



Diffuser Testing for Fine Bubble Diffuser Pumping Rates

Diffuser systems employed in ponds and lakes as aeration use the lifting action of the air bubbles to bring large volumes of water into contact with the atmosphere at the surface where gas exchange occurs. This gas exchange is the aeration, increasing oxygen levels and allowing other gases to escape. The diffuser system assists the pond in breathing. The gas exchange ongoing between the bubble surface and the water is minimal compared to the gas exchange as the large volumes of water are rolled at the surface in contact with the atmosphere.

Diffuser stations are placed at the bottom of the pond or lake and are supplied air from a compressor on shore, via weighted tubing. Diffusers break up the air into fine bubbles and these bubbles rise through the water column at about 1 foot per second. The diffuser station design and the resulting pattern of bubbles have been known to affect the efficiency of this process greatly.

In 2009, Kasco Marine contracted GSEE, an independent testing firm, to evaluate diffuser designs and the efficiency at which they lift water. Eight diffusers were evaluated for induced water pumping rates at three different pumping rates: 1.5, 2 and 2.5 CFM per diffuser. Testing was performed in a 21 foot diameter tank, at 6.5 feet of depth. Head loss (the amount of air flow lost due to friction, or pressure necessary to push it through an orifice) was also evaluated among the eight diffusers. Head loss affects the amount of pressure necessary to deliver the same volume of air. It also affects the air volume delivered, given a set amount of energy to deliver it.

The diffusers station designs that were tested included:

AQ	Aqua Control 4 x 1" rubber membrane diffuser
OT	Otterbine 4 x 9" membrane disk diffusers
SW	Zig-zag Pattern 4 x 6" ceramic stone diffusers-custom Vertex 5 x 9"
VT	membrane disk diffusers
RA	4 x 1" porous rubber U tube diffusers-custom
HP	Aquatic Ecosystems "H" Pattern 4 x 6" ceramic stone diffusers Five
FF	Finger 5 x 6" ceramic stone diffusers-custom
MF	Many Fingers porous rubber tube diffusers-custom

Results:

- Induced pumping rates continued to increase with increases in air flow for all diffusers from 0.5 CFM to 3 CFM.
- The RA, U-tube diffusers demonstrated the highest pumping capacity at all three air supply rates.
- The rubber membrane disk systems, OT and VT, had higher head loss than the other systems.
- The RA, U-tube diffusers had the lower head loss than the other designs consistently between 0.5 and 5 CFM.

CFM	Induced pumping rates in gallons per minute of eight diffuser designs at 1.5, 2, and 2.5 CFM of supplied compressed air.							
	AQ	OT	SW	VT	RA	HP	FF	MF
1.5	585	589	649	818	927	567	595	744
2	485	734	766	927	1,053	691	822	938
2.5	666	861	877	998	1,189	805	959	1,063
CFM	Flow rates of diffusers as percentage of the flow rate of RA, the top performer.							
	AQ	%of RA	OT	%of RA	SW	%of RA	VT	%of RA
1.50	585	63.11%	589	63.54%	649	70.01%	818	88.24%
2.00	485	46.06%	734	69.71%	766	72.74%	927	88.03%
2.50	666	56.01%	861	72.41%	877	73.76%	998	83.94%
	RA	%of RA	HP	%of RA	FF	%of RA	MF	%of RA
1.50	927	100.00%	567	61.17%	595	64.19%	744	80.26%
2.00	1,053	100.00%	691	65.62%	822	78.06%	938	89.08%
2.50	1,189	100.00%	805	67.70%	959	80.66%	1,063	89.40%