

## Review and Recommended Changes to the Saturated Paste Method to Determine Concentrations of Sodium and Chloride in in Muskeg



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# Outline

Cl-

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# Motivation for Project

- Saturated Paste Method
  - Good for Mineral Soil
  - Not designed for muskeg
- Significant High Bias for Reported [Na] & [Cl] in Muskeg
- This Results in Unnecessary Remedial Excavation!
- Bad for the Environment





## Background: Peat Bog in Canada

- 35% of World's Peatlands in Canada
- 11% of Canada's Surface Area
- Verses 9% covered by water bodies
- Peat Concentrated in NE BC and Western Canada
- Typical Moisture Range 70-95%





## Background Sample Collection

- 1) Salt dissolves in water.
- 2) Sample Collection.
  - Unintentional and unavoidable water loss.
  - Water loss = salt loss.

Recommendation: Don't Squeeze the water out of your Muskeg Sample





### Background: Saturated Paste Method

- 1. Standard Dry/Grind Method
  - Dry Sample
  - Grind
  - Add Deionized Water, by the chemist in the lab, to achieve a 'Paste" (i.e. point of saturation)
- 2. Report as:
  - mg/L, or
  - mg/kg

Sat % = [(Wt water @ saturation) / (Soil dry wt)] \* 100%





#### **Reasons Changes are Needed**



In the Environment		In the Sample Jar			
Actual Concentration in Water	100	mg/L	Actual Concentration in Water	100	mg/L
Current Sat. Paste Method (mg/L)	150	mg/L	Current Sat. Paste Method (mg/L)	67	mg/L
Current Sat. Paste Method (mg/kg)	900	mg/kg	Current Sat. Paste Method (mg/kg)	400	mg/kg
Assumption: Weight of water at sa	turation	= 600%			



## History of Prior Work (in BC..)

#### ALS (~2012)

- Mark Hugdahl, Technical Director
- Problems Created with mg/kg units (dry weight) (i.e. Bias 1)
- Evidence to support Solution Based Salt Standards (mg/L)
- BC CSR Salt Standards should be converted to mg/L Solution Standards.
- Recommendation: Measure the Pour Water (MWs, etc.).

Some BC Regulators Considered mg/L Results be Compared to mg/kg Standard, as a supporting Line of Evidence

- Pros: Bias 1 addressed.
- Cons: Bias 2 not addressed.
  - "New" Bias. With water loss, the denominator exacerbates the bias.



## History of Prior Work

SynergyAspen & Likely Others (~2013)

Wet Weight (mg/kg [wet])

- Pros: Bias 1 addressed.
  - maintain mg/kg units required in BC CSR (pro or con?)
- Cons: Bias 2 not addressed. (contaminant loss from water loss)



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### Is There a Better Way?

"Your brain is like a sponge that absorbs knowledge, but that's not exactly how it's done."



#### **Research Project - Methodology**





#### Research Project - Analysis Summary

Concentration	Muskeg Moisture Content						
(mg/L)	60%	70%	80%	90%			
C1	M1	M1	M1	M1			
Note 1	M2	M2	M2	M2			
	M3	M3					
	M4a	M4a	M3	M3			
	M4b	M4b					
C2	M1	M1	M1	M1			
Diluted 5X	M2	M2	M2	M2			
	M3	M3					
	M4a	M4a	M3	M3			
	M4b	M4b					
C3	M1	M1	M1	M1			
Diluted 10X	M2	M2	M2	M2			
	M3	M3					
	M4a	M4a	M3	M3			
	M4b	M4b					
<b>C4</b>	M1	M1	M1	M1			
Diluted 25X	M2	M2	M2	M2			
	M3	M3					
	M4a	M4a	M3	M3			
	M4b	M4b					
Red = "Dry, Grind & Sa	turate" Saturated	C1: [Na] = 39,200 mg/L					
Purple = "As Received"	'Saturated Paste	C1: [Cl] = 110,	000 mg/L				
Green = "Over Saturate" Saturated Paste Method							



## **Research Project Methodology**

M1: Dry, Grind & Saturate mg/kg

M2: Dry, Grind & Saturate mg/L

M3: Squeeze Method

M4a Add DI Water to Achieve 90%

M4b Add 100ml of DI Water

### Chloride Results – Best, Worst (high & low)

	Best			Worst (high)			Worst (low)			Range
Method	% Recovery	spike	moisture	% recovery	spike	moisture	% recovery	spike	moisture	(High - Low)
M1	101.2	C4	70	120.3	C4	80	63.6	<b>C1</b>	90	57
M2	101.2	C4	70	120.3	<b>C4</b>	80	63.6	<b>C1</b>	90	57
M3	102.3	C1	80	131.4	C4	90	89.2	<b>C1</b>	90	42
M4a	101.5	C2	60->90	101.9	<b>C3</b>	70->90	86	<b>C1</b>	60->90	16
M4b	101.6	C1	60	106.3	C1	70	87.8	C2	60	18

All results correlated well; however:

- M3 correlated better than M1 & M2
- M4a and M4b correlated better than M3

"Dry, Grind & Saturate" Saturated Paste Method

"As Received" Saturated Paste Method "Over Saturate" Saturated Paste Method



### **Chloride Results - Standard Deviation**

Method	Method Definition	Standard Deviation	
M1	"Std" Saturated Paste (mg/kg)	16.36	
M2	"Std" Saturated Paste (mg/L)	16.36	
M3	As Received (Squeeze & Analyze)	12.6	
M4a	Intentionally Over-Saturate (add DI to 90 content, squeeze & analyze. Report as u	5.28	
M4b	Intentionally Over-Saturate (add 100 ml & analyze. Report as undiluted)	6.04	
	ate" Saturated rated Paste curated Paste		



#### Sodium Results – Best, Worst (high & low)

	Best			Worst (high)			Worst (low)			Range
Method	% Recovery	Spike	Moisture	% Recovery	Spike	Moisture	% Recovery	Spike	Moisture	(High - Low)
M1	98.8	C2	70	124.7	<b>C4</b>	80	56.1	<b>C1</b>	90	68.6
M2	98.8	C2	70	124.7	<b>C4</b>	80	56.1	<b>C1</b>	90	68.6
M3	96.2	C2	80	171.7	<b>C4</b>	90	81.7	<b>C1</b>	80	90
M4a	101.4	C2	70->90	136	C4	60->90	93.5	<b>C1</b>	60->90	42.5
M4b	102.3	C2	60	148.7	C4	70	102.3	C2	60	46.4

"Dry, Grind & Saturate" Saturated Paste Method "As Received" Saturated Paste Method "Over Saturate" Saturated Paste Method



### Sodium Results - Standard Deviation

Method	od Method Definition	
M1	"Std" Saturated Paste (mg/kg)	19.25
M2	"Std" Saturated Paste (mg/L)	19.25
M3	As Received (Squeeze & Analyze)	30.9
M4a	Intentionally Over-Saturate (add DI to 90% moisture content, squeeze & analyze. Report as undiluted)	16.05
M4b	Intentionally Over-Saturate (add 100 ml of DI, squeeze & analyze. Report as undiluted)	15.83

"Dry, Grind & Saturate" Saturated Paste Method "As Received" Saturated Paste Method "Over Saturate" Saturated Paste Method



## **Recommendations & Observations**

 Lab results & numerical standards/criteria should be reported as mg/L, not mg/kg.

(i.e. consistent with prior recommendations)

2. The BC Environmental Laboratory Manual allows the M3, M4a and M4b methods.

### **Conclusions of Research Project**

- 1. "Dry/Grind/Saturate" Saturated Paste Method
  - Worse accuracy.
  - Bias 1 addressed (when reported in mg/L)
  - Bias 2 not addressed.
- 2. "As Received" Saturated Paste Method
  - Better Accuracy.
  - Bias 1 Addressed (mg/L)
  - Bias 2 Addressed.
  - Didn't work for samples with 60% and 70% moisture.
- 3. "Over Saturate" Saturated Paste Method.
  - Best Accuracy.
  - Bias 1 Addressed (mg/L)
  - Bias 2 Addressed
  - Fine tuning of method is still needed



SynergyAspen Recommended.

## Summary (Take Away for Muskeg Research Project)

## Recommended Revised Lab Method (M4a/M4b):

- 1. Oversaturate "As-Received" Muskeg Samples
  - (do not dry, grind & re-saturate)
- 2. Squeeze Water Out, Analyze [Na] & [Cl]
- 3. Report as Undiluted.

What Does this Mean?

This Method Analyzes the Pour Water



## Call to Action

- Refine Technique & Further Study
  - Refine technique
  - Use a larger sample size
- Regulators
  - Current Sat. Paste Method for Muskeg is Bad for the Environment.
  - Be Open to Change at Provincial & Federal Levels.



### Thank You

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## Questions?

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