



Eco-friendly Residue Upgrading Technologies for Refineries

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Abstract: With the increase in population, the demand of useful refinery products is also increasing. As demand is increasing, production and use of these refinery products is giving rise to harmful emissions resulting in various problems for environment as well as humans. This growth in demand - coupled with increasingly stringent sulfur content specifications, is leading in the direction of a shortage in refinery products - particularly those of lower sulfur contents. In order to reduce emissions eco-friendly upgrading technologies are needed. This led to the development of eco-friendly refinery technologies which are suitable for transforming these residues into more useful products and also these processes are environment friendly. The main objective of these residue upgrading technologies the pre-treatment of feedstock for other conversion units, increasing distillates and the production of fuels with a low sulphur content. The major upgrading technologies are Hydrodesulphurisation, Delayed coking, LC-FINING, Residue desulphurization Process, and Solvent deasphalting. These processes are used for upgrading the residue. Also at the same they remove the harmful contaminants such as metals, sulphur, nitrogen etc. which leads to harmful emissions.

Keywords: Residue upgrading technologies, LC Fining, LC Max

I. Introduction

The demand for refined products is increasing worldwide and also is projected to increase significantly in the next 20 years, driven by population growth, and transition of emerging markets into the global economy. Production and use of these refinery products is giving rise to harmful emissions resulting in various problems for environment as well as humans.

In order to reduce emissions eco-friendly upgrading technologies are needed. This led to the development of eco-friendly refinery technologies which are suitable for transforming these residues into more useful products and also these processes are environment friendly. The major upgrading technologies are Hydrodesulphurisation, Delayed coking, LC-FINING, Residue desulphurization Process, and Solvent deasphalting. These processes are used for upgrading the residue. Also at the same they remove the harmful contaminants such as metals, sulphur, nitrogen etc. which leads to harmful emissions. These technologies will also allow these refineries to process larger quantities of heavy, high sulfur, lower priced crudes, resulting in increased profitability.

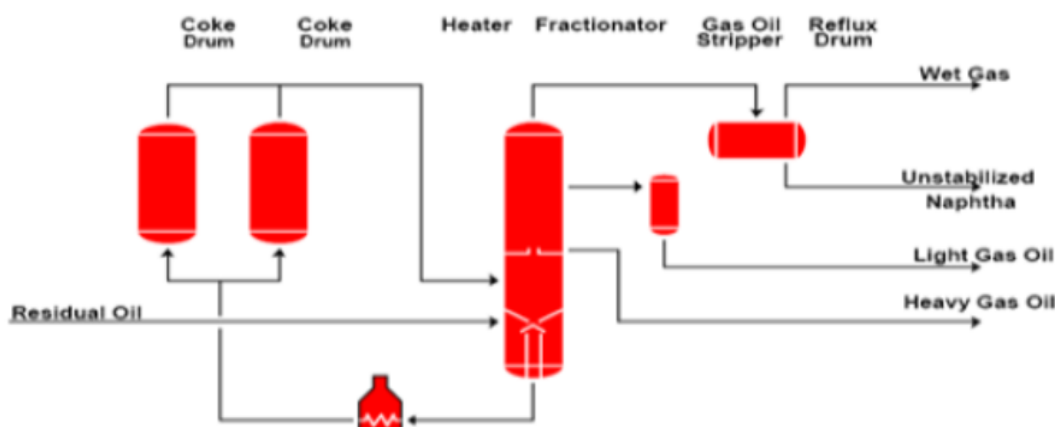
II. Residue Upgrading Technologies

The residue upgradation technologies are developed with a good on-stream factor, to maximise the most valuable product, to handle more difficult crudes and are environmentally compliant to meet future stringent specifications [1][2]. The major Upgrading technologies are: Hydrodesulphurisation, Delayed coking, LC-FINING, Residue Desulfurization(RDS), Solvent Deasphalting(SDA).

A. Delayed Coking

The most widely used residue conversion technology is Delayed Coking. This is particularly valuable when a long-term off take arrangement for coke exists. This is the primary residue conversion process for almost all the refineries all over the worlds except the refineries in Scandinavia, Western Europe, and Eastern Canada, where coking units are not preferred. Advantages of this process are that it can handle very poor quality feed i.e that contains high percentage of contaminants, and also in this process there is no residual product left for further treatment, and also this process is favourable in low price environment[2].

Fig. 1. Flow diagram of Delayed Coking



B. LC Fining Process

The LC-FINING process is a residuum conversion process that hydrocracks the most difficult, heavy, lower-value hydrocarbon streams such as petroleum residua, heavy oils from tar sands, shale oils, etc., to lighter more valuable products such as VGO, diesel, and naphtha.

The process features high distillate yields and high heteroatom and metals removal, and is an efficient way of handling petroleum bottoms and other heavy hydrocarbons. The LC-FINING process hydrocracks heavy vacuum residue feeds to lighter distillates while simultaneously removing sulfur, nitrogen, micro-carbon residue (MCRT), and metals containing species.

C. Residue Desulphurisation Process

Residue Desulfurization is a fixed bed process that has multiple beds of catalyst to remove metals, nitrogen and sulphur from petroleum residua in the presence of hydrogen. The process is normally used to produce low sulphur fuel oil or to produce a feed stream that is suitable for cracking in a residue FCC (RFCC) unit.

D. Solvent Deasphalting Process

When the residue contains high concentration of asphaltene, which can be solvent deasphalted by a separation process called Solvent deasphalting [5][6]. Solvent deasphalting (SDA) is a unique separation process in which residue is separated by molecular weight (density) instead of by boiling point. Solvent deasphalting has the advantage of being a relatively low cost process that has flexibility to meet a wide range of DAO qualities. Solvent Deasphalting Process is useful in recovering large quantities of high quality oils which can be further upgraded via traditional FCC and Hydrocracking units [3].

E. LC Max Process

CLG developed the LC-MAX process to alleviate conversion constraints resulting from feedstock quality and/or fractionator fouling limitations. This process combines LC-FINING and solvent deasphalting (SDA) in an integrated hydroprocessing configuration. With LC-MAX residue conversions ranging from a minimum of 80 up to 90 percent can be attained, even when processing very difficult high sediment forming feeds such as Russian Export crude (Urals) or South American and Canadian heavy crudes like Hamaca or Cold Lake [4]

The LC-MAX process provides an efficient cost effective solution for achieving high residue conversions. By rejecting asphaltenes in the SDA pitch residue conversions of 85 volume percent can be attained even when processing very difficult high sediment forming opportunity crudes. With LC-MAX high conversion levels can be attained with reduced reactor volume, catalyst addition rate and hydrogen consumption than required by slurry hydrocracking processes. The LC-MAX process concept has been thoroughly vetted through extensive pilot plant testing and is ready for commercialization [4].

III. Conclusion

Major upgrading processes such as Delayed Coking, Desulphurisation, LC Fining etc. not only upgrade the residue but also removes harmful contaminants. These technologies also allows Refineries to process larger quantities of heavy, high sulfur, lower priced crudes, resulting in increased profitability. LC-FINING when combined with Delayed coking can handle very difficult (sourer, low quality) feed. Residue desulfurization process is relevant when there is a high premium for low sulphur fuel oil and there is high demand for gasoline.

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