ETI - Environmental Technology Initiative
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What is aeration?

Aeration is a step in wastewater treatment where air is added to wastewater for mixing purposes and to enhance biological growth. The purpose of aeration is to dissolve oxygen into wastewater so that the microorganisms can utilize it while they break down organic material.

What is fine bubble aeration?

Fine bubble aeration is a subsurface form of diffusion in which air is introduced in the form of very small bubbles to aid or enhance the treatment of wastewater. Air flows from a pipe into diffusers located at the bottom of a tank. These diffusers have numerous small openings (known as pores) through which air flows into the wastewater in the tank.

In the past, various diffusion devices have been classified as either fine bubble or coarse bubble based on how efficiently they transferred oxygen to the wastewater. Since it is difficult to clearly distinguish between fine and coarse bubbles, diffused aeration systems have been classified based on the physical characteristics of the equipment.

In a fine bubble aeration system, several diffusers are mounted or screwed into a header pipe that may run along the length or width of the tank or on a short manifold mounted on a movable pipe. These diffusers come in various shapes and sizes, such as discs, tubes, domes, and plates.

The common types of coarse bubble diffusers are fixed orifices, valved orifices, and static tubes. The bubble size of these diffusers is larger than the porous diffusers, thus, lowering the oxygen transfer efficiency (OTE).

Fine pore diffusers (discs, tubes, domes, and plates) are usually made from ceramic, plastic, or flexible perforated membranes. Although many materials can be used to make fine pore diffusers, only these few are being used due to cost considerations, specific characteristics, market size, and other factors.

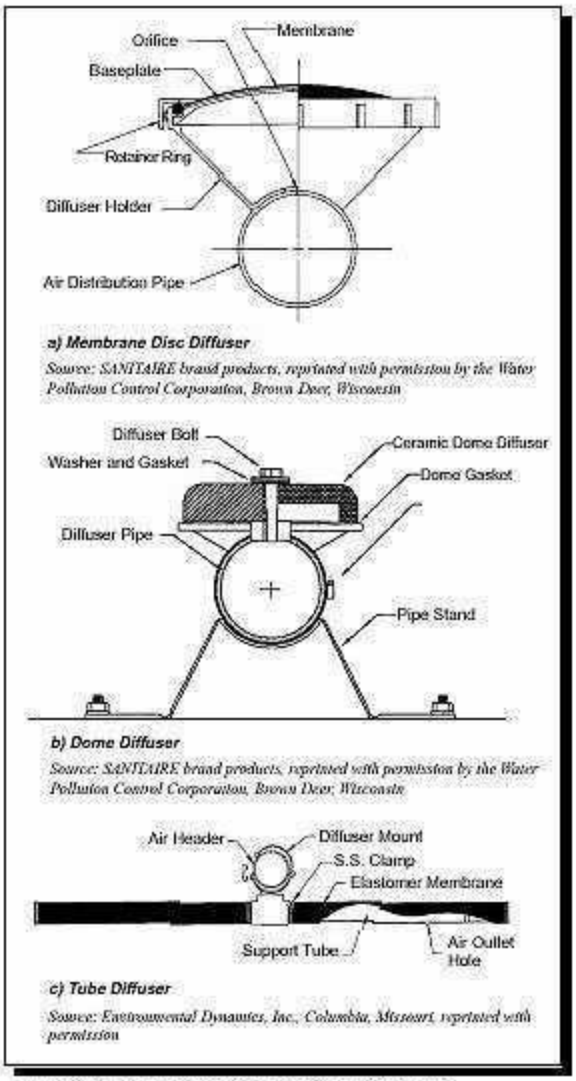

Figure 1: Schematic of Various Fine Bubble Diffusers

What are the advantages and disadvantages of using fine bubble diffusers?

Advantages

- Exhibit high OTEs
- Exhibit high aeration efficiencies (mass oxygen transferred per unit power per unit time)
- Can satisfy high oxygen demands
- Are easily adaptable to existing basins for plant upgrades
- Result in lower volatile organic compound emissions than nonporous diffusers or mechanical aeration devices

Disadvantages

- Fine pore diffusers are susceptible to chemical or biological fouling that may impair transfer efficiency and generate high headloss; as a result they require routine cleaning.
- Fine pore diffusers may be susceptible to chemical attack (especially perforated membranes); therefore, care must be exercised in the proper selection of materials for a given wastewater.
- Because of the high efficiencies of fine pore diffusers at low airflow rates, airflow distribution is critical to their performance and selection of proper airflow control orifices is important.

- Because of the high efficiencies of fine pore diffusers, required airflow in an aeration basin (normally at the effluent end) may be dictated by mixing-not oxygen transfer.
- Aeration basin design must incorporate a means to easily dewater the tank for cleaning.

What determines the performance of fine bubble diffusers?

The performance of diffused aeration systems under normal operating conditions is directly related to the following parameters:

- Fouling;
- Wastewater characteristics;
- Process type and flow regime;
- Loading conditions;
- Basin geometry;
- Diffuser type, size, shape, density, and airflow rate;
- Mixed liquor dissolved oxygen control and air supply flexibility;
- Mechanical integrity of the system;
- Operator expertise; and
- The quality of the preventive operation and maintenance program.

Are fine bubble diffusers easy to operate and maintain?

Yes, if proper procedures are followed. It is essential that diffusers be kept clean through cost-effective preventive maintenance. Preventive maintenance can virtually eliminate air-side dust and particulate fouling of fixed fine pore diffusers. Some cleaning methods for diffusers are acid washing, alkaline washing, gas injection, high-pressure water jetting, and air bumping. Maintaining the filtration equipment involves cleaning and changing the filter media.

What is the cost of fine bubble diffusers?

An aeration system consumes about 50 to 65% of the net power demand for a wastewater treatment plant. Construction cost items for an aeration system include aeration tanks, air piping and headers (according to the design), aeration devices and their supports, air cleaning equipment, blowers, and buildings to house these items.

How do I stay informed about fine bubble aeration technology?

For more information on fine bubble aeration or a list of other fact sheets, contact the National Small Flows Clearinghouse (NSFC) at West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Phone: (800) 624-8301 or (304) 293-4191. Fax: (304) 293-3161. World Wide Web site: ***http://www.nsfc.wvu.edu***.

The NSFC provides free and low-cost informational services and products to help homeowners and small communities address their wastewater needs. Also, information about manufacturers, consultants, regulations, and facilities can be obtained from the NSFC's databases.

References

McCarthy, J. 1982. "Technology Assessment of Fine Bubble Aerators." U.S. Environmental Protection Agency (EPA) Wastewater Research Division. Municipal Environmental Research Laboratory. Cincinnati, Ohio. EPA-600/2-82-003.

Metcalf & Eddy, Inc. 1991. *Wastewater Engineering: Treatment, Disposal, and Reuse.* 3d ed. The McGraw-Hill Companies. New York, New York.

U.S. Environmental Protection Agency. 1985. *Summary Report: Fine Pore (Fine Bubble) Aeration Systems.* EPA Water Engineering Research Laboratory. Cincinnati, Ohio. EPA/625/8-85/010.

---. 1989. *Design Manual: Fine Pore Aeration Systems.* EPA Center for Environmental Research Information. Cincinnati, Ohio. EPA/625/1-89/023.

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