MicroGas™
Microbubble Generator for Flotation and Gas Transfer

DIRECT MICROBUBBLE TECHNOLOGY
Working Principle

1. Compressed gas (air, O₂, O₃, CO₂) is injected at 1–2 bar into a hollow shaft.
2. The rotating motor spins the shaft at 200 rpm.
3. The gas flows through the discs into the liquid, generating a cloud of microbubbles between 40-60 micron (white water).

Energy Efficiency

Direct Microbubble Technology means that no pressure is necessary to dissolve gas into the liquid, making MicroGas™ the most energy efficient in the market.

Simplicity

MicroGas™-powered plants require minimal equipment and are therefore easy to install, operate and maintain.

Compact

Flotation, oxygenation and ozonation plants powered by MicroGas™ have smaller footprints and tank volumes.

Unlike conventional microbubble generation technologies, the MicroGas™ technology is not based on the gas dissolution principle but on direct microbubble induction. This results in energy efficient systems that require fewer components to function.

As a consequence, MicroGas™-powered plants are easy to install, operate and maintain and have the smallest possible footprint. MicroGas™ is the simplest and most energy efficient microbubble generator available on the market for flotation and gas transfer (O₂, O₃, CO₂) applications.

Products

**Series S**
- Gas flow rates: 1 – 50 NL/min per unit
- Slide-in installation: the unit is inserted into the tank through a side opening and is then flanched on the tank surface, so that the rotating motor is accessible at any time.
- Automatic cleaning - No downtimes
- Adjustable gas flow rate - Quick & simple
- Withstands extreme temperatures and pH

**Series XL**
- Gas flow rates: 12 – 75 NL/min per unit
- Drop-in installation: the unit is dropped into the tank from above. Ideal for retrofitting sedimentation tanks/basin and obsolete DAF plants.
- Automatic cleaning - No downtimes
- Adjustable gas flow rate - Quick & simple
- Withstands extreme temperatures and pH

**Bubble Size Distribution**

Extract form from Helmholtz Institute’s report

![Bubble Size Distribution Graph](image)
**MicroGas™** generates white water for optimal removal of FOG and TSS without dissolving gas into water and hence no recycle stream is required. For this reason, **MicroGas™**-powered flotation plants can be designed with smaller tank volumes and footprints whilst keeping the required HRT (Hydraulic Retention Time) for an optimal performance. Additionally, our technology uses a fraction of the energy of conventional microbubble generating processes.

### Key Benefits

- **Lowest footprint**
- **Simplicity** - No recycle stream - minimal equipment required
- Avoid downtimes related to pump and nozzle failures
- **Lowest energy consumption** < 0.05 kWh/m³ - Up to 90% lower due to lower operating pressures (1-2 bar) independently from salinity and temperature.
- **Adjustable gas flow rate** - only changing inlet pressure

### Markets & Applications

**MicroGas™** can be applied in the same applications as DAF systems:

- Food & Beverage
- Wastewater / Clarification
- Sludge Thickening
- Oil & Gas
- Aquaculture
- Others
Due to their small size (40-60 micron) the bubbles produced by MicroGas™ have 600x more surface area than those of conventional diffusers. The larger gas-liquid interface combined with the slow rising velocity of the microbubbles enables MicroGas™-powered reactors to achieve much higher gas transfer efficiencies than competing technologies.

Our Direct MicroBubble Technology is extremely energy efficient, since it operates at low pressures and requires lower gas volumes. These features render the use of microbubbles for gas transfer applications economically feasible for the first time – unlike conventional micro and nanobubble generation technologies. MicroGas™-powered reactors can be designed with minimal footprints and depths for an effective mass transfer of gases.

**Oxygenation - O₂**

MicroGas™ allows to operate plants at a 55% higher SOTE and to save up to 50% on their energy bills (SAE) than competing technologies:

- SOTE (Standard Oxygen Transfer Efficiency) up to 85%
- SAE (Standard Aeration Efficiency) up to 10 kg O₂/kWh

**Ozonation - O₃**

Ozone is supplied directly to the MicroGas™ device without the need of additional equipment or booster pumps. Unlike conventional technologies MicroGas™ delivers ozone in form of microbubbles (vs 2-3 mm of conventional technologies) and provides automatic mixing by the rotation of the shaft. This means that the target ozone demand can be achieved faster (lower contact time) and more efficiently, thereby reducing the risk of having to destroy residual ozone.

- Reduced required reactor height
- Simplification of installation and lower footprint: no booster pump and less piping required
- No chemical cleanings required

**Carbon Dioxide - CO₂**

In carbon dioxide applications MicroGas™ can provide lower operating costs due to the lower gas volumes and pressures required. As a result of the higher transfer efficiency of MicroGas™ the capital expenditures can be reduced, due to a reduction of the reactor footprint and volume.

- Up to 90% reduction of contact time due to higher transfer efficiency
- Up to 50% lower footprint
- Lower gas volumes required

**Carbon Capture**

- Lower reaction time required
- Only one-step reactor required - lower footprint
- No clogging

**pH Adjustment**

- No chemicals required
- Lower maintenance costs - CO₂ is less corrosive
### CASE STUDIES

<table>
<thead>
<tr>
<th><strong>DEVELEY</strong> – 2019</th>
<th><strong>FISH FARMING</strong> – 2019</th>
<th><strong>FUJI OIL</strong> – 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Challenge</strong></td>
<td>Challenge</td>
<td>Challenge</td>
</tr>
<tr>
<td>Existing Dissolved Air Flotation (DAF) plant had frequent clogging of pipes and nozzles.</td>
<td>Looking for a compact solution for the disinfection of the water of their RAS (Recirculating Aquaculture System) plant.</td>
<td>High sensitivity of operational parameters in existing DAF plant led to unreliable white water generation and removal efficiencies.</td>
</tr>
<tr>
<td><strong>Technical Data</strong></td>
<td><strong>Technical Data</strong></td>
<td><strong>Technical Data</strong></td>
</tr>
<tr>
<td>• Flow rate: 10 m³/h</td>
<td>• Flow rate: 216 m³/h</td>
<td>• Flow rate: 15 m³/h</td>
</tr>
<tr>
<td><strong>Benefits with MicroGas™</strong></td>
<td><strong>Benefits with MicroGas™</strong></td>
<td><strong>Benefits of retrofit with MicroGas™</strong></td>
</tr>
<tr>
<td>• Payback time of 1,6 years</td>
<td>• Simple installation and operation: no need for booster pump and injector</td>
<td>• Quick installation of two MG units in the existing tank.</td>
</tr>
<tr>
<td>• Higher TSS removal (53% vs 45%)</td>
<td>• Higher COD removal (98% vs 96%)</td>
<td>• Reliable white water generation and removal efficiencies.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>PLASTIC RECYCLING</strong> – 2020</th>
<th><strong>PANNONIA BIOREFINERY</strong> – 2018</th>
<th><strong>BMW</strong> – 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Challenge</strong></td>
<td><strong>Challenge</strong></td>
<td><strong>Challenge</strong></td>
</tr>
<tr>
<td>Effluent of existing DAF plant did not reach the TSS targets for wash water reuse. Avoid clogging problems in recycle stream.</td>
<td>Looking for a reliable solution for the removal of solids from the fermentation process to improve the yield of the ethanol production.</td>
<td>Wash water containing high oil and TSS required a pretreatment before being fed to the existing ultrafiltration plant.</td>
</tr>
<tr>
<td><strong>Technical Data</strong></td>
<td><strong>Technical Data</strong></td>
<td><strong>Technical Data</strong></td>
</tr>
<tr>
<td>• Flow rate: 20 m³/h</td>
<td>• Flow rate: 5 m³/h</td>
<td>• Flow rate: 7 m³/h</td>
</tr>
<tr>
<td>• TSS Feed: 37.850 mg/L</td>
<td>• 99% TSS removal (down to 353 mg/L)</td>
<td>• 99.9% oil removal</td>
</tr>
<tr>
<td><strong>Benefits with MicroGas™</strong></td>
<td><strong>Benefits with MicroGas™</strong></td>
<td><strong>Benefits with MicroGas™</strong></td>
</tr>
<tr>
<td>• Targets reached without chemicals</td>
<td>• High content of dry matter in sludge</td>
<td>• 95% TSS removal</td>
</tr>
</tbody>
</table>

---

Proven Technology. Proven Expertise.
akvola Technologies GmbH is a water technology company that provides cost-effective and environment-friendly solutions based on the MicroGas™ Microbubble Generator and akvoFloat™ – a proprietary flotation-filtration process based on novel ceramic membranes. These technologies were designed to clean hard-to-treat industrial wastewater containing high concentrations of oil (free, dispersed and emulsified) and suspended solids.

Our solutions have been implemented in the major water-using industries: Automotive & Metalworking, Food & Beverage, Oil & Gas, Refining & Petrochemicals, and Steel & Aluminum.