BIOGRAPHY

Daniel Gillis
UOP, LLC

Dan Gillis is the Business Manager, Heavy Oil in the Refining Business Group at UOP, LLC. Dan is accountable for the Product Line Management and Technology Sales coordination of UOP’s current and emerging Heavy Oil technologies, including the commercialization of UOP’s Uniflex Process. At UOP, Dan has had roles in Technology Sales Support, predominately Heavy Oil, and more recently management of Engineering and Sales Support functions for Clean Fuels, Heavy Oil, and Gas Processing technologies. He joined UOP in 1995 after working in the Refining and Oil Sands Industries in operations and process engineering, followed by project and business development roles. Dan is a 1977 engineering graduate of the University of Saskatchewan, Canada.

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ABSTRACT

Breaking Though the Bitumen Upgrading Barriers with the UOP Uniflex™ Process

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Bitumen upgrading has never before been challenged as it is today. Justification in today's environment to install conversion and hydroprocessing facilities, whether at the production site or self supporting upgrading plants, is difficult due to the high capital investment requirements, expected modest rates of return, and unclear future product prices. Further challenging justification of these projects is that the yields from conventional processes such as coking and ebullated bed hydrocracking are much lower than desired. Consequently, to justify upgrading there is a need for processes that can maximize conversion and selectively produce transportation boiling range products, especially distillates. Not only is there a technical challenge to provide a reliable high-conversion technology, there is a commercial financing challenge, due to the risk averseness of the investment community in what is perceived as “new” technology.

UOP has responded to this market situation with the UOP Uniflex Process, a commercially based, high-conversion residue upgrading process that selectively converts residues from both conventional crude oils and bitumen to transportation fuels, especially distillates, and high quality synthetic crude oil.

This presentation will explain the technology features, commercialization background, and how this technology meets the challenges of significantly improving the profitability of upgrading while managing the technical and commercial concerns when applying new technologies. Also discussed are recent advances being developed by UOP under the AERI Hydrocarbon Upgrading Demonstration Program, including catalyst, engineering design and residue byproduct utilization. UOP's latest flow scheme options, especially for applications with existing residue upgrading technologies, are presented.
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Bitumen Upgrading Challenges

- Product Yields and Qualities
- Byproduct Disposal
- Expansion of Existing Assets
- Return on Investment
- Project Financing
Strong Incentive for High Conversion Technologies

Source: 2008 FACTS Global Energy
High Conversion Technology Barriers

- Technical Issues
- Commercialization Status
- Costs
- Technology Support
- Risk Management
UOP Uniflex Process

- Up flow high temperature and pressure reactor
- Hydrogen and proprietary dispersed phase catalyst added to the feed
- Results in high conversion to desired products

Contains elements of proven processes
- Commercialized CANMET Hydrocracking Process
- UOP Unionfining™ and Unicracking™ Processes

Uniflex Process has a 26 vol% yield advantage!
CANMET Hydrocracking Process Background

- Supported by 25 years of R&D
- Technology owned by Natural Resources Canada
- Commercially proven high conversion on a wide range of feedstocks
- UOP acquired exclusive licensing rights in 2007

Petro-Canada Montreal Unit

- 15 years of operation
- Achieved 95% conversion
- Processed many vacuum residues
- Also processed VGO, Visbroken Vacuum Residue, FCC Slurry Oil
- Long term operational learning curve
- 97%+ availability
Product Yields Drive Economic Advantages

Uniflex Process focus is on medium to high conversion with high process reliability!
UOP is Advancing the Technology

- Best Practices from CANMET Experiences
- Advanced Pilot Plants
- New Catalysts
- Flow Scheme and Equipment Improvements
- Pitch Product Options
Alberta Energy Research Institute (AERI)

- Energy technology arm of the Alberta Government
- Partners with industry to develop technologies of strategic importance

Hydrocarbon Upgrading Demonstration Program (HUPD)

- Phase 1: Screened over 100 technologies for upgrading bitumen
- Phase 2: UOP Uniflex Process was selected for further development and demonstration
- AERI providing financial support

**AERI support is helping to enable technology advances**
Petro-Canada Montreal Unit Yields

Vacuum Residue Conversion, wt%

Product Yields, vol%

- Diesel
- VGO
- Naphtha

UOP 5228-10
UOP Pilot Plant Yields Match Petro-Canada Montreal Unit Yields

Vacuum Residue Conversion, wt%

Product Yields, vol%

Diesel

VGO

Naphtha
Key Equipment designed to assure Product Stability and avoid Equipment Fouling

UOP Uniflex Process Basic Flow Scheme
UOP Uniflex Process with Heavy Vacuum Gas Oil Recycle

- Feed
- Catalyst
- Hot Flash Drum
- Cold Flash Drum
- Stripper/Product Fractionator
- Fractionator Heater
- Vacuum Fractionator
- Naphtha
- Diesel
- LVGO
- HVGO
- Pitch
- Makeup $H_2$
- HVGO Recycle
- Recycle Gas Heater
- Feed Heater
- Hot Separator
- Cold Separator
- $C_4^-$
- Naphtha
- Diesel
- LVGO
- HVGO
- Pitch
- UOP 5228-13
Poly-aromatics ideal for reducing mesophase by improving asphaltene solubility

UOP Uniflex Process
Heavy Vacuum Gas Oil
Significant improvement in VGO quality to downstream FCC and Hydrocracking
Pitch Product Utilization

- End uses include:
  - Cement kilns
  - Fluidized bed boilers
  - Conventional boilers
  - Gasification
  - Delayed coking
  - Solvent deasphalting

- Can be handled in:
  - Liquid form for nearby uses
  - Solidified for transportation to distant markets

*UOP can assist customers for all applications*
UOP Uniflex Process Creates Additional Opportunities

- Heavier Crude Processing
- FCC Slurry Oil Conversion
- Hydroprocessing Integration
- Synergies with other Residue Processes
  - Solvent Deasphalting
  - Delayed Coking
  - Residue Hydrotreating
Integration can reduce Costs
Benefits are Project Specific

- Several integration options are possible
- Best flow scheme depends on product objectives
- Project specific issues need to be considered
Fractionation Approach has Implications

- Yields are impacted by both process conversion and fractionation approach
- Maximizing conversion and product recovery can lead to equipment reliability issues
- Uniflex Process has addressed these issues with:
  - Flow scheme and equipment designs that manage product stability and fouling issues
  - Advanced separation systems to maximize product recoveries

Product Separation Approach Impacts Profitability and Process Reliability

Uniflex Process

Feed → Products

Residue

Recycle

Pitch

Advanced Separation Systems

*NCUT Pilot Plant

Pitch Yield versus Conversion*

Uniflex Process Conversion

Yields are impacted by both process conversion and fractionation approach.

Maximizing conversion and product recovery can lead to equipment reliability issues.

Uniflex Process has addressed these issues with:

- Flow scheme and equipment designs that manage product stability and fouling issues
- Advanced separation systems to maximize product recoveries
Uniflex Process Integration with Coking

![Diagram showing integration of Uniflex Process and Coking]

- Conventional residue byproduct
- Yields much less sensitive to Uniflex Process conversion
- High margins even at low Uniflex Process conversion

Very high margins can be sustained based on combining proven technologies
UOP Uniflex Process Breaks Through the High Conversion Selection Barriers

- Best Practices from CANMET Hydrocracking
- Continuous Development facilitated by AERI
- High Conversion and Upgrading Margins
- Design assures High Reliability
- Meets Investors Expectations

UOP Uniflex Process Will Maximize Your Upgrader’s Profitability