CHITIN AS A FRACTIONAL AMENDMENT TO SPENT MUSHROOM COMPOST TO ENHANCE THE EFFICIENCY AND EFFECTIVENESS OF TREATMENT OF MINE IMPACTED WATER[1]

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Abstract: The slow-release, fermentable, organic substrates commonly used to support the biological treatment of mine impacted water (MIW) are often deficient in nitrogen, thereby limiting the activity of sulfate reducing bacteria and inhibiting the performance of passive treatment systems. Recently, our laboratory has shown that chitin (poly-N-acetylglucoseamine), a nitrogen-rich, sustainable waste product of the shellfish industry, is capable of enhancing the activity of sulfate reducing bacteria and improving the efficiency of MIW treatment. This research explores the possibility of using chitin as a fractional amendment to spent mushroom compost substrate (SMS) to facilitate the development of a cost-effective, practical approach for thorough MIW bioremediation.

Microcosm experiments were conducted to test the ability of varying mixtures of ChitoRem® SC-20 crab-shell chitin and SMS to support bacterial communities for the remediation of MIW. Six different fractions of chitin ranging from 0 to 100% were combined with SMS to give a total substrate mass of 0.25 g and then added to serum bottles containing 100 mL MIW and 0.5 g stream sediment (bacterial source). Control microcosms were similarly prepared: Abiotic Controls contained MIW, sterilized substrate, and no sediment, whereas Negative Controls contained only MIW and sediment. All microcosms were established in duplicate and shaken continuously in the dark. After four weeks, the microcosms were sacrificed. Aqueous samples were tested for pH, alkalinity, acidity, volatile fatty acids, dissolved organic carbon, ammonia, anions, and dissolved metals. Notably, MIW treated with chitin:SMS substrate mixtures of 1:4, 1:1, and 1:0 yielded sulfate concentrations 49%, 68%, and 86% lower than MIW treated with SMS alone. The corresponding iron concentrations were 43%, 99.7%, and 100% lower than the iron concentration in MIW treated only with SMS.

Metagenomics were applied to sediment samples to document changes in microbial diversity following treatment with chitin and SMS and correlated with the observed pollutant reduction rates. The ultimate aim of this work is to identify specific microbial groups that are responsible for enhancing MIW treatment, and provide insight on substrate compositions that could be utilized to increase their population and activity to improve the design of MIW treatment systems.

Additional Key Words: Acid mine drainage, bioremediation, crab shell, passive treatment.

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