Getting to Low P

PILOT TESTING WITH CLOTH MEDIA FILTRATION DOCUMENTS ONE WAY TO ACHIEVE THE STRICT EFFLUENT TOTAL PHOSPHORUS LIMITS BEING PRESCRIBED IN TODAY'S PERMITS

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Effluent phosphorus limits are being ratcheted down in many states, challenging clean-water plants to find cost-effective ways to meet them.

In Wisconsin, for example, plants face phosphorus limits as low as 0.075 mg/L. To remove phosphorus, operators have options that include chemical and biological treatment, technology solutions and adaptive management — working with upstream landowners to limit phosphorus contributions from runoff to the receiving stream.

Aqua-Aerobic Systems, which offers a variety of wastewater treatment technologies, has been pilot-testing cloth media filtration as a way for plants to hit today's extremely low phosphorus targets. The company deployed a portable pilot plant using a microfiber filter media to three clean-water plants in Wisconsin.

Aqua Aerobic Systems' Mark Hughes, senior process engineer, and James Horton, director of product management, along with Tom Dennis of Drydon Equipment, a distributor of the company's products, talked about phosphorus challenges and the pilot testing process in an interview with *Treatment Plant Operator*.

tpo: What was the impetus behind this pilot testing program?

Hughes: Plants in Wisconsin are facing some of the most stringent total phosphorus limits in the country. We've seen a number of permits with limits as low as 0.075 mg/L. Operators were asking us: Can your filters do this? Our answer was: Yes, we believe they can, and we set out to prove it with pilot testing.

tpo: Leaving technology aside for the moment, what is the potential role of adaptive management in reaching these low phosphorus limits?

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Dennis: Adaptive management can work. It has been applied with success, generally in communities where more than just government entities are involved — where watershed organizations and other citizens groups are assisting. On the other hand, judging from research I've read and sources I've spoken to, the concern is that there is no policing of landowners. For example, suppose 15 farmers agree to do adaptive management to help a plant meet its limit. If, three years later, 10 of those farmers discontinue the management practices, there is limited recourse. The responsibility will then likely fall back to the treatment plant.

That is a concern many operators have. If adaptive management goes by the wayside and the plant is no longer meeting its limit, then fines come into play. Some plants are taking the stand that they are just going to spend the money on technology because they don't want to deal with adaptive management — it has worked well so far in some settings, but in the long term, we'll see.

tpo: What other basic options do plants have to achieve low phosphorus?

Hughes: Many plants already have biological or chemical phosphorus removal in their secondary processes. This works very well, especially when you have phosphorus limits around 1.0 mg/L, and sometimes even lower than that. We often see ferric chloride and alum used for phosphorus removal. Of course, in either case, you generate chemical solids that need to be removed. When you get down to a total phosphorus limit of, say, 0.5 mg/L, you definitely need a filter. The solids the filter removes may contain as much as 3 to 5 percent phosphorus.

tpo: Why can't low phosphorus limits be achieved with biological processes?

Hughes: A bio-P process will generally remove significant phosphorus, but you can't always get enough uptake by the microorganisms to get down to a very low effluent level. And if you have substantial solids in the effluent, that can prevent you from getting to low levels biologically.

tpo: Many clean-water plants use sand or mixed-media filters as a tertiary step. Why won't these filters achieve the necessary phosphorus removal?

Hughes: Granular media filters are great filters. The really ideal filter would be a very deep-bed gravity filter. That would remove almost all the solids if you made it deep enough. The challenge with that kind of filter is the headloss through it and the large footprint. You can only get so much flux through an area of sand filter, and you end up using a lot of space. And the cost of that filter can go up rather quickly because of all the civil work and the maintenance required on the sand.

tpo: What are the benefits of cloth filtration?

Hughes: Cloth media filtration can offer the performance of a sand filter in about a quarter of the footprint. Water flows into the filter tank and passes by gravity through the filter cloth. Our traditional cloth media has a pile layer — people say it looks like carpet. The cloth removes the solids in a couple of

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ways. If a particle is too big to go through a pore, it will be removed. Particles are also trapped in the depth of the pile fibers.

Horton: You can think of this kind of cloth media as having two parts. One is the pile, which is analogous to the sand in a sand filter. That pile is woven into a backing material, which is analogous to the underdrain in a sand filter.

tpo: What led you to believe cloth media would be a solution for achieving low effluent phosphorus?

Hughes: Twenty years' experience told us cloth media did an excellent job of removing solids. And what was happening in Wisconsin wasn't new to us. In the Chesapeake Bay region, for example, we had seen permit limits in the range of 0.2 to 0.1 mg/L total phosphorus. So we thought 0.075 mg/L was achievable.

tpo: What is different about the microfiber cloth used in the pilot plant?

Hughes: Our standard cloth has worked well for many years, including in low-phosphorus applications, but we asked what would happen if we made a tighter cloth. Our standard cloth has a nominal pore rating of about 8-10 microns. Our microfiber cloth has a nominal rating of 3-5 microns. It's a much finer filter. That helps us remove more TSS, yet with the same hydraulic throughput and the same headloss as the standard cloth.

Horton: Levels down to 0.1 mg/L have been achieved with nominal 10-micron filters and screens. Moving to 3- to 5-micron microfiber captures more of the finer particles. That gets you to the effluent phosphorus level you need with less chemical addition. It also makes operators' lives easier. As you get to lower effluent limits, operator attention and responsibility tend to increase. Removing more of the smaller particles means you effectively get more phosphorus removal with the same basic operational requirements. It effectively gives operators a safety factor over using a filter with a larger nominal rating.

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tpo: What does your pilot testing unit consist of?

Hughes: We have a trailer that travels on the back of a semi. It includes our Aqua MiniDisk cloth media filter, which is our smallest configuration. It provides the ability to add chemicals to the influent stream, and it includes substantial instrumentation.

tpo: How exactly did the pilot tests proceed?

Hughes: A recent pilot test in Wisconsin was at a site that faces a total phosphorus limit of 0.075 mg/L in the future. We began by testing a sample of secondary effluent in our lab for phosphorus speciation and filterability. We also did jar tests to determine the best coagulant or metal salt dose and the best polymer and polymer dose, so we had a good idea where we should be with chemical addition before the filter.

We found that there was a fraction of soluble reactive phosphorus in the water. By adding alum coagulant, we reacted it and formed solids. Those were very fine solids, so we added polymer to bind them up more.

Our pilot plant technician went to the site and repeated those tests on our trailer. Then we started pumping water into our filter at the chemical doses we had chosen, while monitoring the effluent. We used orthophosphate analyzers to monitor the influent and effluent, essentially live. We also analyzed composite samples and grab samples on the trailer. Those samples were split, and half was sent to the on-site lab. In the end, we achieved 0.075 mg/L effluent total phosphorus.

tpo: What happened at the other two test sites?

Hughes: The second site had the same effluent requirement of 0.075 mg/L, and our approach was very similar, although we used ferric as a coagulant. The challenge here was that our lab analysis found they had 0.05 mg/L of nonreactive soluble phosphorus — we couldn't touch that fraction. We monitored the speciation very carefully. Fortunately, the reactive phosphorus fraction remained at around 0.03 mg/L throughout the study, so that gave us a little more room and we were able to achieve the effluent target consistently.

We're currently doing a study at a third site. They have a limit of 0.2 mg/L total phosphorus, which is not challenging after we've achieved 0.075. But here the goal is to hit the effluent target with the lowest chemical dose possible.

tpo: What do you conclude from these pilot studies?

Hughes: The cloth media filters can help plants reliably meet effluent phosphorus targets at 0.075 mg/L. The right chemical dosing is a key component of that. In addition, the upstream processes need to be optimized. Phosphorus removal is a plantwide process. You can't just look at the filter — you need to look at all the processes leading up to it. You can't send the filter influent with 2 mg/L total phosphorus and expect to achieve these low limits. tpo