EVALUATION OF MULTI-STAGE LAGOONS AND WETLAND SYSTEMS FOR SOUTHERN DAIRIES

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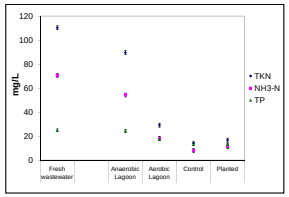
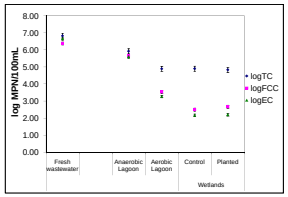
Figure 1. Dairy Wastewater Treatment Evaluation System

BACKGROUND

Most of the nearly 200 dairy enterprises in Louisiana are currently operating in the northern-most regions of the Lake Pontchartrain Basin, near the border between Louisiana and Mississippi. Dairy farms in the region are relatively small (120 cows/farm) and rely heavily on pasture to supply nutrients to their cows. All dairy facilities are required to install single-stage lagoon system. The single-stage treatment is considered a BMP with limited treatment capacity. Waste and effluent must be periodically, sometimes frequently, pumped out and land applied to recycle nutrients and avoid lagoon overflow. This practice is time-consuming and requires knowledge of pathogen decay in the wastewater, current N and P levels of the wastewater and the receiving acreage, season of the year during application, soil moisture prior to application, and timing of such events in order to avoid rainfall and runoff after land application.

We previously evaluated a sequential wastewater treatment system composed of anaerobic lagoon followed by aerobic lagoon and constructed wetlands with significant decrease in concentration of most pollutants evaluated during that trial.





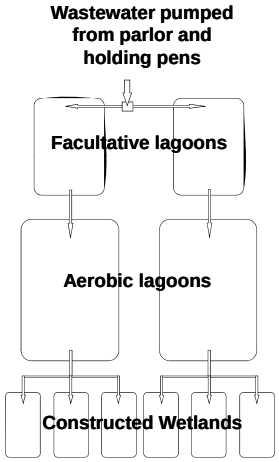
The objective of this study was to evaluate pollutant abatement effectiveness when aerobic lagoon were replaced by smaller constructed wetlands.

RESEARCH DESIGN

The Dairy Wastewater Treatment Evaluation System (**DWTES**) consists of replicated two-stage lagoons and constructed wetlands. Approximately 7,000 gallons of untreated dairy waste and wash-water enters the system twice daily (am and pm). Wastewater is pumped to the distribution box and equally split between two **anaerobic lagoons** (**ANL**). The effluent flows by gravity, independently for each replicate, into the next treatment stage, two **aerobic lagoons** (**AEL**),. The outflow from the aerobic lagoons is distributed among six tertiary treatment cells (**constructed wetlands, WLD**).

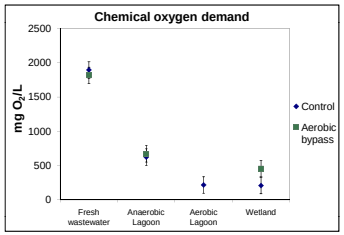
DWTES:

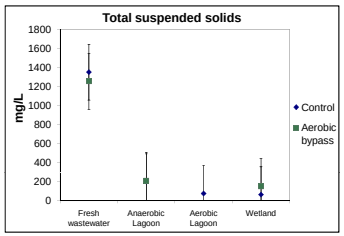
Dairy Wastewater Treatment Evaluation System

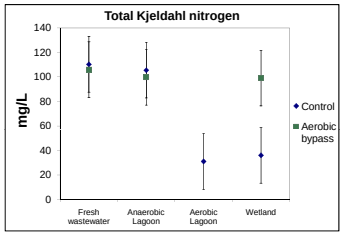


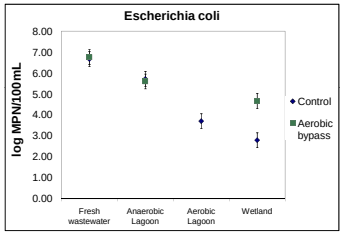
Water quality monitoring began on November 20, 2006 and concluded on June 7, 2007. Sampling was conducted bi-weekly at all sites, starting with the untreated dairy wastewater and at the terminal end of each stage of the treatment system. The system was used to simultaneously compare and quantify treatment effectiveness of a control, three-stage system (ANL, AEL, WLDs) with a two-stage treatment (ANL, WLDs).

Wastewater COD, solids, nutrients (TKN, TP), and coliforms were monitored at all stages in the system for 6 months. Wastewater characteristics were analyzed at the W. A. Callegari Environmental Center Environmental Quality Laboratory. Treatment was applied 3 months to each replicate while the counterpart was maintained as control in a cross-over design. Statistical comparison was made among WLD effluents in different systems.









RESULTS

The combined surface area of the three WLDs in each replicate represented 41% of the size of the AEL.

Three-stage treatment systems outperformed two-stage systems in all treatments.

COD removal with the aerobic by-pass reached 84% of the three-stage treatment system. Sediments were removed at 77% (TDS), 85% (TS), and 92% (TSS) efficiencies compared to the three-stage system. Two-stage treatment system performed poorest to remove TKN (10% of three stage system), total coliforms (69%), and *E. coli* (53%).

IMPLICATIONS

Herd expansion when land is limited and increased proximity to human dwellings require intensive waste management. Sequential anaerobic-aerobic lagoons-constructed wetlands intensified nutrient and pathogen removal in this study. Wetlands receiving anaerobic lagoon effluent can outperform aerobic lagoons per unit of area for several characteristics (COD, TSS, phosphorus, and coliforms). However, land requirement for wetland construction to maintain comparable removal efficacy of nitrogen would be 4 times larger in anaerobic lagoons-constructed wetlands sequential systems than the size of aerobic lagoons in a three stage system.

For situations that require maximization of nitrogen removal we recommend a anaerobic lagoon-aerobic lagoon or a three-stage sequential treatments (anaerobic lagoon-aerobic lagoon-constructed wetland).