Modelling Assessment of Oil Sands Pit Lakes Turn-Over Potential

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Abstract

Pit Lakes are proposed as a treatment step for oil sands surface mining reclamation waters. The main objective of the Cumulative Environmental Management Association's End Pit Lake Sub-group is to establish design and management guidelines that will enable operators to achieve acceptable water quality for these lakes. The extent to which these factors can be adjusted to achieve the desired level of pit lake water column turn-over or stratification may establish important pit lake design parameters. While both biological and physical processes influence turn-over potential, this presentation focuses on pit lake size, depth, starting lake salinity concentrations, inflow rates and inflow salinity flux, primarily because of their expected dominant influence on density gradients and hence turn-over potential.

One-dimensional and two-dimensional modelling simulations were carried out to examine turn-over potential for a large range of pit lake configurations and conditions. The pit lake scenarios selected for modelling included numerous permutations of the following parameters: 3 lake sizes (1, 4 and 8 km^2), 3 lake depths (5, 20 and 50 m), 2 lake starting salinities (1 and 5 parts per thousand), 2 inflow rates (2 and 10 million m^3/yr), 3 starting inflow salinity concentrations (1, 2 and 4 parts per thousand) and 2 rates of influent salinity decrease (6- and 28- year half-life).

The modelling showed that fall is the governing season for determining turn-over potential. The expelling of salt from saline water upon ice formation (salt-rejection) and the effect of fresh water loading on during spring melt events were not found to be dominant factors governing turn-over potential, at least for the scenarios examined in this study.

This presentation reviews the models that were employed (DYRESM, CE-QUAL-W2, and RMA), the conclusions reached using those models and the follow-up work that is currently being pursued.