

Synopsis of the Project

Petroleum Products are the major requirements in any industry but today they are rapidly depleting. The supply, as expected is decreasing day by day and on the contrary the demand has rapidly increased.

To meet the current and future demands of humanity the petrochemical industry is working continuously on different fields and is coming up with a number of technologies to make alternate forms of fuels. One of these technologies is the up-gradation of *vacuum residue* (VR) obtained from the vacuum distillation unit at temperature greater than 565°C. VR is the waste obtained after the crude oil at different temperatures and extracting every possible useful middle distillate (for e.g. petrol, diesel, kerosene, jet fuel). There are various different techniques to upgrade this VR namely, *Delayed Coking*, *Vis-breaking*, *Fluidized Catalytic Cracking* and *Hydrocracking*.

This project is based on the hydrocracking method wherein, the VR is thermally cracked at very high temperature and pressure in presence of Hydrogen gas. Hydrocracking is used for:

- Prevention of formation of polycyclic aromatic compounds if feedstock has a high paraffinic content.
- Reducing tar formation and impurities
- Preventing the build-up of coke on the catalyst
- Achieving high cetane number fuel
- Converting Sulphur and Nitrogen present in the feedstock to H_2S and NH_3 (Sulphur being one of the major constituents of the VR, H_2S formation is a very important part)

In hydrocracking, the technology used in the project is called slurry hydrocracking as the project title suggests, *slurry phase technology*. This means that the feed to be processed in the reaction is not a regular fluid but slurry which constitutes the vacuum residue mixed with the catalyst and this mixture is called slurry.

The VR is of not much use currently, but if it gets converted into useful fuel while also being economically feasible, it can reduce the high dependency on fossil fuels and can make them last for longer time.

The project consists of reactions performed on a slurry hydrocracker pilot plant and a high batch reactor where different conditions i.e. temperatures and pressures are set and reactions are performed accordingly. The feed used in the project is vacuum residue. The major goal of the project is to check the quality of the product achieved at every condition and also deduce the best condition to perform the cracking at a larger (industrial) scale.

Apart from this project work other reactions have also been performed in this time period which were very different from the highly viscous feed and different catalysts developed by other institutions have also been used as per the requirements. These tasks were a training on how different types of feeds should be handled for residue upgradation purpose.