Chapter 4
Advanced Catalysis and Processes to Convert Heavy Residues Into Fuels and High Value Chemicals

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ABSTRACT

The petroleum refining process begins with distillation, first at atmospheric pressure and after at reduced pressure. The volatile fractions, in both cases, have greater economic value, and the distillation residue-produced atmospheric residue and vacuum residue represent a significant portion of a barrel of crude. The need to convert bottom of the barrel into cleaner and more valuable olefins and liquid products is continuously increasing. Thus, residue must be converted into more valuable products, and further processes can be employed for upgrading residue. Examples are delayed coking, visco-reduction, and fluidized catalytic cracking.

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On the other hand, the optimization of refining facilities to deal with such feeds brings economic competitiveness since these oils have low prices in the international market. Studies on processes and catalytic cracking are quite important under this aspect. The conversion of heavy petroleum fraction into valuable liquid products and high value chemicals has been important objectives for upgrading heavy petroleum oils.

INTRODUCTION

The petroleum refining process begins with distillation, first at atmospheric pressure and after at reduced pressure. The volatile fractions, in both cases, have greater economical value and the distillation residues produced – atmospheric residue and vacuum residue represent a significant portion of a barrel of crude. The need to convert bottom of the barrel into cleaner and more valuable olefins and liquid products is continuously increasing. Thus, residue must be converted into more valuable products and further processes can be employed for upgrading residue. Examples are delayed coking, visco-reduction and fluidized catalytic cracking. On the other hand, the optimization of refining facilities to deal with such feeds brings economical competitiveness, since these oils have low prices in the international market. Studies on processes and catalytic cracking are quite important under this aspect. The conversion of heavy petroleum fraction into valuable liquid products has been one of the important objectives for upgrading heavy petroleum oils (Corma, 2017). At present this conversion is mainly achieved by thermal cracking, catalytic cracking and hydro-cracking.

ATMOSPHERIC DISTILLATION RESIDUE

Crude petroleum as it is produced from the field is a relatively low-value material since, in its native state, it is rarely usable directly. Due to the presence of contaminants such as sulfur, heavy metals and asphaltenes (Sahu, 2015) .However, it can be refined and further processed into any number of products whose value is many times that of the original oil.

The first step in any petroleum refinery is the separation of the crude into various fractions by the process of distillation. These fractions may be products in their own right or may be feed-stocks for other refining or processing units.

In most refineries, this process is carried out in two stages; the oil is first heated to the maximum temperature allowable for the crud being processed and for the operation being practiced and then fed to a fractionating tower which operates at

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