

# ENERGY CONSUMPTION AND TYPICAL PERFORMANCE OF VARIOUS TYPES OF AERATION EQUIPMENT

## Aeration Systems

### Technical Presentation

Engineers, customers, and everyone associated with the use of biological wastewater treatment systems have significant reason to review and consider the impact of energy efficiency of the aeration mixing devices employed. As in most industries the “imagination” of many suppliers and manufacturers sometimes exceed the capacity of commercial aeration devices to deliver expected performance.

Over the years fairly strict rules of measurement of the performance of mechanical aerators, diffusers, and standards have been established by independent groups such as the American Society of Civil Engineers to evaluate these products. Most manufacturers use the standard methods approach and the ASCE Test Procedures for evaluating and presenting their products. When trying to select a basis of design, it is helpful to have a chart that gives a general comparison of efficiencies of the most common aeration mixing devices currently on the market. The attached chart can be used for and reference and should be considered realistic and a very close comparison of relative performances. The exact performance of any aeration device is extremely dependent on the circumstances for which it is measured. It is important to note the tested conditions as it is seldom one has the opportunity to compare one aeration device against another on a side-by-side basis in the same tank under identical conditions. Such variation as liquid depth, density of diffusers, energy level in the tank, etc., can significantly impact the pounds of oxygen per horsepower hour transferred. As a result, you will see the data presented as a range of normal operating practice for each of the devices. Specific values can fall either above or below these values but would generally fall somewhere in the middle to upper range of the values listed. The purpose of this comparison is not to give specific design values for any aeration devices, but to show the relative energy impact of the generic type device when trying to evaluate a system energy and PW cost.

The most efficient devices currently being employed by the industry are fine pore aeration systems either the ceramic or the rubber flexible membrane. Regardless of what other aeration mixing systems do, in a normal design situation fine pore aeration will always end up being the lowest energy consumption system. There are some applications where coarse bubble or other types of systems may be employed because

of the nature of the waste, temperature, or special circumstances and processes but the basic premise holds: Fine pore aeration technology has a tremendous energy benefit and is gaining almost universal application for energy conservation.

Membrane diffuser technology is fairly recent yet almost all advances in oxygen transfer efficiency in system performance are occurring in membrane technology. In addition, membrane diffusers operate with lower maintenance so there are multiple benefits. Advanced Technology Membranes are now available that will deliver oxygen transfer efficiencies up to 4% oxygen transfer per foot of submergence and this translates as much as 12 pounds of oxygen per horsepower hour. Membrane diffuser aeration systems continue to capture much of the aeration market.

General surface aeration efficiencies are shown. Surface aeration systems have a limited range for optimum operation and effective aeration and mixing. Surface aeration systems are limited above 12 feet water depth. When the water level of surface aerators drops below about 5 to 6 feet the zone of influence of the aerator may be dramatically reduced. This reduced circulation capacity of the aerator reduces its oxygen transfer efficiency and its overall zone of influence.

This comparison is to show that diffused aeration systems, in particular fine pore membrane aeration diffuser systems, offer tremendous energy savings versus other aeration devices currently available. In addition, it should be strongly emphasized that fine pore aeration systems offer these benefits regardless of the depth of the basin, geometry of the basin, or the application to be employed.

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

GENERAL OXYGEN TRANSFER EFFICIENCIES<sup>1</sup>

**Mechanical Aeration Systems**

	<u>#/Hp Hr</u>	<u>Kg/KWH</u>
Rotors (brush aerators) surface aeration	2.5 to 3.5	1.52 to 2.13
Slow speed surface	3.0 to 3.5	1.82 to 2.13
High speed splash surface aeration	2.5 to 3.25	1.52 to 1.98
Induced surface aeration (Aire O2 type)	1.0 to 1.5	0.61 to 0.91

**Combination Systems**

Submerged Turbine (turbine mixer and compressors)	1.5 to 2.5	0.91 to 1.52
Jets (pumps with compressors)	2.0 to 3.5	1.22 to 2.13

**Diffused Aeration**

Coarse bubble system		
Static tubes	2.0 to 3.0	1.22 to 2.13
Wide band grid	2.5 to 3.5	1.52 to 2.13
Misc. coarse bubble	2.0 to 3.0	1.22 to 2.13
Traditional Fine Pore Aeration		
Ceramic disc or ceramic dome grid	5 to 7	3.04 to 4.26
Flexible Membrane Disc or Tubes Grid at Conventional Flow Rates	4 to 7	2.43 to 4.26
Advanced Technology Membrane Fine Pore Aeration	up to 12	7.30

<sup>1</sup> For your reference, the data supplied in the enclosed oxygen transfer table is taken from several sources including the US EPA Fine Pore Aeration Manual, the clean water test results done at Los Angeles County by the US EPA and LA County Sanitation District, plus published data on rotors and surface aerators.