THE POWER OF THE DUCKBILL

Backflow is among the most common causes of failure in bubble diffusion systems. Learn how adding only a few inches of elastomer can eliminate backflow risks and optimize diffused aeration processes.

For a steadily growing percentage of wastewater treatment facilities, bubble diffusion systems are the centerpiece of an efficient, reliable, and thorough aeration process.

In settings ranging from aerobic digesters and biological nutrient removal reactors to settling ponds and equalization basins, bubble diffusion systems distribute controlled bursts of oxygen from a blower or air compressor throughout the tank. This steady influx of oxygen discourages solids in wastewater from settling to the bottom of the tank, a vital concern in many primary and secondary wastewater treatment processes.

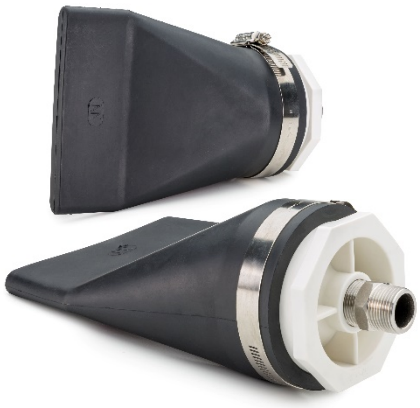
Questions surrounding the best ways to optimize diffused aeration technology are as diverse as the systems themselves. Where in the tank should aerators be installed to mix the entirety of the wastewater pool without leaving behind dead zones? What is the ideal bubble diameter to strike a balance between oxygen transfer and energy costs?

Operators in every wastewater facility that features a bubble diffusion system must ask one question, however, that is more consequential than any other: What happens when airflow suddenly stops?

Preventing Backflow With Duckbill Check Valves

Whether airflow loss occurs voluntarily, such as to enhance denitrification or sludge-thickening processes, or involuntarily, such as during a power outage, even momentary airflow loss creates risks of backflow.

Backflow occurs when a sudden loss of pressure causes wastewater — as well as any number of hazardous substances it may contain — to seep backwards through the bubble diffusion system into the manifold of the blower or air compressor. This type of backflow can not only reduce system efficiency by clogging the pipeline



Coarse bubble diffusion boasts several advantages over other approaches to aeration.

Compared to fine bubble diffusion, for example, coarser bubbles tend to rise through the process fluid faster and with more force, shearing more easily through viscous wastewater. Mechanical approaches to aeration, such as via propellors and brush aerators, tend to be more energy intensive. They also run the risk of aerosolizing wastewater pollutants, which can worsen odor issues within the facility and its surroundings. Coarse bubble diffusion is an ideal way to keep solids in suspension and maintain a completely homogenous mixture with minimal energy and maintenance concerns.

with accumulated fluids, but also cause serious damage to aeration and diffusion infrastructure. Backflow is one of the most common culprits behind bubble diffusion system failure.

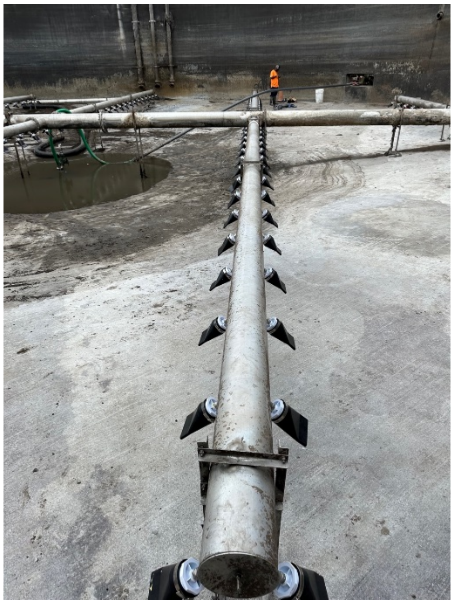
To minimize these risks, bubble diffusers require reliable and well-designed backflow-prevention mechanisms. Several options exist on the market, but one of the most dependable is the duckbill check valve.

Duckbill check valves feature a pliable, rubber-like piece with a high sensitivity to static head pressure, which in the context of wastewater aeration results from the interaction between oxygen-propelled fluids and gravity. These valves, mounted over the emittance point of a bubble diffuser, remain open while the flow of oxygen creates static head pressure. However, the piece instantly snaps shut to a 100% closed position upon loss of static head pressure, eliminating backflow risks and protecting both the diffuser and the aerator manifold piping.

Duckbill check valves remain open while the flow of oxygen creates static head pressure, but instantly snap shut to a 100% closed position upon airflow loss, protecting both the diffuser and the aerator manifold from backflow.

Empowering Beneath-the-Pipe Placement

In most types of diffusion-based aeration systems, particularly coarse bubble diffusers that feature wider openings than fine bubble systems, the lingering threat of backflow during airflow loss often necessitates installation on either the top or side of aeration pipes. As airflow loss causes suspended media in the wastewater to settle along the bottom of the tank, pointing a diffuser downward will increase clogging risks if it becomes submerged in settled solids.



However, even in cases of sudden and extreme increases in the solids concentration of the process fluid, duckbill check valves eliminate these clogging risks by remaining closed until airflow returns. Diffusers placed along the bottom of the aeration pipe will discharge air directly toward the bottom of the tank once the blower or compressor comes back online without allowing entry by unwanted media. The force of this discharge re-suspends accumulated solids and creates a complete overturn loop that quickly resumes the aeration process.

Bottom placement also means that any liquid that may have accumulated inside the aeration pipe via condensation during airflow-free periods will immediately blow out into the tank upon blower reactivation. This liquid does not discharge as easily from pipes with side- or top-mounted diffusers, increasing risks for buildup that can compromise the long-term efficiency of the system.

Perhaps the greatest benefit of installing a diffuser at the bottom of the pipe, however, is its effect on the aeration system's mixing capacity. Generating bubbles along the sides or top of the aeration pipe leaves behind a dead zone at the bottom of the tank — often only a few inches, but sometimes as large as a few feet — without agitation, creating potential for solids to accumulate. By providing whole-of-tank coverage, installing diffusers at the bottom of the pipe can eliminate the need for system owners to manually clean the bottom of their tanks or deploy bottom-scrubbing devices, both of which run the risk of damaging the pipeline through accidental bumps.

Preparing for Power Loss

Power outages are one of the most common causes of involuntary airflow loss, and according to the White House Office of Science and Technology Policy, an uptick in extreme weather events means that they are happening more frequently. For example, PowerOutage.us, an aggregator of utility blackout data, finds that U.S. utility customers experienced 1.33 billion outage hours in 2020 — a 73% increase from approximately 770 million outage hours in 2019. As even momentary power losses can result in backflow, investing in proper backflow-prevention devices is critical to ensure aeration facilities remain as disaster-resilient as possible.

Choosing the Ideal Elastomer

The duckbill check valve's unique design offers several advantages, but maximizing those benefits requires careful attention toward selecting optimal materials.

Such synthetic, rubber-like elastomers as *ethylene propylene diene monomer* (EPDM) and Neoprene are excellent candidates for duckbill valves, offering superb flexibility as well as unmatched durability. Not only do these elastomers reliably resist tears and abrasions, but also stand up to harsh acidic and alkali substances often present in wastewater. EPDM and Neoprene boast exceptional resistance to heat, a necessity in any device intended for prolonged contact with compressed air and fluids exposed to solar warmth, which can sometimes reach temperatures as high as 300°F or more.

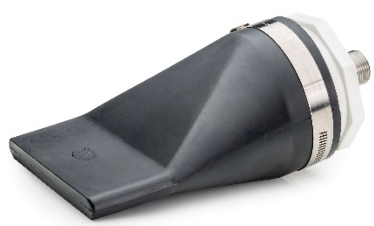
As EPDM, Neoprene, and other state-of-the-art elastomers become more commonplace in industrial applications, many aeration system owners opt to retrofit existing bubble diffusers —typically made from thermoplastic polymers such as PVC or ABS — with separate, elastomeric check valves. However, prolonged use often causes these separate coverings to loosen their grip on the plastic diffusers and eventually pop off, floating into the tank and once again rendering the diffuser susceptible to backflow issues in the case of airflow loss. For that reason, the most failure-proof aeration systems integrate both the diffuser and the duckbill check valve into a single, elastomeric piece.

Meet the ProFlex™ Series 730CBD

ProFlex™ Series 730CBD Coarse Bubble Diffusers, available from Proco Products, Inc., are a thoughtfully designed, single-piece aeration solution that both eliminates risks of backflow-related damage and promotes efficient, whole-of-tank mixing for suspended substances in wastewater. The device's sturdy, maintenance-free construction is designed for longevity as well as seamless re-circulation after lapses in airflow.

The ProFlex™ 730CBD is available in diameters ranging from 1.5" to 4" to meet the needs of any size and type of tank, accommodating airflow rates up to 40 standard cubic feet per minute (scfm). Standard components include EPDM or Neoprene elastomers, with other alternatives available by request, as well as a specialized "Hex" ¾" NPT stainless-steel nipple that enables a simple and safe sealing experience between the diffuser and the aeration manifold. Optional flow control orifice reducers are also available, which provide additional pressure moderation to optimize the performance of multiple diffusers installed along a single air-supply pipeline.

A diverse collection of aeration facilities located across North America have already adopted Proco's duckbill-equipped coarse bubble diffusers, enhancing performance while minimizing maintenance and repair needs.



About Proco Products, Inc.

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Overview:	• 39 years in business • Specialists in expansion joints, check valves, pipe connectors, low-torque gaskets, penetration seals, and more • Serving various industries including water and wastewater, chemical/petrochemical, HVAC, marine, mining, oil and gas, power generation, pulp and paper, and steel	**Professional Memberships:**	Fluid Sealing Association (FSA); Water Environment Federation (WEF); American Water Works Association (AWWA); Cooling Technology Institute (CTI); National Association for Hose and Accessories Distribution (NAHAD); Industrial Distributer Co-Op (IDCO); American National Standards Institute (ANSI)
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