DECENTRALIZED AEROBIC TREATMENT SYSTEMS

By Carol Brzozowski

Until three years ago, aerobic treatment systems weren't on the radar screen in Maryland.

"In the past three years, things have opened up nicely for all types of advanced wastewater treatment systems," says Bob Sheesley, a former regulator and now an environmental consultant with Eco-Sense in Lane Ellicott City, MD. The firm handles water and wastewater projects for residential and commercial applications.

The precipitating factors for increased aerobic treatment systems installation in Maryland included projects where a creative solution was needed in an area without access to water and sewer.

Also, Maryland has a shared facilities law that allows for lots to share a sewage disposal system and a disposal area based on two or more lots.

"By doing that, they are able to cluster lots and utilize the rest of the space for open space, agriculture preservation, and other competing land interests," says Sheesley.

Aerobic treatment systems also are becoming more common because of the Chesapeake Bay restoration. There, the critical area is 1,000 feet from the shoreline of any tributary to the bay, Sheesley says.

"In some of the more heavily residential areas, we have failing septic systems that have not had a solution, and we're starting to get a lot of good use from the multiple units on the market now that seem to be doing a fairly decent job," he says.

"Because of the influence of the bay issues, nutrient removal has risen to the top of the list, and nitrogen is significantly reduced now, required in permits down to 8 milligrams per liter total nitrogen," he adds. "Regular septic systems can't even approach any of those numbers, and some form of advanced wastewater treatment is needed to meet those requirements."

What's happening in Maryland is being echoed throughout the United States: Aerobic treatment systems are becoming more popular.

Aerobic treatment is one member of the family of advanced treatment systems.

Aerobic treatment systems provide an environment abundant in oxygen for organisms that reduce waste's organic parts into carbon dioxide and water in the presence of oxygen.

While septic systems and aerobic systems both use natural processes to treat wastewater, the aerobic system requires oxygen that is mechanically injected and circulated inside the treatment tank. The oxygen is transferred to the wastestream by diffused air, sparged turbine, or surface entrainment devices.

Blowers, pumps, and other mechanical parts are designed for heavy-duty use as they are exposed to harsh environments. The higher-rate process of aerobic systems enables the system to attain improved effluent quality.

There are two types of aerobic systems: suspended growth (or activated sludge) and fixed film. In suspended growth systems, the microorganisms responsible for waste breakdown are maintained in suspension with the wastestream.

Suspended growth systems use a type of blower, and there may be an air compressor injecting air into a treatment compartment that is increasing the dissolved oxygen content and allowing the bacteria to grow, says Trapper Davis, a former state regulator who now owns Coastal Plains Environmental Group, a Virginia company devoted to the maintenance of alternative treatment systems.

In fixed-film systems, microorganisms attach to an inert medium.

The earliest systems, dating from the 1950s, were made with just an aerator placed inside of a traditional septic tank. Noise, odor, and maintenance problems were common. The systems were used only where standard septic tanks were not viable.

Aeration package plants are now constructed of noncorrosive materials, including reinforced plastics, fiberglass, coated steel, and reinforced concrete, and their performance has improved considerably.

From her position as the executive director of the National Onsite Wastewater Recycling Association (NOWRA), Linda Hanifin Bonner sees the use of aerobic treatment systems increasing.

“More states—particularly those along the coastlines—have issues with respect to nitrogen and nitrogen removal capabilities,” she says. “That’s one of the drivers for the increased demand for them. Also, they can be far more effective on difficult sites. They offer strong reliability and have operation and maintenance [O&M] service requirements, and that falls within the United States Environmental Protection Agency advocacy of what they are pushing.”

Davis notes that in Virginia, if a property owner does not have 36 inches of dirt to be able to install a conventional system and a drainfield, then an alternative treatment system is necessary.

“You want to have something that’s treating better than septic tank effluent. In that case, you would go to an aerobic treatment unit,” he says.

“If you really need to come up shallow and get close to a water table, in Virginia there are 40 of the media filters that have undergone extensive testing and are allowed to get as close as 6 inches to the water table in certain forms.”

Davis explains the typical septic tank drainfield effluent numbers are a biological oxygen demand (BOD) effluent of anywhere from 150 milligrams per liter to 300-plus that varies from resident to resident depending on sewage usage, as well as total suspended solids (TSS) of 75 milligrams to 150 milligrams, and nitrogen levels from 30 milligrams to 75 milligrams per liter.

“When you put in an aerobic treatment unit with one of the packed bed filters (sand, glass, peat moss, synthetic textile), the minimum standard is what we call 30/30,” says Davis. “You reduce your BOD from the septic tank from 150 [milligrams] down to 30 milligrams or less.

ame thing with TSS—you drop it from 75 [milligrams] to 150 milligrams down to less than 30 [milligrams]. You’re trying to reduce your nitrogen levels from 40 [milligrams] or 75 [milligrams] down somewhere in the 15 [milligrams] to 10 [milligrams] level.

“By doing those numbers, overall you’re putting a less hazardous effluent out into the environment. With some of these treatment systems, you can actually reduce some of those numbers down to 10 [milligrams].

“When you’re looking at the 10 [milligrams]-or-less level, you’re looking at treatment that is comparable to a municipal sewage treatment plant or is better than what they’re discharging to our rivers and streams.”

In addressing decentralized aerobic treatment systems, the EPA outlines their several advantages and disadvantages.

Benefits include a higher treatment level than a traditional septic tank, water resources protection where septic

systems are failing, an alternative for sites unsuitable for septic systems, an extension of a drainfield's life span (and the drainfield can be smaller), and reduction of ammonia discharged to receiving waters.

Drawbacks include the fact that they are more expensive to operate in some cases than septic systems, electricity is required (a drawback when power goes out), mechanical parts can break down, more frequent routine maintenance is required than for a septic tank, upsets when under sudden heavy loads or neglected, and they may release more nitrates to groundwater.

"Nitrates and phosphorus reduction are both hot topics right now in this industry, and some of the aerobic plant manufacturers are doing research to see how well this activated-sludge suspended-growth process works to reduce nitrate and phosphorus levels," says Bo Coffman, a regional sales manager and specialist for onsite wastewater for Gast Manufacturing, an air compressor manufacturer that supplies oilless rotary vein compressors as well as a linear diaphragm pump to wastewater plant manufacturers. While both technologies are used in wastewater, the one used most frequently is rotary vein.

While septic systems are still the most common onsite wastewater treatment in rural areas, the EPA notes that the systems are not suitable for all decentralized wastewater treatment applications, with two-thirds of all US land area estimated to be unsuitable for their installation.

Such areas include homes located in wooded lots or close to water bodies, where wastewater from a traditional septic system is not of high enough quality to be discharged to a nearby body of water.

Failing septic systems are the major contributing factor to the selection of aerobic waste-water treatment units, according to the EPA.

Coffman says his company is producing more pumps for aerobic units.

"Increasingly, as urban sprawl continues out into areas of the country that years ago weren't developed for residential use but now are, we are more and more getting into building home sites in areas that aren't sewered," Coffman points out.

"Thus, the obvious question has to come into play as to whether or not more residential development can justify centralized water treatment and sewered communities."

That—coupled with improved technology for decentralized wastewater treatment—has resulted in such systems being the ones of choice in more community developments.

Advanced and secondary treatment has mushroomed in response to the failure of conventional decentralized systems consisting of a septic tank and drainfield, with water quality in the system's discharge being of primary concern.

Photo: Bord Na Mona

Peat moss for filtration and bacteria

"Certainly, as state and county regulations change to become more strict in minimum effluent quality levels allowed, you almost have to go to advanced or secondary treatment where decentralized systems are used," Coffman points out.

Marty Pagnucco of Pag's Excavating in Alliance, OH, is installing many aerobic treatment systems in the trend driven by a lack of room for conventional systems.

Pagnucco says he finds the systems easy to install. He installs systems from Stark Aeration & Supply in Canton, OH, which does the maintenance after the installation.

"They do add cost and have the maintenance and electricity cost," Pagnucco says of aeration treatment systems. "One nice thing about aeration systems is they run 'forever,' whereas a conventional system can fail in a year. Aeration water is treated and sent on its way, and you don't have as many problems later on."

Photo: BioMicrobics
Suspended and fixed growth media

For those who have a "postage stamp-sized" lot, there is no other alternative but to install an alternative system, Pagnucco says.

"It takes a minimum amount of room, and you can install it in a day," he says. "With a conventional system, you are tearing up a 50-foot–by–150-foot area, you've got a lead feed, the tanks—and they're going to settle—whereas with an aerobic system, you may tear up a 20-foot–by–40-foot area with a tank and a line to where it's discharged, and that's it.

"They are really good systems. We like installing them, and I believe the homeowners benefit from it."

As the EPA points out, aerobic treatment systems need to be maintained more often than traditional septic systems and require a higher level of maintenance because of the mechanical parts involved—estimates range from once to twice a year.

"A septic tank to a drainfield or even some advanced or secondary treatment systems that would discharge to a peat moss bed, for example, could be described as a more passive system where hydraulic flow from the home delivers influent to the plant and then—even in the best case where gravity flow would deliver it to a drainfield—you could have a system with no mechanical parts," Coffman points out.

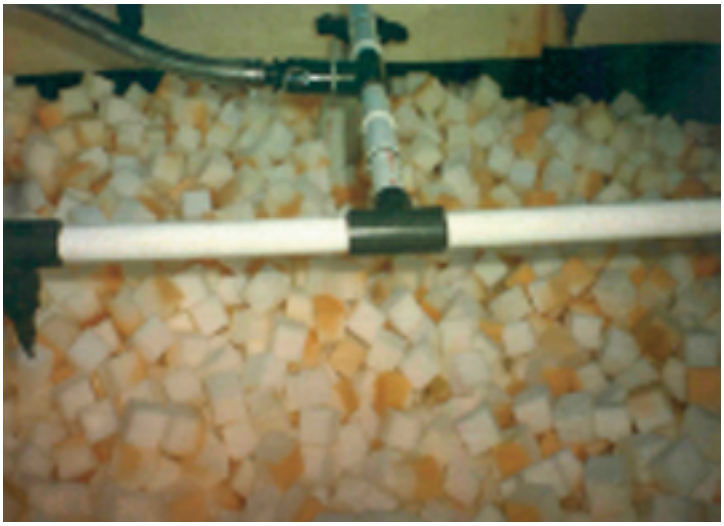

Photo: Waterloo Blowfilter
Foam cube filtration

"Aerobic plants are different by design. You need an air pump providing aeration for the activated sludge part of the process," he adds. "It's a mechanical device that has limited life and needs to be maintained."

Discharge may not merely involve gravity flow to a drainfield, but rather there could be surface irrigation or a pumping station, depending on the grade of the homesite.

"Other mechanical devices, such as a sewage pump, are also present, and that can be in passive or nonpassive systems, but represents more mechanical equipment that needs to be maintained and can fail and would need to be replaced," says Coffman.

"A homeowner wants to be able to flush the commode and not think about it again," he adds.

"The maintenance aspect is a very hot issue right now—many systems are failing due to lack of maintenance."

But like traditional septic systems, aerobic systems also must be maintained against the backdrop of the property owners' typical mentality of "out of sight, out of mind."

While there is technology on the horizon where the use of valving and monitoring equipment may be able to control dosing from a homesite, maintenance is a prime issue with aerobic treatment systems, Coffman says.

The mechanical parts result in vulnerability, he adds.

“Air diffusion is what an air compressor is used for,” explains Coffman. “Other aerators use an agitator like a paddle wheel blade inside a tank, and that’s another method of introducing oxygen into the tank.

“The finer the bubble and the more of them that you can get, the more surface area of oxygen you can create within water and the higher you can raise dissolved oxygen levels, which is part of the treatment process and why some companies went to using fine air diffusers.”

Porous stone at the end of an air line is an example of where one can obtain finer air diffusion than with just an open air line at the bottom.

“The trade-off is you get more surface area—more oxygen—at a faster rate inside the tank, and the oxygen is what allows the natural bacteria to grow and multiply, commonly referred to as the floc.

“Then you are accelerating the natural breakdown process of the waste—that’s why it’s called activated sludge—sludge being the natural bacteria already present in waste, and it gets activated by introducing higher than normal levels of oxygen, and then the treatment process happens faster and more efficiently.”

Photo: Hoot

Suspended growth media

The trade-off for doing that process mechanically has been that it creates higher back pressure on the air compressor.

“Fine air diffusers can clog much faster than if you don’t have them, which can put very high back pressures on the air compressor, which is one of the biggest causes of premature failure on these air compressors,” Coffman says.

Controls and alarms are useful in monitoring the system. After treatment, the discharge goes to surface irrigation or subsurface drip irrigation, which typically requires controls and float switches to turn the pump on.

“Within the National Sanitation Foundation standard, there are basic requirements that if pressure is lost on the system, you need an audible and visible alarm,” Coffman says.

Photo: Inground Sand Filter

Gravel and sand filtration

Davis points out he operates in a state that has no mandatory maintenance of aerobic treatment systems. Thus, customer education is a major portion of his company’s maintenance program.

“These mechanical parts need to be looked at on a regular basis,” Davis says. “In Virginia, I do an inspection at the end of May or first part of June, which is our pollen season. We have to clean all of the air screens and filters to keep them operating properly.”

Aerobic treatment systems have a specific learning curve on everything from design and installation to operation and maintenance that is being addressed by training sessions such as those offered by NOWRA and state-based wastewater associations that address the growing educational needs of industry practitioners.

"There are more mechanical and electronic parts, so the education in understanding anything from control panels to the way the unit itself works is important," says Hanifin Bonner.

Some standards are being developed by such groups as the Consortium of Institutes for Decentralized Wastewater Treatment, a group in which Davis was involved.

Photo: Orenco
Packed bed media filter

Davis calls the training procedure "MOM": management, operation, and maintenance. "These systems have control panels and electrical wiring. Those maintaining it need to be capable of replacing pumps, float components, and similar equipment, and they also need to be familiar with diagnosing problems.

"They have to get with their client, learn their water use, manage the treatment system, and learn to operate it and maintain it."

In terms of the cost-effectiveness of the aerobic treatment systems, "In today's dollars, they are much better than they were five years ago," notes Davis.

"Folks may see an increase in their electrical bill of about $10 a month," he says. "The cost of maintenance depends on the locality. My company tries to keep it comparable to as if someone was on public sewer; we charge about $350 a year to cover telemetry monitoring, upgrades of parts, and manufacturer's warranty inspections."

As with many evolving technologies, issues emerge that will dictate success, Sheesley says, adding there are three primary factors at the heart of the matter for such advanced wastewater treatment as aerobic treatment systems.

"While the technology, for the most part, can meet lower limits for BOD, TSS, and total nitrogen, the concern by the regulatory community that has to permit these and approve the use of them is whether they can really do what the manufacturers say they can do," says Sheesley. "Will the manufacturer stand behind his product, and, if so, how long?"

Operation and maintenance is a third concern, Sheesley says. "There is a concern of having people available—who are certified by their state to do water and wastewater management systems—to have the expertise to manage all of these systems coming on the market," he says.

Given those factors, Sheesley says a level of trust will develop around such systems that are not passive in nature but involve a mechanical and biological process requiring property owner attention.

The concern is that if the traditional septic system industry has had challenges in convincing property owners to maintain their systems properly, aerobic treatment systems will only prove successful to the extent that they get necessary maintenance.

"If we take the next leap to advance the science of onsite wastewater treatment to the point we are now at with septic systems, once we get there, everybody will have achieved a lot," Sheesley says. "We've got to get that way. The septic systems did their job in getting sewage underground, and certainly that had a major impact on public health. But there are too many situations where they aren't working or they don't last as long.

"It's time to move on and recognize something else and have the industry and people available to work on it."

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