INSTALLATION OF THE KEROSENE MEROX TREATER BY CEYLON PETROLEUM CORPORATION, OIL REFINERY AT SAPUGASKANDA IN ORDER TO SAVE ENERGY

by

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The Ceylon Petroleum Corporation, Oil Refinery went into production in 1969 and commenced production of Aviation Turbine fuel in 1971. The requirement of Illuminating and Aviation Turbine Kerosene (jet fuel) was obtained from the Crude Distillation unit. (Kerosene thus obtained had to be further treated to meet the jet fuel specifications. This was accomplished by treating in a secondary catalytic hydro-desulphurisation process known as unifining. This made use of a reactor containing Cobolt/Molybdenum catalyst operating at 45 bars pressure and 320/350°C temperature. Sulphur, Nitrogen and Oxygen present in various compounds were removed by treating with Hydrogen. This hydrotreating is a highly energy intensive process. Large quantity of hydrogen gas is used up during the reduction. Hydrogen needed is obtained from another process where it is produced as a by-product. Most of this hydrogen could be otherwise utilised as a fuel in the refinery heaters. The kerosene and the hydrogen to be treated were preheated by a heat exchanger train and further heated to reactor temperature by passing through a furnace before entering the reactor. After the reactions, the reactor products which were undesirable had to be removed by stripping which consumed further quantities of energy. The maintenance cost of these equipment was fairly high. The high energy consuming hydrodesulphurisation process appeared becoming still more expensive with the escalation of petroleum fuel prices. From the time the refinery went into production upto 1978 the fuel prices in the world market had risen by about 900%. The cost per ton of fuel oil which was below US $ 8.0 in 1970, had increased to around US $ 70.0 in 1978.

In early 1974, the refinery set up an energy conservation committee and various studies were undertaken by this group. During this stage, all energy intensive processes were scrutinized and it was felt that installation of Kerosene Merox Treater to process kerosene was a possibility.

A series of feasibility studies were carried out and cost estimates were done in this regard during 1978. This process which is licenced by Universal Oil Products Processes (U.O.P) International Inc., of U.S.A. was accepted for installation. The U.O.P. Merox process is used for the Chemical Treatment of petroleum distillates to remove mercaptans

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or to convert mercaptans to disulphides by a process of oxidation. This is based on the ability of an organo-metallic catalyst to promote the oxidation reaction using air as the source of oxygen. This process does not have to depend on Hydrogen as in the case of Hydrotreating. The reactions take place at a temperature of 40 - 45°C as against the relatively high temperature range of 320 - 350°C in the hydrodesulphurisation process, saving a considerable amount of energy.

The overall reaction of the Merox process is :

$2RSH + \frac{1}{2} O_2 \longrightarrow RSSR + H_2O$, where R is a Hydrocarbon chain, saturated or unsaturated. The Merox process used for the heavier boiling fractions like Kerosene/jet fuel streams is referred to as sweetening. This is usually applies to distillates containing mercaptans that cannot be removed completely by caustic extraction.

Getting back to the initial concept of the process, original studies with regard to the installation of the Kerosene Merox Treater were carried out with information supplied by the process Liason and equipment prices given by them. At this stage further study of the process revealed that total project cost could be reduced if fabrication of the large number of pressure vessels required was carried out locally. Study of a similar plant revealed that the expertise and skills available at the refinery could be utilised to fabricate vessels at the refinery thereby reducing the installed cost. The estimated installed cost of a 1000 mt/d Kerosene Merox Treating plant inclusive of initial batch of chemicals and the total royalty payments was rupees 11 million, the foreign component of which was rupees 8.5 million. The pay back period was less than one year. The Cabinet approval was obtained for the expected financial commitments for the installation of the plant during the latter half of 1980. However, the erected cost in 1981 was rupees 4.1 million higher than the estimate of 1978 due to increase in equipment cost following the second energy crisis of 1979. It is to be noted that there had been over 100% increase in fuel prices during this period thus not affecting the pay back period. The estimated U.S. Gulf Coast erected cost of a similar plant was rupees 28 million.

The process design was done by the U.O.P. and detail engineering was carried out by the Refinery Projects Department and approved by the U.O.P. The reactor and all other pressure vessels were fabricated in the refinery. The steel plates required for the fabrication of the pressure vessels were rolled locally. The formed dished heads were purchased from an international supplier selected from quotations received. The construction of the unit was completed in May 1981.

This is a fixed bed type sweetening process where the Merox reagent is supported on an activated charcoal bed. Here the Kerosene is fed into an electrostatic precipitator provided with a continuous caustic wash, in order to bring down the acid number of the feed stock to the reactor. In the reactor, the merox reactions take place. The alkaline medium is provided by a sodium hydroxide injection keeping the kerosene flow unaltered. The reactor product flows into a horizontally placed caustic settler, where gravity separation of acqueous caustic solution takes place. Next is the water wash vessel which uses the demineralised water for the removal of any surfactants in the Kerosene. The salt filter packed with granular rock salt. (NaCl), receives the kerosene from the water wash vessel. Here, the free water entrained in the kerosene streams plus a portion of the dissolved

water are removed. Finally, the product passes through a clay filter containing a bed of Fuller's Earth type clay for the removal of oil soluble surfactants, metal compounds, particulates, corrosion inhibitors and the compounds affecting the thermal stability or water separation related to product specifications. The kerosene thus treated meets the jet fuel specifications.

For commissioning of the unit, the services of a Technical Adviser was obtained from U.O.P. After extensive checking with regard to the Physical condition of the plant, the performance test at 80% design throughout was carried out from 20th to 23rd July 1981, using kerosene feed stock. The kerosene was derived from Iranian Light crude oil for which the unit was designed. The unit was accepted as meeting the process guarantees based on the test run results.

The AVTUR mercaptan sulphur (RSH) specification is 30 ppm. max. and the total sulphur specification is 0.3% wt. max. However, this process does not lower the total sulphur content of the treated product but changes its chemical structure to a non-corrosive form.

With the commissioning of the Kerosene Merox Treater, thus replacing the kerosene hydrodesulphurisation unit, the fuel saving alone was found to be about 1675 MT of standard refinery fuel (SRF) per annum. The total energy saving amounted to aproximately 2775 MT SRF per annum. Taking into consideration the present fuel prices, the reduction in cost of Energy as a result of developing the Kerosene Merox Treater is in the region of rupees 12 million annually. This process unit has been operating quite satisfactorily for the past five years.