ALTERNATIVE ORGANIC SUBSTRATES IN CONSTRUCTED WETLANDS: PRELIMINARY RESULTS OF BATCH EXAMINATION[1]

by

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Abstract: Bacterial sulfate reduction (BSR) can be a major contributor to the generation of alkalinity in some acid mine drainage (AMD) passive treatment systems. BSR requires anaerobic conditions, adequate sulfate concentrations, pH >4, and sufficient labile organic carbon. Hundreds of compost wetlands containing organic substrates have been constructed to treat AMD over the past two decades. Spent mushroom substrate (SMS) has been the most common substrate utilized, in part because of its ready availability in the Northern Appalachian coalfields. In areas where SMS is not readily accessible, such as the southeastern Oklahoma coal mining region, alternative organic substrates are needed for the construction of effective passive treatment systems. This study examines the possibility of using several alternative organic substrates in AMD treatment wetlands for the generation of alkalinity. Alternative substrates were chosen due to their local availability and abundance. Water quality changes were monitored in microcosms containing six organic substrates (SMS, 100% horse manure, 100% cow manure, a horse manure/sawdust/straw mixture, an 80% cow manure/20% sawdust mixture by mass, and broiler house chicken litter) in bench-scale, batch experiments over a period of two months. Mine drainage from a nearby discharge (pH 3.5, >450 mg/L acidity as $CaCO_3$ eq., >200 mg/L total Fe, 10 mg/L Al^{+3}, 10 mg/L Mn^{+2} and 1800 mg/L SO_4^{-2}) was added to substrate-containing microcosms incubated at room temperature. Individual microcosms were sacrificed weekly for analyses. Preliminary data indicate that broiler litters may impart greater than 15 times the amount of alkalinity as SMS, with all substrates raising pH to near circumneutral. Broiler litter alkalinity increased to over 6000 mg/L as $CaCO_3$ eq., and reached an equilibrium state of 5600 mg/L. Both horse manure substrates increased alkalinity values significantly, with steady weekly increases, reaching 1840 +/- 77 mg/L HM/SD and 1600 +/- 67 mg/L after seven weeks. Similar trends were found for cow manure substrates, although these imparted significantly less alkalinity than the horse manure substrates. The CM substrate raised alkalinity to 1210 +/- 65 mg/L, while CM/SD substrate increased alkalinity values 1000 +/- 38 mg/L. Spent mushroom substrate imparted the least amount of alkalinity to the water (340 +/- 80 mg/L). These data indicate that the generation of alkalinity from SMS is an order of magnitude lower than that by the broiler litter. Broiler litter may offer a promising alternative to SMS as an alkaline generating substrate in compost wetlands, however, further study must be completed into the potential problems caused within receiving streams, such as increased BOD and nutrient enrichment.

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