Title: **Field Investigation of Groundwater Impacts from Absorption Pond Systems Used for Wastewater Disposal (Study No. 19)**

Investigators:

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Objectives: To characterize the soil treatment capabilities, effects on the groundwater and nitrogen removal efficiencies by soil absorption at two absorption pond sites.

Background/Need: Wisconsin groundwater standards necessitate evaluation of absorption pond design as a method of wastewater treatment.

Methods: Sites selected for study included a typical municipal system discharging high volume/low organic strength domestic wastewater from a secondary treatment facility and a typical industrial system discharging low volume/high organic strength dairy wastewater from a cheese factory. Water table wells and piezometers were installed in the saturated zone to establish groundwater flow and quality characteristics. Nested tensiometers and suction lysimeters were installed in the unsaturated soils to evaluate moisture movement and soil pore water quality in the unsaturated zone. Groundwater and soil samples were collected and groundwater elevations were recorded. Site observations including treatment system operation, performance and wastewater infiltration rates were also recorded. Groundwater and soil pore water samples were collected monthly and analyzed for standard wastewater parameters, nutrients and selected cations.

Results/Conclusions: Characterization of wastewater from the municipal system indicated that total nitrogen contamination decreased by more than 50% during the summer months compared to winter. Nitrate was the primary form of nitrogen in the wastewater from May through November while ammonium was the primary form from December through April. Mass balance calculations indicated that 94% of the total nitrogen applied as effluent in 1985 reached the water table. Impact on groundwater (above NR 140 standards) was detected in monitoring wells within 250 feet downgradient and 35 feet below the municipal site. Temporal fluctuations in the nitrogen species detected in monitoring wells correlated to fluctuations in the effluent concentrations and confirmed estimated travel times. A dilution of approximately 10% was estimated within this zone. Percent removals of other effluent constituents included 75% of the chemical oxygen demand, greater than 95% of the biological oxygen demand and 70% of the total phosphorus.

Characterization of wastewater from the industrial system indicated that organic nitrogen was the dominant form present in the ponds. Concentrations were variable with no correlation to seasonal conditions and organic loading rates were high for the type of system. The infiltration capacity of the ponds was limited due to fine-grained silt soils and the ponds were hydraulically overloaded at times. The highest impacts on the groundwater were concentrated within 100 feet below the ponds. No impact within underlying dolomite bedrock was detected 75 feet downgradient of the ponds. Evaluation of nitrogen data indicated reductions of 85% 20 feet downgradient of the ponds, primarily due to restricted infiltration capacities.

Recommendations/ Implications:

Investigators recommend further work to identify the type of soils which will balance hydraulic capacity with treatment capability. Design of future systems should consider the configuration of ponds and their loading sequence in relation to local groundwater flow patterns. The impacts of warm and cold climates must be considered for characteristics of wastewater, soil properties and groundwater in the operation of absorption pond systems. Alternatives to land disposal during winter should be considered for larger systems to minimize the overall nitrogen impacts on groundwater. More reliable means for sampling the soil pore water quantity and quality are needed. Investigative work should continue on absorption pond systems to correlate information and improve current design criteria.

Availability of Report:

This report is available for viewing and loan at:

The Water Resources Center
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Key Words:

Absorption pond, ammonium-nitrogen, nitrate-nitrogen, rapid infiltration system, wastewater

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