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INTRODUCTION

This operating manual is only a guide and reference for personnel connected with the operation and maintenance of the **Light Hydrocarbons Kerosine Hydrotreater Unit**. As such, this manual does not cover every step to be taken in ordinary operation of the unit.

Some flow sheets and equipment specifications are furnished in this manual for ready reference. For details beyond those included, refer to mechanical specifications, manufacturers' data books and special instructions, technical books, etc.

Throughout this manual, certain **notes, cautions, and danger** statements are provided. These statements will be used to clarify certain points of interest and to inform the unit personnel of any possible dangers associated with the operation of Light Hydrocarbons Hydrotreater unit.

1.0 NORMAL OPERATIONS

This section of the manual will incorporate information on the operation and installation of any future equipment installed in the Light Hydrocarbons Hydrotreater area. This information will give the operators of the unit a background for understanding the equipment being installed. Along with operating instructions, Process and Information diagrams will be supplied to insure the operator's comprehension of the changes that are to be made.

2.0 NORMAL OPERATIONS

2.1 Light Hydrocarbons Hydrotreater Objective

Hydrotreating is a hydrodesulfurization process for improving the quality of Crude Mineral Spirits (CMS). or Kerosene charge stocks by hydrogenation in the presence of catalyst. Light Hydrocarbons Hydrotreater serves to:

1. Reduce sulphur, nitrogen, and other oxygen compounds.

2. Improve color, doctor, flash and corrosion specifications.

3. Make a high quality charge stock (C.M.S.) for further processing, or to make a high quality finished C.M.S. or Kerosene product.

2.1.1 Light Hydrocarbons Hydrotreater Process Description

The contaminant which we will be concerned with primarily is sulphur. Sulphur compounds, in the form of mercaptans, sulfides, and disulfides, will be converted to H2S. The contaminants are then in the form where they can be easily removed from the oil by stripping fractionation and treating methods. The catalyst is relatively unaffected by most components of charge stock which are known poisons to other catalytic refining processes such as Catalytic Reforming. The activity of the catalyst usually falls off by the gradual deposition of coke upon it, rather than metals contamination. The catalyst can be regenerated, off site, by controlled burning of the coke.

Hydrogenation liberates heat. In straight run stocks, very little heat is liberated because very little hydrogen is consumed. With heavier stocks, more heat is liberated because more hydrogen is consumed. All of the charge stock for Light Hydrocarbons Hydrotreater is straight run product.

As mentioned above, the activity of the catalyst usually falls off by the gradual deposition of coke upon it. With light charge stocks, such as that on Light Hydrocarbons Hydrotreater, comparatively mild coke lay down will be experienced. This is mainly due to lower operating temperatures required for lighter stocks to obtain the necessary sulfur conversion.

Light Hydrocarbons Hydrotreater is designed to remove sulfur compounds through the process of heat and reaction. This will be done in the Reactor section of the unit. The Reactor section of the unit will be concerned with such elements as doctor, color, and sulfur. The Stripping section of the unit will separate the light hydrocarbons from the heavy hydrocarbons through a process of heating and cooling. The Stripping section will be concerned with such elements as corrosion, flash, and distillation.

The finished Kerosene and Crude Mineral Spirits (CMS) product will be sent to storage tanks.

2.2 Light Hydrocarbons Hydrotreater Flow Sequence

The following flow sequence should be used in conjunction with the flow diagram, provided in this section, to better understand the process flow of the unit.

2.2.1 Reactor Section Flow Sequence

Charge is introduced to the unit through the charge pump. The unit takes suction from either (CMS) tanks or (Kerosene) tanks. The charge pump sends the charge through the charge control valve. From the charge control valve, the charge enters two preheat charge exchangers on the tube side. From the bottom of these exchangers, the charge goes through three Reactor charge/ Reactor effluent exchangers on the tube side.

The charge leaves the bottom of these exchangers and enters the top of the Reactor heater. Leaving the bottom of the heater, the charge then enters the top of the Reactor. After leaving the bottom of the Reactor, the charge then goes back through the shell side of the Reactor charge/Reactor effluent exchangers.

From here, the charge enters the shell side of the charge preheat exchangers. The product will then enter a Reactor products cooler before entering the top of the Product Separator. From the Product Separator, which is operated on Level Control, the product will then be ready for the Stripper section of the unit. The Separator pressure will be controlled by the use of an off gas control valve leaving the top of the Separator. The off gas can be sent to an Amine unit. Sour water is drawn from the bottom of the Separator, on hand control, and sent to the Decant drum at the flare system.

2.2.2 Stripper Section Flow Sequence

After leaving the Separator, the charge will enter the shell side of a single Stripper charge/Stripper bottoms exchanger on the shell side. Leaving the first exchanger, the charge will then enter the tube side of the two Stripper charge/Stripper bottoms exchangers. After leaving these exchangers, the charge will then enter the shell side of the Stripper charge steam preheater before entering the Stripper tower.

From the bottom of the tower, a bottoms flow will be pressured through a vertical steam reboiler and back into the tower. The bottoms product will be heated with the steam preheater, the Stripper reboiler, and the stripping steam in the tower. Light hydrocarbons will flow out the top of the tower and into the overhead line through a condenser before entering the overhead receiver. The overhead pump will take suction from the bottom of the receiver and split the product into two streams.

The reflux will be sent back into the tower to control the top temperature. An overhead to storage line will be sent to a designated slop tank. Sour water is drawn from the bottom of the receiver, and sent to the Decant drum at the flare system. The bottoms pump will take suction off the bottom of the stripper tower and send the product through the shell side of two stripper charge/ stripper bottoms exchangers.

From there, the bottoms will go through the tube side of the final stripper charge/ stripper bottoms exchanger before going through a bottoms cooler and out to storage. The bottoms will be sent to different tanks depending on which product is being run.

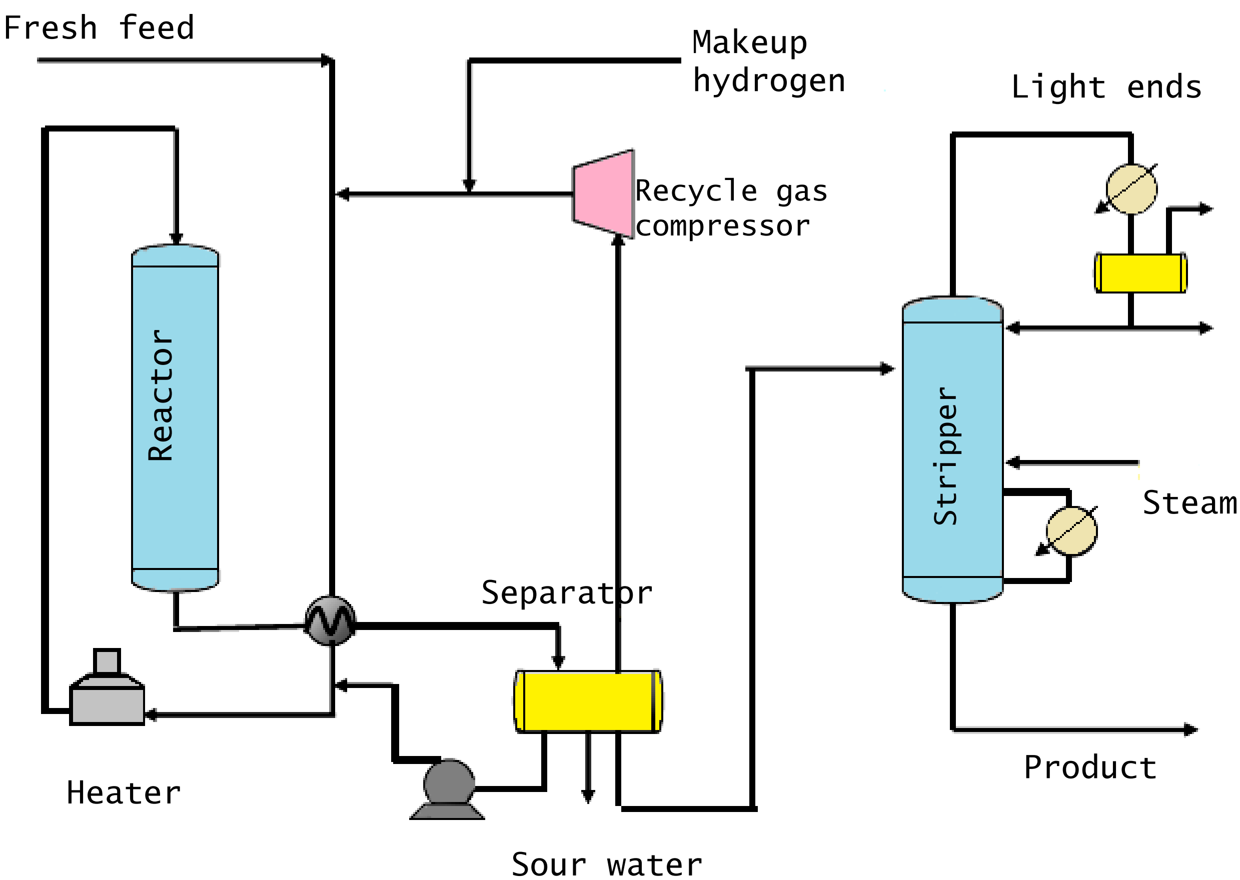
The stripper tower pressure will be controlled with an off gas control valve. The off gas will flow off the top of the overhead receiver and will go to the Sat. Gas compressor suction at the Crude unit.

2.2.3 Light Hydrocarbons Hydrotreater Fresh and Recycle Hydrogen Flow

There are two hydrogen flows on Light Hydrocarbons Hydrotreater: a recycle flow and a fresh hydrogen flow. The recycle flow takes suction off the top of the Separator and flows through a knockout pot to displace any liquid that might enter the compressor. The hydrogen then flows into the top of the compressor and is pumped out the bottom. The recycle hydrogen is then introduced with the charge before entering the charge preheat exchangers. The fresh hydrogen flows from the Hydrotreater manifold and is introduced along with the recycle hydrogen into the charge line.

2.3 Light Hydrocarbons Hydrotreater Process Flow Diagrams

The following flow diagrams can be used to help in the process flow description narratives. These diagrams do not depict every line or block valve associated with the process of Light Hydrocarbons Hydrotreater. They do, however, represent the basic flow of the unit and its related major equipment. More detailed information will be provided in the P & ID's.



Fresh feed
Makeup hydrogen
Light ends
Recycle gas compressor
Reactor
Stripper
Steam
Separator
Heater
Product
Sour water

2.4 Operating Conditions

2.4.1 Reactor Section Operating Conditions

As mentioned in the Process Description, Light Hydrocarbons Hydrotreater will be concerned with the removal of sulfur and other contaminants. The type of catalyst used on Light Hydrocarbons Hydrotreater is different from that of the Catalytic Reformer. It is designed to remove sulfur compounds which are known poisons to the Catalytic Reformer Reactors.

Light Hydrocarbons Hydrotreater has a capacity of approximately 7,000 B/D and generally runs at or near its' capacity. Light Hydrocarbons Hydrotreater employs one (1) reactor. Light Hydrocarbons Hydrotreater has only one reactor instead of two (2) reactors as on Diesel Hydrotreater because of the lower capacity of the unit and the processing of lighter charge stocks. Light Hydrocarbons Hydrotreater just as Diesel Hydrotreater, does employ a stripper section after the Reactor section.

The stripper section helps to improve the distillation specifications by the removal of highly corrosive light end material. The following is a guide of parameter ranges along with optimal conditions for the operation of the Light Hydrocarbons Hydrotreater Reactor section. Though these parameters may vary from their stated ranges, due to charge stock changes or specific operating conditions, they are considered good operational control.

2.4.1.1 REACTOR SECTION OPERATING RANGES

PROCESS VARIABLE	RANGES	OPTIMAL
A. Charge Line Pressure	350 - 390 PSIG	365 PSIG
B. Reactor In. Pressure	310 - 340 PSIG	325 PSIG *
C. Reactor Out. Pressure	300 - 330 PSIG	320 PSIG *
D. Separator Pressure	290 - 310 PSIG	300 PSIG
E. Charge Temperature	90 - 130 °F.	100 °F.
F. Reactor Htr. Temperature	550 - 590 °F.	ADJUST **
G. Separator Temperature	90 - 140 °F.	120 °F.
H. Charge Flow	3000 - 7,200 B/D	6,500 B/D
I. Separator Off Gas Flow	246 - 615 MSCFD	369 MSCFD
J. Separator Level	30 - 60 %	50 %

* THE REACTOR INLET AND OUTLET PRESSURES WILL VARY DEPENDING ON THE LIFE OF THE CATALYST AND THE RATE OF CHARGE IN THE UNIT.

** THE REACTOR HEATERS WILL BE ADJUSTED ACCORDING TO WHICH PRODUCT, WHETHER KEROSENE OR CMS, IS BEING RUN IN ACCORDANCE WITH THE SULFUR RESULTS ON THAT SPECIFIC PRODUCT.

2.4.1.2 REACTOR SECTION STEPS TO CORRECT DEVIATION

Since Light Hydrocarbons Hydrotreater is concerned with the removal of sulfur from its charge stocks (Kerosene and CMS), the proper operation of the Reactor section of the unit is critical for the accomplishment of this goal. Although the process is not complete without the proper operation of the Stripper section of the unit, poor operation of the Reactor section generally can not be corrected in the Stripper tower. Various charge stocks, and the quality of these stocks, will determine how the unit as a whole is operated. It is also important to consider the three stream qualities listed above when operating the Reactor section of the unit.

The most important aspect of any desulfurization unit is to remove the sulfur from the product. Although the sulfur specifications listed above are obtained from the bottoms product, the Reactor heater is adjusted to help maintain these parameters. With lighter stocks such as Kerosene and CMS, less heat will be required in the sulfur removal process. If the sulfur content on the bottoms product is high, whether on Kerosene or CMS, the heater will need to be increased. Unless the results are far from being within range, the heater will generally be increased in 10° increments. If the results are far from acceptable, the heater should be increased in a step wise manner, as necessary, to bring these results back within range. The opposite is true for results which are low. The heater will need to be decreased, as necessary, to hold the sulfur parameter within range. If the heaters have reached a point where the temperature is at its upper limit and the color (discussed shortly) begins to drop off, the charge may need to be decreased slightly to maintain both parameters.

As listed above, the Doctor specifications should be kept in an (O.K.) status. The results will generally be given as (O.K.), slightly positive (SP), or positive (P). Since the Doctor is a function of the sulfur specification, it will tend to follow the results of the sulfur. When the product is high in sulfur content, the Doctor may be of a slightly positive (SP), or positive (P) nature. As with the correction for high sulfur content, a slightly positive (SP) or positive (P) Doctor will necessitate an increase in the heater temperature. When the sulfur is within range, the Doctor result will generally be (O.K.); therefore, no adjustment will be necessary on the Reactor heater. The only time the Doctor results will be out of range is with high sulfur content products. Therefore, an increase in the heater temperature will be the only adjustment necessary for an off specification Doctor.

Another specification required on Light Hydrocarbons Hydrotreater and affected with the operation of the heater, is color. Color problems can arise when CMS or Kerosene are run. In either case, however, if the color results are low, the heater should be decreased. The problem with these adjustments is that a decrease in the heater temperature for correcting a low color may affect the sulfur results. Close attention must be paid to both specifications when these adjustments are necessary. Generally, the adjustments are made in 10° increments with samples sent to the lab for a check prior to making any further adjustments. Although changes must be made for a low color, adjustments are not necessary when the color is high. As long as the results are above the required specifications, no changes are necessary.

As is evident, temperatures in the Reactor section, are of great importance. Another point of interest in this area will be the charge line pressure. Generally, close attention should be paid to this parameter when the charge rate has reached its maximum limits and/or the life of the catalyst is to a point where the pressure differential in the Reactor is at its limit. When these two conditions occur, the charge line pressure will be higher than during routine operations.

When the Reactor pressure drop is high, there is more resistance to the charge entering the Reactor section of the unit. This, therefore, increases the charge line pressure. As indicated in the equipment design area of the manual, the charge line relief valve is set at 400 PSIG. Generally, the pressure will run 40 - 50 PSIG below the relief valve setting. When the conditions mentioned above occur, the pressure on the charge line may reach 390 - 400 PSIG. At this point, the charge should not be allowed to be increased. It may even be necessary to reduce the charge rate to help lower the charge line pressure.