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OSTRF MEMBERS



Natural Resources Canada / Ressources naturelles Canada



Reza Nik collecting cake from the filter cloth



Cake sample

POSSIBILITY OF USING CENTRIFUGAL FILTRATION FOR MANAGEMENT OF OIL SANDS TAILINGS

It is about a decade that the oil sands industry in northern Alberta has started production of CT (composite / consolidated tailings) or NST (non-segregating tailings) as a method of tailings management. CT/NST is composed of MFT (mature fine tailings) plus a coagulant (gypsum) and the sand from cyclone underflow. This engineered waste stream is non-segregating when discharged, but in practice it is not particularly robust and partial segregation has been observed resulting in fines release at the surface following deposition. In order to achieve a more robust tailings stream,

a CT/NST with higher solids content is desired. Reza M. Nik, a PhD student working under supervision of Dr. D. C. Segó and Dr. N. R. Morgenstern at the U of A, has been pursuing this goal though studying different methods of solid-liquid separation. The possible approaches he has looked into them have been further enhancing the solids content of CT/NST as a mixture of fine (MFT) and coarse particles (Sand), or dewatering each of these components separately before mixing them to make CT/NST. *(continued on page 2)*

FIRST INTERNATIONAL OIL SANDS TAILINGS CONFERENCE: A SUCCESS!

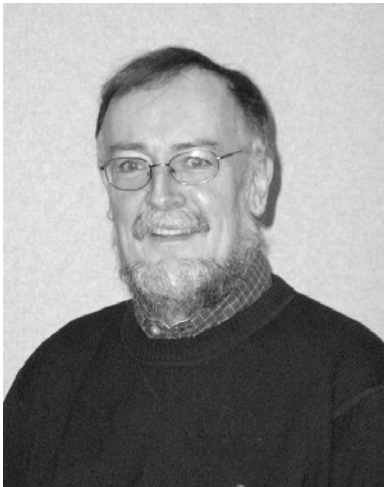
Edmonton, Alberta - The Oil Sands Tailings Research Facility (OSTRF) and the Canadian Oil Sands Network for Research and Development (CONRAD) hosted the first the International Conference on Oil Sands Tailings (IOSTC) December 7-10. The IOSTC was host to over 230 delegates, 11 keynote speakers along with 40 presenters from around the globe who gathered to discuss the challenges related to the management of oil sands tailings – an area of increasing increasing public interest. Considerable technical work and research advancements have been carried out over the last

40 years but much of it has not been easily accessible to the public resulting in major advancements, not being acknowledged. This conference was the first meeting to focus on compiling research advances, last done at the Fine Tailing Fundamentals Consortium in 1995, collectively. The OSTRF and CONRAD would also like to thank the industry sponsors that helped make the conference a success! We look forward to seeing at the next International Oil Sands Tailings Conference in 2010.



Standing room only during the conference

COACH'S CORNER by Richard Houlihan, Chief Oil Sands Engineer, Energy Resources Conservation Board (ERCB)



Richard Houlihan

Management of fluid tailings has been an ongoing challenge for the oil sands operators in terms of containment volumes as well as achievement of trafficable surfaces for land reclamation. Over the years, Energy Resource Conservation Board (ERCB) decisions have expressed concerns about accumulation of fluid tailings and the need to develop and apply technology to minimize and eventually eliminate it.

The ERCB decided that regulation of fluid tailings was required to ensure tailings were managed as set out in applications and as required by regulators. Regulation supports sustainability of the industry in an environment of ever increasing global scrutiny and vocal influential detractors.

The ERCB tailings directive (074) Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes was issued in February 2009 and includes phasing in the requirements over a three year period. The internet link for the directive is http://www.ercb.ca/portal/server.pt/gateway/P_TARGS_0_0_303_263_0_43/http%3B/ercbContent/publishedcontent/publish/ercb_home/industry_zone/rules_regulations_requirements/directives/directive074.aspx

The key requirement of Directive 074 is the formation of Dedicated Disposal Areas (DDAs). These are required to capture 50% by weight of the fines (defined as <44 µm) in the ore processed and become trafficable and reclaimable in a short period of time.

Although an operator can accomplish the directive requirements with one technology, the ERCB encourages a suite of technologies be adopted to mitigate implementation risk factors and increase operational flexibility.

The ERCB is working with Alberta government departments to review policy and regulation in response to commitments in legislation and growing public concerns. The management of fluid tailings, water and reclamation are key elements of this work. The tailings directive is a first step and regulators will introduce other steps in the next several years.

The Oil Sands Tailings Research Facility is a key building block in tailings expertise and technology development. In turn this supports ERCB identified need for tailings technology development and adds expertise to do things the directive requires. At the recent First International Oil Sands Tailings Conference in Edmonton, Professor Dave Sego commented that to date, 24 students have either graduated or are conducting graduate studies under the auspices of the OSTRF. The majority of these graduates – knowledgeable in tailings technologies – are now working for the oil sands industry as employees with one of the operators or with a supporting consultant or contractor. In fact, the ERCB has recently hired Junwen Yang and Yetimgeta Mihiretu who conducted research at the OSTRF (and also Tara Wang and Aref Najafi who conducted research at the sister Oil Sands Research Chair under Professor Jacob Masliyah).

Kudos to the OSTRF – the oil sands industry needs you and your graduates.

The ERCB is optimistic that the day is close when through the efforts of the current generation of tailings technical talent, the transfer of fluid tailings liabilities to future generations will be at least minimized if not eliminated.

Continued from Page 1

CENTRIFUGAL FILTRATION FOR MANAGEMENT OF OIL SANDS TAILINGS *continued*

A major part of Reza's work has been focused on dewatering MFT. Review of previous attempts made in this field shows that different methods of centrifuging and pressure/vacuum filtration have been examined for thickening MFT,

but it was for the first time in the present research that possibility of using a filtering centrifuge was studied. After doing a series of small scale tests with a clinical centrifuge at the U of A, in May 2008 Reza started using a filtering centrifuge at the OSTRF research centre to evaluate its capability for making a more concentrated MFT. In a period of about five months, he conducted several tests on MFT received from Syncrude, Suncor and Albian Sands companies for a variety of test conditions. The results indicated that a significant percentage of the MFT fed into the system could be collected as a cake with solids content ranging from 43%wt to 65%wt, suitable either for making a robust CT/NST or for deposition as paste. Also the filtrate obtained was fairly clear, with a solids content less than 1%wt.

It should be mentioned that a challenge for filtration of oil sands tailings has been the presence of bitumen and its tendency to clog the filter pores. The present research revealed one significant advantage of using centrifugal filtration for this purpose: *Bitumen, due to its lower specific gravity, forms an internal layer close to the centre of rotation and has less opportunity to touch the filter medium. This significantly reduces blockage of the filter pores contained in the filter cloth.*

More details of this research work are available in the proceedings of the First International Oil Sand Tailings Conference, Dec. 7-10, 2008, Edmonton, Alberta, Canada, pp. 200-208.



Sample of filtrate water.

WHAT'S UP

The next installment of the OSTRF Student-Industry Interaction Day will be held October 1, 2009 at the Alberta Research Council Millwoods Facility. Additional information will be posted soon at www.ostrf.com. Mark it in your calendars!

The University of Alberta will be hosting the Tailings and Mine Waste 2009 conference on November 1-4, 2009 at The Banff Springs Hotel in Banff, Alberta. Details are available at www.ostrf.com/seminars

Speaker presentations from the International Oil Sands Tailings Conference 2008, are available for download from www.ostrf.com/seminars. Proceedings are also available for purchase. Please contact Nicholas Beier (nabeier@ualberta.ca).

CONGRATULATIONS

Heather Kaminski successfully defended her PhD research work on Mineralogy of oil sand solids using electron microscopy and quantitative x-ray diffraction.

Additional Info

Readers are referred to the new and improved OSTRF website (www.ostrf.com) for all the latest information regarding the OSTRF, including current and previous OSTRF projects summaries. A publications list is also available.

STUDENT FOCUS - CARMEN LI (MSc. Biological Sciences)

Large volumes of oil sands tailings, a combination of water, sand, silt and clays, are produced during bitumen extraction from oil sands. Tailings are transferred to tailings ponds where solid particles settle to become dense material that can be reclaimed as land. The released water is reused for bitumen extraction. Recently, the tailings pond at Albian Sands Energy Inc. has begun generating methane. While we know that the cause is microbial activity, the microbial species involved and the substrates being used to produce methane are unknown. We are also uncertain of the effects of methane production on Albian tailings densification in the pond.

So far in my project, we have found strong evidence that the source for microbial production of methane is citrate, used as a water softening agent in Albian's tailings pond.

Currently, I am investigating the effects of citrate on the microbial population in Albian tailings, its effect on the production of methane from these tailings, and the effects of gas release on the tailings densification rate. My work is mainly molecular analysis to identify the microbial species in Albian tailings and involves denaturing gradient gel electrophoresis analysis and restriction fragment length polymorphism analysis of clone libraries. My work also includes monitoring methane release from Albian tailings in sealed microcosms using gas chromatography and monitoring tailings densification in both large and small settling columns. A better understanding of the process of methanogenesis from Albian tailings holds implications for tailings management, control of greenhouse gas emissions, land reclamation options, and water reuse.



Carmen Li preparing large 3 m columns at OSTRF for settling experiments.



Carmen Li and Saidul Alam (PhD, Geoenvironmental Engineering) collecting a sample from the large settling columns.

STUDENT ACTIVITIES AT OSTRF

On any given day of the week you can find University of Alberta graduate students working in Devon on their OSTRF projects. For example, Saidul Alam (PhD, Geoenvironmental Engineering) has been busy preparing several large columns for a joint project with Carmen Li (MSc Biological Sciences). Their collaborative work will investigate the impact of methane production on MFT characteristics including self-weight densification for Albian Sands tailings.

Chenxi Zang (MSc, Geotechnical Engineering) and Nicholas Beier (PhD, Geoenvironmental Engineering) have set up a novel inline dewatering pumping loop and have been conducting experiments since July 2008. This project was even included in a German Science documentary on the Oil Sands. There should be lots of interesting results at the next OSTRF Student-Industry Day in September 2009.



Chenxi Zhang (top) and Nicholas Beier (bottom) preparing a dewatering experiment at OSTRF.



CURRENT STUDENT PROJECTS

1. Dewatering Behaviour of Oil Sands Tailings from Different Processes – Saidul Alam, PhD, Geoenvironmental Engineering, 2010
2. Foam Tailings: A New Methodology of stabilization of Tailings – Ehsan Abazari, PhD, Geotechnical Engineering, 2010
3. Implications of Tailings Management and Planning Options - -Nicholas Beier, PhD, Geoenvironmental Engineering, 2010
4. Crossflow filtration for Dewatering oil sands tailings – Chenxi Zang, MSc, Geotechnical Engineering, 2009
5. The Potential Role of Aliphatic Diluent in Biogenic Methane Production and Accelerated Denitification of Tailings at Albian Sands – Carmen Li, MSc, Biological Sciences, 2009
6. Water Treatment Options and Their Applicability to Oil Sands Operations for Recycle and Safe Discharge - Atefeh Afzal (PhD), Parastoo Pourrezaei (PhD), Yingnan Wang (MSc), and Amena Sadek (MEng), Environmental Engineering.
7. Approaches to Achieve Non-Segregating (Oil Sands) Tailings with Higher Solids Content – Reza Moussavi Nik, PhD, Geotechnical Engineering, 2008
8. Experimental Study of Sand and Slurry Jets in One and Two Phase Flow I and II, Neil Hall (MSc) and Mohamed Elanany (Post Doc), Water Resources Engineering.
9. Consolidation Behaviour of MFT using Centrifuge - Amarebh Sorta (PhD), Geotechnical Engineering.
10. Sand and Slurry Jets in Artificial and Real MFT without Water Capping - Jianan Cai (PhD), Water Resources Engineering.
11. The Removal of Naphthenic Acids in Oil Sands Process-Affected Water by Coke Adsorption - Christina Small (MSc), Geoenvironmental Engineering.
12. Characterization of Petroleum Naphthenic Acids in Oil Sands Process Affected Waters Using Fluorescence Technology - Andrea Ewanchuk (MSc), Geoenvironmental Engineering.



Conceptual demonstration of foam tailings deposition.



OSTRF students and CANMET staff.



Demonstration of sand jets in artificial MFT.

OSTRF MANDATE

To develop novel approaches for tailings treatment, to reduce their volume, and to improve their physical characteristics to assist in the development of cost effective, environmentally superior post depositional restoration.

To attract worldclass researchers and students to undertake projects at the facility.

To train significant pools of highly qualified scientists and engineers who will become the next generation of oil sands industry leaders, consultants and regulators.

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NEW STUDENT PROJECTS - CHARACTERIZATION AND REMOVAL OF NAPHTHENIC ACIDS

Process affected water from the oil sands production plants contains a large number of naphthenic acids that present an environmental challenge to the industry due to their toxicity and corrosiveness to refinery units. Andrea Ewanchuk and Christina Small are both tackling this problem from different angles. Andrea is developing a novel analytical technique using ultraviolet light in the range of 260-350 nm. The generated fluorescence signal is a unique attribute of

the excited naphthenic acids, which can be used as a "signature" or "fingerprint" to identify them. Christina is using principles of adsorption to remove naphthenic acids from process-affected tailings water. The goal of the project is to determine whether carbonaceous media has the ability to improve oil sands water quality. Both have applied for NSERC IPS scholarships as they are working towards their MSc degrees in GeoEnvironmental Engineering.



Andrea Ewanchuk and Christina Small