



# TECHNOLOGIES FOR OIL SANDS CRUDE QUALITY IMPROVEMENT

Heather D. Dettman (NRCan)

Shunlan Liu and Duke DuPlessis (AI-EES)

CCQTA/COQA Joint Meeting

Kananaskis, Alberta

June 19-20, 2012

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Ressources naturelles  
Canada



Canada 

# Background

- Under the Hydrocarbon Upgrading Demonstration Program (HUDP) funded by Alberta Innovates – Energy and Environment Solutions (AI-EES), Jacobs Consultancy (Rich Hill) performed a review of upgrading technologies
- From that review, separation technologies were found to have inherent advantages over conversion processes for upgrading oil
  - Lower operating and capital costs
  - Higher reliability and operability

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



**Canada**

## Background (cont'd)

- However, the application of separation technologies to extra heavy crudes like oil sands crude has been limited due to:
  - Low yield (impacting economics and GHG emissions)
  - Poor contaminant segregation
  - Poor chemical and physical characteristics of products

CanmetENERGY

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



Alberta  
Innovates  
Energy and  
Environment Solutions

Canada

# Separation Technology Development

- A new program initiated by AI-EES and Natural Resources Canada (NRCan) in November 2010 is looking at new approaches for:
  - Removal or segregation of metals and chlorides
  - Reduction of naphthenic acid content
  - Maximization of product yield
  - Improved extraction of oil from water, clays, and sand
  - Minimization of tailings formation

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Ressources naturelles  
Canada



**Canada**

## Program Focus

- Three year program aimed at developing separation technologies to be used in the field to:
  - Improve the quality and value of oil sands crude
  - Reduce the environmental impacts of upgrading and refining oil sands crude

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



**Canada**

## Program Focus (cont'd)

- Research and development projects are being conducted under three areas:
  - Improved Processing for Mitigation of Fouling and Corrosion Problems
  - Novel Separation Technologies
  - Advanced Separation Pilot Plant

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



Alberta  
Innovates  
Energy and  
Environment Solutions

**Canada**

# Improved Processing for Mitigation of Fouling and Corrosion Problems

- Aims to develop fundamental knowledge of the molecular species and mechanisms involved during process issues
  - Development of analytical techniques for quantifying and characterizing problem species
  - Construction of test units for measuring the impacts of different mitigation approaches

CanmetENERGY

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



Canada

# Novel Separation Technologies

- Aims to assess different separation technology strategies under the same test conditions to allow performance comparisons
  - Screening of technologies with batch extraction experiments
  - Determination of the impacts of thermal pre-treatment of the oil
  - Development of continuous pilot plant facilities for test runs of promising technologies to obtain information for engineering and economic evaluations

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



**Canada**



# Advanced Separation Pilot Plant

- Aims to construct pilot-scale facilities in collaboration with industry partner(s) for demonstration of promising separation technology
  - Discussions with technology vendors
  - Selection of technology(s)
  - Construction of facilities
  - Performance of test programs

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



Alberta  
Innovates  
Energy and  
Environment Solutions

**Canada**

## Progress to Date

- Improved Processing for Mitigation of Fouling and Corrosion Problems
  - Both batch and continuous corrosion test units have been constructed and are being used to test the corrosivity of global crudes and crude fractions under refinery vacuum tower conditions
  - Both batch and continuous fouling test units have been installed and are being used to test the fouling propensity of crudes and crude blends under refinery preheater conditions
  - Method development underway to isolate and characterize the “most corrosive” naphthenic acid species

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Ressources naturelles  
Canada



Alberta  
Innovates  
Energy and  
Environment Solutions

**Canada**

## Progress to Date (cont'd)

- Novel Separation Technologies
  - In collaboration with KBR, a continuous pilot-scale extraction test unit is being constructed at CanmetENERGY
  - Batch-scale extraction tests have been conducted using paraffinic solvents, with and without additives
  - Literature review of separation technology patents has been prepared

CanmetENERGY

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



Canada

## Progress to Date (cont'd)

- Advanced Separation Pilot Plant
  - Design of a pilot plant for installation at CanmetENERGY to demonstrate JGC supercritical water technology for upgrading oil sands crude is underway
  - Discussions with extraction technology vendors continue....

CanmetENERGY

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



Canada

## Going Forward....

- Experimental test scenarios will be completed and the performance information captured in an extraction simulation model
- With industry partners, development of promising new technologies will be continued

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



Alberta  
Innovates  
Energy and  
Environment Solutions

Canada 

# Funding Acknowledgements

- Partial funding from:
  - Natural Resources Canada through the Canadian Program for Energy Research and Development, and the ecoENERGY Innovation Initiative
  - Alberta Innovates – Energy and Environment Solutions

**CanmetENERGY**

*Leadership in ecoInnovation*



Natural Resources  
Canada

Resources naturelles  
Canada



**Canada**