ACID MINE DRAINAGE TREATMENT WITH WETLANDS

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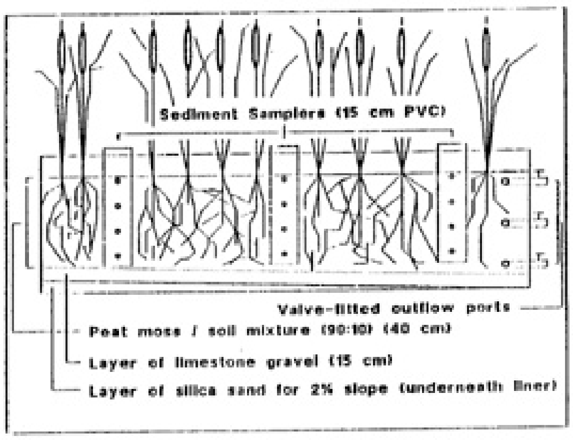
Biological neutralization of acid mine drainage (AMD) in man-made cattail (Typha) wetlands was investigated utilizing model wetlands (480 x 60 x 60 cm) constructed in the greenhouse. A naturally occurring AMD (430 mg L-1 iron, 2900 mg L-1 sulfate, pH 2.75) was added to the wetlands with a detention time of 4 days. During the first year of operation, anoxic conditions (-300 mV) and near neutral pH (6.5) were maintained in subsurface sediments. Sulfate concentrations decreased with depth (ca. 200 mg kg-1) due to the establishment of active sulfate reducing bacteria as indicated by 35SO42- reduction. Reduced iron sulfides accumulated as 80% acid volatile sulfides / 20% pyrites. Iron sulfide formation could account for between 15.5 % of the total iron removed from AMD during passage through the wetlands. The remainder of the iron was retained as follows: exchangeable, 34.5 %; organically complexed, 17.1; and oxides, 31.9. Overall, the wetlands retained nearly 66% of the total applied iron in the first year.

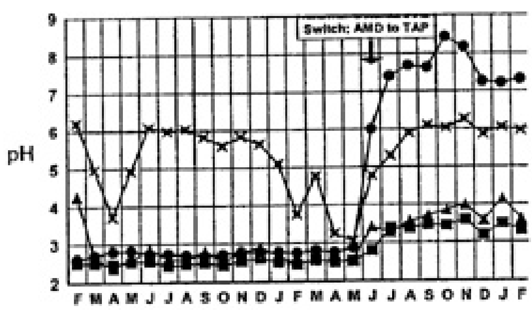
The experimental wetlands have continued to receive AMD for an additional 2 years testing the sustainability of these systems. The accompanying Figures (see back of this page) illustrate monthly changes in pH and total iron from effluent water obtained 15, 25, and 35 cm below the wetland surface. During routine daily operation water exits the wetland primarily from the 35 cm depth. Wetland # 3 (data not shown), a fresh water control, has shown no appreciable changes from circum neutrality over the past 3 years. Wetlands #1 and #4 illustrate removal of iron by complexation and oxide formation in surficial water, with little amelioration of the acidic pH. Subsurface sediments contains greater concentrations of dissolved iron, however excess alkalinity buffers the interstitial water near pH 6 due to active limestone dissolution and continued bacterial sulfate reduction. Subsurface amelioration of the acidic water failed in Wetland # 1 following 26 months of loading with AMD. However, once AMD was replaced with freshwater, acceptable pH was regenerated in the subsurface effluent. Perhaps more importantly, metals retained within the wetland matrix were not remobilized once AMD addition ceased. Conversely, when Wetland #2 was switched from freshwater addition to AMD, effluent chemistry similar to the previously AMD treated wetlands was rapidly established.

Wetland # 4 has been receiving continuous AMD addition for 36 months and continues to produce a neutral effluent high in soluble iron. These data suggest that this wetland may function in a similar manner to an anoxic limestone drain, allowing the advantage of post-system precipitation of iron hydroxides, without reacidification of the effluent water. Recent increases in soluble iron export from this system relative to influent water could be the result of microbial iron reduction. Active iron reduction in - the wetland could be advantageous, since limestone in anoxic drains will armor in the presence of excess ferric iron.



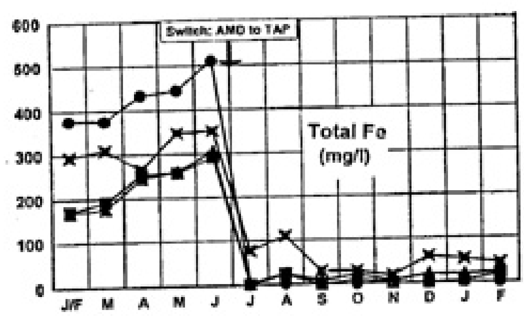
Inflow/Outflow pH Chemistry of Wetland #1

(Feb 1991 to Feb 1993)



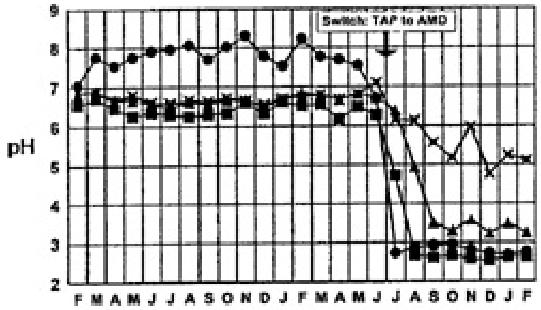
Fe Chemistry of Wetland #1

(Jan 1992 to Feb 1993)



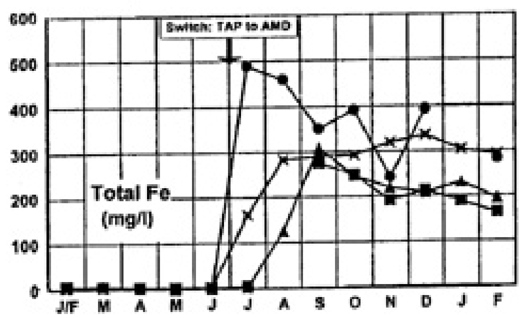
Inflow/Outflow pH Chemistry of Wetland #2

(Feb 1991 to Feb 1993)



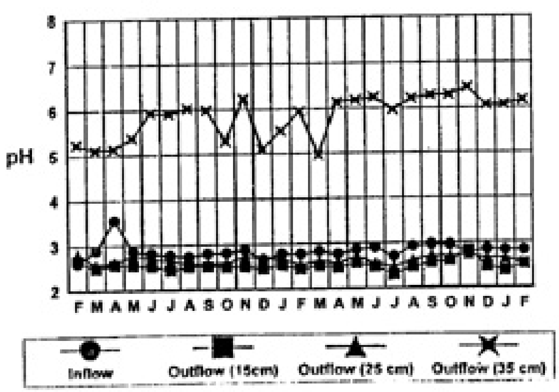
Fe Chemistry of Wetland #2

(Jan 1992 to Feb 1993)



Inflow/Outflow pH Chemistry of Wetland #4 (AMD)

(Feb 1991 to Feb 1993)



Fe Chemistry of Wetland #4 (AMD)

(Jan 1992 to Feb 1993)