Abstract

Process Economics Program Report 211B

HYDROCRACKING OF HEAVY OILS AND RESIDUA

(December 2008)

Hydrocracking of heavy oils and residua is increasingly import to refiners due to increased global production of heavy and extra heavy crude oils coupled with increased demand worldwide for low sulfur middle distillates and residual fuel oils. Upgrading bitumen into synthetic crude oil (SCO) is of great current and future interest due to the planned and forecast large expansion of Canadian tar sands production and subsequent bitumen upgrading by hydrocracking into SCO.

Hydrocracking of residual oils mainly increases the production of high quality middle distillates for blending into jet and diesel fuels while reducing the volume of low value, high sulfur residual fuel oil. Hydrocracking increases the degree of saturation of the products which increases product quality, for example, the diesel fuel's cetane number. Recent interest is the integration of hydrocracking with hydrotreating of the hydrocracked products to produce either very low sulfur middle distillates or low sulfur SCO valued at a premium to many conventional crude oils. Capital and operating costs of the integrated plant is lower than two separate plants.

This PEP Report provides an overview of the heavy oil hydrocracking process, feed and product supply and demand, hydrocracking chemistry, catalysts and hardware technology since PEP Report 228, *Refinery Residue Upgrading*, issued in 2000. We then develop process economics for two bitumen upgrading processes that both integrate hydrocracking with hydrotreating of the hydrocracked gas oil and lighter products to produce SCO. The first process hydrocracks vacuum residue in ebullated bed reactors in a single stage without heavy oil recycle. Bitumen derived naphtha and gas oils from the crude unit are also charged to the single stage hydrotreating section of this plant. The second process hydrocracks atmospheric residue in a slurry reactor with a portion of the residue oil recycled to the hydrocracking reactor. Two-stage hydrotreating is used. Both processes use conventional fixed bed hydrotreating reactors.

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CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Concluded)

FIGURES

FIGURES (Concluded)

TABLES

TABLES (Continued)

TABLES (Continued)

TABLES (Concluded)