# A benchmark comparison between FlowMixer units and propeller agitators.

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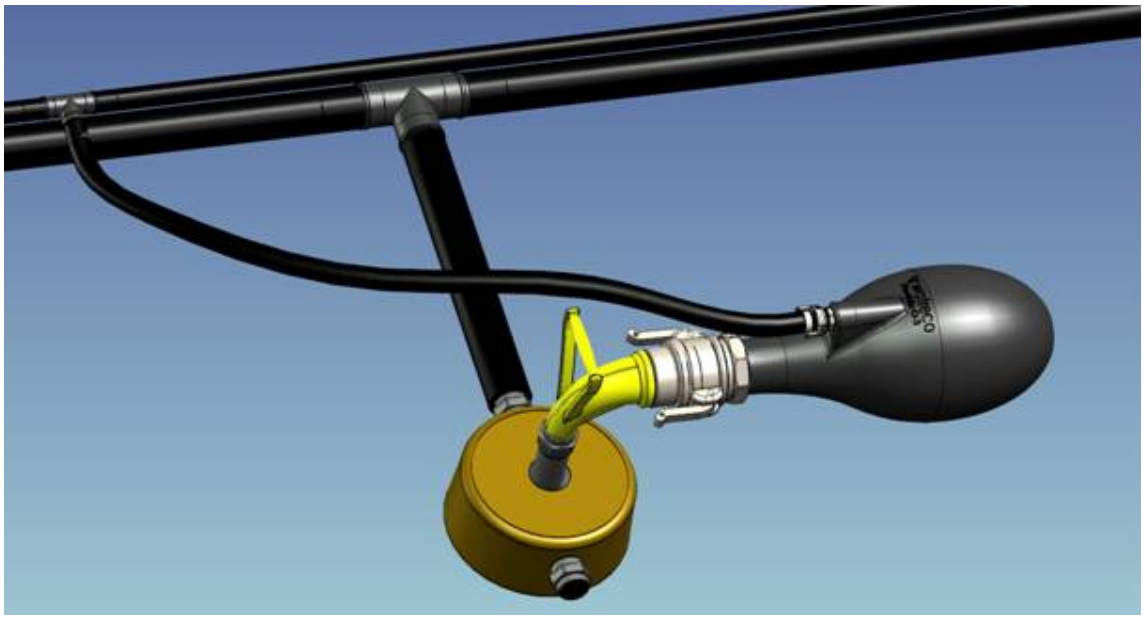
# Watreco FlowMixer system



The FlowMixer is a system that normally is placed on the bottom in a system where a central water pump pumps water into a system of hoses.

At the end a FlowMixer unit is placed and a vortex is generated inside sucking in air from the surface and the water that comes out from the system is directed backwards generating a blending flow of water in the pond. That is why 2 hoses are connected to the FlowMixer. When the system is placed very little further maintenance is needed. The units can be placed and directed so that oxygen-rich surface water also can be pulled down, there are many possibilities. The system has been tested in Eindhoven in Holland and considered as one of the best tested. For maintenance, the units can very easy be disconnected, brought to the surface, divided, cleaned and mounted back again, on the spot (boat) from where you operate. The units are connected to the hoses via a “stone” (orange in picture) made out of concrete working as an anchor and a platform for the unit. Eventually the air hoses can be buoyed to the surface in order to save material. This also means that it is easy to find the individual units if there is a need. The connector to the stones and the air hose is a “Kamlok” connector that provides a very quick and convenient handling during installation and lay out.

The system works so that a vortex is generated by the flow inside the FlowMixer causing a low pressure in the center of the vortex. This low pressure is connected to the surface via the air hose, sucking in a lot of air.

The air is mixed with the water and finely distributed, and later, it goes with the flow into the bulk water. As the air bubbles enter the water, oxygen in the air starts to dissolve into the water, the finer bubbles, the better transfer of oxygen. Tests have shown that around 20 times more water is involved than what you pump through a unit, meaning that if you pump 100 liter per unit every second some 2000 liter of water is circulated at the same time.


A close up on the system during action in a pool showing the fine bubbles leaving the units.

A single unit with the camlock connectors

A double system with the units mounted vertically on a pump, with hoses, connectors etc

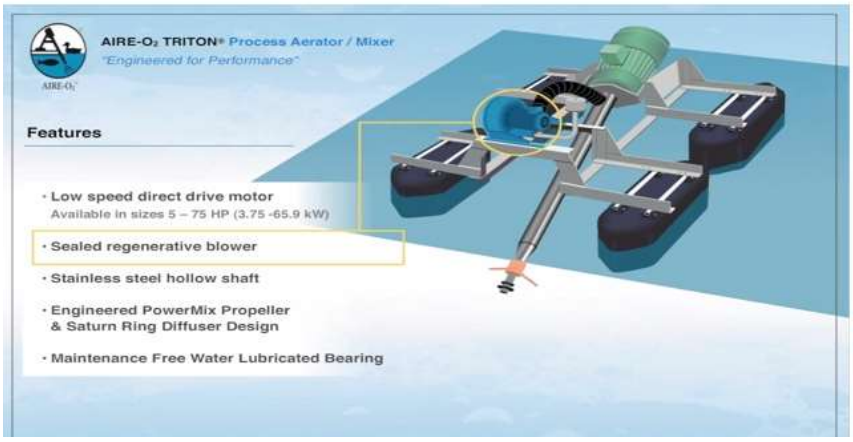
# Product data FlowMixer

| Product | | FlowMixer 10 | FlowMixer 50 |
|---|---|---|---|
| Length (mm) | | 349 | 700 |
| ø (mm) | | 153 | 329 |
| Material unit | | PA 2200 | PA 2200 |
| Weight (kg) | | 1.4 | 10 |
| Inlet water (") | | 2 | 4 |
| Air inlet (") | | 1 | 2 |
| Flow water min-max ($m^3/h$) | | 5 - 11 | 25 - 50 |
| Flow air min-max ($m^3/h$) | | 5 - 11 | 25 - 50 |
| Max Pressure (bar) | | 6 | 6 |
| Max deep (m) | | 1.5 - 2.0 | 1.5 - 2.0 |
| Max temperature (Celsius) | | 100 | 100 |

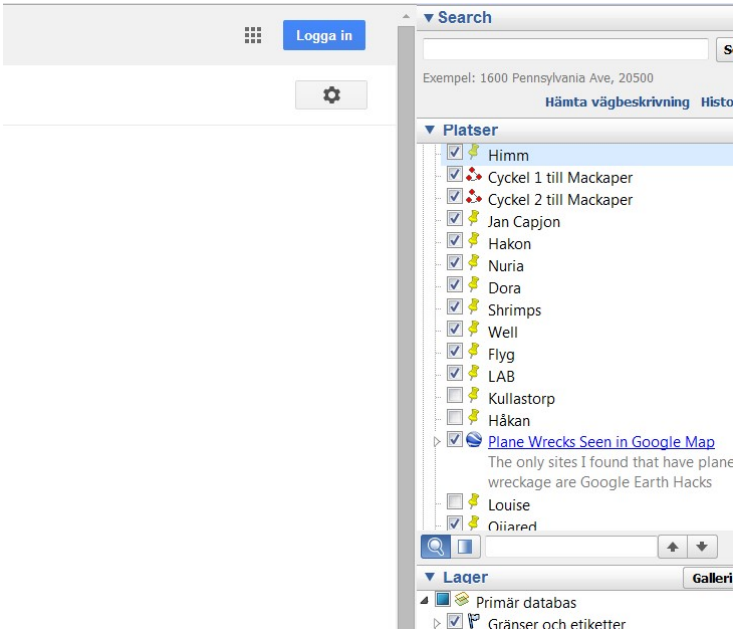
## Possible applications of the FlowMixer units

The first application we found was to treat ponds that had an algae problem. Here oxygen was introduced as the unit could pull in a lot of air. Algae, especially thread algae prefer high pH levels (around 9,5) and as the oxygen lowered the pH levels to normal the thread algae started to die out. In this way it is possible to control algae growth buy just pumping water and without the usage of chemicals. Of course the same application can be used for aquaculture purposes as fish and shrimp farming.

Another usage is in wastewater dams as an actual case where Watreco have tested a unit in a fat separator in a dam for storing wastewater from agricultural industry. Here the water is treated in two places where the first is a receiving pond. As the water comes directly from the food industry it contains a lot of fat, starch and solids. Therefore the water needs to be stirred and aerated. For this purpose 10 Aire combined aerator agitators have been installed. These agitators can be used from 1,8 to 10 m depth.




Principal picture of the Aire agitator




The pond with the agitators in action.

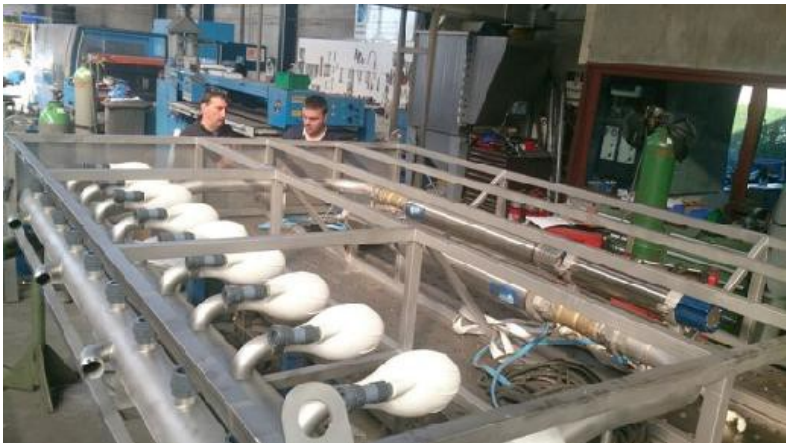
The receiving pond is 46 by 86 m and contains around 11000 m3. The goal is to keep the oxygen level at 2 mg/liter at all time. In order to do this the 10 units uses 30 kW each, all in all some 300 kW.

## Dommelen Project, Eindhoven, The Netherlands

A prototype of a 10-unit FlowMixer system has been developed and is now under test in Holland. The reason is that in small natural river systems oxygen levels are influenced by rainfall. The sewage water treatment plants will bypass this oversupply of water, directly into the small water systems. This causes low oxygen concentration in the flora and fauna. To prevent these oxygen drops the FlowMixer 10-100 is installed. It enables the community to mix in oxygen in the natural water system, without interfering with the flora and fauna. This kind of system meets that same demand as the earlier described Aire agitator/oxygenator.

The FlowMixer Skid is a metal stand for mounting 10 FlowMixer 10 (see Product data) and feed them with pressurized water at a total flow of 100 m3 / h.

The FlowMixer Skid is being designed.



Here the 10 FlowMixer 10 units have been mounted

The FlowMixer Skid is being put in place, note the air hoses

The Skid in action

The dimensions of the Skid is 2500x3500x500 mm (LxWxH), and uses the following system set up:

**System setup FlowMixer 10-100**
To achieve the required flow of 100 m3/h we have the following setup:
10pcs FlowMixer 10 units
2pcs Submersible pumps Pedrollo type SR44/5 with a pressure of 3.3 bar at 100m3/h
2pcs Motors 400V 7,5 kW at 16A
1pce Water pipe (header) SS 150mm, total length of 3m and a flow of 100m3/h at 1.57 m/s.
1pce Air pipe (header) SS 125mm diameter, total length 6m at a flow of 100m3/h at 2.26 m/s.
10pcs Water pipe (connector) SS 50mm diameter, overall length, 2m at a flow rate of 10m3/h at 2.5m/s.
10pcs Air pipe (connector) SS 40mm diameter, overall length, 2m at a flow rate of 10m3/h at 1.41m/s.

The system sucks in around 100 m3 of air per hour delivering some 800 gram of pure oxygen per hour. As the flow is 100 m3 it circulates 2000 m3 of water per hour using 15 kWh. A tuning of the system will allow a better circulation in the production model.

## Benchmarking the FlowMixer Skid with the Aire agitator/aerator.

- A comparison between the FlowMixer Skid with the agitator in a similar case as in the waste water pond show that the FlowMix skid can do the same work or better, i.e. circulating and aerating around 2000 m3 per hour but just using 50% of the energy used by the agitator. The agitator uses 28 plus 2 kW (agitating and air pumping), a total usage of 30 kW.
  The Skid is powered by 2 Pedrollo pumps on 7,5 kW each, 15 kW in total.

- The Skid can operate in shallow water down to 0,5 m compared with the agitator that need at least 1,8 m but probably more than that in order to operate properly.

- The agitator need a special stand to rest when the water is to shallow, this gives a more expensive and complex solution.

- The FlowMixer Skid offers in general a less complex solution and therefore has a lower maintenance level. The FlowMixer Skid has a dual operation where the pulling in of air is built into the solution for circulation of water. The agitator uses two solitaire systems for the same solution something that is even more expensive and complex.

- The FlowMixer Skid has a better oxygen transfer as the bubbles coming from the FlowMixer Skid are much finer.

- The general freedom of usage is greater with the FlowMixer Skid system. They can be used in ponds against algae growth without any tangling of long algae threads. The FlowMixer system can have different attitude so that surface water can be pulled down but with the same functioning as earlier. The FlowMixer system opens for an alternative powering as with wind power, both directly and via electricity.

- The FlowMixer Skid is safer for humans and animals! The agitator has a sharp, fast rotating propeller that easily can chew anything that comes into it. This also limits the agitator for non use in aquaculture as it chew fishes and shrimps. Also, if an accident happens and a person falls into the water they can be drawn into the propeller of the agitator as well. The intake of water to the FlowMixer is well hidden and equipped with a grid that prevents such accidents.