"Engineering Evaluation for Upgrading Solids Separation Performance at an Industrial Biological Wastewater Treatment Plant"

by

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BACKGROUND

A moderately sized specialty chemical manufacturing facility has a biological wastewater treatment plant for treating target wastes from manufacturing operations. The wastewater treatment system has a fairly good history of compliance. Recent changes in the permit status are compelling the plant to analyze treatment system performance and assess potential upgrades that may be required to meet tighter permit limits for the wastewater treatment plant discharge. It is anticipated that these upgrades will be primarily involved with facilitating the removal of suspended solids that periodically tend to discharge spuriously from the secondary clarifiers. These suspended solids discharges were acceptable under old permit limits but, with new proposed limits, the plant will likely have to implement measures to ensure that the facility can meet new proposed limits for both total suspended solids (TSS) and biochemical oxygen demand (BOD5). Plant personnel are also interested in evaluating the potential in water recycle/reuse strategies. The plant strategy is to ensure that any treatment plant upgrades that are implemented will technologically mesh with future effluent recycle/reuse efforts. Also, it is desirable to implement an interim solution quickly to ensure near term compliance. This measure provides time to devise a comprehensive long term plan that incorporates a recycle/reuse approach.

KEY TECHNICAL ISSUES

A process schematic of the wastewater treatment plant is given in Figure 1. Raw water is pumped from wells and is treated in the water treatment plant to remove iron. The treated water is conveyed to the production units where it is applied for making product as well as for cooling and washing applications. Total wastewater flow is approximately 1 MGD.

Primary effluent is sent to the activated sludge system that consists of two MG reactors and two clarifiers. The effluent from this system is sent to the river. The key performance issues involve the secondary clarifiers. Effluent solids from these units can frequently run close to 1 00 mg/L for prolonged periods of time. This level of performance was adequate for the existing permit but new permit requirements compel the plant to assess alternate measures to ensure better solids separation performance. The technical challenge is to determine the root cause for loss of biological solids in the effluent.

ENGINEERING APPROACH

The initial efforts on this project suggested that the fluctuation in influent TDS concentration would be the primary issue. Subsequent bench testing efforts indicated that influent TDS equalization would not have a substantive impact on biomass settling and separation characteristics. These tests also indicated that a selector approach would also not be effective. Other tests showed that the solids separation issues did not correspond with a loss in BOD or COD removal efficiency and that the biomass solids leaving the facility were likely active and not organic debris that was exiting the system. These data

and observations indicated that some form of effluent filtration or a technology with equivalent results would be needed to augment the existing activated sludge system.

The effluent filtration approach would have to consider alternatives to “traditional” sand filtration because of the potential for periodic slugs of effluent TSS at levels of 500 to 1,000 mg/L. High sustained solids loadings to sand filters are extremely problematic and sand filtration was thus removed from further consideration. Also, it is desirable to implement an interim solution quickly to provide time to develop a comprehensive compliance plan that incorporates a recycle/reuse approach. Two interim solutions were assessed:

- Vacuum-driven hollow fiber membrane filters
- Ballasted flocculating reactor (BFR)

A vacuum-driven hollow fiber membrane system would be feasible but would require a relatively large capital expenditure and long lead time. It would enable the plant to achieve compliance but may not represent an optimal solution.

It was decided to proceed with a BFR. BFRs have been primarily used in combined sewer overflow (CSO) treatment applications. This technology works by utilizing a coagulant and polymer to attach target particulate organics to sand. The sand “ballasts” the particulates enabling them to be removed using gravity settling. A cyclonic device is then used to separate the sand from the organic particles and the sand is then recycled. A 500 gallon per minute (gpm) pilot unit was shipped to the plant site and hooked-up. This unit treats approximately 75% of the plant effluent which enables the facility to be in

compliance. This represents a relatively unique application for BFR technology. It is not clear if this technology will play a long term role at the facility. The current plan to achieve interim compliance using the BFR technology and then devise an ultimate compliance plan that also incorporates provisions to keep options open to move towards a recycle/ reuse mode. The paper will report on the operational results with the BFR and its unique application, and the technical results with a long term compliance plan.