MILWAUKEE AREA TECHNICAL COLLEGE

SUSTAINABLITITY WEBSITE

WET LAND RESTORTION

The constriction of the Oak Creek and Mequon Campus some thirty years ago included the creation of storm water retention ponds. Initially these ponds contributed to aid in the reduction of water flow during periods of spring melt and heavy rains. This reduces the demand on Milwaukee Metro Sewage District (MMSD) and aided in reducing the amount of waste released untreated into Lake Michigan. Thirty years of service to the Cities of Oak Creek, Mequon and Thiensville have, however, taken a toll.

Chemicals have dropped from vehicles parked on the parking lots and have been carried by rain runoff into the retention ponds. This has resulted in a sediment build up in the pond that has converted the ponds into deserts lacking life beyond algae. MATC has begun a project at the Mequon Campus that will convert the pond into a living filter of chemicals.

The Horticulture department and the Chem. Tech Program are going to rehab the pond and then plant vegetation that will filter future run off and eliminate the chemicals before they leave the MATC property. This will improve the water quality downstream from MATC and add to the recovery of the Milwaukee River

PRESS RELEASE

Nature's filter: Wetlands clean selenium from agricultural runoff
02 January 2003

By Sarah Yang, Media Relations

Berkeley - Researchers from the University of California have found a natural detox program for selenium-contaminated farm runoff in the form of wetland vegetation and microbes.

Results from a two-year study by UC Berkeley researchers show that man-made wetlands in the state's San Joaquin Valley were able to remove an average of 69.2 percent of the selenium in agricultural drainage water. More significantly, some plant populations showed remarkable promise at converting selenium into a harmless gas consisting primarily of dimethyl selenide. That means less of the selenium would end up in sediment or plant tissue.

The new study, published online Wednesday, Jan. 1, in the journal *Environmental Science and Technology,* follows previous research at the Chevron oil refinery in Richmond, Calif. The researchers found that wetland ponds built in Richmond could take out as much as 89 percent of the selenium from millions of gallons a day of refinery discharge, preventing it from reaching San Francisco Bay.

"We thought that if wetlands could filter selenium from oil refinery wastewater, then they could probably be used for agricultural runoff," said Norman Terry, professor of plant biology at UC Berkeley's College of Natural Resources and principal investigator of the study. "We're basically learning that some of the best, most efficient filters for pollutants can be found in nature."

Terry said the entire wetland ecosystem is acting as a bio-geo-chemical filter. "Everything is working in concert to take the selenium out of the drainage water," said Terry. "The extensive root system of the plants slows down the water flow so the selenium gets trapped in the sediment. The plants also provide a source of fixed carbon to fuel microbes, which metabolize the selenium into non-toxic gas. It is truly an amazing process."

The UC Berkeley research is part of a larger project funded by the UC Salinity/Drainage Program. The program involves researchers from the UC campuses at Berkeley, Davis and Riverside, and from the Tulare Lake Drainage District in Corcoran, Calif., who have been studying ways to provide irrigation for Central Valley farmers while mitigating ecological risks.

The toxic effects of selenium made headlines in 1983 when high levels from polluted farm water were found at the Kesterson national wildlife refuge in the San Joaquin Valley, part of the Central Valley. The soil on the west side of the San Joaquin Valley is naturally rich in selenium, which leaches into the shallow groundwater of the region. Excessive agricultural irrigation accelerates this leaching process.

A large quantity of selenium-polluted agricultural drainage water was being discharged into the reservoir in the early 1980s. The selenium was linked to severe deformities suffered by birds and other wildlife at the Kesterson refuge.

"Kesterson lacked proper environmental monitoring and management, so the selenium continued to build up, becoming concentrated over time through the food chain," said Zhi-Qing Lin, lead author of the study and former post-graduate researcher with Terry at UC Berkeley.

The discovery of selenium in the reservoir put the brakes on the construction of a drain that would have carried irrigation water from the Central Valley to the Delta. Farmers say the disruption of the irrigation drain, however, allowed salt to build up in the soil, leaving their land fallow.

The situation was bad enough that, last month, the federal government agreed to pay $107 million to San Joaquin Valley farmers for 34,000 acres of salt-poisoned farmland.

To test the effectiveness of wetlands in cleaning selenium out of agricultural drainage water, researchers from the UC Salinity/Drainage Program built 10 separate wetland ponds in the Central Valley at a site in Corcoran. The ponds, or "cells," contain a single plant species - such as cordgrass, saltmarsh bulrush and rabbitfoot grass - or a combination of plants. One pond was left unplanted as a control. Separate pipes brought water in and out of the ponds, which are roughly the size of two basketball courts.

In measurements taken from 1997 to 1999, they found that most of the selenium was retained in the sediment, and less than 5 percent accumulated in plant tissue.

"Selenium is not considered an essential nutrient in plants," said Lin, who is now assistant professor of environmental ecology at Southern Illinois University at Edwardsville. "However, selenium is a chemical analogue to sulfur, which is essential to plants. One theory holds that plants metabolize selenium through similar bio-chemical pathways as sulfur."

The researchers say constructed wetlands can be retired and drained when the concentration of selenium in the sediment and plant tissue gets too high. This would allow another process of selenium removal to kick into gear.

"Once the water and wetland plants are removed, we can plant pickleweed or other vegetation into the soil," said Lin. "In lab tests, these plants and various strains of bacteria associated with them take over the remediation process and volatilize the selenium in the soil."

The researchers were particularly excited by the amount of selenium volatilized by the wetland ponds. In one summer month, nearly half of the selenium entering the pond containing rabbitfoot grass was volatilized into a gas mostly consisting of dimethyl selenide.

"Grasses that have extensive root systems, such as rabbitfoot grass and cordgrass, do a better job of providing surface area for microbes that help volatilize selenium into dimethyl selenide," said Terry.

Prior studies have found dimethyl selenide to be about 500 times less toxic than the inorganic forms of selenium.

"Converting the selenium into gas helps get the chemical out of the area entirely rather than having it build up in sediment or plant tissue," said Terry. "Air currents carry away the dimethyl selenide to the eastern part of the state where the soil is so deficient in selenium that farmers there actually feed their livestock selenium supplements to keep them healthy."

Terry noted that the air in the northern hemisphere already contains about 10,000 metric tons of volatile selenium from volcanoes, soil and plants. "The amount of dimethyl selenide released by wetlands would be negligible in comparison," he said.

The researchers are studying ways - including using genetically engineered plants - to improve volatilization rates throughout the year. Currently, volatilization is greatest during warmer months. When winter and fall periods were taken into account, an average of 9.4 percent of the total selenium entering the rabbitfoot grass pond was volatilized.

Terry said wetland plants could become a major wastewater remediation tool for both agriculture and industry.

"The upshot is that wetlands are a very efficient and affordable solution to ridding polluted water of a toxic chemical," said Terry. "Plants grow year after year, and while a constructed wetland system would need to be monitored, it would be relatively easy to maintain."

The Electric Power Research Institute helped support the UC Berkeley study.