Research Project

01-1ENV

Capsule

Technology Transfer Program

LTRC

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Optimization of Subsurface Flow and Associated Treatment Systems

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LTRC

Louisiana Transportation Research Center

Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

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Problem

Highway systems are extensive, linear corridors connecting points of population and industrial or agricultural density. As a result, access to facilities such as electricity, potable water, and sanitary sewers is difficult and uneconomical at rest areas, weigh stations, bridge tenders, and other remote facilities. Treatment of wastewater at such facilities is currently conducted through small, on-site packaged plants, constructed wetlands, or septic systems. Adverse conditions for on-site treatment exist at many of these sites resulting in frequent violations of discharge permit limits. Within the next few years, it is expected that even more stringent U. S. Environmental Protection Agency (EPA) discharge limits will be mandated.

There is currently no single, preferred on-site solution; therefore, this research will consider the efficacy of competitive candidates for on-site treatment systems, specifically subsurface flow (SSF) and solar recirculating

Rock plant filter (Grand Prairie SSF System)

floating bead bioclarifiers (SR-FBB).

Previous work done at the I-49 Grand Prairie rest area has demonstrated that SSF can reliably meet discharge standards for BOD and TSS without proactive operation and maintenance. The SR-FBB is an economical treatment developed in Louisiana, requiring minimal infrastructure, that can possibly be used for very small, intermittent flows.

However, ammonia removal via nitrification does not naturally occur in SSF or SR-FBB systems due to a lack of dissolved oxygen. Ammonia levels above 10 mg/l can pose a potential barrier to using these systems. Space constraints may also limit the use of these systems at some sites.

Objectives

This project will examine the degree to which rock plant filters, in conjunction with bead bioclarifiers, can produce an effluent capable of meeting anticipated wastewater discharge limits. The project will also investigate the level of operator interaction required to run the system, relative to other waste treatment methods.

Objectives include:
(a) Investigate the capability of SSF systems, operating with and without plants, to treat BOD, TSS, and ammonia over extended periods of time.

(b) Investigate the degree to which nitrification can be enhanced in SSF systems using simple aeration type recirculation.

(c) Investigate the added treatment efficiency which can be obtained from using floating bead bioclarifiers in conjunction with SSF systems.

(d) Determine the skill and time required for operation and maintenance of these treatment systems.

Description

The proposed research will attempt to optimize the application of rock filter technology to meet the increasingly stringent regulations being promulgated by the EPA and the Louisiana Department of Environmental Quality. This research will investigate the treatment efficacy and economy of at least two separate on-site treatment systems at Grand Prairie. The use of plants, biological additives, and simple aeration systems to meet the ammonia permit limits will be investigated with the SSF system. The new SR-FBB system will use a small solar cell/battery back-up for recirculation, aeration, and occasional bead-bed management as a means to meet ammonia limits. Operational and capital costs of both systems per volume of wastewater treated to discharge standards will be evaluated.

Research tasks include:

1. Conduct a comprehensive literature search.

2. Evaluate the potential for ammonia removal and develop a simple method for meeting EPA limits.

3. Evaluate the effect of plants on ammonia removal and the overall efficiency of treatment systems.

4. Construct and install a solar recirculating floating bead bioclarifier (SR-FBB) and evaluate its potential for treating wastewater flow streams.

5. Compare the efficiency, cost, and space requirements for the SR-FBB compared to rock filter and mechanical aeration systems.

Implementation Potential

These research results can be implemented at DOTD rest areas and visitor centers across the state, resulting in a low cost/low maintenance alternative for waste treatment that will meet existing and proposed discharge limits. Deliverables from this project will be facility design criteria and operational guidelines.