REPORT SUMMARY

Treatment of wastewater to meet regulatory discharge standards represents a significant cost of compliance for the electric utility industry. Constructed wetland treatment systems can offer significant cost savings over chemical treatment alternatives for some utility wastewater discharges. This report summarizes the design practices, treatment performance, and economic advantages of the Springdale project, and R&D constructed wetland treatment system applied to coal combustion by-product (CCB) leachate in western Pennsylvania.

Background

Coal-burning electric power generation facilities may encounter compliance difficulties with metals-contaminated wastewater discharges during land disposal of CCBs. These discharges must comply with National Pollutant Discharge Elimination System (NPDES) effluent limitations on metals and other contaminant concentrations. At the Springdale CCB disposal facility, owned by Allegheny Power in western Pennsylvania, a constructed wetland treatment system has proven highly effective for removing regulated parameters from CCB leachate. Cost analyses show this system can be operated and maintained at a significantly lower cost that chemical treatment alternatives sized to provide the same level of compliance. The Springdale project is a tailored collaboration between EPRI and Allegheny Power.

Objectives

To evaluate a variety of constructed wetland treatment cells to determine treatment efficiency; to provide design criteria and recommendations for improvement; and to summarize the operational and cost advantages of constructed wetland treatment over chemical treatment alternatives.

Approach

Investigators designed the Springdale system to evaluate the performance of five constructed wetland treatment technologies, three of which were experimental. They monitored water quality parameters at the inlet and outlet of each system component for a period of two years. Concurrent flow measurements allowed calculation of net pollutant loading reductions for each system component and extrapolation of removal efficiencies for the individual technologies. Investigators documented system construction costs for comparison to chemical treatment alternatives. They projected O&M costs for constructed wetland and conventional chemical treatment based on chemical loading data and operational results from existing systems of similar construction.

Results

The Springdale constructed wetland treatment system has proven highly effective in treating aqueous metals, achieving compliance for all site NPDES metals parameters. The only notable

exception was boron, which does not appear to be treatable by any means on this site. Concentration reductions for the primary parameters were 98% for iron, 92% for manganese, and 71% for aluminum. The system also significantly reduced unregulated pollutant parameters and beneficially increased pH and alkalinity.

Cost analyses indicate a 50-year net present value savings of approximately $1.3 million for the wetland system compared to the least expensive chemical treatment alternative. Capital construction costs for the wetland system and the chemical treatment alternatives are approximately equal, while O&M costs are considerably lower for the wetland system. These O&M cost savings are primarily the result of lower on-site labor and reduced waste disposal costs due to denser sludge formation in the wetland system. Similar economic and treatment performance is expected for other constructed wetland treatment systems for CCB leachate or metals-contaminated wastewaters.

EPRI Perspective

Constructed wetland treatment systems offer an emerging technology within the electric utility industry for the treatment of point and nonpoint source discharges. EPRI conducts a research program dedicated to developing constructed wetland systems as a cost effective technology for treating these discharges. Currently, EPRI is collecting field data from the wetland systems built as a result of EPRI tailored collaboration projects (WO9065-01 and WO8204-01). EPRI will use this information in developing design criteria and system models to help electric utilities meet NPDES effluent discharge limits.

TR-111473

Keywords

Passive Treatment
Discharge Compliance
Trace Metals Removal