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Louisiana Transportation Research Center

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Optimization of Subsurface Flow and Associated Treatment Processes

Introduction

On I-49, approximately 40 miles south of Alexandria, Louisiana, the waste treatment system at the Grand Prairie Rest Area has operated continuously since November 1, 1996. The system operates under a general permit limiting the maximum daily flow to 25,000 gal/day and the maximum daily biochemical oxygen demand (BOD) and total suspended solids (TSS) to 30 mg/liter each. Two previous reports are available documenting earlier research at this rest area and others in the state (LTRC Final Reports 335 and 346). A major impetus for these studies was the Louisiana Department of Transportation and Development's (LADOTD's) desire to develop a robust, low cost, low maintenance waste treatment system suitable for small flows in situations where knowledgeable treatment plant operators are not available. Samples have been collected and field tests conducted on a biweekly basis over the life of the system. Numerous modifications to the original system have been made. This report focused on modifications made and operational results obtained during the period from 2001 to 2004. These modifications involved replacing granite rock media in cell 3 with synthetic media in 2002. The modified system was then examined for pollutant removal efficiency, including ammonia-N removal. Earlier data will be used where it is considered useful for comparison, clarity of intent, or providing the reader perspective.

Objective

The objective of this study was to examine the use and performance of synthetic media (growth substrate) in a rock filter waste treatment system located at the Grand Prairie Rest Area. Specifically, this study examined the performance of the synthetic media in removing BOD and TSS as compared to the granite rock media previously used. In addition, the performance of the synthetic media in the removal of ammonia-N from the waste was evaluated. Observations and data specifically related to the ease of installation and amount of maintenance required for the synthetic media will be accumulated, evaluated, and compared to similar information and experience for the granite media used previously.

Scope

This project investigated several methods for improving the pollutant removal capabilities of the existing Grand Prairie treatment system, one of which involved removing the granite rock media from cell 3 and placing it on top of the rock media in cell 4. A synthetic media (brand name

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Kompact) manufactured in 2-ft. x 2-ft. x 4-ft. blocks was then placed in cell 3 and covered with commercially available shade cloth. The cloth was held in place by treated 2-ft. x 6-ft. x 12-ft. pieces of lumber. The standard sampling frequency (bi-weekly) was followed. Samples were collected and analyzed for BOD, TSS, TKN, NH3, and NO3. In addition, field tests for pH, dissolved oxygen, and conductivity were performed when samples were collected. After allowing system performance to stabilize, three recycle pumps were installed at the effluent end of cell 3. Treated effluent was recycled (41:1 recycle ratio) and sprayed into the air to strip out unionized ammonia.

Methodology

All laboratory test results were produced in the Folk Memorial Laboratory at Louisiana Tech University. Samples were collected on-site, stabilized as required with acid, and placed on ice. Samples were then transported to the Folk Lab and testing began within the prescribed time limit for each individual test. The Folk Lab is accredited by the Louisiana Department of Environmental Quality's Environmental Lab Accreditation Program. All quality measures were adhered to during testing and quality control data were maintained by the lab. Field tests, pH, conductivity, and dissolved oxygen were conducted on site; the instruments used were calibrated before each use.

Water-use data contained in this report were obtained from daily readings of a totalizing water meter placed in the discharge line of the well supplying water to the facility. Sequential readings were subtracted to obtain water use during the previous 24-hour period.

Conclusions

Based on the results of this research study, the following conclusions can be drawn:

- The rock filter treatment process at the Grand Prairie Rest Area has proven to be highly robust with respect to rapid and substantial changes in flow rate and waste quality.
- The treatment system at Grand Prairie can successfully and reliably meet all current discharge permit limitations.
- The process is capable of substantial total nitrogen removal (> 80 percent), but work remains to be done on improving nitrogen removal reliability.
- A skilled operator is not required for this treatment process to function reliably and efficiency.
- Operational costs of the process are negligible. Energy costs are approximately $0.065 per 1,000 gallons.

Recommendations

Based on research results, it is recommended that this process be seriously considered for small flows (less than 50,000 gal.) in situations where skilled operators are not available and additional work be carried out on nitrogen removal in order to meet expected permit limitations on this constituent in the future.