

A Low Cost, Easily Controlled System for the Biologically Treatment of Wastewater

The "One-Tank-Reactor"-Technology (SBR)

The One Tank Reactor Technology (OTR) of [Biogest International GmbH](#) answers the need for a reliable, easy controlled wastewater treatment system, that fits within limited financial budgets. The OTR-Technology is particularly suited:

- * for a wide range of inflow and / or organic loadings
- * requiring minimal operator attention
- * asking for high demands of effluent quality (such as for removal of N and P)
- * for small to medium size communities and industries (i. e. such as food processing etc.)



Photo No. 1: BSK-Surface Aerator for a tannery in Germany (two SBR-stages are operating in change). The high efficient oxygen input needs not only the requirements of the extremely polluted wastewater, but guarantees a sufficient oxygen supply - even under peak load conditions.

1. Innovation Rooted in Proven Concepts

The OTR-Batch Reactors of [Biogest International GmbH](#) (basically comparable with the so called SBR-process) represent an innovation in the field of wastewater treatment - but the concept of treating wastewater by the batch goes way back. In fact, the original (1914) activated sludge plants were batch operations. The switch to the now-conventional continuous flow methodology was largely made to solve mechanical difficulties (i. e. diffuser problems) and to reduce the supervision

required by the not reliable batch control systems.

The OTR-Technology of [Biogest International GmbH](#) gives you the benefits of high quality, low cost batch treatment without the original disadvantages. Aeration is effected by high efficient floating surface aerators (also used in hundreds of conventional plants) as well as with the excellent HyperClassic-Technology. Both resist clogging as well as create an outstanding high rate of oxidation. Plant operation is simplified by use of all functions.

No clarifier, sludge recycle pump stations, sludge return pumps or bridgework are involved, so construction costs are minimised.

Tank walls can be of reinforced concrete or steel. No rotating shafts, gear drives or submerged bearings are used. Consequently, maintenance costs are low. Energy needs are also at the lowest level.



Photo No. 2: The BSK-Surface Aerator is the standard equipment for the OTR-plants. Totally six sizes (900-3,150 mm) are available for a wide range of OTR-sizes.

2. Basically, it is a One-Tank-System

Conventional continuous flow treatment systems employ separate staged tanks arranged in a series of process wastewater.

The OTR-system of **Biogest International GmbH** does it all in just one tank. You may put several OTR-tanks in operation, but that's a modular adjustment to project-specific capacity needs.

Each OTR-tank is mainly equipped with a high efficient surface aerator (floating BSK-Turbine) as well as with an arrangement of a clear water decanter and an excess sludge pump to carry wastewater through all processes like biological oxidation, sedimentation, nitrification and denitrification. These processes occur in a timed sequence during five basic operating modes or periods: (1) fill, (2) react, (3) settle, (4) draw and (5) idle (anoxic fill). For more details study illustration no. 1, which shows the typical process-phases.

According to control panel programming, the fill-up period includes contact with micro-organisms, mixing and - as least part of the period - aeration. Aeration may be stopped sometimes during the fill to promote settling and / or denitrification. The air supply and mixing are adjusted during the react period. Then the tank is allowed to settle, leaving clarified water to be decanted during the draw. Mixing and aeration of the remaining sludge can

be resumed during the idle period, while waiting for new influent.



Photo no. 3: Typical example for the application of floating BSK-Turbines for industrial wastewater treatment. The so called "CMC-project" near Cairo (Egypt) is operating a 2-stage SBR designed and equipped by Biogest International GmbH.

In a multiple OTR-system, different tanks will be in different modes, with incoming wastewater directed to the first idling unit. A single-tank OTR-system can be adapted for either a continuous or non-continuous inflow.



Illustration no. 1: Wastewater Treatment Plant for a 5 Star Hotel at the Island of Madeira, Portugal (1,200 p.e.)

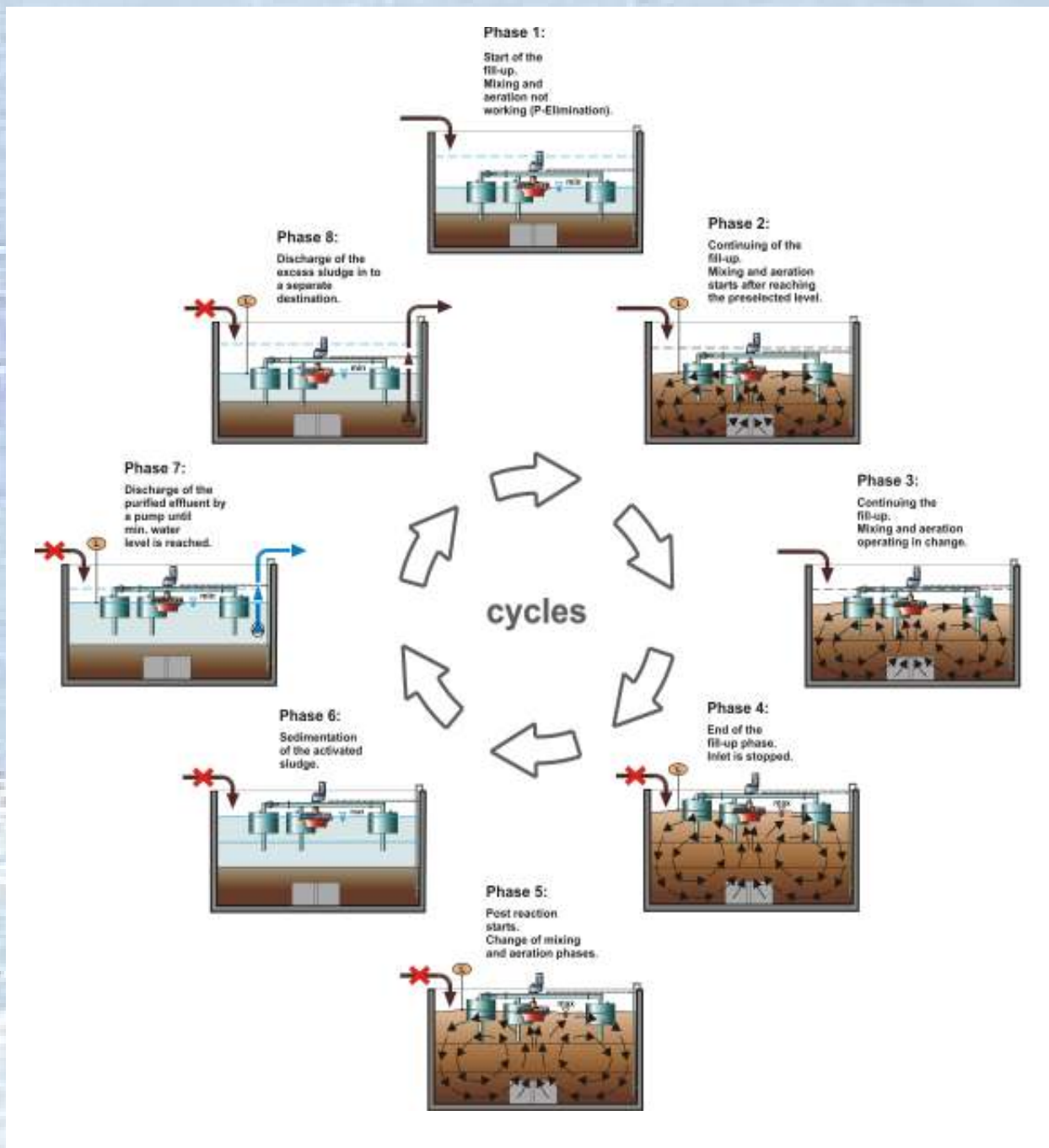


Illustration no. 2: Typical process phases of the OTR-treatment concept.

The need of sludge wasting (excess sludge discharge) ranges from the infrequent in low-yield single tank systems, to once each cycle in high-yield multiple tank systems.

3. Our Customer gets a System to Suit

Biogest International GmbH can adapt an OTR-system to a wide variety of plant sizes, wastewater characteristics and effluent requirements - in rectangular tanks, circular basins and oxidation ditches.

We custom the design of not standard installations and can help our customer with everything from initial design through start-up and final operation.



Photo no. 4: Two-stage OTR-treatment system for the Korean town "Muju". Design and equipment were performed by Biogest International GmbH. Connection load is 15,000 p.e.

However, we also can offer OTR-package plants (including tankage) in modules for inflows of 20 m³/d to 120 m³/d and pre-engineered OTR-plants for inflows of 80 m³/d to 400 m³/d.

Components common to all OTR-systems of Biogest International GmbH include:

- * **Floating BSK-Surface Aerator** - basically operating in change of zero-speed and high speed. A properly sized gear drive stands for trouble free operation for decades.
- * **As an alternative to the BSK-Turbines:** HyperClassic-mixing and aeration system as a perfect solution, if our customer requires a fine bubble membrane system (compare our Info-Bulletin No. 097-e).
- * **Decanting system** - designed to discharge

clear liquid without scum or disturbance of settled sludge. Handles peak hydraulic flows occurring during storm cycle. The special design eliminates solids accumulation during the react period.

- * **Level control system** - for a failure free operation of the batch process upon water level. Two (2) independent systems (one duty - one stand-by).



Illustration no. 3: BSK-Turbine with a solids macerator. Preferably to be used in smaller OTR-plants in order to avoid a screen for solids-removal.

- * **Process control panel** - directs sequential operation of the BSK-Turbine or the HyperClassic-System and discharge control valve based on the selected program. A proper sequence will be set during start-up. However, the operator can easily reset for a new sequence according to the operation experience.
- * **Influent screen or inlet macerator** - to prevent settling of coarse material and clogging of sludge waste pump.
- * **Sand removal trap** - necessary if the OTR is loaded with a mixture of wastewater and storm-water.

4. Advantages of the OTR-System

- * **BSK-Turbines and HyperClassic-Aerators** improve process stability through more effective mixing. The superior process kinetics of the OTR increase biomass activity, providing

reaction enhancement. The inherent equalisation capability buffers organic or toxic shock loads. The ability to hold without concomitant discharging, offers the possibility of treatment to a desired level prior to discharge.



Photo no. 5: Example for a completely indoor-solution: OTR-treatment system for a small village in Germany. Including stormwater treatment (automatically operating sand trap). The treatment system is located next to the private housing area.

- * **Baffled or sequencing tank design** eliminates short circuiting of influent, promotes a fast settling of biological floc (low SVI) and enhances substrate utilisation.



Photo no. 6: Two-stage OTR-treatment system for a village with industry in Saxony (Germany). Connection load is 2,400 p.e.

- * **Sequencing operation** adds to control shock loads and greatly increases surface settling area for liquid-solids operation.
- * **Automatic control** provides a flexible response to varying load conditions or production schedules, while reducing the operator attention.
- * **The design eliminates** the conventional

overflow clarifier and gives simpler and more positive biological solids control. It also eliminates sludge return pumping stations and difficult-to-control "common baffle" sludge return systems.

- * **All operating equipment** is easily accessible and serviceable. No extended shafts or high maintenance technical equipment is used.
- * **Mixing and aeration** by BSK-Surface Aerators or by use of the HyperClassic-Systems is highly energy efficient. Less power is needed to do the same work than with other systems.



Photo no. 7: The test-cylinder is demonstrating one of the typical process-steps of the OTR-operating: settling has already be finished, so that the clear water could be discharged by the decanter. Settling and effluent discharge take place under perfect conditions - in contrary to conventional clarifiers, in which settling and overflow has to be managed simultaneously.

5. Different Options for Mixing and Aeration for Perfect Customising the OTR-Wastewater Treatment Plant

It is well-known that wastewater as well as project conditions may differ. Consequently, **Biogest International GmbH** offers not completely fixed standard solutions, but custom the OTR to the individual situation.



Illustration no. 4: Pre-designed OTR-treatment system for an industrial field in the South of China. The hydraulic connection load is 10,000 m³/d and the organic pollution reaches up to 80,000 p.e.

For the mixing and aeration of the OTR-wastewater treatment plants totally three (3) experienced options are available:

- * **BSK-Surface Aerators (turbines)**, each installed at a floating system (stainless or coated steel). The BSK-Surface Aerator is the basic equipment for years with hundreds of proper references.
- * **"HyperClassic"-mixing and aeration systems** consisting of a centrally installed stirrer as well as a noise-proof roots-blower. Aerosol-free operation and perfect separation of mixing and oxygen supply (compare Info-Bulletin No. 097).

* "Hyperjet" self-suction aerator for smaller OTR-systems. Completely constructed of stainless steel and useable up to an oxygen input of up to 4 kgO₂/h.

Based on our customers information, we would be pleased to design the suitable OTR-plant for the benefit of a reliable, economic and long-term operation.

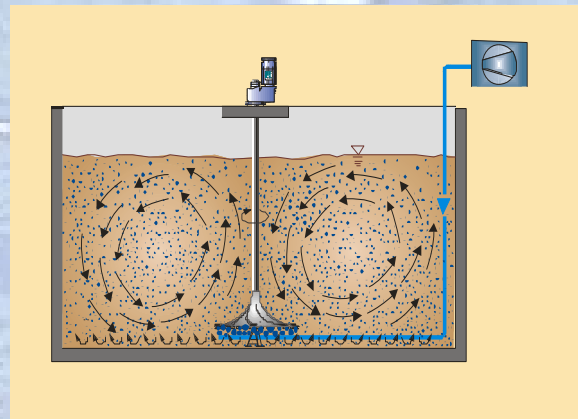


Illustration no. 5: Principle operation of the HyperClassic-mixing and aeration system. Coarse bubbled air is blown below the rotating stirrer. Result: Dispersion of the air to micro-bubbles and perfect mixing of the tank contents.



Photo no. 8: OTR-treatment system realised by use of two circular batch reactors. Connection load 3,000 p.e.



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