method was used to remove sulfur from heavy Arab oil. Sulfur removal from crude oil and diesel was achieved by combining the use of gamma rays and other physical and chemical processes which leads to reduce the total sulfur content to 36% of the oil and 78% for diesel as well [3]. the efficiency of the process was of removing sulfur by extracting with solvents and then using Acetonitrile was studied carefully and showed high efficiency in extracting the sulfur compounds up to 28% and the mixing ratio of 1: 3 solvent oil [4, 5]. The method of oxidation by using hydrogen peroxide as an oxidizing agent showed the efficiency of removal by increasing the temperature up to 20.65% is achieved through topical extraction of sulfur-containing compounds [6].

There are other methods of extraction, in this case, using ionic solutions. It has the advantage of being an economical, simple, effective and easy to handle less costly reagents. With this, the sulfur content in oil products such as kerosene, diesel oil and heavy waste can be reduced to 70%. [7].Although using Zeolite as it has a strong adsorption property towards impure substances and is abundant in nature [8]. In this field, two researchers studied the production of clay catalysts from Bentonite ore and compared them with manufactured silicates [9].Because the cost of the catalysts is very high and consumes over time, many researchers have been using dirt and natural clays, as it was noticed that the clays caused acceleration in the breakdown of oil derivations, but the industrial application of these discoveries did not happen until 1936 using catalysts of the type of aluminum silicate [10].

In this research, red soil and kaolin clay is used since they contain various elements such as cadmium, nickel, copper and aluminum, and these elements are effective in removing sulfur from crude oil [11].The method used in this case is adsorption, which is characterized as a quick and easy process. In the case of kaolin, better results appear depending on the purity of the raw material, mineral and elemental composition, and particle size [12].

II. RESULTS

In Table No. (1) The values of red soil analysis for different regions are mentioned, where the chemical composition of these soils shows the presence of various elements such as potassium, sodium, calcium, magnesium, etc., depending on the nature of the geographical area. What concerns us in this study are the transitional elements that are widely used as auxiliary factors in several chemical and other physical processes such as adsorption, which we are now discussed in this research where there are important elements in this soil, especially chromium, cadmium, copper, nickel, aluminum, cobalt, and others with iron in great proportions, especially in Batifa models where its presence negatively affects the process of removing sulfur from crude oil, especially in some cases where the temperature increases.

Table 1: The chemical Composition of Red Soil in different places in Zakho

Characteristics	Samples by Region				
	Lefan - 1	Lefan -2	Lefan -3	Batofa	Jamsirmo
pH	8.16	8.07	8.26	7.87	7.95
Sodium adsorption ratio %	3.22	2.10	3.35	Nil	Nil
Electrical Conductivity ms	0.12	0.16	0.14	95	129
Chloride ppm	88.61	95.43	83.07	34.79	26.27
Dissolved Calcium ppm	360	352	216	36	34
Dissolved Magnesium ppm	88.8	85.2	242.4	18	16.8
Dissolved Sodium ppm	2.2	2.4	0.8	2.3	65
Dissolved Potassium ppm	1.2	2.6	2.2	2.8	2.6
Extractable Calcium ppm	14,000	14,400	13,400	7100	6078
Extractable Magnesium ppm	12,000	10,560	10,800	507.6	991.2
Extractable Sodium ppm	368	230	368	40	25
Extractable Potassium ppm	1,525	2,815	6,804	95	130
Extractable Lithium ppm	91	98	133	40	40
Zinc ppm	98	114	106	77..9	89.9
Lead ppm	1.63	3.67	2.99	32.83	40.9
Cadmium ppm	0.31	0.45	0.38	0.085	Nil
Chromium ppm	431.6	660.3	526.1	43.5	22.8
Iron ppm	23,953	22,590	19,947	19146.6	21127.7
Copper ppm	39.1	29.6	38.8	10.85	20.93
Nickel ppm	600.8	625.6	551.2	1111.9	932.1
Cobalt ppm	53.45	51.11	41.99	0.764	0.589
Aluminum ppm	77,498	110,463	521,763	31056.4	61714.2
Manganese ppm	1717	1310	1732	1096.4	1025.4

In Table No. (2) the results of the chemical analysis of Kaolin for Kwashe region in northern Iraq and Hilla in the middle where we note that the values are different and the PH value of kaolin Hilla is less than 7 as well as the absence of elements such as lead and cadmium in both models and the presence of important elements used as catalyst factors in the suit model such as Nickel, copper and cobalt; it is components chemical composition of soil and kaolin to be used as a catalyst for the treatment of crude oil.In Table No. (3) following, two samples were taken of the first crude oil, the Tawke export, where the sulfur content was 3,2ppm and the second model was from the Qadia export, where the sulfur content was 3,1945ppm. It was treated with the red soil and kaolin mentioned in Tables (1 and 2). It is noticed that the elements present in red soil and kaolin have played their role as a catalyst by reducing the sulfur present in the oil by rates of up to 6% in the case of red soil and 6.3% in the case of Kaolin Hillah without using any external factors as noted.

Table 2: The chemical composition of kaolin in Kwashe and Hilla

Characteristics		Samples by Region	
		Kwashe	Hilla
pH		7.4	6.37
Electrical Conductivity	ms	371	637
Chloride	ppm	68.9	3077
Soluble Calcium	ppm	50	21.99
Soluble Magnesium	ppm	30	14.7
Soluble Sodium	ppm	5.1	936
Soluble Potassium	ppm	3.6	21
Extractable Calcium	ppm	19212	1212.5
Extractable Magnesium	ppm	48	262.4
Extractable Sodium	ppm	42.5	5530
Extractable Potassium	ppm	160	300
Extractable Lithium	ppm	17	20
Zinc	ppm	77.78	64.5
Lead	ppm	Nil	Nil
Cadmium	ppm	Nil	Nil
Manganese	ppm	681.15	766.7
Chromium	ppm	78.81	40.7
Iron	ppm	20487	19788.1
Copper	ppm	38.06	37.2
Nickel	ppm	Nil	260.9
Aluminum	ppm	20442	16517.5
Cobalt	ppm	Nil	97.3
Sulfur	ppm	Nil	3516
Phosphorus	ppm	Nil	12.59

Table 3: The results of treatment of raw oil for Tawaki and Qadia with different types of red soil and kaolin at room temperature

Q crud oil S%
3.132
3.101
3.095
3.120
3.164

Red soil sample was taken, specifically Lefan red soil and the Kaolin model of Hilla, and processed with Qadia export crude oil. In different degrees, the results were obtained and illustrated in Table (4). It appeared that the increase in temperature at the beginning increases the percentage of sulfur in crude oil and this is what is preferred in this study, but at higher temperatures the ratios were different. This is due to the response of the cofactor (soil and kaolin) to the adsorption process caused by the presence of iron in a large percentage in their composition.

Table 4: Evaluate the results of treating Qadia crude oil with different types of red soil Lefan and Kaolin Hilla at different temperature

Soil	T 40c° S%	T 60c° S%	T 80c° S%	T 100c° S%
Lefan	3.101	3.091	3.205	3.038
Hila	3.247	3.123	3.192	3.048

To examine this process to remove sulfur from crude oil by using red soil as an auxiliary agent, red soil was treated with a sample of lefan with the Qadia export crude oil using a different amount of soil as shown in Table (5) at room temperature. various sizes of crude oil in Table (6) also at room temperature and different temperatures in Table (7). Since the oil used in these experiments is better in terms of the presence of sulfur, at 2,447ppm the reduction was therefore less, because obtaining crude oil with good specifications requires good catalyst factors using the high pressure and temperature factors.

Table 5: The results of treating the Qadia crude oil with the red soil of Lefan at room temperature.

Soil g	Volum Oil ML	PPM S%
5	100	2.446
10	100	2.403
15	100	2.395
20	100	2.431

Table 6: Results of red soil treatment at room temperature with different sizes of crude oil.

Soil g	Volum Oil ML	PPM S%
10	50	2.446
10	100	2.403
10	150	2.395
10	200	2.431

Table 7: Results of red soil treatment at room temperature with different sizes of crude oil.

Soil g	Volume Oil ML	T C° S%	PPM S%
10	100	40	2.435
10	100	60	2.406
10	100	80	2.375
10	100	100	2.460

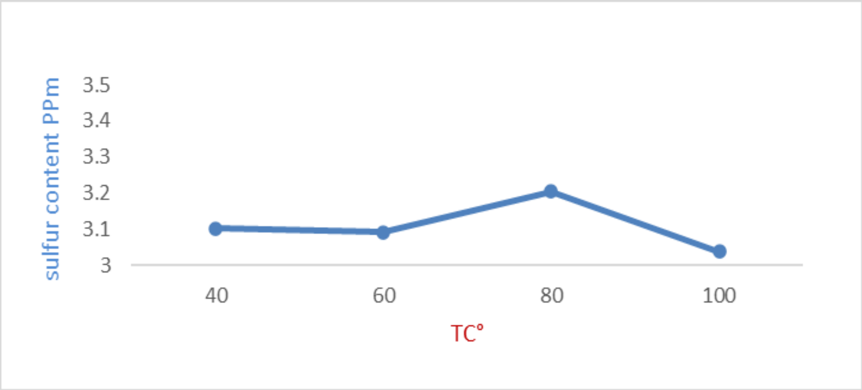

Fig 1: Effect of temperature on Lefan red soil in removing sulfur from crude oil.

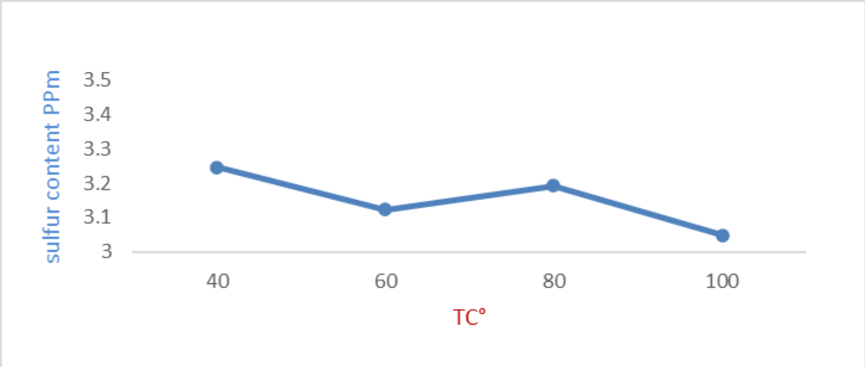

Fig 2: effect of temperature on Hilla kaolin in removing sulfur from crude oil.

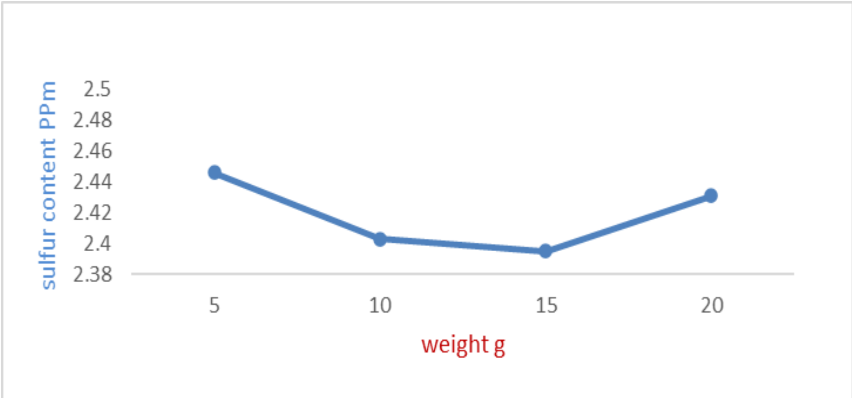

Fig 3: Effect of amount of red soil on removal sulfur from crude oil.

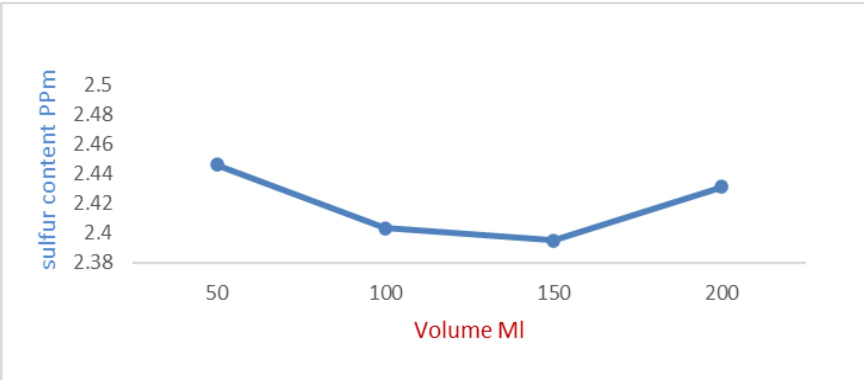

Fig 4: Effect of volume of crude oil on red soil to remove sulfur.

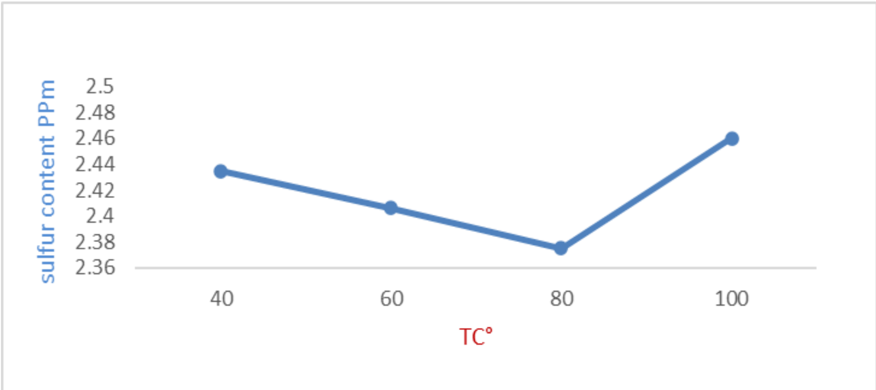

Fig 5: Effect of temperature on red soil in removing sulfur from Qadia crude oil.

III. CONCLUSION

It appears through the study of the chemical composition of red soil and kaolin the presence important elements that can be used as catalyst agents and sometimes as a support material in the process of removing sulfur from crude oil (the most difficult problem in the oil industry) despite the presence of some undesirable elements in the composition of red soil it has been able to reduce the percentage of sulfur in crude oil to a significant extent, although we did not use any additional external factors. The effect of the degree of heat, the amount of the substance used as a catalyst and the volume of liquid (crude oil) were also found in this study. In the end, from observing the results, a conclusion can be drawn, which is red soil found in abundance in Kurdistan Region can be used in the process of removing sulfur from crude oil for limited quantities or as a support material for catalyst factors such as molybdenum in the mentioned process.

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