

Mass Balance and Modeling for Se Remediation in TLDD Flow-through Wetland Cells

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Executive Summary

The TLDD flow-through wetland system was established in 1996 to test if wetland cells with various substrates can remove Se from saline irrigation drainage. This project is a collaborative effort between UCB (Terry) and UCD (Tanji/Gao) supported by the Salinity Drainage Program, TLDD and DWR. The principal findings to date include: Se in drainage water can be removed to as low as 4 to 5 ppb with residence times of about 7 and 21 days and with certain substrates, the major sink of Se in the cells is the sediment and fine organic detritus matter on top of the sediments with smaller sinks in the standing crop, volatilization losses and seepage losses, and the essential role of organic carbon in Se reduction mediated by microbes. However, several important questions remain unanswered by the current findings that include accurate estimate on Se mass balance and partitioning in the wetland cells and potential extension of database from experimental plots to scaled-up operational systems. The objectives of this research proposal are:

1. Determine the magnitude of Se sink in the sediments and fine organic detrital matter and fallen litter on top of the sediments in all ten cells. Also determine Se speciation including organic Se in these sinks in collaboration with UCB.
2. Estimate the mass balance of water and Se in each of the 10 cells in collaboration with DWR for water and UCB for Se (run wetlands for two additional years).
3. Develop math models for flow-through wetland system at two levels in collaboration with colleagues from UC Berkeley and DWR. Level 1 Model will be based on partition coefficients for a compartment mass balance on both water and selenium. Level 2 Model will be a linkage between a hydraulic submodel to calculate residence time and a simultaneous Se transformation/fate submodel based on first-order kinetics.

To accomplish the above objectives, a collaborative effort with UCB and DWR is essential. In Objective 1, sediment core samples, fine organic detrital matter (fom), and fallen litter on top of the sediments in all ten cells will be taken after August 2000 in order to compare with August 1999 data. The mass partition of Se in each compartment and Se speciation in sediments and organic detritus will be evaluated using both chemical methods (UCD) and x-ray absorption (XAS) technique (UCB). In Objective 2 partially supported by DWR, monitoring of water inflow and outflow from each cell and analysis of weekly samples will be continued for both concentration and Se speciation in collaboration with DWR. Data sets will be processed to compute water flow, residence time, water and Se mass balance, Se removal ratios, and to obtain parameters for Objective 3. The purpose of Objective 3 is to integrate what we have learned about the behavior of wetland cells and contribute towards the engineering design and performance evaluation for scaling up to operating systems.

It is suggested that two more years are required to address major questions of using wetlands to remove Se from saline irrigation drainage before disposal into evaporation basins.