



**Calcium Humate Reduces Disposal Costs by
lowering Electrical Conductivity and Sodium
Adsorption Ratio in
Potassium Silicate based Drilling Waste**

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Outline

- Overview of Potassium Silicate drilling fluids
- Regulatory Guidelines
- Salinity of Potassium Silicate Drilling Waste
- Challenges for Disposal
- Calcium Humate
- Laboratory Results
- Field Trials
- Cost evaluation
- Conclusions
- Questions





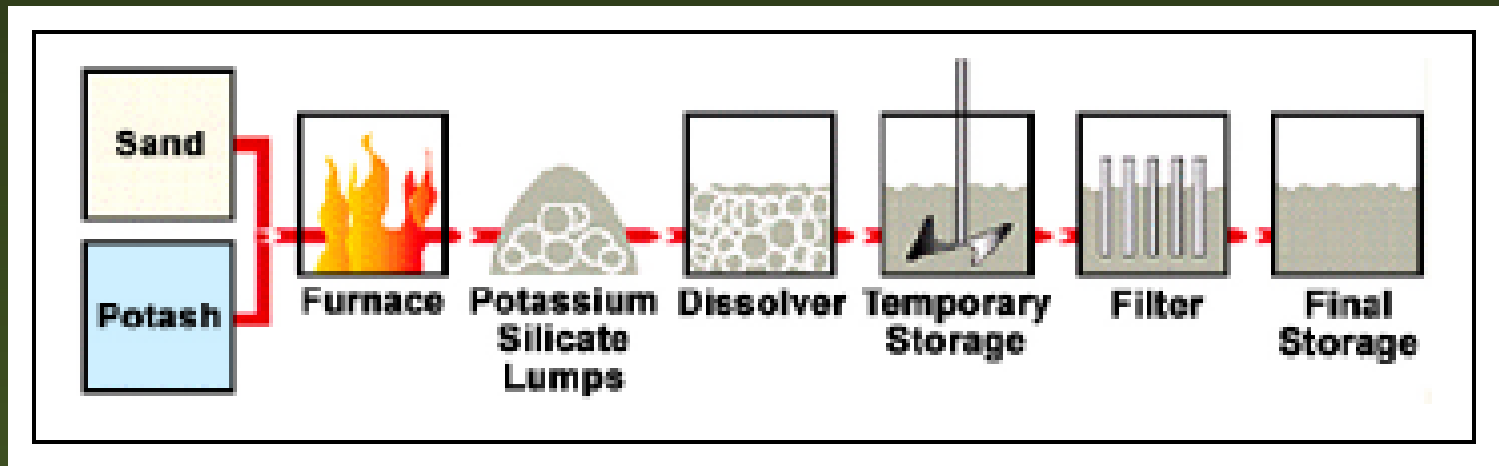
Overview of Potassium Silicate Based Drilling Fluids

- A well established drilling fluids additive.
- Typically used in the foothills drilling.
- This system provides excellent shale stability.
- It is used as an alternative to oil based fluids.
- It has superior health, safety and environmental characteristics.





Potassium Silicate Production



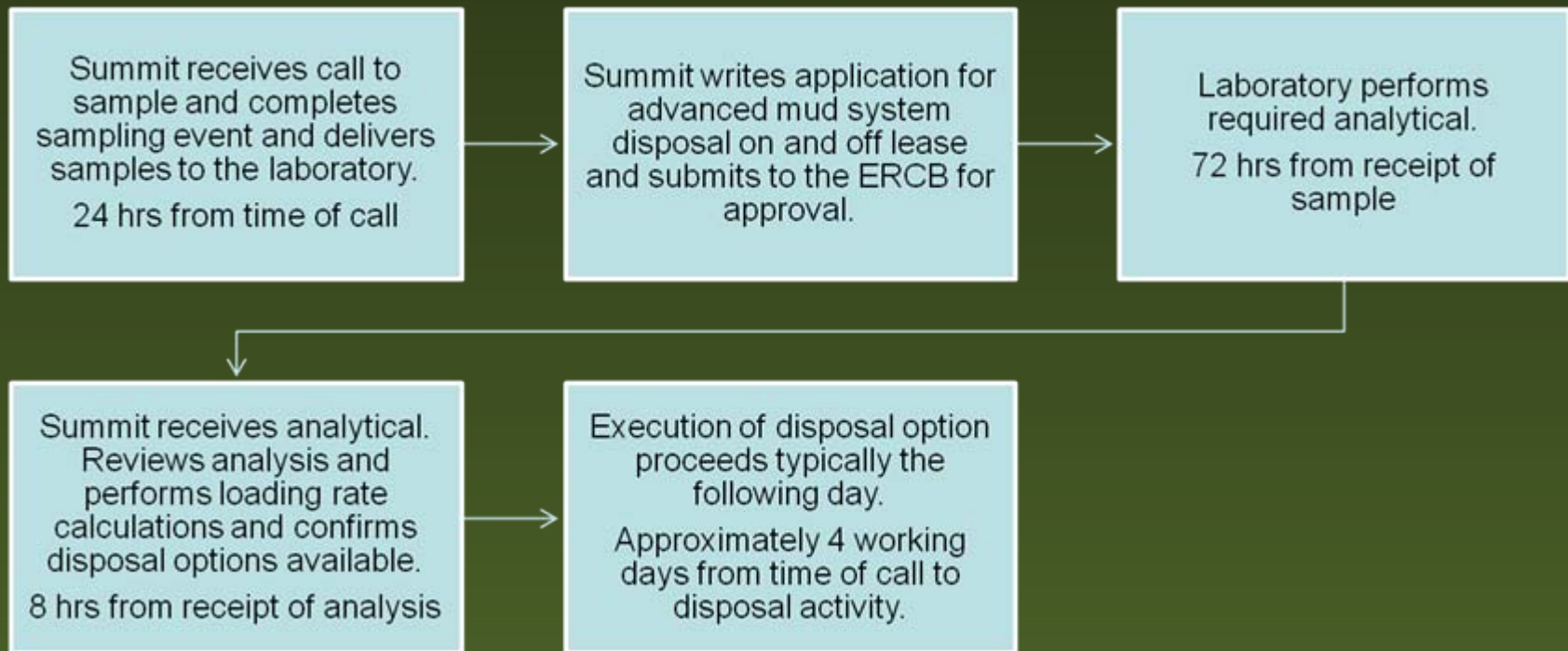


Regulatory Guidelines

- 1996 Directive 50 was written to guide suitable disposals of drilling wastes in Alberta. Focusing on methods for on and offsite disposal methods for fresh water mud systems.
- IL 2001-3 was published to address mud systems that utilized larger concentrations of ionic salts in their engineering. These systems have been named by the ERCB to be “Advanced Mud Systems”.
- Non-facility based disposals of advanced mud systems require ERCB written approval.



Generic Approval Process





Criteria of Current Approval

- CWS Hydrocarbon analysis – BTEX, F1-F4 accordingly to land use and grain size.
- All standard 1996 D50 criteria for various methods.
- EC and SAR max increase of 2 units from background but not beyond 5 and 8 (fair soil category, SCARG). Some variation to this has been approved relating to soil depths.
- Sodium max application rate of 500kg/ha.
- Mix ratio maximum 7:1.
- Microtox pass.
- Post sampling within 2 months of disposal.



Challenges with onsite disposal

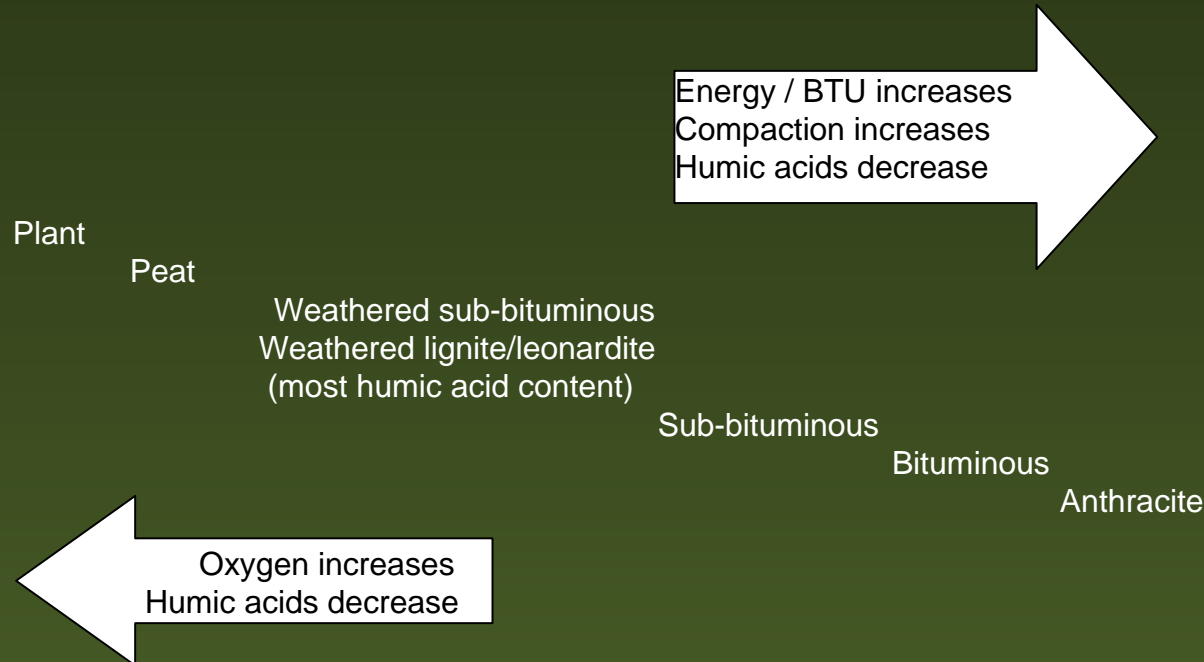
- Elevated SAR is the typical limiting parameter when planning disposals of potassium silicate mud systems.
- What is good down hole is not so beneficial when disposing in soils in the perspective of CEC. Suitable soil chemistry requires a balanced SAR. A measure of the exchangeable sodium in soil.
- Silicates precipitate out nearly all calcium and this results in relatively high SAR in cuttings and fluids even at low concentrations of sodium.
- Traditional treatments lower SAR by adding soluble calcium but in turn raise the EC which is counter productive.



Humic Material as an Amendment



Natural Carbon Based Materials





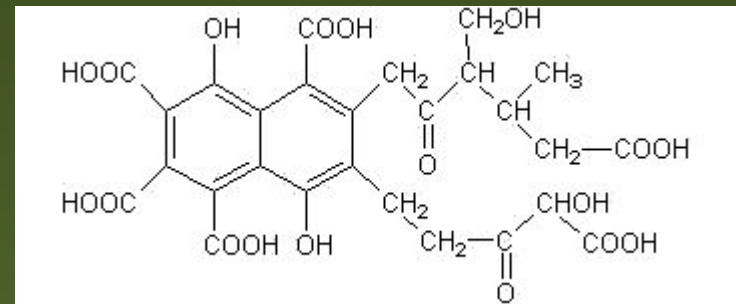
Current Uses for Humic Material

- Registered soil amendment (Canada and other countries)
 - improves growth / yield
 - decreases fertilizer requirements
 - Adds carbon source for improve use of nitrogen.
- Treatment of hydrocarbon, salt impacted soils.
 - Biological (fosters microbial activity and improves plant growth)
 - Physical (makes soil more friable and improves percolation rates)
 - Chemical (chelates salts, releasing as plants require)



Chemical Properties of Humic Material

- Possesses strong negative charges (from COOH and OH groups)
- Excellent chelating properties for common nutrients in agriculture.
- Cation Exchange Capacity (CEC) of 600 meq/100g.
- Suspected improved exchange power as pH increases.
 - Potassium silicate benefits due to elevated pH.





Calcium Humate

- Chelation process and cation exchange is taking place with respect to sodium and calcium. However more research is needed to define the mechanism.
- This chemical process assists in moderating the SAR of the final soil-waste mix.
- Properties of interest
 - Contains 5% calcium by weight
 - Cost effective and readily available
 - Passes Microtox
 - Trace Elements are negligible.
 - Good performance in lab testing and initial field trials
 - Safe and simple to work with.
 - Non Hazardous or TDG regulated.

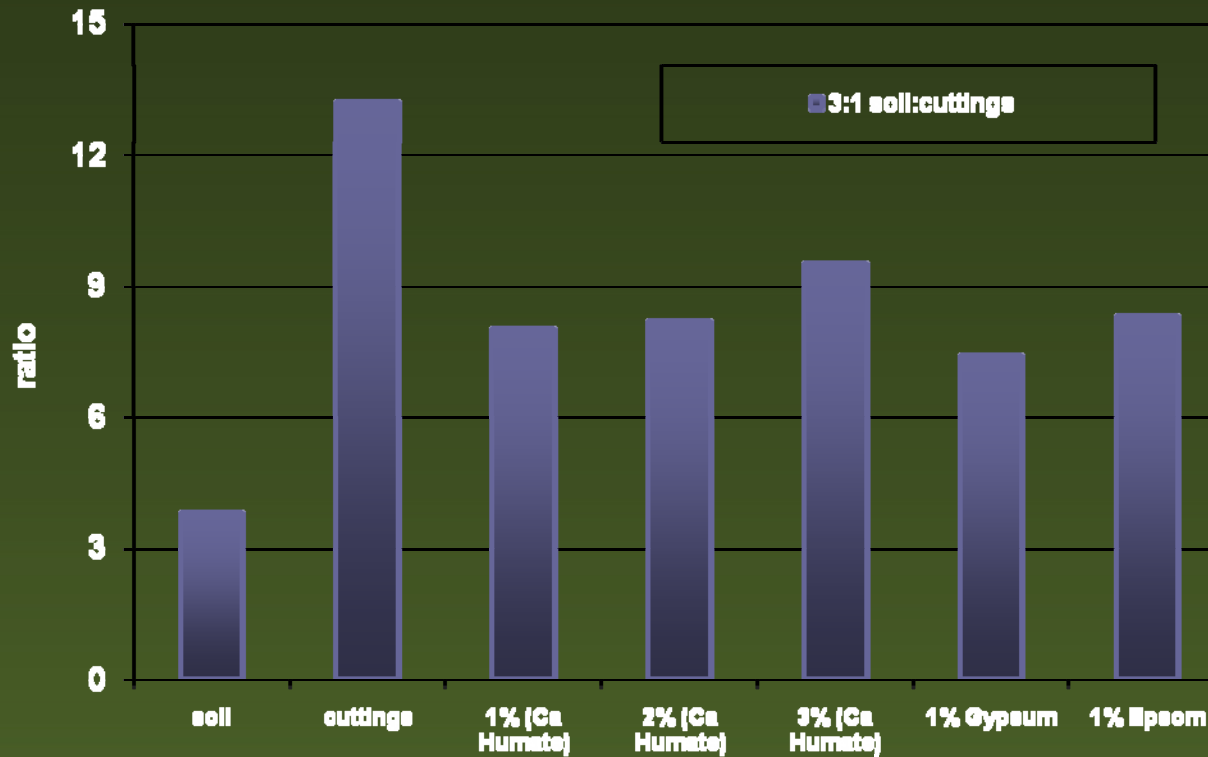


LABORATORY RESULTS

ARGOSY 13-34-011-26w4

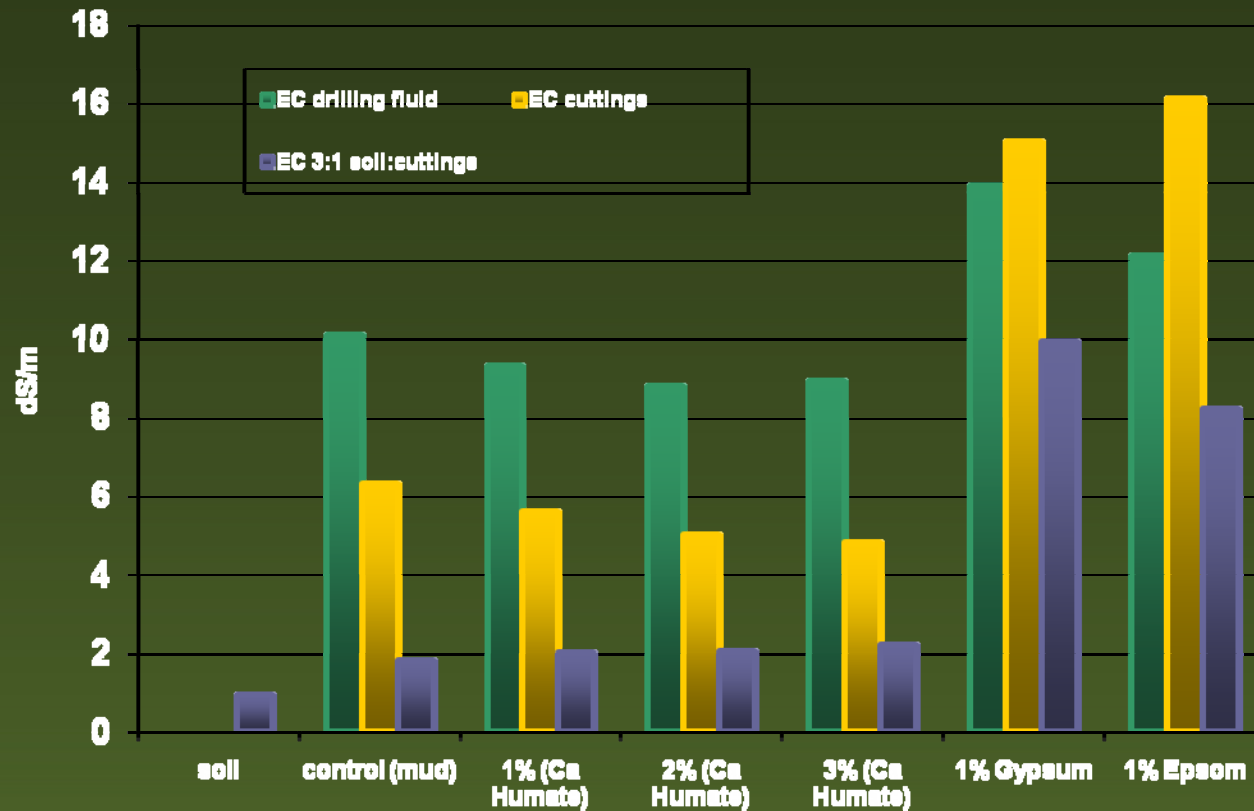


Sodium Adsorption Ratio vs. Amendment





Electrical Conductivity vs. Amendment





Field Trial

ARGOSY

09-11-012-26W4M



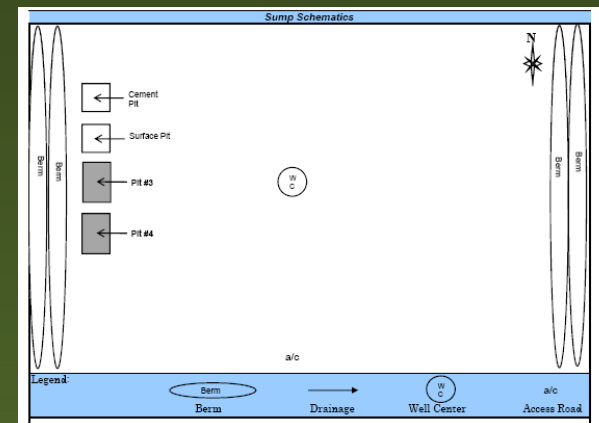
Implementation of Treatments

- The importance of thoroughness.
 - The right tool for the job
 - Success will be secured through the use of the proper tool and process to ensure amendments make contact with the entire waste stream.
- Options for treatments
 - Circulate products post drilling to treat spent mud system.
 - Apply and mechanically incorporate product to cuttings pile.



Treatment Rate

- Calcium humate was dispersed into the cuttings using an excavator and dozer.
- 3 pallets of calcium humate were used at the sump for an estimated loading of ~1.3% by weight.
- Mix ratio 5:1 soil:cuttings





Summary of Field Trial

Parameter Tested	Receiving Soil	Pit #3 Drilling Waste (as received)	Pit #3 – Raw Drilling Waste (1% CaH)	Post Disposal (initial) 5:1 mix ratio
Micotox EC (50) 15-charcoal	n/a	>81.9	n/a	n/a
SAR	2.66	86.3	26.2	4.89
EC (as received)	4.39	5.51	5.74	4.47
pH (as received)	7.9	9.6	9.6	8.0
Specific Ions				
Potassium (mg/l)	11	580	737	268
Sulphate (mg/l)	2600	879	996	2960
Sodium (mg/l)	305	974	1100	457
Calcium (mg/l)	516	8	123	332
Magnesium (mg/l)	291	1	6	201
Nitrogen Total	13.32	<0.037	<0.037	4.9
Chloride (mg/l)	17	181	211	46
SG (as received) g/cm ³	1410	1480	1490	1680
Soil category	Fair			



Cost Evaluation

- Class II facility costs complete with trucking, loading, stabilization material, and reporting range from an estimated \$60-\$120/m³.
 - Trucking conditions, distance, and material density being the largest factors in rate variation and well as total cost of disposal.
- Typical landspread or MBC estimated at \$28-35/m³.
- Disposal option decision requires thorough assessment for most suitable solution.
- Environmental service sampling fees are marginally greater for onsite disposals compared to Landfill methods due to current increased lab work, post sampling requirements and variance in reporting efforts required.



Conclusions

- Calcium humate is an effective chemical treatment for reducing/balancing salinity in potassium silicate drilling waste.
- This amendment demonstrates great prospect for economical onsite disposal alternatives to facility disposal of potassium silicate based drill waste.
- Ongoing trials are needed to develop a better understanding of potential improvements to soil quality and plant growth from a holistic approach for shallow disposal methods such as landspreading.



Conclusions

- A brief look at other forms of drilling waste suggests that humic material might also be effective at reducing the salinity of non-silicate based drill waste.
- More research for inclusion of chelated forms of calcium, magnesium and sodium for purposes of SAR evaluation could be beneficial.



Thank-you kindly.

QUESTIONS?