Solvent Recovery and Removal from NAE Extraction Gangue (T08-P01): Transport and removal of a solvent in porous media in the presence of bitumen

Monir Hosseini Anvari, Qi Liu and Phillip Choi[1]

BACKGROUND

- Solvent based oil sands extraction is a more environmentally favorable alternative to water based process.
- There is an environmental and financial urge for recovering the residual solvent (such as cyclohexane) remained in gangue.
- The removal process is the transport of solution in a porous medium with a highly viscous solute at low concentrations.
- In this study, the effect of composition of residual bitumen and initial cyclohexane content on the removal of cyclohexane is investigated

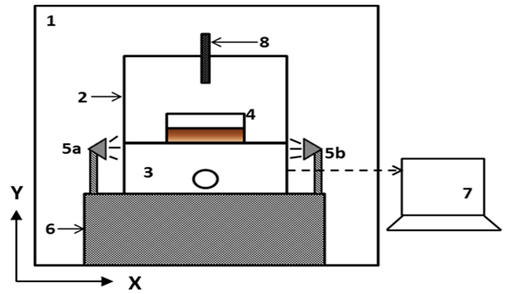
SHORT-TERM OBJECTIVES

- Studying the diffusion/evaporation behaviors of cyclohexane in NAE extraction gangue from packed beds
- Studying the affinities of the solvents to fine mineral solids with different degrees of bitumen coating by an Intelligent Gravimetric Analyzer (IGA)
- Investigation of the degradation of the residual solvents in the NAE extraction gangue under both aerobic and anaerobic conditions, to examine the fate and decomposition rate of the residual solvents

PROJECT OVERVIEW

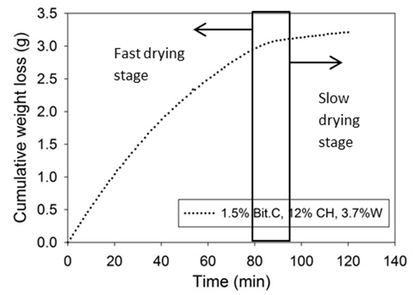
➢ **Material and Method:**

- Use of reconstituted gangue to control the compositions
- 0.5-2.0 wt% of organic or bitumen associated C (BitC%) on a dry basis, 3.7 wt% water content, 8 and 12 wt% cyclohexane content
- A 2-hour drying cycle for each sample. The setup:



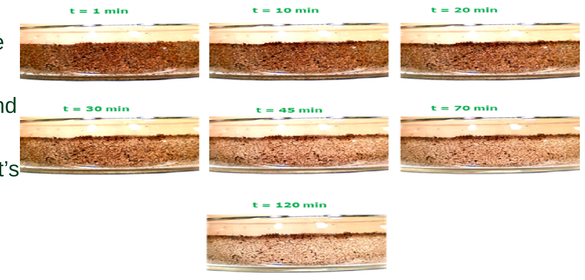
1 – Fumehood 2 – Balance chamber, 3 – Weighing Scale 4 – Glass petri-dish with gangue sample 5 a, b – Lamps for illumination 6 – Blackened cardboard 7 – Continuous monitoring of liquid mass loss in sample 8 – Temperature/Humidity probe

- Use of a piece-wise regression on the cumulative weight loss data of the sample over the time in order to determine the transition time from the fast (solvent) evaporation to the slow (water) drying



➢ **Research Highlights:**

- Studying the effect of residual bitumen concentration on the drying flux (rate) of the fast stage at a constant solvent concentration
- Studying the effect of initial solvent concentration on the drying rate of the fast stage and on the length of the transition times
- Studying the effect of bed height (0.5 to 1.4 cm) on the transition time
- Investigating the mechanism of solvent evaporation and migration of bitumen to the top of the bed
- Investigating the contribution of lowering of the solvent's vapor pressure, blockage of the pores and viscosity of the solution to the reduction of amount of recovered solvent at higher bitumen concentration



THEME OVERVIEW

Heavy Oil - Non-Aqueous Recovery

Excessive freshwater use and its eventual capture in tailings ponds represent some of the most concerning elements of the oil sands industry. The requirement for water to be heated as part of the process is also a serious concern, as it demands the use of considerable energy as part of the extraction process. Developing a Non-Aqueous Extraction (NAE) method for recovering oil from the oil sands without the use of water could significantly reduce the environmental and carbon footprint of extracting these resources, and the fundamental science developed to support this process could enable significantly improved cleanup of oil sands sites.

EXPECTED OUTCOMES

➢ In the short run, it is expected to observe:

- Higher cumulative weight loss and shorter transition time at lower bitumen concentrations
- Lower initial (fast stage) drying rate at lower initial cyclohexane content and significant increase in the transition time for higher cyclohexane concentration at high bitumen concentrations
- Clearer effect of bitumen content on the weight loss of the sample for higher bed heights
- Less intense and uneven migration of the bitumen to the top of the bed at lower cyclohexane concentration due to loss of capillary connectivity with reduction of cyclohexane
- Hindrance of evaporation and capillary transport of bitumen at higher concentrations of bitumen. The great increase in the solutions viscosity is anticipated to be the main parameter which affects this transport and recovery of the solvent.

➢ Long-term Outcomes:

The ultimate goal is developing a strategy to minimize the amount of solvent loss in the non-aqueous extraction process due to environmental and financial concerns. Studying the mentioned variables and investigation of the drying mechanism is a step forward in achieving this goal.

EXTERNAL PARTNERS

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[1]Department of Chemical and Materials Engineering, University of Alberta, Edmonton, AB, CANADA