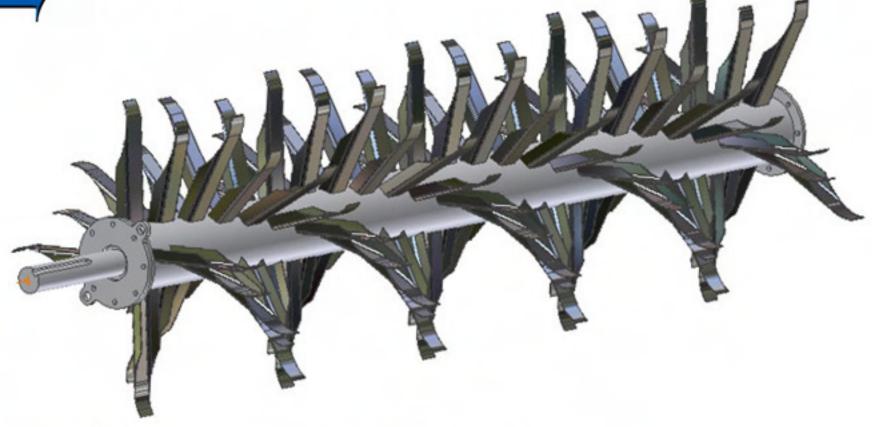


The Source for Floating WWT Equipment Brush Rotors - Mixers - Polishing RBCs

# PERFORMANCE O2 TRANSFER & MIXING





Rotors differentiate HP through six different rotor lengths (3.5' to 12.5') and two different diameter (36" and 42")

The offset between the blades in a row is the same on all **SAN ARROLL OF Rotors**. The offset was refined to produce an aggressive spiral at maximum submergence for greater pumping.

The NAMED Rotors alternate blade lengths to enhance O2 transfer.



### **BLADE DESIGN ELEMENTS & BENEFITS**



### Blade Design

C-shaped base extends vertically to form a deeply cupped channel that tapers to a slight curved tip.

### **Blade Performance**

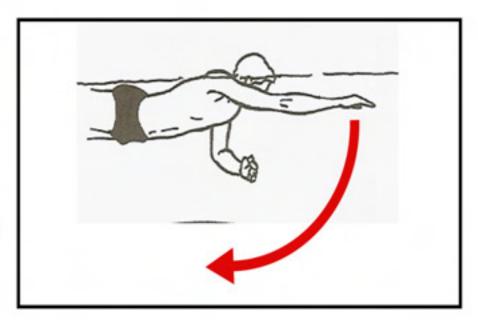
Tapered tip easily transfers energy to the water and the channel shape traps the water and pushes it away from the rotor.

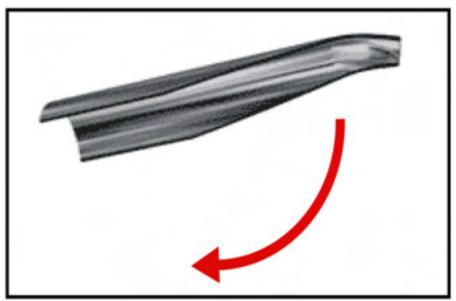
### Blade Strength

Sides of the blades serve as gussets to reinforce the vertical strength of the blades and take pressure off of the welded joints.

## MAXIMIZING PERFORMANCE

- Like an Olympic swimmer maximizing his stroke, the cupped shaped blade improves the performance.
- Higher 0<sub>2</sub> transfer
- Better Mixing





## PERFORMANCE SUMMARY

## Higher Pumping Rates DELIVER:

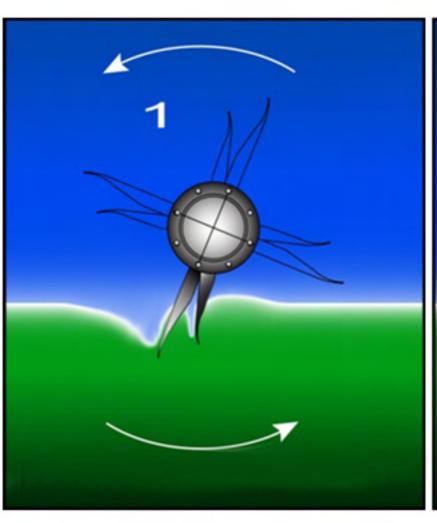
Higher O<sub>2</sub> Transfer

Improved Mixing Efficiency

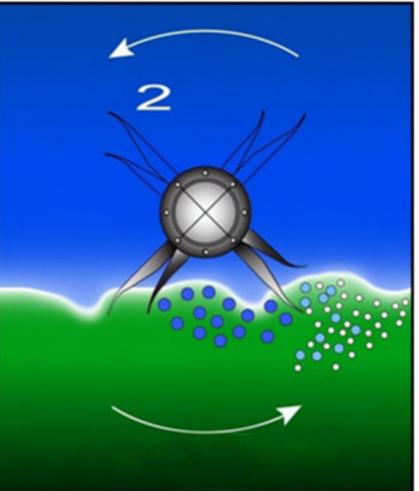




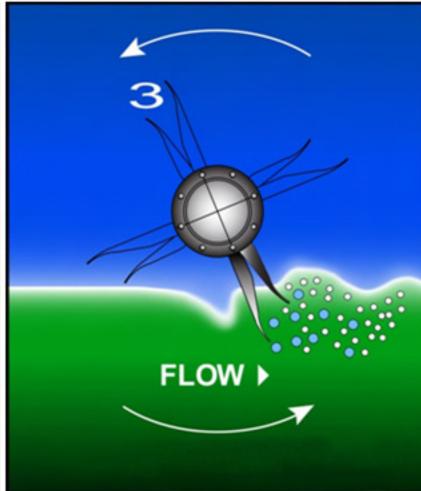
## Primary Phase of the Oxygen Transfer Process



Air cavity forms behind blades entering water.



The air cavity is dispersed into bubbles by the trailing blades.



Oxygen transferred to water flows away as the next cycle of blades prepares to enter the water.



## Secondary Phase of the Oxygen Transfer Process

Spraying water into the air provides a second source of aeration, making the equipment highly efficient for O<sub>2</sub> transfer.



# The Floating Brush Rotors enhance biological treatment using less HP than most conventional mechanical aerators

### High oxygen transfer rates

- 3.0 lb oxygen/HP-hr ASCE (clean water test)
- 2.3 lb oxygen/HP-hr (field adjusted transfer rate)

### Excellent mixing and high pumping rates

- 2100 gpm per HP (field adjusted pumping rate)

### **Energy savings**

- 30 to 60% lower HP requirements for oxygen demand
- 50% less HP required for pumping/mixing
- Operates at 90% of rated HP



## **Independent Testing**



April 17, 2003

S&N Airofio

Ms. Laura Hong P.O. Box 1994 Greenwood, MS 36935

RE: March, 2003 20HP AERATOR Test Results

Dear Ms. Hong:

Attached are the results of the three (3) certified tests completed on the 20HP 65.6 RPM Aerator. The results of the certified tests are summarized below. The detailed data and plots are attached.

#### TABLE 1

RATE .	SWD	80	W.	Kely	K, apr	SOTR		E	C'n	Pos	194
	Ft	PSM.	9C	M.	M.	#02/hv	SOUTH HP.	POSTE HP.	mg/L	HP <sub>rese</sub>	HP.
			Non L	inear Re	gression	Amalysis			1000	20000	
5 - 20 HP - 55.5 RPM	5.00	14.49	26.45	7.25	7.17	50.48	3.04	2.37	9.40	16.58	38.22
5 - 20 HP + 65.6 RPM	5.00	14.50	19.06	100	7.23	50.88	3.06	2.28	9.27	16.65	18.29
7 - 20 HP - 65.6 RPM	5.00	14.47	21.14	7.15	0.76	45.61	2.87	2.62	9.52	17.05	18.74
Average	5.00	14.49	20.22	7.16	7.12	10.12	7.99	2.72	9.43	16.76	18.40

All time, were analyzed according to the most recent ASCE Clean Water Coygen Tran conducted to the S&N Airoflo test basin at a liquid depth of ~5 feet, GSEE INC. cort results shown above represent the efficiency of the unit at the test conditions.

If you have any questions regarding these results, please don't hesitate to give us a

Sincerely,

GSEE, Inc.

Gerald L. Shell, R.E. President

TABLE 1
TEST RESULTS

Run	SWD	BP	Wt	KLaT	K <sub>1</sub> a <sub>20</sub>	SOTR	SA	VE .	C, 30	Pov	wer
	R	PSIA	°C	hr'1	hr'1	#02/Hr	#OyHr HPm	#O <sub>3</sub> /Hr HP <sub>4</sub>	mg/L	HP <sub>motor</sub>	HPwee
			Non t	inear Re	gression	Analysis					
5 - 20 HP - 65.6 RPM	5.00	14.49	20.45	7.25	7.17	50.48	3.04	2.77	9.49	16.58	18.22
6 - 20 HP - 65.6 RPM	5.00	14.50	19.08	7.07	7.23	50.88	3.06	2.78	9.27	16.65	18.29
7 - 20 HP - 65.6 RPM	5.00	14.47	21.14	7.15	6.96	49.01	2.87	2.62	9.52	17.05	18.74
Average	5.00	14.49	20.22	7.16	7.12	50.12	2.99	2.72	9.43	16.76	18.42
			Lin	ear Regr	ession A	nalysis					
5 - 20 HP - 65.6 RPM	5.00	14.49	20.45	6.94	6.87	48.36	2.92	2.65	9.49	16.58	18.22
6 - 20 HP - 65.6 RPM	5.00	14.50	19.08	7.07	7.23	50.87	3.06	2.78	9.27	16.65	18.29
7 - 20 HP - 65.6 RPM	5.00	14.47	21.14	7.19	7.00	49.29	2.89	2.63	9.52	17.05	18.74
Average	5.00	14.49	20.22	7.07	7.03	49.51	2.95	2.69	9.43	16.76	18.42

GSEE, INC. 599 WALDRON BOAD LAVERGNE, TN 37086 643-793-7547 FAX: 643-793-5070 omail: preintilemental



## Regulatory Approval



## MISSISSIPPI DEPARTMENT OF NATURAL RESOURCES Bureau of Pollution Control P. O. Box 10315 Jackson, Missisppi 30209 [601] 961-5171



March 22, 1988

Mr. Buster Norris S & N Sprayer Company, Inc. P.O. Drawer 1994 Greenwood, Mississippi 38930

Dear Mr. Morris:

We have evaluated your submittal in support of our approval of the S & H Sprayer Electric Paddle Micel Acrator to be applied to waste-mater treatment. You have asked that the S & N Acrator be approved for treatment systems there secondary levels of treatment (i.e., not less than 30 mg/l BCD<sub>c</sub>) is required. Our current criteria calls for 8 H.P. per million gallons under treatment to be supplied for oxygen dispersion. You have asked that we approve 4 to 5 H.P. per million gallons under treatment for the S & H Acrator.

The data supplied as a result of testing by Professor Claude Boyd at Auburn University provides us with the mixing characteristics of the S & N Acretor. The results appear impressive. Additionally, we called Professor Boyd and discussed the results of his testing. He sent us additional saterial presenting the results of other testing performed on aerators. While most of Professor Boyd's work was with aerators for catfish farming, the aeration and mixing abilities could be effective in wastewater treatment.

After review of all the data submitted, we feel we are in a position to approve the S & N Sprayer Electric Paddle Wheel Acrator at no less than 4 N.P./million gallons under treatment for secondary levels of treatment on a cuse by case basis as submitted by project design engineers. Other applications where more stringent limits are required will also be reviewed case by case.

Please be more that this merator has not been applied to vastewater treatment in this manner for meeting certain effluent limits. The permittee will be advised in all cases of this and will be held responsible for meeting required effluent limitations.

If you have any questions, do not hesitate to call me at 961-5171.

Sincerely,

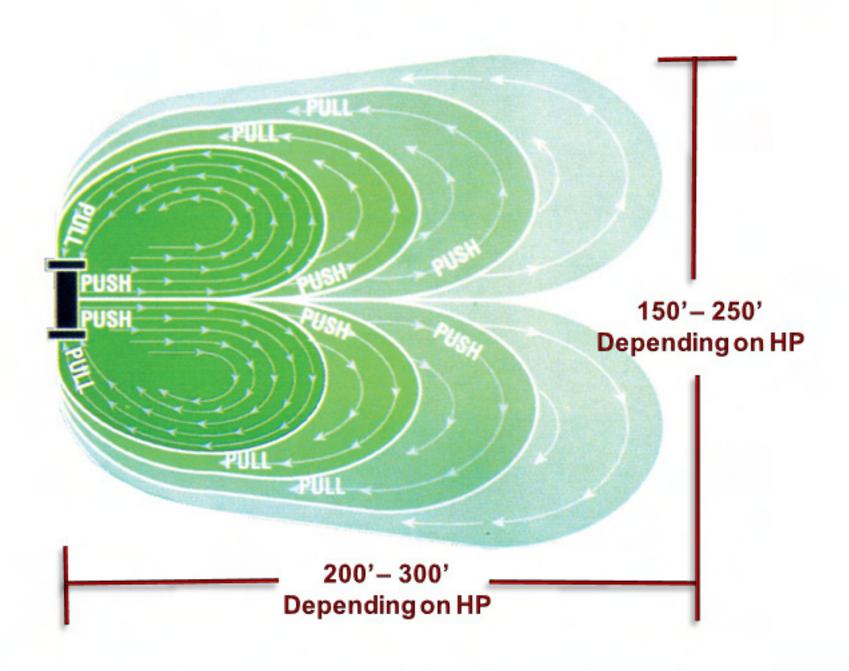
Hunn F. Odom Glenn L. Odom, P.E. Coordinator Permit Compliance Section

GLO/vevs

- In 1989, S&N Airoflo requested an approval for the use of its rotors at 4 HP/mg vs. the state standard of 8 HP/mg.
- S&N Airoflo supplied O2 transfer and mixing tests performed at Auburn University to the Mississippi Department of Natural Resources, who in turn forwarded the information to Region IV Department of Environmental Quality in Atlanta, Ga.
- S&N Airoflo units approved for 4 hp/mil gal partial mix – one half of the original 8 hp/mil gal.
- Ruleville, MS first WW installation. MDEQ suggested S&N equipment. Add 200 households to system.



## Active Mixing Zone in Open Basis or Lagoon



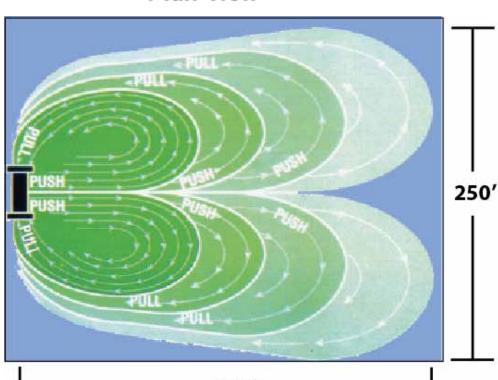


## Verification of Increased DO Readings Establishes the Size of the Active Mixing Zone

### 15 HP Floating Brush Rotor @ 83 RPM

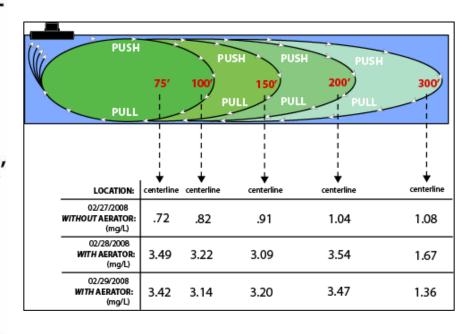
\* Average Depth of Lagoon - 7 feet

#### Plan View



300'

### Elevation View



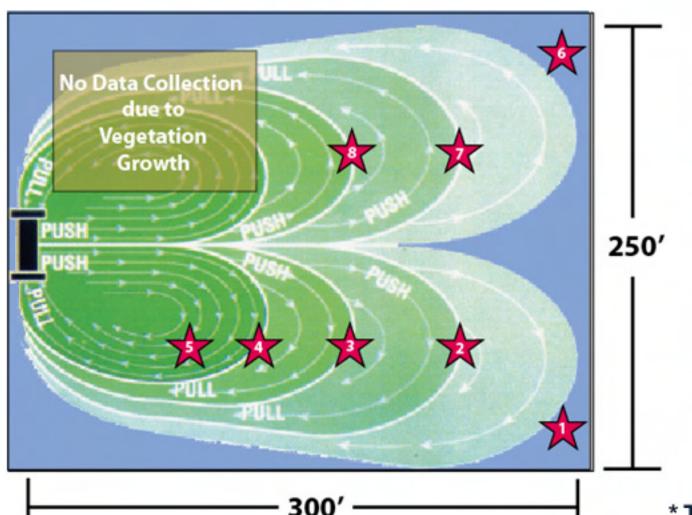
\* Testing performed by AquAeTer, Brentwood, TN, at a large paper mill.



# Verification of Increased DO Readings Establishes the Size of the Active Mixing Zone

15 HP Floating Brush Rotor @ 83 RPM

### Plan View

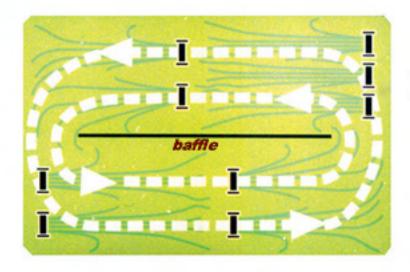


LOCATION:	02/27/2008 WITHOUT AERATOR: (mg/L)	02/28/2008 WITH A ERATOR: (mg/L)	02/29/2008 WITH AERATOR: (mg/L)
150'west of 300'centerline	1.02	1.62	1.75
75' west of 200' centerline	.86	3.26	3.18
75'west of 150' centerline	.80	3.43	3.33
75'west of 100' centerline	.68	3.23	3.26
75' west of 75' centerline	.64	3.18	2.82
150' east of 300' centerline	.97	1.64	1.35
75'east of 200'centerline	1.13	2.31	2.96
75'east of 150' centerline	1.06	2.57	3.02

<sup>\*</sup> Testing performed by AquAeTer, Brentwood, TN, at a large paper mill.



## Placement Effects on Treatment

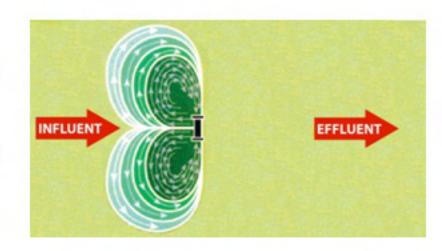


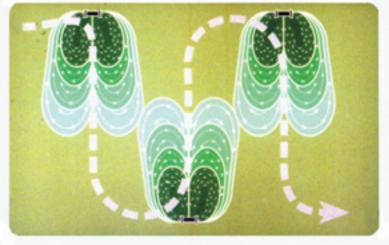
### **Modified Raceway -**

7 acre facultative lagoon converted to raceway design

### **Influence of Placement -**

- Eliminates Short-Circuiting
- Completely mixes the influent and exposes it to O2





### **Serpentine Flow Pattern -**

- Water moves from unit to unit
- Independent Mixing Zones
- Creates separate zones of mixing and treatment
- Prevents Short-Circuiting

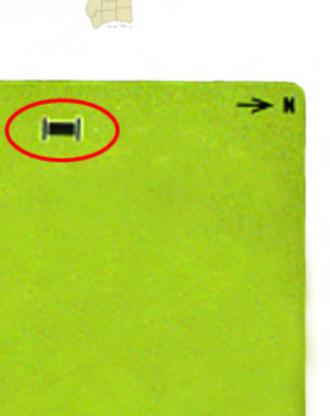


## Multi-Cell Facility: Soft Drink Plant

Gulf State Canners, Inc. - Clinton, MS







## Velocity Test

Performed by: Dennis D. Truax, PhD., P.E., D.E.E. Department of Civil Engineering Mississippi State University

- One 10 HP unit operating.
- Approx. 0.4 surface acres (0.7 mil gal @ 14HP/mg)
- Approx. 7 ft at deepest point.
- Velocity & sludge accumulation measured.
- Collected at 7 points by two people in a rope-stabilized boat using a digital velocity meter.

### **Test Results:**



0

Water Depth: 5 feet Sludge Accumulation: None

Distance below surface	Velocity (fps)		
0.2 ft.	2.5		
1.0 ft.	2.1		
2.0 ft.	1.5		
3.0 ft.	1.1		
4.0 ft.	0.5		

Average Velocity: 1.54 fps

2

Water Depth: 4 feet Sludge Accumulation: None

Velocity (fps		
0.5		
0.6		
0.4		
0.5		

Average Velocity: 0.50 fps

3

Water Depth: 5.3 feet Sludge Accumulation: None

Distance below surface	Velocity (fps)		
0.2 ft.	0.6		
1.0 ft.	0.5		
2.0 ft.	0.6		
3.0 ft.	0.5		
4.0 ft.	0.6		

Average Velocity: 0.50 fps

### **Test Results:**





Water Depth: 4.5 feet Sludge Accumulation: 0.5 feet

Distance below surface	Velocity (fps		
0.2 ft.	0.5		
1.0 ft.	0.5		
2.0 ft.	0.6		
3.0 ft.	0.4		

Average Velocity: 0.50 fps

5

Water Depth: 5.5 feet Sludge Accumulation: 0.25 feet

Velocity (fps)			
0.7			
0.6			
0.5			
0.5			
0.5			

Average Velocity: 0.50 fps

6

Water Depth: 6.8 feet Sludge Accumulation: 0.75 feet

Distance below surface	Velocity (fps)		
0.2 ft.	0.5		
1.0 ft.	0.5		
2.0 ft.	0.5		
3.0 ft.	0.4		
4.0 ft.	0.5		

Average Velocity: 0.48 fps

## **Test Results:**





Water Depth: 6.8 feet Sludge Accumulation: 0.75 feet

Current direction constantly changing. Velocities above sludge varied between 0.1 and 0.5 fps, with higher values near surface.