STRUCTURE MODIFICATIONS OF HYDROLYTICALLY DEGRADABLE POLYMER FLOCCULANT FOR IMPROVED WATER RECOVERY FROM MATURE FINE TAILINGS

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Oil sands mining operations in Canada produce large volumes of waste tailings that are difficult to dewater using commercial polyacrylamide-based flocculants. Recently, we have developed a novel hydrolytically-degradable polymer synthesized through micellar radical polymerization of short-chain polyester cationic macromonomers. Poly(PCL_2ChMA), made of polycaprolactone choline iodide ester methacrylate with two polyester units, effectively treated mature fine tailings (MFT) solutions as evaluated by measuring initial settling rate, supernatant turbidity, and capillary suction time (CST) of the sediments[1]. Moreover, the novel materials become more hydrophobic with time, leading to an 85% reduction in CST after accelerated degradation for one week at 85 °C. The achievements described in this follow-up work is twofold. First, we have developed a procedure to directly measure the extent of sediment dewatering that results from the polymer degradation, as previously the performance was indirectly inferred through CST measurements. Second, an investigation of the relationship between macromonomer structure and the performance of the polymer flocculant has led to the development of an improved material. Neither the substitution of PCL with poly(lactic acid) (PLA) units or replacement of the methacrylate functionality with acrylate greatly affects the ability of the resulting cationic flocculants to settle and separate the sediments in diluted MFT solutions because the synthesized polymers had similar charge densities and molecular weights. However, the faster degradation rates of the PLA-based materials lead to significantly faster dewatering of the sediments. As illustrated in Figure 1, over 50% compaction was observed in PLA-polymer flocculated samples held for 5 days at 50 °C, whereas it was necessary to increase the temperature to 85 °C to achieve the same dewatering with the PCL-polymer flocculated samples. As a comparison, it was found that dewatering did not occur when the MFT material was flocculated with a non-degradable cationic polymer. A similar 50% compaction occurs in MFT sediments flocculated with poly(PLA_4ChMA) held at room temperature over several weeks, indicating that the LA-based materials degrade at a fast enough rate to provide solids compaction under field conditions. Work continues to investigate the relative performance of copolymers, and to develop larger scale testing procedures.

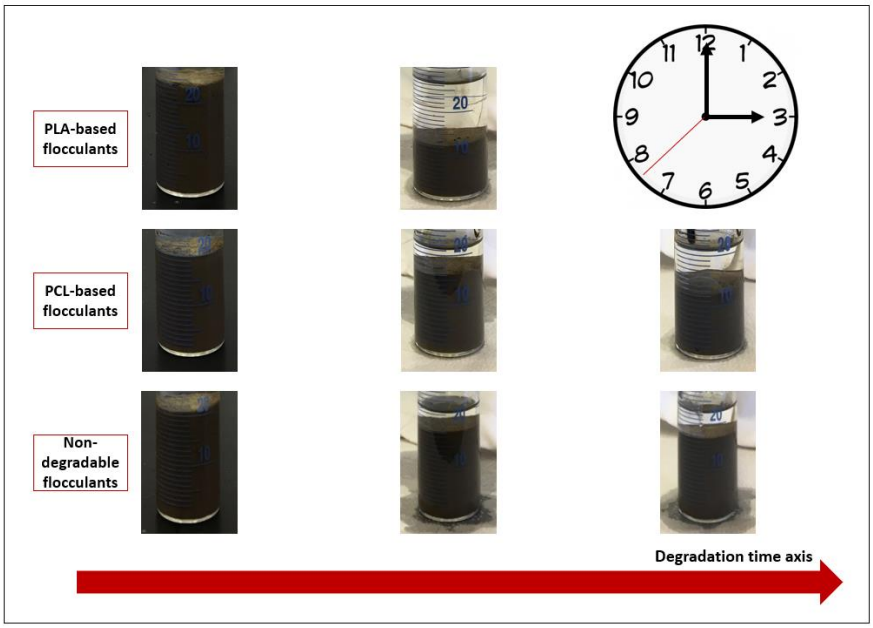

Figure 3 – Comparison of the compaction of sediments treated with PLA-based, PCL-based, and non-degradable flocculants with time

References:

[1] S. P. Gumfekar, T. R. Rooney, R. A. Hutchinson, and J. B. P. Soares, "Dewatering Oils Sands Tailings with Degradable Polymer Flocculants," *ACS Appl. Mater. Interfaces* **2017**, *9*, 36290-36300.