SURFACE AND GROUNDWATER MANAGEMENT
IN THE OIL SANDS INDUSTRY

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KEY MESSAGES FOR DECISION MAKERS

- A serious wastewater management concern in the oil sands industry is the complex mixture of compounds, called naphthenic acids (NAs), which are found in process-affected waters. This research highlights the need for better characterization of these compounds and informs threshold levels for NA concentrations likely to adversely affect fish health.
- The level of ecosystem function in oil sands-affected wetlands over time is not equivalent to reference wetlands.
- NAs do not biodegrade in groundwater affected by tailings seepage; therefore, treatment may be required to protect surface water environments.
- Ozonation followed by microbial degradation accelerates the removal of NAs.
- This research has implications for assessing environmental risks, as well as reclamation, remediation and monitoring options to complement existing and future oil sands reclamation strategies.

WHO IS THIS INFORMATION RELEVANT FOR?

- Wastewater managers in the oil and gas sector
- Environmental regulators (provincial and federal governments)
- Policy makers in reclamation planning and closure

WHAT WAS THE RESEARCH FOCUS?

The project addressed aquatic environmental issues associated with oil sands development, with the aim of improving wastewater management of NAs. The research focused on:

1. Determining the concentration and composition of NAs in tailing waters,
2. Biological effects,
3. Fate and transport in groundwater, and
4. Remediation options of oil sands process-affected waters to assist in directing future wet landscape reclamation.

WHAT WAS THE RESEARCH METHOD?

The multi-disciplinary research team developed and executed a wide range of projects to address knowledge gaps in analytical chemistry, biogeochemistry, hydrology, ecology and toxicology related to oil sands tailings storage and reclamation.

WHAT WERE THE RESEARCH RESULTS?

More acid-extractable constituents have been identified in oil sands process-affected water as a result of improved analytical chemistry. Biological effects assessments of aged oil sands reclamation provide evidence of residual toxicity. Residual toxicity may be removed by emerging treatments such as ozonation.

WHAT ARE THE IMPLICATIONS FOR DECISION MAKERS?

- Studies identified > 50% of compounds in oil sands process-affected water are not NAs, highlighting the need for better characterization of these compounds to determine their associated environmental risks.
- Toxicological studies provided estimates of NA concentrations likely to adversely affect fish health, which can aid in setting thresholds for reclamation strategies. It was found that NA concentrations greater than 25 mg/L and conductivity greater than 2000 µS/cm negatively impact fish reproduction.
- Ecotoxicological studies indicated that the natural aging of oil sands-affected wetlands over a 20-year time span did not fully restore ecosystem function to equivalent reference levels. These findings demonstrate the limitations of reclamation strategies in meeting regulatory requirements.
- Groundwater seepage from tailings ponds is a potential source of process-affected water reaching surface water environments. There may be need for long term wastewater management of groundwater, in part due to the lack of biodegradation of acid-extractable organics in anaerobic settings.
- Advances in analytical methods (ultra performance liquid chromatography/high resolution mass spectrometry) and remediation options (mild ozonation followed by microbial degradation) have provided promising tools to improve the characterization of surface water and groundwater quality and remediate NAs.

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