

# Fine Bubble Aeration

## Bulletin Brief

Fine bubble aeration or fine pore diffusers are widely applied in water and wastewater applications today. The initial technology for fine bubble aeration dates back to the early 1920's. Advancements in the technology have greatly improved the performance capabilities of the product and largely account for the broad application of the technology today.

Fine bubble aeration systems are inherently more efficient in oxygen transfer than coarse bubble aeration systems. Overall, a fine bubble aeration system arranged in a grid configuration will operate at approximately 50% the energy consumption of coarse bubble systems. Because of this high operating efficiency and corresponding reduction in energy consumption, fine bubble aeration systems have been and continue to be evaluated and applied in a wide range of wastewater treatment applications.

## Technical Presentation

The development of new fine pore technologies, specifically, flexible membrane diffusers, has resulted in numerous performance enhancements and improved service life and reliability. The capabilities of flexible membrane diffusers further broaden the applications for fine bubble aeration systems to a point where today, fine pore diffusers are being applied in a majority of wastewater treatment applications.

### Rigid Fine Pore Media (ceramic diffuser units)

Ceramic plates were offered as the initial fine bubble aeration technology. This technology uses what is referred to as rigid fine pore media. The ceramic media in this case was installed in the floor of the reactor in channels or diffuser boxes. This configuration provided excellent oxygen transfer efficiency; however, the installed cost of the system was quite high.

The introduction of ceramic dome and disc diffuser units offered significant improvements in installation and mechanical reliability as compared to plate-type systems. Today, disc units are the predominant rigid fine pore technology available in the marketplace.

### Limitations of Rigid Fine Pore Diffusers

Regardless of diffuser configuration, ceramic or rigid fine pore diffusers have inherent operational limitations. These inherent operational limitations include but are not limited to:

**Dry Side Fouling** Air filtration and the cleanliness of the air piping system is critical as rigid fine pore media are subject to mechanical fouling from airborne

particulates. High air filtration efficiency and non-corroding construction materials for header piping are appropriate design criteria to reduce the potential for this condition.

**Wet Side Fouling** Rigid, open porous media is subject mechanical fouling during idle or low flow conditions. The provision of stand-by power, online spare blower units, and constant operation are required to minimize this condition.

**Biomass Accumulation** In addition to mechanical fouling, the low pore utilization rate and the surface properties of ceramic media under both normal and low flow conditions result in ideal conditions for biomass accumulation. Proprietary systems including anhydrous HCL gas injection have been developed to offset the performance losses associated with this condition. The effectiveness of these systems is variable and does not eliminate the requirement for manual maintenance of the diffusers.

#### **Flexible Fine Bubble Media (membrane diffuser units)**

The development of flexible membrane, fine bubble aeration systems directly focuses on the primary deficiencies associated with rigid fine pore products. While initial flexible membrane products suffered from a multitude of design deficiencies themselves, well-designed membrane diffusers provide the following major benefits:

- Economical system configuration for low installed costs.
- Direct backflow prevention features at the membrane wall to prevent the backflow of liquid and solids into the diffuser unit. The diffuser units should be suitable for on/off operations.
- Membrane diffuser units are less susceptible to dry side, mechanical fouling. In general, moderate efficiency, single stage air filtration is recommended. Materials of construction for header components is less critical than for rigid fine pore products, although non-corroding materials are recommended for maximum service life of piping components.
- Oxygen transfer efficiency of membrane diffusers exceeds that of rigid fine pore diffusers. Higher operating efficiencies are achievable because the airflow per diffuser may be optimized for operating efficiency whereas rigid fine pore devices must be operated at a moderate gassing rate to maintain media activity.

Membrane diffusers are being applied in a wide range of applications and are largely displacing the application of rigid media ceramic diffusers and coarse bubble diffusers. Currently available systems offer all the advantages of energy conservation, operational flexibility, and reduced maintenance.

Technical Bulletins are presented as a service by Environmental Dynamics Inc. of Columbia, Missouri.  
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Advanced Technology EDI FlexAir disc and tube diffuser products are featured in the EDI catalog. These fine bubble diffuser products can be configured to provide maximum efficiency at a reasonable cost and offer the very latest in process and technology developments.

For specific information on proper design and evaluation of your existing system contact Environmental Dynamics at 573-474-9456.