

Assessment of Metal Removal, Distribution and Retention in Constructed Wetland H-02 over 15 Years

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The H-02 wetland was constructed on the Savannah River Site (SC, USA) in 2007 to remove copper (Cu) and Zinc (Zn) from the Tritium Extraction Facility and storm runoff water. Water samples were collected in June, July, and August of 2023 at the primary discharge pipe, influent and effluent of each wetland cell, and receiving stream. Water parameters were measured in situ; the total, dissolved, and particulate metal (Cu and Zn) concentrations were determined, and the bioavailable pool of Cu and Zn were evaluated with diffusive gradient in thin film (DGT) probes. Sediment samples were collected for a single time point (7/13/2023) for the measurement of metal binding in the sediment. Eight sediment cores were collected from each wetland cell, each cell was spatially divided into 4 quarters (A, B, C, and D) along its long axis, and two replicate cores were taken from each quarter. Each core was divided into three layers: organic sediment – top layer (0-5 cm), shallow inorganic sediment (5-10 cm), and deep inorganic sediment (10-20 cm). Sediment data were used to assess the horizontal and vertical distribution of metals in the wetland sediment and metal retention and bioavailability (with DGT probes) in the wetland sediment. Total metal concentrations in the effluent were lower than the regulatory discharge limit with an average removal efficiency of 62.0% for Cu and 76.9% for Zn. Copper concentrations in surface waters measured by DGT generally decreased along the flow path paralleling the pattern observed with total Cu concentrations in water. Also, sediment DGT Cu concentrations near the cell discharge points were over 60% lower than DGT Cu concentrations near the influent points of the cells. DGT measurements of Cu and Zn in the sediments were much lower than bulk sediment measurements. These results suggest that most of the Cu and Zn deposited in the H-02 wetland sediments over 15 years of operation was not bioavailable as a likely consequence of adsorption to sediment particles and complexation with organic and inorganic substances.