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Fine Bubble Aeration

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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 fine bubble products and largely account for the broad application of the technology today.

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Fine bubble aeration systems are inherently more efficient in oxygen transfer than coarse bubble aeration systems. Overall, a fine bubble aeration system configured 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.

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 broadens 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.

The initial fine bubble aeration technology offered ceramic plates. 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.

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

1. Dry Side
   - Air filtration and the cleanliness of the air piping system is critical as rigid fine pore medias are subject to mechanical fouling from airborne particulates. High air filtration efficiency and non-corroding materials for construction of header piping are appropriate design criteria to reduce the potential for this condition.
2. **Wet Side Fouling**

- Rigid open porous media is subject to mechanical fouling during idle or low flow conditions. Stand-by power, online spare blower units, and constant operation are required to minimize this condition. In addition to mechanical fouling, the surface properties of the media and low pore utilization rate 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 are variable and do not eliminate the requirement for manual maintenance of the diffusers.

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, the advanced technology membrane diffusers offered by Environmental Dynamics Inc. (EDI) provide the following major benefits:

1. **Economical system configuration for the lowest installed cost of any flexible membrane aeration system.**
2. **Direct backflow prevention features at the membrane wall prevents the backflow of liquid and solids into the diffuser unit.** The diffuser units are suitable for on/off operations.
3. **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 the header components are less critical although non-corroding materials are recommended for maximum service life of the piping components.
4. **Oxygen transfer efficiency of membrane diffusers exceeds that of rigid fine pore diffusers.** Higher operating efficiencies are available 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.

Advanced technology EDI 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 of the advantages of energy conservation, operational flexibility, and reduced maintenance.

The EDI FlexAir® disc and tube 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.