

Metal Reclamation Units (MRUs Wetlands in a Box) for AMD and Nutrient Cycling ¹

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Abstract: Metal Reclamations Units (MRUs) are passive, modular, scalable, rapidly deployed wetland bioreactors. The biofilm which grows upon the support matrix inside the MRUs is self-selecting and determined by the introduced pollutants and how they are attenuated throughout the treatment process. MRUs use multiple stepped waterfalls (1-750 Lpm), which decrease short circuiting, increase gravity precipitation to the bottom sludge vault, and engender 3 periodic and efficient gas exchanges per MRU. These gas exchanges speed the oxidation or reduction process by de-gassing biotic/abiotic products and swapping them for preferenced gases in the open or closed MRU. The metabolic pathways that develop and change through attenuation represent all three microbial domains and are the MRUs work force. MRUs also support a diverse array of breeding micro and macro fauna, functioning as vernal ponds when buried to the lid and the treated flow surpasses sensitivity thresholds. Currently, our systems function as tertiary treatment at six sites removing Mn and Al, pH<7, where residual Fe and Al are captured to below 0.35 mg/L and Mn is removed at rates up to 200+grams/m2/day to achieve TMDLs (3, 4). At another site, raw treatment of dissolved Fe, pH <5.5 max to 3.2> minimum, demonstrated rates up to 4kg/day of Fe captured using two MRUs Mk1.5s in series, residence 20-25 minutes, flow 280 Lpm (5). Replications show that nutrient additives which consider biofilm ecological needs increase biological remediation of metals. Concerning aquaculture, an MRU which receives diverted leachate from grow rooms recycles the intentional over-nitrification of P and K almost indefinitely, while nitrate is produced from the aquaponic nitrifier dynamic. The highly diverse and aerobic ecosystem in the MRUs function as integrated pest managers, limiting the dangers of pathogens, pests, and metal toxicity from uncycled fertigation water in closed loop environments.

Keywords: biofilm, natural attenuation, aquaponics

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