

**Abstract**  
**Process Economics Program Report 211B**  
**HYDROCRACKING OF HEAVY OILS AND RESIDUA**  
**(December 2008)**

Hydrocracking of heavy oils and residua is increasingly important 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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# HYDROCRACKING OF HEAVY OIL AND RESIDUA

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## CONTENTS

<b>GLOSSARY</b> .....	<b>xiv</b>
<b>1 INTRODUCTION</b> .....	<b>1-1</b>
<b>2 CONCLUSION</b> .....	<b>2-1</b>
<b>3 SUMMARY</b> .....	<b>3-1</b>
COMMERCIAL ASPECTS .....	3-1
TECHNICAL ASPECTS .....	3-2
ECONOMIC ASPECTS .....	3-4
<b>4 INDUSTRY STATUS</b> .....	<b>4-1</b>
PROCESSING BITUMEN .....	4-3
SYNTHETIC CRUDE OIL.....	4-4
CRUDE OIL SUPPLY .....	4-5
Conventional Crude Oil Supply .....	4-5
Synthetic Crude Supply .....	4-6
RESIDUAL OIL MARKET .....	4-7
MIDDLE DISTILLATE MARKETS .....	4-9
Product Demand.....	4-9
Price Trends .....	4-13
PRODUCT SPECIFICATIONS.....	4-15
Diesel Fuels.....	4-15
Premium Diesel Fuel .....	4-19
Diesel Fuel Additives .....	4-20
Distillate Fuel Oils.....	4-24
Gas Turbine Fuel Oils.....	4-25
Jet Fuel .....	4-26
Kerosene .....	4-27

## CONTENTS (Continued)

Residual Fuels .....	4-27
CATALYTIC METAL PRICES .....	4-28
INSTALLED RESID HYDROCRACKING CAPACITY .....	4-31
New Construction .....	4-35
<b>5 GENERAL PROCESS REVIEW .....</b>	<b>5-1</b>
CANADIAN CRUDE OILS .....	5-1
FEEDSTOCK CHARACTERIZATION .....	5-5
Analytical Techniques.....	5-5
Resid Composition .....	5-7
Asphaltenes.....	5-11
Unit Structure.....	5-13
Characteristics.....	5-13
Sulfur and Nitrogen.....	5-16
CHEMISTRY.....	5-18
Reactions.....	5-18
Thermal Hydrocracking .....	5-21
Mechanism for Paraffins.....	5-22
Ring Opening.....	5-23
Mercaptan Recombination .....	5-24
Sediments and Heavy Polynuclear Aromatics .....	5-25
Thermodynamics .....	5-27
Kinetics .....	5-30
CATALYSTS.....	5-37
Mechanism .....	5-38
Commercial Catalysts.....	5-40
Advanced Catalysts.....	5-42
Carbon Substrate .....	5-42

## CONTENTS (Continued)

Pillared Clay .....	5-43
Cobalt Saponite .....	5-44
NiMo/Ti Zeolite .....	5-44
Limonite .....	5-45
<b>6 RESIDUE HYDROCRACKING PROCESS REVIEW .....</b>	<b>6-1</b>
HYDROTREATING VERSUS HYDROCRACKING .....	6-1
REACTORS .....	6-3
Fixed Bed Reactors .....	6-4
Ebullating Bed Reactors .....	6-4
Slurry-Phase Reactors .....	6-6
TYPES OF HYDROCRACKING PROCESS .....	6-6
HEAVY OIL HYDROCRACKING PROCESSES .....	6-7
H-Oil <sub>RC</sub> .....	6-8
H-Oil <sub>DC</sub> .....	6-10
LC-Fining .....	6-11
ISOFINING .....	6-13
KOBELCO SPH .....	6-13
UOP Slurry Hydrocracking Process .....	6-15
(HC) <sub>3</sub> <sup>TM</sup> Technology .....	6-15
Veba Combi-Cracking Process .....	6-16
CANMET .....	6-16
Micorcat-RC Process .....	6-18
MRH Process .....	6-20
Residue Hydroconversion Process .....	6-21
China University of Petroleum Slurry-Bed Process .....	6-23
ALTERNATIVE HYDROGEN SOURCES .....	6-23
OPERATING CONDITIONS .....	6-24

## CONTENTS (Continued)

LHSV .....	6-24
Recycle .....	6-24
Slurry Process Conditions .....	6-26
YIELDS .....	6-32
DESIGN CONSIDERATIONS .....	6-34
Reactors .....	6-34
Internals .....	6-35
Quench Zone .....	6-35
Gas Separation .....	6-35
Liquid Product Separation .....	6-36
Corrosion .....	6-36
Catalyst Unloading .....	6-37
Environmental Considerations .....	6-37
<b>7 VACUUM RESIDUE HYDROCRACKING ECONOMICS.....</b>	<b>7-1</b>
PROCESS DESCRIPTION .....	7-1
Hydrocracking Section (100) .....	7-2
Hydrotreating Section (200) .....	7-20
Hydrocracking Section (300) .....	7-21
PROCESS DISCUSSION.....	7-21
Feedstock .....	7-21
Hydrocracking Sections (100 and 300) .....	7-22
Hydrotreating Section (200) .....	7-22
Hydrogen System .....	7-22
Materials of Construction.....	7-23
Waste Treatment and Disposal .....	7-23
COST ESTIMATES .....	7-23
Capital Costs .....	7-24

## CONTENTS (Concluded)

Production Costs .....	7-27
Profitability .....	7-30
<b>8 ATMOSPHERIC RESIDUE HYDROCRACKING ECONOMICS .....</b>	<b>8-1</b>
PROCESS DESCRIPTION .....	8-1
Hydrocracking Section (100) .....	8-2
Hydrotreating Section (200) .....	8-2
PROCESS DISCUSSION.....	8-19
Feedstock .....	8-19
Hydrocracking Sections (100 and 300) .....	8-19
Hydrotreating Section (200) .....	8-19
Hydrogen System .....	8-20
Materials of Construction.....	8-20
Waste Treatment and Disposal .....	8-20
COST ESTIMATES .....	8-20
Capital Costs .....	8-20
Production Costs .....	8-24
Profitability .....	8-27
<b>APPENDIX A: PATENT SUMMARY TABLES.....</b>	<b>A-1</b>
<b>APPENDIX B: DESIGN AND COST BASES .....</b>	<b>B-1</b>
<b>APPENDIX C: CITED REFERENCES.....</b>	<b>C-1</b>
<b>APPENDIX D: PATENT REFERENCES BY COMPANY.....</b>	<b>D-1</b>
<b>APPENDIX E: PROCESS FLOW DIAGRAM .....</b>	<b>E-1</b>



## FIGURES

4.1	Refinery Residue Hydrocracking.....	4-2
4.2	World Demand for Residual Fuel Oil.....	4-8
4.3	Distribution U.S. Sales of Middle Distillate Fuel Oils by End Use, %.....	4-10
4.4	U.S. Middle Distillate Sales .....	4-11
4.5	Historical U.S. Fuel Oil Price .....	4-13
4.6	European, Asian and U.S. Diesel Fuel Prices.....	4-14
4.7	Price History of Molybdenum, 1997 - 2007 .....	4-28
4.8	Price History of Nickel, 1997 - 2007 .....	4-29
4.9	Price History of Cobalt, 1997 - 2007 .....	4-29
4.10	World Residue Hydrocracking Refineries, Number Distribution .....	4-34
4.11	World Residue Hydrocracking Refineries, Capacity Distribution .....	4-35
5.1	Molecular Evolution in the Hydrotreating Reactor.....	5-20
5.2	Molecular Evolution in the Hydrocracking Reactor .....	5-21
5.3	Cetane Number Improvement by Ring Opening.....	5-23
5.4	Postulated Reaction Mechanism for Fluoranthene Hydroconversion.....	5-24
5.5	Hydrocracking Reaction Chain for Polyaromatics and Naphtheno- Aromatic Compounds .....	5-32
5.6	Seven Lump Kinetic Reaction Model for Hydrocracking Vacuum Residue Feedstock .....	5-36
6.1	Schematic Representation of the H-Oil Ebullating Bed Reactor.....	6-5
6.2	LC-Fining Ebullating Bed Reactor .....	6-6
6.3	H-Oil <sub>RC</sub> Process .....	6-9
6.4	H-Oil <sub>DC</sub> Process .....	6-11
6.5	LC-Fining Process .....	6-12
6.6	Kobelco SPH Process .....	6-14
6.7	Canmet Process .....	6-17
6.8	Microcat-RC Process .....	6-19
6.9	MRH Process .....	6-20

## FIGURES (Concluded)

6.10	The Residue Hydroconversion (RHC) Process .....	6-22
7.1	Vacuum Residue Hydrocracking.....	E-3
8.1	Atmospheric Residue Hydrocracking by Slurry Process.....	E-7

## TABLES

3.1	Summary of Cost Estimates for Hydrocracking VR and AR .....	3-5
4.1	Typical Bitumen from Thermal Production .....	4-3
4.2	Refinery Constraints and Modifications for Oil Sands Crude Processing .....	4-5
4.3	World Crude Oil Supply by Region.....	4-6
4.4	Forecast U.S. Residual Fuel Oil Price and Consumption .....	4-9
4.5	World Demand for Middle Distillates .....	4-12
4.6	ULSD Fuel Implementation Schedule .....	4-15
4.7	Diesel Fuel Grades.....	4-16
4.8	Relationship of Diesel Fuel Properties to Composition and Performance Property .....	4-17
4.9	ASTM D975 and Carb Requirements for Diesel Fuel Oils.....	4-18
4.10	European Automotive Diesel Fuel Specifications (EN 590).....	4-19
4.11	NCWM Premium Diesel Property Requirements .....	4-20
4.12	Types of Diesel Fuel Additives .....	4-21
4.13	Common Diesel Fuel Additive Types and Predominant Blend Locations.....	4-23
4.14	ASTM D396 - Detailed Requirements for Fuel Oils .....	4-24
4.15	ASTM D2880 - Detailed Requirements for Gas Turbine Fuel Oils .....	4-25
4.16	ASTM D1655 - Detailed Requirements of Aciation Turbine Fuel.....	4-26
4.17	ASTM D3699 - Detailed Requirements for Kerosene .....	4-27
4.18	World Hydrocracking Capacity Summary, B/CD (Number of Refineries) .....	4-31
4.19	Residue Hydrocracking Refineries Capacities.....	4-32
4.20	Residue Hydrocrackers - Global Distribution of Capacities .....	4-34
4.21	Announced New Hydrocracking Construction Projects .....	4-36
5.1	Typical Canadian Crude Oil and Resid Properties .....	5-2
5.2	Properties of Parent Cnadian Crude Oils.....	5-3
5.3	Sulfur and Nitrogen Analysis of Sara Fraction of Canadian Crude Oils .....	5-3
5.4	Properties of Heavy Crude Oils and Athabasca Bitumen and Resids .....	5-4
5.5	Yields of Atmospheric and Vacuum Residue from Different Heavy Crude Oils....	5-5

## TABLES (Continued)

5.6	Summary of the Analytical Procedures Used for Characterization of Heavy Oil Fractions .....	5-6
5.7	Characteristics of Four Petroleum Residues.....	5-7
5.8	Modified Sara Analysis of Vacuum Residues from Chinese and Middle Eastern Crudes .....	5-7
5.9	Properties of Three Vacuum Bottoms from Canadian Crude Oils .....	5-8
5.10	Components of Vacuum Residues (WT% on Heavy Oil/Bitumen) .....	5-9
5.11	Characteristics of Athabasca Bitumen Vacuum Fractions Obtained by Supercritical Fluid Extraction .....	5-9
5.12	Characterization of SFEF Residue End Fraction and Whole Residue .....	5-10
5.13	Characterization of Asphaltenes from Saudi Arabian Heavy and Medium Crude Oils.....	5-12
5.14	Characterization of Asphaltenes from Vacuum Residue from Selected Crude Oils.....	5-14
5.15	Hydrocracking Conversion of Asphaltenes from Three Sources .....	5-15
5.16	Bulk Properties and Summary of Sulfur and Nitrogen Species in HVGO and DMO.....	5-17
5.17	Thermal Hydrocracking of Polyaromatics Derived from Cold Lake Vacuum Bottoms.....	5-21
5.18	Elemental and Metal Analysis of Sediments and Vacuum Residue Asphaltenes	5-26
5.19	Yields of Solvent Defined Sediment Fractions .....	5-27
5.20	Thermodynamics of Major Hydrocracking Reactions .....	5-28
5.21	Bond Dissociation Energies .....	5-29
5.22	Hydroprocessing Reactions and Enthalpy of Reaction.....	5-29
5.23	Rate Constants for Hydrocracking of Maya Atmospheric Residue .....	5-31
5.24	Relative Reaction Rates for Groups of Hydrocracking Reactions Shown in Figure 5.5.....	5-33
5.25	Reaction Rate Constants and Activation Energies for Reactions During Hydrocracking of Ural Vacuum Residue .....	5-35
5.26	Rate Constants and Kinetic Parameters for Hydrocracking of Vacuum Residue Over Slurried Pyrite Catalyst and Slurried Mixed Pyrite and Activated Carbon Catalyst.....	5-37

## TABLES (Continued)

5.27	Effect of Particle Size and Shape on Hydrodesulfurization Activity .....	5-40
5.28	Commercial Heavy Oil Hydrocracking Catalysts .....	5-41
5.29	Properties of Feedstock and Products .....	5-45
5.30	Properties of Limonite.....	5-46
5.31	Characterization of Offshore Brazil Marlim Vacuum Residue .....	5-46
5.32	Comparison of Limonite Catalysts for Hydrocracking Activity and Yields.....	5-47
5.33	Slurry Hydrocracking of Marlim Vacuum Residue Results .....	5-48
6.1	Range of Partial Pressure and Conversion for Hydrotreating and Hydrocracking	6-2
6.2	Types of Reactors for Hydroconversion of Residues.....	6-3
6.3	H-Oil Process Feedstock and Product Data .....	6-10
6.4	LC-Fining Process Product Yields from Residues from Arabian Light and Heavy Crude Oils .....	6-12
6.5	Properties of Atmospheric Topped Bitumen and Kobelco SPH Product Yields and Properties .....	6-15
6.6	Vera Combi-Cracking Process Yields .....	6-16
6.7	Canmet Process .....	6-17
6.8	Microcat Process Yields from Hydrocracking Cold Lake Heavy Oil Vacuum Residuum .....	6-19
6.9	MRH Process Feedstock and Product Data .....	6-21
6.10	RHC Process Yields .....	6-22
6.11	Jobo - Morichal Vacuum Residue Feed and First Pass Product Properties.....	6-25
6.12	Properties of Vacuum Residue Product After Successive Recycle Reactor Passes .....	6-26
6.13	Effect of LHSV on Slurry Hydrocracking of Ural Vacuum Residue .....	6-28
6.14	Effect of Temperature on Slurry Hydrocracking of Ural Vacuum Residue.....	6-30
6.15	Effect of Hydrogen Partial Pressure on Slurry Hydrocracking of Ural Vacuum Residue.....	6-31
6.16	Conditions and Yield Data on Hydrocracking Middle East Residue .....	6-32
6.17	Resid Hydrocracking Yields by the LC-Fining Process.....	6-33

## TABLES (Concluded)

6.18	Ural Vacuum Residue Yields from H-Oil Process .....	6-33
7.1	Design Bases and Assumptions.....	7-3
7.2	Feedstock and Product Characterizations .....	7-5
7.3	Bitumen Vacuum Residue Hydrocracking Stream Flows.....	7-6
7.4	Bitumen Vacuum Residue Hydrocracking Process Major Equipment .....	7-16
7.5	Bitumen Vacuum Residue Hydrocracking Process Utilities Summary.....	7-19
7.6	Bitumen Vacuum Residue Hydrocracking Process Total Capital Investment.....	7-25
7.7	Bitumen Vacuum Residue Hydrocracking Process Capital Investment by Section.....	7-26
7.8	Bitumen Vacuum Residue Hydrocracking Process Production Costs .....	7-28
7.9	Effect of SCO Market Value on Pretax ROI .....	7-30
8.1	Design Bases and Assumptions.....	8-3
8.2	Feedstock and Product Characterizations .....	8-5
8.3	Bitumen Atmospheric Residue Hydrocracking Stream Flows.....	8-6
8.4	Bitumen Atmospheric Residue Hydrocracking Major Equipment .....	8-16
8.5	Bitumen Atmospheric Residue Hydrocracking Utilities Summary.....	8-18
8.6	Bitumen Atmospheric Residue Slurry Hydrocracking Total Capital Investment.....	8-22
8.7	Bitumen Atmospheric Residue Slurry Hydrocracking Capital Investment by Section.....	8-23
8.8	Bitumen Atmospheric Residue Slurry Hydrocracking Production Costs .....	8-25
8.9	Effect of SCO Market Value on Pretax ROI .....	8-28