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Modification of Steam Stripper in DHDS Unit

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Abstract — *The present work investigates the hydro treating process of a diesel to achieve low Sulphur content. The main objective for removal of Sulphur from diesel is that it contributes to increased level of air pollution and equipment corrosion. The objective of this project emphasizes to maintain Sulphur level about 40ppm, to ensure flash point about 77°C and to ensure less Sulphur content by using copper corrosion test. The steam stripper is used for removal of hydrogen sulphide and ammonia. During feed steam stripping, there is an addition of moisture or water in diesel hence it is sent to salt dryer where rock salt is present which absorbs moisture content from diesel. Due to very high consumption of rock salt we are using a reboiler instead of a rock salt dryer. As reboiler is not efficient for removal of moisture we replace reboiler with vacuum drier.*

Keywords- *Hydrodesulphurization, Salt drier, Vacuum drier, Sulphur removal.*

I. INTRODUCTION

It is now widely recognized that sulphur dioxide pollution of the atmosphere can no longer be tolerated. Thus, widespread attention has been given to removing sulphur from fuels that now will burn. The desulphurization of petroleum and petroleum fractions is almost universally accomplished by the catalytic reaction of hydrogen with sulphur compounds in the charge stock to produce hydrogen sulphide, which is readily separable from the oil. Such hydrodesulphurization operations are in widespread use in the petroleum refining industry. Another important reason for removing sulphur from the inter mediate product naphtha streams within a petroleum refinery is that sulphur, even in extremely low concentrations, poisons the noble metal catalysts platinum and rhenium in the catalytic reforming units that are subsequently used to upgrade the of the naphtha streams.

Hydrogenation of the sulphur compounds results in the formation of undesirable, toxic gaseous hydrogen sulphide. The industrial hydrodesulphurization processes include facilities for the capture and removal of the hydrogen sulphide gas. In petroleum refineries, the hydrogen sulphide gas is then subsequently converted into by-product elemental sulphur. In fact, the vast majority of the 68,000,000 metric tons of sulphur produced worldwide in 2010 was by-product sulphur from petroleum refining and natural gas processing plants. Hydro-desulphurizing gas oil for diesel engine reduces pollution and leads to an improvement in cetane number and stability. 68 cities use Euro4 diesel which contains less than 50ppm of desulphurised diesel and Euro3 150ppm plus desulphurised diesel in villages. In 2020 Euro6 diesel will be used which will contain 10ppm desulphurised diesel. In Diesel hydrodesulphurization in order to remove moisture salt dryer is used. But consumption of salt is more so salt dryer is replaced with a vacuum dryer.

II. MATERIALS AND METHODS

Experimental Methodology and Equipment

Table 1: Parameters

1	Pressure	5.5 kg
2	Weight of catalyst	1500 kg
3	Height of the stripper	20800mm
4	Number of plates	24
5	Inlet temperature	220°C
6	Feed flow rate	248780kg/hr
7	Steam temperature	310°C
8	Steam flow rate	6800kg/hr

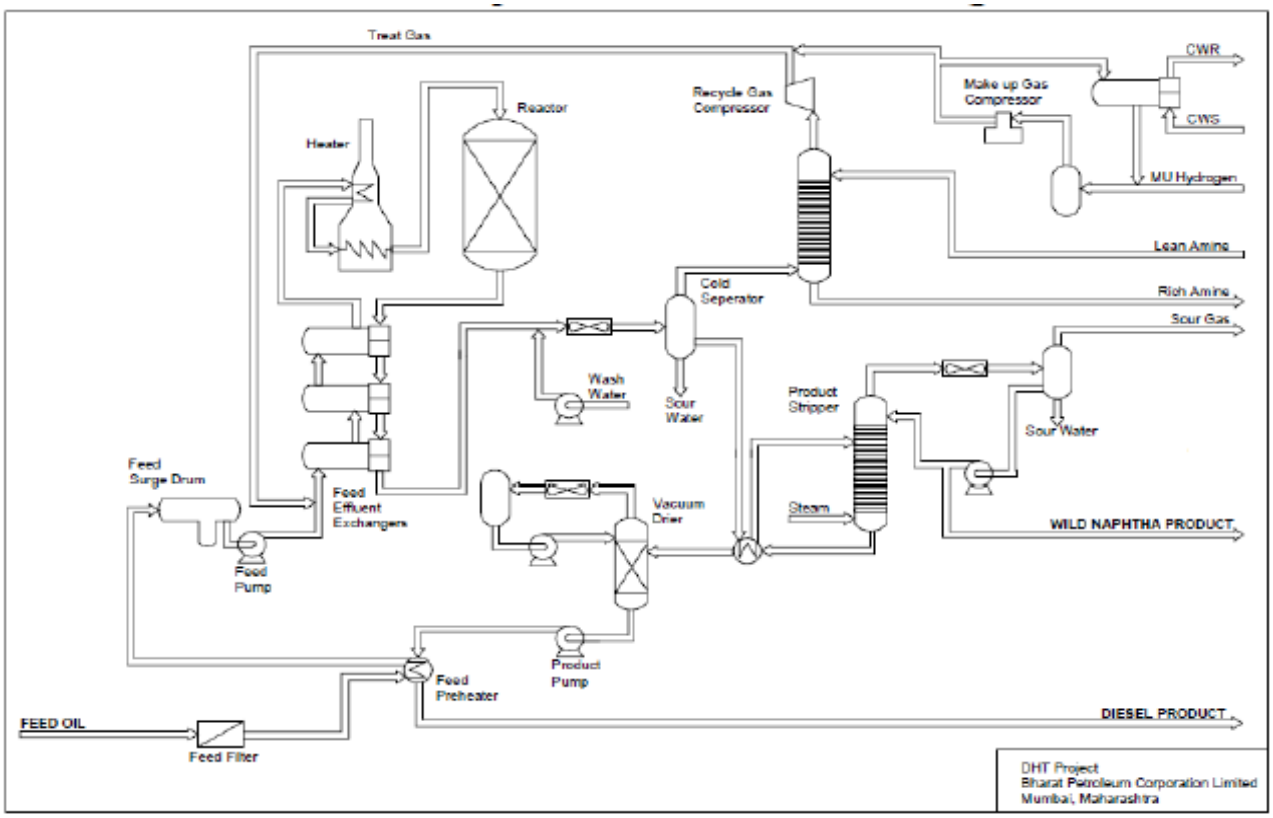


Fig 1: Process diagram

The catalysts are Ni-Mo and Co-Mo catalyst which is 1500kg weight which is used for removal of sulphur. The composition and feed product is given below:

Table 2: Composition and feed product

Composition	3510 Shell outlet	3520 Shell outlet	4000 Stripper feed	4010 Stripper vapour	4030 E-13 outlet	4030 E-09 outlet
COMPONENT MOLAR RATE						
H2S	4.34	4.34	9.23	332.55	332.55	332.55
NH3	0.02	0.02	0.04	0.05	0.05	0.05
H2S	13.61	13.61	28.93	31.82	31.82	31.82
H2	14.11	14.11	30.00	30.08	30.08	30.08
Methane	5.23	5.23	11.11	11.30	11.30	11.30
Ethane	5.16	5.16	10.98	11.82	11.82	11.82
Diesel	484.8	484.8	1030.4	34.6	34.6	34.6
i-Butane	1.73	3.68	4.99	4.99	4.99	4.99
Butane	3.46	3.46	10.47	10.47	10.47	10.47
Naphtha(C5-150oC)	21.73	21.73	46.19	35.16	35.16	35.16
Propane	5.19	5.19	11.03	13.30	13.30	13.30

Table 3: Composition in kg/hr

COMPONENT WEIGHT kg/hr						
Naphtha(C5-150oC)	2385.2	2385.2	5070.0	3606.0	3606.0	3606.0
Diesel	113312	113312	240859	5156	5156	5156

According to these parameters the process unit is operated. DHT unit will comprise of Feed stock conditioning section, Reaction Section including Amine absorber, Product separation section, Fuel gas and Naphtha treatment section. The diesel feedstock, including straight-run Light Gas Oil, Heavy Gas Oil, Kerosene and Naphtha streams from the Crude Distillation Units and Light Cycle oil streams from the Catalytic Cracking units are mixed and filtered to remove insoluble impurities. After removal of free water combined feed stocks will be processed in Reaction Section. Feed stocks are now mixed with hydrogen and heated in preheat exchangers and fired heater to the reaction temperature. The feed mixture is passed over catalyst beds in a reactor with interbed hydrogen quench. The Diesel Hydro treating Unit reduces the levels of sulphur, Nitrogen and other contaminants in diesel fuel products to meet regulatory specifications. Reactor Effluent is cooled in series of preheat exchangers, and mixed with wash water to remove ammonia (NH_3) and then separated in Hydrogen Rich gas and Liquid product streams in a separator. The aqueous wash fraction containing some hydrogen sulfide and ammonia is removed in a separator, and routed to the sour water collection system. Hydrogen sulfide (H_2S) in Hydrogen Rich gas is removed in an amine absorber downstream of the separator. The H_2S-rich amine from the contactor is regenerated before being returned to the recycle gas scrubber as lean amine. Make up Hydrogen gas through makeup gas compressor and the sweetened gas from the amine absorber is recycled back to the recycle gas compressor at the reaction section inlet. Liquid effluent from the separator is routed to a Product Stripper where distillates and unstabilized naphtha are separated. Unstabilized sour naphtha is routed to Naphtha Treatment plant to remove H_2S and then routed to other units of the refinery to separate Fuel Gas (FG), Liquefied Petroleum Gas (LPG), Light Naphtha (LN) and Heavy Naphtha (HN). The Diesel product from stripper bottom is sent to storage for blending.

Amine regeneration Unit (ARU):
The function of Amine Regeneration units is to remove the acid gases (H_2S and CO_2) from the rich amine streams produced in the refinery processing units. Rich amine from HP amine absorber, FG Amine Absorber and Naphtha Treatment Plant (NTP) is received in a flash column. Rich amine is allowed to flash in the column to drive off hydrocarbons. Some H_2S also gets liberated. The liberated H2S is again absorbed by a slip stream of lean amine solution making counter current contact with liberated gases over a packed bed. From the flash column, the rich amine is routed to amine regenerator, after preheating in lean amine/rich amine exchanger. H_2S is removed from amine. The acid gases (H_2S) are routed to the SRU. Lean Amine is recycled back to amine absorbers and NTP.

Revamp of Hydrogen Generation Unit - II (HGU-II):
Hydrogen Plant revamp for 30 % (approx.) increase in Hydrogen production is done by utilizing heat available in the process gas at Steam Methane Reformer (SMR) outlet for steam reforming in a heat exchanger type of reactor. In a parallel combination with SMR, 20 - 30 % of the feed is split and taken to heat exchanger type of reactor. A proportion of heat is utilized in the process side which reduces the steam production from the plant. The major advantage of this revamp scheme is increase in hydrogen production without any increase of Fuel / Utility consumption.

Sour Water Stripper (SWS) Revamp:
Sour water from DHT unit will be treated in existing two stages SWS Unit after revamp of the same. H_2S is stripped off from sour water in first stage column and NH_3 is stripped off in second stage column. H_2S is sent to SRU for Sulphur recovery and NH_3 is sent to incinerator stack. The stripped water from two stage stripper is sent separately to DHT.

Sulphur Recovery Unit (SRU) Revamp:
To recover sulphur from sour gas generated from DHT unit, revamp of existing SRU units will be done using Oxygen enrichment technology for SRU.

III. RESULTS AND CONCLUSION

For removal of moisture salt dryer is used in DHDS unit. As the consumption of salt (100ml of water requires 40gm of salt) has gradually increased, so we have replaced the salt dryer with vacuum dryer. In vacuum dryer there is no temperature fluctuation.

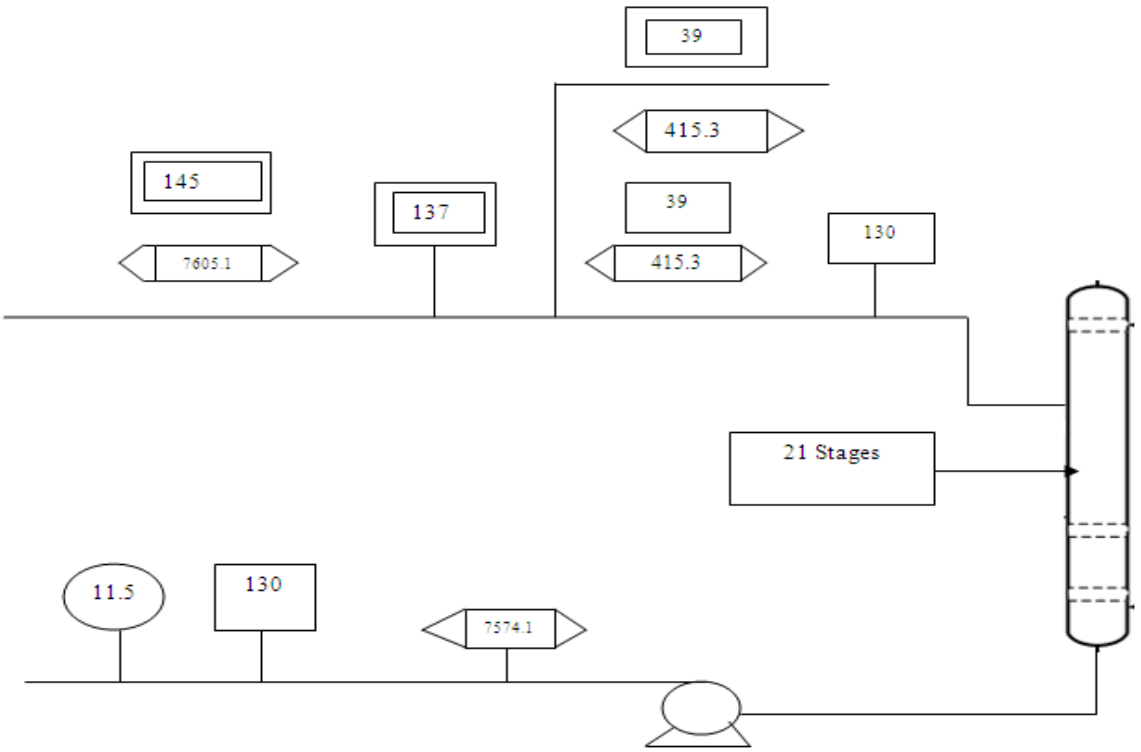
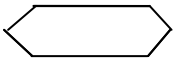
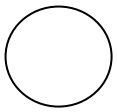


Figure 2: Replacement of salt dryer with a vacuum dryer

Temperature(130^{o}C)



Flow MTPD



- Pressure (11.5) kg/m^2

Thus the above figure 2 explains that there is no temperature fluctuations in vacuum dryer and the operation and maintenance cost of vacuum dryer is comparatively low than salt dryer and in salt dryer salt has to be changed after every 3 months.

IV. CONCLUSION

Thus, the vacuum dryer proves to be effective than salt dryer. Thus, the temperature is maintained in the vacuum dryer compared to rock salt dryer.

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