Converting Rendering Waste to Value-Added Products for Oil Sands Tailings Treatment

Heather Kaminsky, Jesse Yuzik, Yuki Gong, Paolo Mussone, Birendra Adhikari, Mike Chae, and David Bressler
What is SRM?

SRM (Specified Risk Material): A mainly proteinaceous waste material from the meat rendering industry

What is a Peptide?

- Polymer of Amino Acids
- Have Variable Lengths
- Make up proteins

- Net 0 charge
- Biodegradable
Hydrolyzation Process

1. Weigh in biosafety cabinet
2. Hydrolyze SRM: 180°C, ≥174 psi, 40 mins
3. Centrifugation to remove insoluble material
4. Filtration and hexane washing
5. Spray Drying
6. Hydrolyzed SRM
7. Test in a Flocculation Experiment
Crude SRM

- Crude SRM is the least refined product which is still safe to handle
- Hydrolyzed but not purified
- Cheapest to produce
Flocculation Experiment - FFT

- 8.89% diluted FFT (#33 of 61)
- pH 8.1-8.2 (as received)
- Gypsum: 300ppm slurry base
- SRM: crude (89% N)
- Doses: 0.5%, 1.3%, 2.2%, 3.0%, 5.0% w/w tailing solid base
- SRM is extremely Water soluble – added dry
FFT Treated With Crude SRM

Settling Curves for Fluid Fine Tailings Treated with Crude SRM

- Control - FFT as is
- Crude SRM Dose Level 1 - 0.4%
- Crude SRM Dose Level 2 - 1.4%
- Crude SRM Dose Level 3 - 2.2%
- Crude SRM Dose Level 4 - 2.9%
- Crude SRM Dose Level 5 - 4.9%
- A3338
Crude SRM in FFT – Effect of Dose

Effect of Dose on Initial Settling rate for Crude SRM Treated FFT

Average of Solid% of Sediment
Crude SRM in FFT – Water Quality

Color of supernatant after 72 hrs of settling

<table>
<thead>
<tr>
<th></th>
<th>Qualitative Color Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.0</td>
</tr>
<tr>
<td>A3338</td>
<td>0.5</td>
</tr>
<tr>
<td>Crude SRM Dose Level 1 - 0.4%</td>
<td>1.0</td>
</tr>
<tr>
<td>Crude SRM Dose Level 2 - 1.4%</td>
<td>1.5</td>
</tr>
<tr>
<td>Crude SRM Dose Level 3 - 2.2%</td>
<td>2.5</td>
</tr>
<tr>
<td>Crude SRM Dose Level 4 - 2.9%</td>
<td>3.0</td>
</tr>
<tr>
<td>Crude SRM Dose Level 5 - 4.9%</td>
<td>3.5</td>
</tr>
</tbody>
</table>
Possible Microbial Activity: Why should we care?

• Bubbling and cracking observed in FFT 24hrs after SRM addition
• So What:
  • Microbial activity? → Is this beneficial for plants? Need to measure in the future
  • GHG emissions → type and quantity of gas not measured
Flocculation Experiment - Kaolinite

- Polygloss 90- Kamin Company – high surface area kaolinite (MBI = 3.5 meq/100g)
- Synthetic process water
- 250 mL cylinders + plunger device
- HPAM used for control – 0.05wt% concentration
- SRM was extremely water soluble – added dry
Crude vs Purified SRM - Kaolinite

![Graph showing Crude SRM vs Purified SRM](image-url)
Modifications Attempted

• Esterification
  • Increase + charge

\[
\text{Carboxylic Acid} + \text{Alcohol} \xrightarrow{\text{HCl catalyst}} \text{Ester Product}
\]

• Glutaraldehyde crosslinking
  • Increase MW

\[
\text{Glutaraldehyde} + \text{Peptide} \xrightarrow{\text{Peptide}} \text{Crosslinked Peptide}
\]
Flocculation of a 4%(wt./wt.) kaolin clay solution over time. 3% (wt./wt.) SRM peptides were used as a flocculant, and gypsum was used at a concentration of 300ppm. NaCl controls were used to compensate for the NaCl added to the SRM during esterification, which was 1.82% (wt./wt). Readings were taken by recording the difference in height of the mudline the initial height of the slurry. Lines represent controls and were not used for statistical analysis. Different letters indicate statistically significant difference in means within time blocks. Three replicates were performed.
Flocculation of a 4%(wt./wt.) kaolin clay slurry over time. Gypsum was added as a coagulant at a concentration of 300ppm. Flocculants were added at a 3% (wt./wt.), and the difference of the mudline and the initial height of the slurry was recorded as the water released. Experiments were performed in triplicate. Different letters represent statistically significant differences of groups.
Conclusions

• SRM derived polymers interact with FFT as flocculants

• Efficiency of interactions not yet optimized
  • Too much unreacted peptide in water (yellow color)
  • Settling still too slow for a thickener application

• Evidence of stimulated microbial activity when added to FFT
  • Potential tailings amendment for stimulating plant growth.
Acknowledgments

Dr. David Bressler and the Bressler Lab group