

Supplemental Materials:

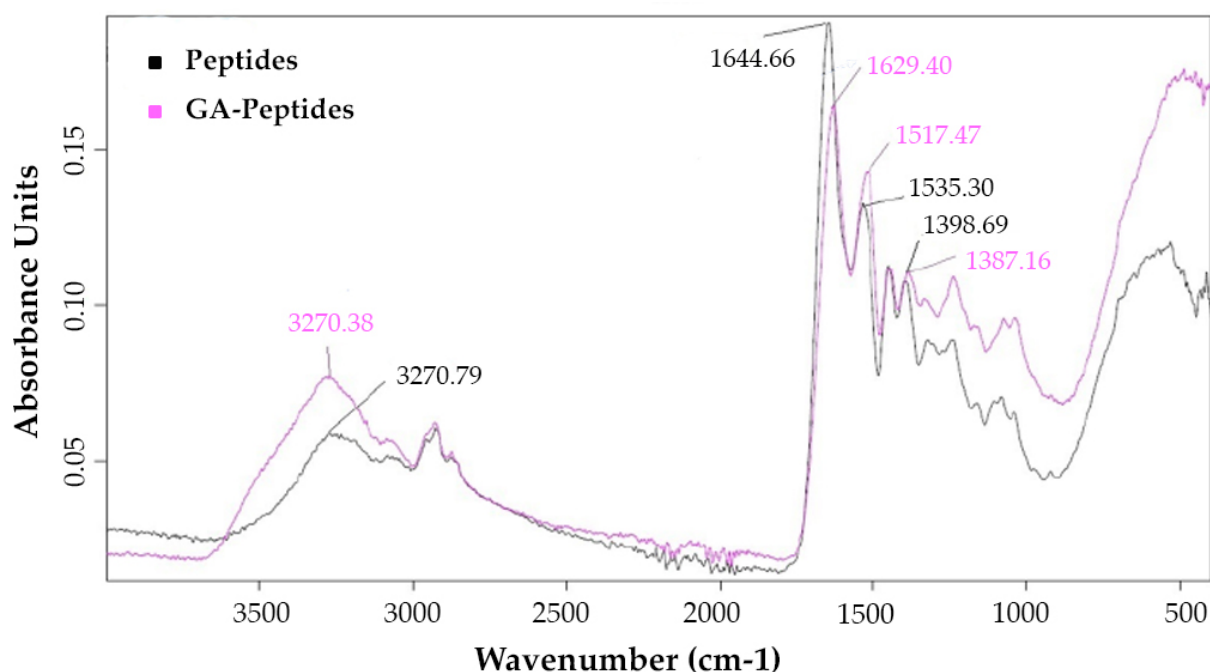
# Ruminant-Waste Protein Hydrolysates and Their Derivatives as a Bio-Flocculant for Oil Sands Tailing Management

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**Figure S1.** Attenuated Total Reflectance (ATR) Fourier-Transform Infrared Spectroscopy (FTIR) spectra of SRM-derived peptides (Peptides) and peptides crosslinked with glutaraldehyde (GA-Peptides; 1:8 ratio).

**Supplemental Table S1.** Percent settling over time in experiments designed to assess the impact of glutaraldehyde cross-linking on the flocculation performance of SRM-derived peptides.

	Method Blank	Gypsum Only	Peptides + Gypsum	GA-Peptides*	GA-Peptides* + Gypsum
<b>0 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%
<b>5 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	39.8 ± 0.3%	25.2 ± 5.3%
<b>10 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.53 ± 0.23%	58.4 ± 0.0%	49.3 ± 1.2%
<b>15 min</b>	0.00 ± 0.00%	0.13 ± 0.23%	2.40 ± 0.00%	62.4 ± 0.0%	54.3 ± 0.6%
<b>30 min</b>	0.27 ± 0.23%	0.53 ± 0.23%	7.33 ± 1.51%	67.4 ± 0.3%	60.3 ± 0.6%
<b>45 min</b>	0.80 ± 0.00%	1.33 ± 0.61%	12.1 ± 2.2%	69.8 ± 0.3%	63.2 ± 0.8%
<b>60 min</b>	0.80 ± 0.00%	3.33 ± 1.01%	16.7 ± 3.0%	71.2 ± 0.0%	65.2 ± 0.7%
<b>120 min</b>	0.80 ± 0.00%	15.6 ± 1.2%	36.0 ± 5.5%	74.2 ± 0.3%	69.5 ± 0.6%
<b>180 min</b>	1.20 ± 0.00%	31.5 ± 2.0%	52.0 ± 6.2%	75.8 ± 0.3%	71.9 ± 0.6%
<b>24 h</b>	3.20 ± 0.00%	70.8 ± 0.4%	77.5 ± 0.6%	83.8 ± 0.3%	80.9 ± 0.2%
<b>48 h</b>	3.73 ± 0.23%	74.9 ± 0.2%	79.7 ± 0.5%	86.2 ± 0.3%	82.5 ± 0.2%

\* Glutaraldehyde crosslinked peptides were obtained using a 1:8 molar ratio (amino:aldehyde groups).

**Supplemental Table S2.** Percent settling over time in experiments designed to assess the flocculation capacity of bioflocculants generated using crosslinking ratios of 1:2 and 1:4 (amino:aldehyde groups).

	<b>Method Blank</b>	<b>Gypsum Only</b>	<b>Peptides + Gypsum</b>	<b>1:2 + Gypsum</b>	<b>1:4 + Gypsum</b>
<b>0 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%
<b>1 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.80 ± 0.00%
<b>2 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	1.20 ± 0.40%
<b>5 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	7.47 ± 3.11%
<b>10 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.80 ± 0.00%	1.73 ± 1.01%	30.7 ± 6.4%
<b>15 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	1.33 ± 0.92%	4.27 ± 4.69%	46.3 ± 3.7%
<b>30 min</b>	0.40 ± 0.00%	0.80 ± 0.00%	6.53 ± 0.83%	31.1 ± 4.0%	58.9 ± 0.5%
<b>60 min</b>	0.80 ± 0.00%	3.60 ± 0.69%	14.7 ± 0.9%	51.5 ± 4.0%	65.2 ± 1.1%
<b>120 min</b>	0.93 ± 0.23%	16.4 ± 1.2%	32.1 ± 1.8%	64.3 ± 1.2%	69.1 ± 0.2%
<b>180 min</b>	1.20 ± 0.00%	32.3 ± 1.7%	48.1 ± 2.0%	65.9 ± 1.2%	71.2 ± 0.0%
<b>24 h</b>	3.07 ± 0.23%	70.9 ± 0.2%	76.3 ± 0.9%	75.9 ± 0.2%	80.5 ± 0.2%
<b>48 h</b>	3.87 ± 0.23%	75.1 ± 0.2%	79.2 ± 0.4%	79.5 ± 0.2%	82.7 ± 0.2%

**Supplemental Table S3.** Percent settling over time in experiments designed to assess the flocculation capacity of biofloc-culants generated using crosslinking ratios of 1:8 and 1:16 (amino:aldehyde groups).

	<b>Method Blank</b>	<b>Gypsum Only</b>	<b>Peptides + Gypsum</b>	<b>1:8 + Gypsum</b>	<b>1:16 + Gypsum</b>
<b>0 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%
<b>1 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	1.33 ± 0.23%	1.73 ± 0.23%
<b>2 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	2.00 ± 0.40%	3.73 ± 0.46%
<b>5 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	20.8 ± 0.8%	34.3 ± 0.6%
<b>10 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.53 ± 0.23%	48.1 ± 0.6%	50.8 ± 1.2%
<b>15 min</b>	0.00 ± 0.00%	0.13 ± 0.23%	2.13 ± 1.22%	53.7 ± 0.2%	55.1 ± 0.8%
<b>30 min</b>	0.53 ± 0.23%	0.80 ± 0.00%	7.87 ± 0.23%	60.3 ± 0.2%	60.8 ± 0.8%
<b>60 min</b>	0.80 ± 0.00%	4.40 ± 0.69%	16.9 ± 0.6%	65.3 ± 0.5%	65.5 ± 0.2%
<b>120 min</b>	0.80 ± 0.00%	15.9 ± 0.2%	36.4 ± 1.2%	70.4 ± 0.7%	69.9 ± 0.5%
<b>180 min</b>	0.93 ± 0.23%	31.3 ± 0.6%	52.5 ± 1.2%	72.1 ± 0.2%	72.1 ± 0.2%
<b>24 h</b>	2.93 ± 0.23%	71.2 ± 0.0%	77.6 ± 0.8%	81.3 ± 0.5%	81.3 ± 0.9%
<b>48 h</b>	3.87 ± 0.23%	75.1 ± 0.2%	80.0 ± 0.8%	84.3 ± 1.8%	81.7 ± 0.2%

**Supplemental Table S4.** Percent settling over time in experiments designed to assess the flocculation capacity of biofloc-culants generated using crosslinking ratios of 1:32 and 1:64 (amino:aldehyde groups).

	Method Blank	Gypsum Only	Peptides + Gypsum	1:32 + Gypsum	1:64 + Gypsum
<b>0 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%
<b>1 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	2.40 ± 0.00%	0.67 ± 0.23%
<b>2 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	8.00 ± 0.80%	1.07 ± 0.23%
<b>5 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.00 ± 0.00%	49.2 ± 0.7%	2.00 ± 0.40%
<b>10 min</b>	0.00 ± 0.00%	0.00 ± 0.00%	0.80 ± 0.00%	57.2 ± 0.4%	9.47 ± 0.83%
<b>15 min</b>	0.00 ± 0.00%	0.27 ± 0.23%	3.73 ± 0.46%	60.3 ± 0.5%	19.5 ± 2.0%
<b>30 min</b>	0.53 ± 0.23%	0.80 ± 0.00%	11.3 ± 0.6%	64.3 ± 0.5%	44.8 ± 4.2%
<b>60 min</b>	0.80 ± 0.00%	4.80 ± 0.40%	23.6 ± 1.1%	68.0 ± 0.4%	58.8 ± 1.1%
<b>120 min</b>	0.80 ± 0.00%	18.7 ± 0.9%	49.7 ± 1.8%	70.9 ± 0.6%	64.5 ± 0.5%
<b>180 min</b>	0.93 ± 0.23%	36.3 ± 1.2%	61.5 ± 0.6%	72.9 ± 0.6%	66.9 ± 0.5%
<b>24 h</b>	2.93 ± 0.23%	71.1 ± 0.2%	77.7 ± 0.9%	80.1 ± 0.2%	77.2 ± 0.4%
<b>48 h</b>	3.47 ± 0.46%	75.2 ± 0.0%	79.9 ± 0.8%	81.6 ± 0.0%	79.2 ± 0.0%