

# Airflow and Air Pressure

## Bulletin Brief

For aeration systems using diffused air (air diffuser systems), the diffuser design must be coordinated with the blower air supply design and the piping design for proper long-term performance. Upgrades or replacement of diffuser systems also require evaluation of the total air supply system and piping system to assure proper performance.

Air is typically supplied to diffuser systems with low-pressure blowers. Design of these blowers or application of blowers requires careful review of air volume and air pressure characteristics of the diffuser and piping system.

## Technical Presentation

Operating air volume is generally a process calculation of air volume for oxygen supply or process air volume for proper mixing. These calculations generally rely on oxygen transfer data and pumpage from diffuser manufacturers to allow selection of proper process air volumes.

Operating pressures are developed by engineering the system air hydraulics. Total system operating pressure must be developed taking the following parameters into consideration.

- Diffuser membrane or unit pressure loss.
- In-basin piping friction losses to top of tank wall.
- Pressure losses in air distribution mains (headers) from the tank wall back to the blowers.
- Pressure loss through the blower system.
- piping and accessories or valves
- inlet filters
- silencers
- Water depth over the diffusers.
- Design increases in diffuser operating pressure vs. time.
- Safety factor in pressure calculations.

Note: typical operating pressures for fine bubble aeration systems are developed using diffuser submergence, plus approximately 3 ft to 4 ft water column losses, plus a safety factor.

For a system with water depth over diffusers of 12 ft, a system design for pressure may be 12 ft submergence + 3.5 ft friction losses, + 0.5 psi safety factor (S.F.). Total design for this example would be 15.5 ft water column (6.71 psi) + 0.5 psi over pressure design (S.F.).

Total blower system design is then approximately 7.21 psi and used with the process air volume to select blowers and size blower motors and electrical controls.

### **Consider both Pressure and Volume**

Pressure and volume must be considered on any design of aeration systems whether fine bubble, coarse bubble, new system or upgrade. For upgrade of diffuser systems it is imperative to know blower pressure/volume characteristics when evaluating a change from coarse bubble to fine or even upgrading existing systems with the same type diffuser. Please confirm blower pressure and air volume characteristics as well as diffuser depth and air piping information on ALL requests for assistance with diffuser selection on diffuser design.

Pressure and air volume affect all blower systems; however, main types of blowers have different design capabilities and limitations. In general:

1. Rotary Positive (P.D.) blowers are used for smaller airflows. P.D. blowers are constant volume delivery regardless of pressure as power is the variable.
2. Centrifugal blowers are generally used for large air supply systems for reduced noise, reduced maintenance plus some operational benefits. Centrifugal machines are constant pressure units with variable air supply volume with small changes in pressures.

A full discussion of blower theory and application technology is beyond the scope of this analysis; however, pressure and air volume are critical design variables for any aeration system. EDI will assist in your air pressure/volume design evaluations when you provide the system characteristics for new designs or for existing system upgrades.

For specific information on aeration system selection considerations, contact Environmental Dynamics, Inc. at 573-474-9456.