Converting Coarse Bubble to Fine Bubble

Bulletin Brief

Many aeration-mixing systems have been installed utilizing coarse bubble diffuser systems or older medium bubble and older fine bubble technologies. These systems present many opportunities to be upgraded fine pore aeration mixing systems to achieve substantial benefits:

- reduced maintenance requirements
- energy savings as much as 50%
- improved process capabilities

Technical Presentation

The above benefits for fine pore aeration mixing systems are substantial. In order to obtain the benefits of these conversions from older technology and older coarse bubble diffuser systems it is necessary to prepare an economic comparison of various technologies. It is also necessary to evaluate the total treatment plant system. Most economic analyses can very quickly show the superior benefits of fine pore aeration. In high energy cost areas the energy savings alone can pay for converting from coarse bubble to fine bubble in less than 1 year and in 2-3 years in areas with more typical energy rates. These economic benefits are impressive and would certainly be in favor of fine pore aeration.

Evaluate Existing Blowers Before Deciding to Upgrade

Before making a final decision to immediately convert it is necessary to review some of the mechanical characteristics of the system currently installed. In particular, it is necessary to review what blower system may be installed and operational in the present facilities. Blowers are generally of two types, either rotary positive or centrifugal machines. These two types of blowers can have very different operating characteristics and may allow easy conversion from the coarse bubble to the fine bubble systems or, in some cases, can be a concern when trying to implement this upgrade.

In general blower systems need to be checked to see if they can operate at the proper air volume and proper pressure. All fine pore aeration-mixing systems operate at slightly greater pressure requirements than coarse bubble systems. In systems that have blowers marginally designed, this modest increase in operating pressure for the fine pore systems can be a major limitation unless proper engineering of the system is implemented.

The model number and characteristics of the blower system should always be evaluated on any project to upgrade from coarse bubble to fine pore high efficiency aeration mixing systems. Total system-operating pressures including the air distribution losses plus the

diffuser losses must be evaluated in the realm of available pressure and capacity of the blower units. This evaluation of the blower systems is not a major item but is a detail that should be considered prior to any major upgrade or conversion activities.

Factors to consider when designing an upgrade

Once the decision is made to upgrade existing equipment, some factors need to be recognized.

Diffuser configuration: Fine bubble diffuser systems generally deliver the greatest energy savings when they can be distributed in a more uniform distribution over the floor of the basin. Systems which employ fine pore aeration mixing systems at one side of the tank with a roll for the tank's liquid contents generally require 15-25% greater energy than systems designed to minimize this liquid movement in the tank with fine pore aeration distributed across the basin floor. This enhanced efficiency is achieved because of improved gas bubble residence and should be considered for maximum return on the investment in the high efficiency diffuser systems. Environmental Dynamics, Inc. can offer suggestions on diffuser distribution when total system design information is provided for review.

Disc vs. Tube diffusers: Fine pore aeration mixing system upgrades from coarse bubble diffusers should yield energy savings of about 50%. Disc diffuser and tube diffuser units are the most common fine pore aeration mixing systems and can each be supplied to achieve the same energy savings.

Selection of tubes versus discs should recognize they can each provide similar performance; therefore, economics of the proper design system should be the major consideration.

In an evaluation of tubes versus fine pore discs it is important to recognize that tube diffuser units have generally better stress resisting characteristics because of the "hoop stress" designs.

Tube diffuser systems tend to be slightly less cost on an installed cost basis over disc diffuser systems. Disc diffuser units generally have enjoyed a wider acceptance in recent times because of some of the historical development characteristics; however, either the disc or the tube can be effectively employed when properly designed. Environmental Dynamics, Inc. offers both disc and tube diffuser units for consideration and application.

Airflow per Diffuser: In the conversion from coarse bubble diffusers to fine bubble diffuser units it is extremely critical to recognize airflow per diffuser. Many coarse bubble diffuser units were supplied with very high airflows per unit to minimize capital cost of the system. Airflow through a coarse bubble diffuser unit has little impact on its total energy conservation, i.e., oxygen transfer efficiency. By comparison, fine pore aeration mixing systems have major gains in oxygen transfer efficiency by keeping the airflow per diffuser at a low rate. It makes sense that the more air you pump through the openings in fine bubble diffusers the larger the gas bubbles will be and the greater pumpage required to carry the

gas out of the tank quickly with a vertical co-velocity. As a result it is important to recognize the benefits of using low gas flow per diffuser unit (more properly offered as gas flow per square foot of diffuser area) in order to maximize performance.

Number of Fine Bubble Units Per Coarse Bubble Unit: Past conversions of coarse bubble to fine bubble diffusers in many cases involved unscrewing the coarse bubble diffuser unit and replacing it with a single fine pore diffuser. This type of conversion may be simple to achieve but it does not often provide an effective or efficient design. For most conversion systems it is necessary to use multiple fine pore diffuser units to replace one coarse bubble diffuser unit in order to keep the gas flux rate per unit area of the fine pore diffuser unit at its optimum performance point. This gas flux rate is not a limitation in the conversion but it is a design consideration that must be addressed in a properly engineered upgrade from coarse bubble or medium bubble or from old technology fine pore aeration to the newer technology diffusers.

Height of Diffuser from Basin Floor: As part of the operating pressure on the blower and overall system performance, the height of the diffusers off the floor must be considered as well. Fine pore diffuser units are normally installed within 6 inches to 2 feet of the aeration basin floor. These same diffusers are generally installed over a significant portion of the floor area of the biological reactor to optimize total system performance by minimizing liquids rolling and thereby increasing gas bubble residence.

Diffusers can be installed at almost any elevation with different types of technologies; however, best performance in most aeration basins is achieved with the diffusers close to the floor, i.e., approximately 6 inches to 1 foot maximum. These elevations for the diffusers must be checked against the blower operating pressure characteristics before final selection is determined.

Please review your existing aeration mixing systems and upgrade possibilities and opportunities. Environmental Dynamics, Inc will be pleased to provide diffuser layouts and recommended diffuser types to optimize total system performance. Details of your blowers are generally available at EDI if the model number and horsepower of the system is made available for evaluation.

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