BC OGRIS Project Profile

Project Name:	Salinity Analytical Method Review for Characterization in Muskeg
Project Number:	EI-2016-03
Proponent:	SynergyAspen Environmental Strategies
Funding Envelope:	Environmental Impacts
Timeframe:	April 15, 2015 – August 31, 2015

Project objectives

SynergyAspen Environmental, working with CARO Analytical Services and Maxxam Analytics, aims to identify the analytical calculation methodology best confirming the actual contaminant concentrations within muskeg samples. SynergyAspen and both laboratories will demonstrate the need to develop a modified approach in the laboratory analysis of muskeg for quantifying salinity contaminant concentrations. The methodology may then be adapted for other contaminants in muskeg.

Project background

Understanding muskeg, a boreal wetland, as a matrix is an important consideration when performing an analytical characterization of a site. Canada has 35% of the world's peat accumulating wetlands with a vast majority of it in the north, including Northeast BC.

Produced water associated with upstream O&G activity, contains high levels of salinity and is a contaminant of concern in the industry. Accurately estimating the volume of salinity contaminated muskeg is critical in environmental cleanup at O&G sites.

Muskeg is currently classified as a soil under the BC regulatory regime. However, the BC MoE analytical method for soil matrix grossly overestimates the concentration of salinity in muskeg. Muskeg behaves more like a sponge and is very moist nature compared to mineral soils for which the analytical methodology was designed for. As such, there is a need to develop a modified approach in the laboratory analysis for quantifying salinity contaminant concentrations specifically for peat matrices like muskeg.

Project Description

Muskeg samples are collected in the native muskeg along the perimeter of an oil and gas well site in Northeast BC, where no known anthropogenic activity occurred. Produced water was obtained from a local producer in the Fort St. John area.

BC OGRIS Project Profile

The intent of the research project is to spike 16 muskeg samples with known concentrations of produced water and analyze each using the saturated paste method, and calculate concentrations using three different methods, M1, M2and M3, as defined below.

The methodology will be completed by two independent accredited BC laboratories. This will provide opportunity to identify consistency in the methodologies between different laboratories.

- The findings of these experiments are to encourage regulators to examine the need to recognize muskeg as a unique media and update analytical methods to represent with better accuracy salinity concentrations in a muskeg environment.
- With this accuracy, SynergyAspen believes there will be huge benefit to the upstream O&G industry, not only in cost savings by reducing the amount of muskeg being unnecessarily remediated, but also preserving the natural muskeg setting which takes thousands of years to generate.

Project Approach

SynergyAspen intends to prepare controlled samples of known moisture content and salinity concentrations and analyze them using the BC MoE Saturated Paste analytical laboratory method, but reporting them using three different calculations:

1) **M1 – Dry Soil Weight Method** – This is the unmodified approved BC MoE analytical method as prescribed, where;

$$C_{salM1} = \frac{\text{mass of salt (mg)}}{\text{dry weight of muskeg (kg)}}$$

The mg/L salinity concentration determined through saturation paste is multiplied by % saturation to obtain a mg/kg value. It grossly over estimates the concentration of contaminant for soils that have a moisture content >50% (such as muskeg) by a factor of up to twenty.

2) **M2 – Lab-Water Wet Soil Weight Method**– This "wet weight" method, being accepted in industry as an alternative to the dry weight method for salinity parameters, where;

$$C_{salM2} = \frac{\text{mass of salt (mg)}}{\text{Volume of water added in lab to create the saturated paste (L)}}$$

The above equation is the mg/L concentration derived in the Saturated Paste Method and is used in "multiple lines of evidence risk based arguments" in support of CoRs and is directly compared to the soil standard (and not multiplied by the % saturation to obtain a mg/kg concentration as per M1). This provides a more accurate representation of salinity concentration within muskeg. However, the limitation is that it is biased by the amount of water the lab chemist adds to the dried sample to make a saturated paste, which forms the denominator in the equation. There is no prescriptive methodology for the volumes used to obtain a saturated paste; it is up to the chemist's discretion.

3) **M3 – Wet Soil Weight Method**- An alternative focussing on representing the water content of true sample condition and not lab intrusion, where:

$$C_{salM3} = \frac{\text{mass of salt (mg)}}{\text{total muskeg sample weight (kg) (i.e. sample water and muskeg)}^{1}}$$

[1] – assumes that moisture content of sample is the "saturated state" of the sample due to nature of the muskeg matrix (i.e. organics)

The above equation is the new proposed calculation by SA, which may be more representative of the actual sample matrix by taking into account the two matrices within muskeg, i.e. water and organics.

SA will compare results produced by all three methods and compare them to the known baseline concentrations of the contaminant. This will determine which of the three methods best represents the "spiked" contaminant concentration. SA postulates that the third method will provide sample concentrations to be closest to the true concentrations, and the current methodology (M1) to be the furthest.

Project deliverables

The deliverables from this project include the following:

- Identifying the analytical calculation methodology best confirming the actual contaminant concentration within the samples.
- SA and both laboratories will demonstrate the need to develop a modified approach in the laboratory analysis of muskeg for quantifying salinity contaminant concentrations. The methodology may then be adapted for other contaminants in muskeg.
- Presentation of project findings to SCEK fund and invited guests
- Presentation at the federal RPIC Workshop in June 2015
- Presentation of findings to BC regulators: MoE and OGC
- Final Report outlining all findings.