Creating Value from the Bottom-of-the-Barrel

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A Century of Innovation in the Oil and Gas Industry

1914 - 2014
Emerging Market Trends

- Increasing demand for diesel
- Declining demand for fuel oil
- Renewed interest in “opportunity crudes”
- More-restrictive product specifications
- Interest in bottoms upgrading/conversion processes
- Potential need for multi-unit solutions

UOP’s review of the last 24 refinery complex engagements indicated 22 included bottom upgrading technologies
UOP BOTB Technology Portfolio

Transport Fuels:
- Gasoline
- Jet Fuel
- Diesel

Distillation
- Naphtha

Distillates

Naphtha HDT & Reforming

FCC or HCU

Distillate HDT

Vacuum Gas Oil

Crude Oil

Residue Conversion

Vacuum Residue

Residues:
- Heavy Fuel Oil
- Pitch
- Coke

Transport Fuels:
- Gasoline
- Jet Fuel
- Diesel

UOP Solutions for Residue Conversion

- UOP RCD Unionfining™ Process
- UOP/FWUSA SDA Process
- FWUSA SYDEC™ Delayed Coking Process
- UOP/FWUSA Visbreaking
- UOP Uniflex™ Process
The Evolution of UOP’s Bottom-of-the-Barrel Portfolio

Marked by development, acquisitions, alliances and mergers:

- UOP/Unocal hydrocracking alliance/merger
- UOP/EMRE premium lubes and fuels alliance
- UOP/Unocal residue hydrotreating merger
- UOP/NRCan’s Uniflex™ alliance
- UOP/Albemarle hydrotreating catalyst alliance
- UOP/FW Visbreaking merger
- UOP/FW SYDEC™ marketing alliance
- UOP/FWUSA SDA merger
- UOP/PCS CDU/VDU alliance

Multi-technology solutions have included:

- Residue hydrotreating + RFCC
- SDA + Hydrocracking
- SDA + DAO Hydrotreating + RFCC
- SDA + Coking
Highlights of UOP’s Bottom-of-the-Barrel Portfolio

Separation Technologies

• UOP/PCS CDU/VDU Alliance
  – Fractionation is critical to BOB processing
  – PCS is world’s leader in CDU/VDU design and revamps
  – >130 designs (>10 MMBPSD on-stream capacity)
  – Unsurpassed experience in heavy crude, bitumen and synthetic crude processing and high-capacity designs

• UOP/FWUSA SDA Technology Merger
  – Merger of UOP’s and FW’s separate SDA technologies
  – Recovers incremental feedstock for FCC and HC units
  – 50+ years of commercial experience
  – 7 designs completed in last 10 years
  – Recently commercialized new extractor design and extractor internals
Highlights of UOP’s Bottom-of-the-Barrel Portfolio

Thermal Processing

• UOP/FW Visbreaking Merger
  – 120+ combined years of thermal processing experience
  – Coil and soaker configurations
  – Utilizes FW-proprietary heater designs
  – 5 designs completed in last 10 years

• UOP/FW SYDEC℠ Coking Marketing Alliance
  – UOP offers FW SYDEC coking technology
  – SYDEC is the world’s most-widely used coking technology
  – Utilizes FW-proprietary terraced wall heater design
  – 70+ revamps completed in last 10 years
  – 40+ new unit designs completed in last 5 years
Highlights of UOP’s Bottom-of-the-Barrel Portfolio

Hydroprocessing Technologies

• UOP RCD Unionfining™ Technology
  – Hydrotreats residue feedstocks (AR, VR and DAO)
  – Pretreats feeds for HC, FCC, RFCC and coking units
  – Result of 1995 merger of UOP and Unocal technologies
  – First unit (1967), most-recent (2014)
  – 2006 catalyst alliance with Albemarle/Nippon Ketjen

• UOP Uniflex™ Technology
  – Slurry hydrocracking for residue feedstocks
  – Based on NRCan’s CANMET Hydrocracking process and UOP’s Unicracking™ and Unionfining™ technologies
  – Achieves 90% conversion
  – Produces 60% diesel yield
  – Eliminates heavy fuel oil production
  – 5 units have been licensed
So, how does all this benefit you?

**Example of Multi-Unit Optimization**

- Refiner was considering residue hydrotreating/RFCC project and had specified operating severities of both process units.
- UOP provided an optimized combined residue hydrotreating/RFCC offering based on our single-source capabilities and knowledge of:
  - interactions between the two technologies,
  - their yield/product and CAPEX/OPEX relationships, *and*
  - the most efficient use of hydrogen.
- UOP’s evaluation revealed the optimal combination of residue hydrotreating and RFCC operating severities and flowschemes allowed the refiner to...

- **Reduce project CAPEX by 7%,**
- **Increase project IRR by 10%,** and
- **Improve project NPV by 25%**
So, how does all this benefit you?

Example of Investment Planning and Configuration Design

- Refiner was considering impact of future MARPOL bunker specs
- Existing refinery:
  - Had limited BOB capabilities
  - Sold excess residue as HS bunker
  - Was short on diesel yield
- UOP’s initial assessment indicated:
  - New specs couldn’t be met by reformulating refinery’s current bunker blend,
  - Residue hydrotreating alone might meet interim specs, but not MARPOL’s ultimate specs or ECA bunker specs,
  - Any shift to a diesel-based bunker would put strain refiner’s ability to satisfy either current or future diesel demands, and
  - Refiner would benefit from technologies, or combinations of technologies, designed to produce diesel from residue feedstock

Refiner requested additional information relating to what technologies, or technology combinations, may be required
BOB Flow Schemes Evaluated

Implications

- LSFO production depends on feed quality
- High-pressure hydrotreating unit
- Hydrogen added to fuel oil product
- Limited diesel production

- Lower-pressure hydroprocessing unit
- Reduced hydrogen requirement
- Pitch by-product
BOB Flow Schemes Evaluated

Implications

- No fuel oil product
- Coke by-product
- Direct diesel production
- HCGO to HC for diesel

Option 4
- Coker
  - Diesel HCGO
  - Coke

Option 5
- Solvent Deasphalting
  - Pitch
- Coker
  - Diesel HCGO
  - Coke
- DAO

Option 6
- Uniflex
  - Diesel
  - Pitch

- No fuel oil product
- Pitch by-product
- High conversion (>90%)
- High diesel yield (60%)
- More efficient hydrogen usage
Product and By-Product Yields from Bottom-of-the-Barrel Configurations

- Multi-unit, phased investment solutions to meet Marpol specifications could include SDA, residue hydrotreating, coking, hydrocracking and slurry hydrocracking technologies.
- Uniflex technology provides significantly higher liquid yields, lower by-product yields and an extremely diesel-selective product distribution.
Summary

- For >100 years UOP has maintained a unique technology position with the refining and petrochemical industries.
- UOP clients benefit from our ability to provide proven Bottom-of-the-Barrel technology solutions.
- The full value of a Bottom-of-the-Barrel project can only be achieved with a technology partner fully capable of designing and integrating each of the required technologies.
- UOP’s single-source capabilities minimize risk while accelerating project implementation.

Align with a partner who brings state-of-the-art technologies to your next project!