

2019 Project Abstract

For the Period Ending June 30, 2022

PROJECT TITLE: Minerals and Water Research - Subproject 1: Mobile Water Treatment Demonstration System for Sulfate Reduction

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APPROPRIATION AMOUNT: \$300,000

AMOUNT SPENT: \$280,972

AMOUNT REMAINING: \$19,028

Sound bite of Project Outcomes and Results

The project provides a cost-effective process for treating wastewater to meet the wild rice sulfate standard of 10 mg/L. The data gathered from the field pilot trial at two wastewater treatment plants will help in implementing a full-scale treatment system to reduce sulfate level for protecting water resources in Minnesota.

Overall Project Outcome and Results

The State of Minnesota adopted a sulfate standard of 10 milligrams per liter (mg/L) for wild rice waters in 1973. Compliance with this standard is a challenge for small industries and municipalities as membrane-based technologies typically require high capital and operation costs. The Natural Resources Research Institute (NRRI) has developed a mobile treatment system based on barite precipitation reactions to reduce sulfate levels. In this project, NRRI deployed the trailer-based modular demonstration treatment system at two municipal wastewater treatment plants (WWTPs) in northeastern Minnesota to perform field pilot trials. The objectives of the field pilot trials were to:

- (1) Evaluate the efficacy of the chemical precipitation process at a flow rate of 1-2 gallons per minute with different wastewater sources (domestic and industrial wastewater);
- (2) Optimize the chemical reagent dosage levels; and
- (3) Estimate the chemical reagent costs.

The pilot tests were conducted using effluent from the Virginia WWTP and the Grand Rapids WWTP from June 2021 until October 2021. The Virginia WWTP treats domestic wastewater exclusively, and the resulting effluent has relatively steady sulfate concentrations of 60 mg/L. The Grand Rapids WWTP treats a mixture of domestic wastewater and industrial wastewater supplied from a regional paper mill with a sulfate level ranging from 85 to 115 mg/L. The pilot test results indicated that the chemical precipitation system consistently reduced the sulfate levels of both wastewaters to below 10 mg/L with optimal chemical dosage rates. The chemical costs were estimated to be \$2.27 and \$5.50 per thousand gallons of effluent from Virginia and Grand Rapids wastewater treatment plants, respectively. Information gained from the field trials was used to develop guidelines for the future design and operation of a plant-scale system.

Project Results Use and Dissemination

This project has produced materials of interest to a wide variety of stakeholders, including the researchers, city councils, wastewater treatment plant operators, and the community. Among these products are presentations, posters, and videos. Sulfate treatment research results were presented in three conferences (Minnesota Water

Resources conference, The Society for Mining, Metallurgy & Exploration Inc. conference, and the International Mine Water Association conference), the Virginia City Council, and the University of Minnesota Duluth University for Seniors class. A [YouTube video](#) was created to describe the sulfate problem in Minnesota and our solution.

The full report is publicly available on the University of Minnesota Duluth Natural Resources Research Institute (NRRI) [Website](#).