Phosphorus Removal With RapiSand™ Ballasted Flocculation

Investigating Treatment Efficiencies on Activated Sludge vs. Trickling Filter Effluents

Location: **United Kingdom**
Owner: **Confidential**

Problem

Existing wastewater treatment plants are encountering ever-tighter discharge requirements for phosphorus and other contaminants. Plants not only face aging infrastructure and limited available space for expansion, but they must also meet new requirements within a shrinking affordability framework.

Lacking the funds for a complete overhaul of its treatment processes, a water resource recovery plant (WRRP) in the United Kingdom was faced with finding appropriate solutions to supplement existing treatment. These solutions had to fit within a limited footprint and provide reliable phosphorus removal to meet new discharge requirements.

As part of its search for a solution, the WRRP contracted with WesTech and our partner: We were to conduct a pilot-scale evaluation assessing the phosphorus-reduction capabilities of ballasted flocculation for multiple wastewater sources.

The goals of the study were threefold:

- Evaluate a high-rate sedimentation technology that reduces phosphorus in a minimized required footprint
- Assess this technology's performance in treating two water sources: an activated sludge process (ASP) effluent and a trickling filter (TF) effluent
- Determine the technology's ability to deliver robust and consistent results over individual daily runs as well as extended continuous operational periods

Solution

The WesTech RapiSand™ pilot unit met the criteria for the study's high-rate sedimentation technology. The trailer-mounted unit has a full laboratory and remote-operation capabilities that are available via a mobile-phone connection. The trailer also includes all necessary chemical makeup and feed equipment.

The RapiSand system is designed to remove suspended solids at typical hydraulic loading rates up to 25 gpm/ft^2 (60 m/h). The system achieves these rates through ballasted flocculation, which consists of coagulation and flash mixing followed by the addition of polymer and a weighting agent (microsand) in a dual-stage flocculation step. The polymer and sand bind rapidly to the suspended particles in the influent, which allows for higher rise rates and shorter hydraulic detention times (approximately 10 minutes) compared with conventional flocculation and sedimentation. Because of this, the RapiSand can decrease the

The pilot unit is trailer mounted and includes a full laboratory and remote-operation capabilities.

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footprint of a traditional flocculation and sedimentation system by more than 95 percent, depending on the application.

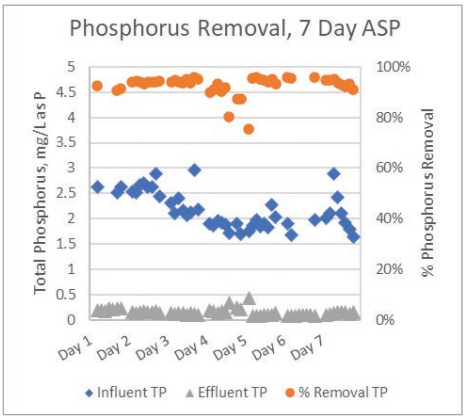
The pilot study took place over a four-month period. In addition to bench-scale evaluations and jar testing throughout the course of piloting, the study followed four main trial phases. The first two phases consisted of daily runs that targeted higher-level effluent phosphorus (0.24 mg/L-P) in the first phase and a lower-level effluent phosphorus (0.16 mg/L-P) in the second phase. The third and fourth phases looked at continuous operation for seven-day periods, with the third focused on treating ASP effluent and the fourth on treating TF effluent.

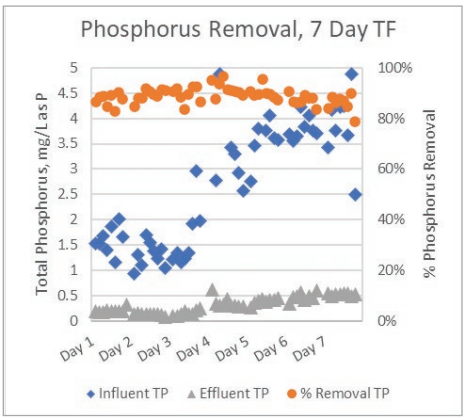
WesTech personnel operated the RapiSand pilot equipment throughout the course of the pilot study. Samples were taken both manually and automatically by means of an autosampler that was programmed to take equal-volume samples at regular intervals (one sample every hour for the first two phases, one sample every three hours for the third and fourth phases). Samples were analyzed in the trailer-mounted laboratory by WesTech as well as in the on-site laboratory and the customer's external laboratory.

Results

Chemical feed rates were established through jar testing and preliminary trials. The rates remained constant through subsequent phases to assess performance impacts and to evaluate process resiliency based on fluctuating feed quality. All four phases successfully met the goals of the study by reliably and consistently meeting target treatment qualities.

The graphs show results from phases three and four for the continuous trials.





Phases three (ASP) and four (TF) demonstrated the RapiSand's consistent performance.

For the third pilot phase – treating effluent from the activated sludge train – coagulant was dosed at a constant rate of 15 mg/L as iron (Fe) and polymer was dosed at a constant rate of 0.9 mg/L active content. Aside from a brief period in the middle of the study where coagulant feed was interrupted, effluent phosphorus remained consistently below 0.2 mg/L-P.

For the fourth pilot phase – treating effluent from the trickling filter train – coagulant was dosed at a constant rate of 20 mg/L as Fe and polymer was dosed at a constant rate of 1.75 mg/L active content. During this phase, influent phosphorus levels in the pilot feed showed a steady and significant increase. Because coagulant dosing was held constant, pilot effluent phosphorus concentrations climbed slightly in response but still showed consistent performance.

Chemical dosing rates were continually optimized through automatic sampling and supplementary jar testing.

This pilot study demonstrated that RapiSand ballasted flocculation technology provides robust and consistent results in a compact footprint and can do so with effluent from various types of upstream wastewater treatment processes.

Effluent for all four trial phases reliably and consistently met target treatment qualities.

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