Title: **A Case Study of Nitrogen Transformations at a Rapid Infiltration System Used for the Disposal of Food Processing Wastewater (Study No. 20)**

Investigators:

Principal Investigator

William C. Boyle, Professor
University of Wisconsin-Madison
Dept. of Civil and Environmental Engineering

Principal Investigator

John A. Hoopes, Professor
University of Wisconsin-Madison
Dept. of Civil and Environmental Engineering

Graduate Research Assistant

John Niewoehner
University of Wisconsin-Madison
Dept. of Civil and Environmental Engineering

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Objectives: To evaluate the nitrogen removal and groundwater loadings which occurred beneath the absorption ponds of a rapid infiltration system receiving food processing wastewater, to examine the hydraulic performance of the absorption ponds and to determine the extent to which absorption ponds have increased the nitrate concentrations in the groundwater.

Background/Need: Observations have shown that many rapid infiltration systems fail to provide sufficient nitrogen removal resulting in elevated nitrogen concentrations in groundwater below absorption ponds. This study was conducted to examine and test conditions for enhancing nitrogen removal at one site.

Methods: Six wells were installed to sample groundwater around old and new absorption ponds. Suction lysimeters and tensiometers were installed to monitor nitrogen concentrations and pore water pressures through the soil. Soil temperatures beneath the absorption ponds were measured to determine sufficiency for nitrification or denitrification to occur. Preserved, filtered well samples provided a comprehensive evaluation of groundwater concentrations, while filtered grab samples from absorption ponds provided concentrations of five parameters in the water applied to the ponds. Soil samples were collected beneath the absorption ponds on three occasions; chemical analysis confirmed the concentrations found in lysimeters. Infiltration rates of absorption ponds enabled evaluation of their hydraulic performance. Measurement of the volume of wastewater applied to absorption ponds assessed their performance with respect to evaporation, precipitation and seepage.

Results:

High Total Kjeldahl Nitrogen (TKN) concentrations resulted in the groundwater beneath pond 2 during the extended loading period, mainly in the form of ammonium-nitrogen; these increased concentrations did not appear in wells further downgradient near pond 3. Ammonium adsorption may decrease the TKN levels. Organic nitrogen not directly transformed to nitrates added to TKN found in impacted wells. All of the impacted wells had nitrate concentrations over the 10 milligrams per liter groundwater standard for at least one month of the study. Denitrification may have been impeded by an insufficient carbon source and lack of anaerobic conditions. Nitrogen was retained in the soil at two of the ponds during a loading period; later it nitrified and flushed through the soil with subsequent loading. This increased the nitrogen concentration of the groundwater. Nitrogen concentrations in the ambient groundwater were near or above the standards which minimized the effects of dilution. Little or no clogging of the ponds occurred (to impede infiltration or promote denitrification). As the pond bottoms did not remain covered very long after flooding, the soils hydraulic capacity was ample.

Conclusions:

Investigators observed less than 50% nitrogen removal as a result of the installation of additional aerators in the lagoons, which was insufficient to meet groundwater standards for nitrogen. All three ponds provided enough surface area to dispose of the applied wastewater quantities. Operation of the ponds is not deterred by winter conditions; freezing of the soil did not occur.

Recommendations/ Implications:

Investigators suggest examination of the mechanism of nitrogen removal in lagoon 2 described in the study and an in-situ experiment to determine the effect of decreasing the infiltration rate on nitrogen removal with respect to hydraulic conductivity of the pond.

Availability of Report:

This report is available for viewing and loan at:

The Water Resources Center
1975 Willow Drive
Madison, WI 53706
(608) 262-3069
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Related Publications:

Sauer, David K. and Scott, Stephen. Wisconsin Groundwater Quality Standards: Can Wastewater Land Treatment Systems Meet Them? Wisconsin DNR publication, Madison, Wisconsin.

Key Words:

Absorption pond, ammonium-nitrogen, nitrogen, rapid infiltration system, Total Kjeldahl Nitrogen (TKN), volatile organic compounds

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