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Study on Effect of Desulfurization of Sour Crude Oil in Petro Chemical Industry

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Abstract: The poor quality of crude oil leads to high sulfur contents of oil products and the technology for desulfurization of crude oil is urgently needed so the sulfur contents in petroleum product could be reduced from the root. The present study aimed toevaluate the effect of desulfurization of crude oil using caustic washing. Caustic washing method is mainly for removing the sulfides from the crude oil by using the caustic solution. Dosing proportions of NaoH in the crude oil is increased to reduce the Parts per million(PPM) level of sulfur. There are four different normality of NaoH solutions (0.125 N, 0.5 N, 0.175 N and 0.2 N) were prepared and mixed with 1 liter of Crude oil and analyzed. Out of four different concentrations, 0.2 N shows significant sulphur reduction (50 %) than any other concentrations. In conclusion, caustic washing with 0.2 N may be a suitable solution for desulphurization of sour crude oil from petrochemical industry.

Keywords:Parts per million, Crude oil, Caustic washing, desulphurization, petrochemical industry.

Introduction

Sulfur in crude oil is very important because it causes difficulties, such as corrosion of metals, in processing the oil and because air pollution results from the burning of high-sulfur fuels processed from crude oils having a high sulfur content. At a time when sulfur content restrictions on the use of fossil fuels are causing shortages and making itmoredifficult for industry to achieve air quality standards, data are needed regarding the quality of availableworld crude oil supplies (1-7). Somearticles in trade journals (8-10) have included a correlation between API gravity and sulfur contentof crude oils to establish which crude oils qualify as "lowsulfur oils," defined as crude oils having a sulfur content less than 60 percent of the average sulfur content of all U.S.crude oils of the same API gravity. The term "low-sulfur oil" refers to oil with a sulfur content of 0.50 percent and less, and the term "high-sulfur oil" refers to oil with greater than 0.50 Percentsulfur content. The International Energy Agency (IEA) estimates that 70% of the world's remaining oilreserves consist of heavy, high sulfur crude. Moreover, there is a common tendency in allbig discoveries found in the last 30 years. The crude from these new oil fields tends to be heavy, difficult to extract, with high sulfur content. One of the reasons of crude oil quality deterioration is depletion of production from conventional, commonly sweet reservoirs. This trend can be seen by looking at the history of crude oil production, which is now extending over more than 150 years (11). In fact, 40% of the world's natural or associated gas reserves currently identified as remaining to be produced, representing over 2600 trillion cubic feet (tcf), are sour, with both H2S and CO2present most of the time. Among these sour reserves, more than 350 tcf contain H2S in excess of 10%, and almost 700 tcf contain over 10% CO2(12). The main purpose of the present study is to yield high quality automotive fuels with least sulfur content.

Materials and Methods

Process Description

In the NRM GGS (Narimanam Gas, Ongc, Cauvery Asset) sour crude treatment unit, the crude oil from the nearest sour well is collected and separated into gas, liquid and water by three phase separators. The separation process is done by caustic washing method. During the dosing of Sodium hydroxide solution the sulfur content in the crude oil is converted into sodium sulphate salt and thus reducing the sulfur content present in the crude oil. It is then directly sent to the further oil refinery process plant. In the unit feed capacity 80-90 kiloliter per day.

NaOH + sulfur 'S' (in crude oil) \rightarrow sodium sulphate.

Static Mixer

To improve the rate of reaction and uniform mixing of the dosing solution with crude oil, it is suggested to install the static mixer in the crude pipe line to enhance the process performance.

Lab Scale analysis

Dosing proportions of NaoH in the crude oil is increased to reduce the PPM level of sulfur.

There are four different normality of NaoH solution is prepared and mixed with 1 liter of Crude oil and analyzed.

- 0.05 liter of NaOH (0.125 N) in 1 liter of crude oil
- 0.05 literof NaOH (0.15 N) in 1 literof crude oil
- 0.05 literire of NaOH (0.175 N) in 1 liter of crude oil
- 0.05 literof NaOH (0.2 N) in 1 literof crude oil

For the four combinations 'S' value is determined by gas Detect Apparatus method.

Gas Detect Apparatus Equipment

The PPM level sulfur indicated in the red color. In this level needle the white color in charged to red color to indicate the amount of H_2S present in the gas.It is a portable type Japanequipment used for measuring the H_2S PPM level in the vent gas from the crude oil. This equipment works with the helps of PPM level indication needle. The gas collected in bladder from sample points. After filling the gas in the bladder, it is connected to the gas tech apparatus. The gear is pulled once the gas filled in the apparatus, then release the bladder for injecting the gas to the apparatus. The needle is placed in the edge of the equipment for measuring the H_2S PPM level. The making in the needles are to be used measure PPM level.

Results

For the 0.125 N Solution in 1 literof crude oil, 'S' in the form of H_2S gas is Detected by Gas Detect Apparatus Method (Tab.1) and Average of H_2S PPM level in 1 liter of Crude oil is 100 PPM of gas (Fig.1).In the laboratory Preparation, For the Normality of 0.15 N NaoHsolutions in 1 liter of Crude oil. The H_2S PPM level is measured by using sulfur detection apparatus (Tab. 2).Approximate value of sulfur PPM level in Crude oil for 0.15 N is 80 PPM (Fig.2).In the laboratory Preparation, For the Normality of 0.175 N NaoH solutions in 1 liter of Crude oil. The H_2S PPM level is measured by using sulfur detection apparatus. Average for the H_2S PPM level is 1 literof Crude oil is 63 PPM of H2S gas (Tab.3). Approximate value of sulfur PPM level in Crude oil for 0.175 is 60 PPM (Fig.3).In the laboratory Preparation, For the Normality of 0.2 N NaoH solutions in 1 liter of Crude oil. The H_2S PPM and the approximate value of sulfur PPM level in Crude oil for 0.2 N is 50 PPM (Fig.4). When normality of NaOH increases, the PPM level of H_2S has been deceased (Tab.5, Fig.5). Similarly, the normality of NaOH increased, the PPM level of crude sulphur decreases (Tab.6, Fig.6). The amount of NaOH (in kg) required for reduction of sulphur content in plant observed in the present study was 320 kg as 0.2N to reduce the sulphur content from 700 PPM to 130 PPM and also it reduced the H_2S (Tab.7).

Table 1. PPM level of H₂S for 0.125 N NaoH

Normality of NaoH	PPM level of H ₂ S
Solution	
0.125	110
0.125	100
0.125	100
0.125	90
0.125	100

Table 3. PPM Level of H₂S for 0.175 NaOH

Normality of NaOH	PPM level of H ₂ S
Solution	
0.175	65
0.175	60
0.175	70
0.175	60
0.175	60

Table 5. Normality of NaoH $V_{\rm S}$ PPM level of H_2S

Normality NaoH Solution	PPM level of H ₂ S
0.125	100
0.15	80
0.175	60
0.20	50

Table.7.Quantity of NaoH required for Plant

Normality NaOH	Kg of NaoH
	Required
0.125N	170Kg
0.15N	240kg
0.175N	280kg
0.20N	320kg



Table 2. PPM Level of H₂S for 0.5 N NaoH

Normality of	PPM level of H ₂ S
NaOH Solution	
0.15	80
0.15	85
0.15	75
0.15	80
0.15	80

Normality of NaOH solution	PPM level of H ₂ S
0.2	55
0.2	50
0.2	45
0.2	50
0.2	50

Table 6. Normality of NaOH vs PPM level'S' in crude oil.

Normality NaOH	PPM level of 'S' in
	crude oil
0.125	130
0.15	104
0.175	80
0.2	60





Conclusion

In the current running process of desulfurization, only desired quantity of sulfur removal (100 PPM) is achieved. To meet the current specifications of environmental regulation (S-50PPM), various quantity of sodium hydroxide normal solution is dosed with crude oil in the lab scale and analysed for the sulfur content removal in PPM level. In the existing process, 200 kg of sodium hydroxide is mixed with 40,000 lire of water for 8 days.4-5 kilolitres of Sodium hydroxide solution is mixed with crude oil per day. Then sulfur content in the crude oil level is reduced from 700 PPM to less than 130 PPM.Even though there are many defects in the caustic soda dosing method such as the poor quality of oil products and lower efficiency of desulfurization, it is suggested to alter the existing method slightly instead of installing the higher cost methodology which affect the total plant layout. From this altered sodium hydroxide dosing method, we can able to meet the sulfur PPM level as per the environmental regulations. However, this method can't remove all sulfur compounds from the crude oil, especially the organic sulfides. At the same time, further increase in the quantity of Sodium hydroxide to reduce the PPM level of sulfur content, it brings too much sulfide-containing waste water, which greatly the environment. Also it is recommended, to install the static mixer to enhance the process performance.

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