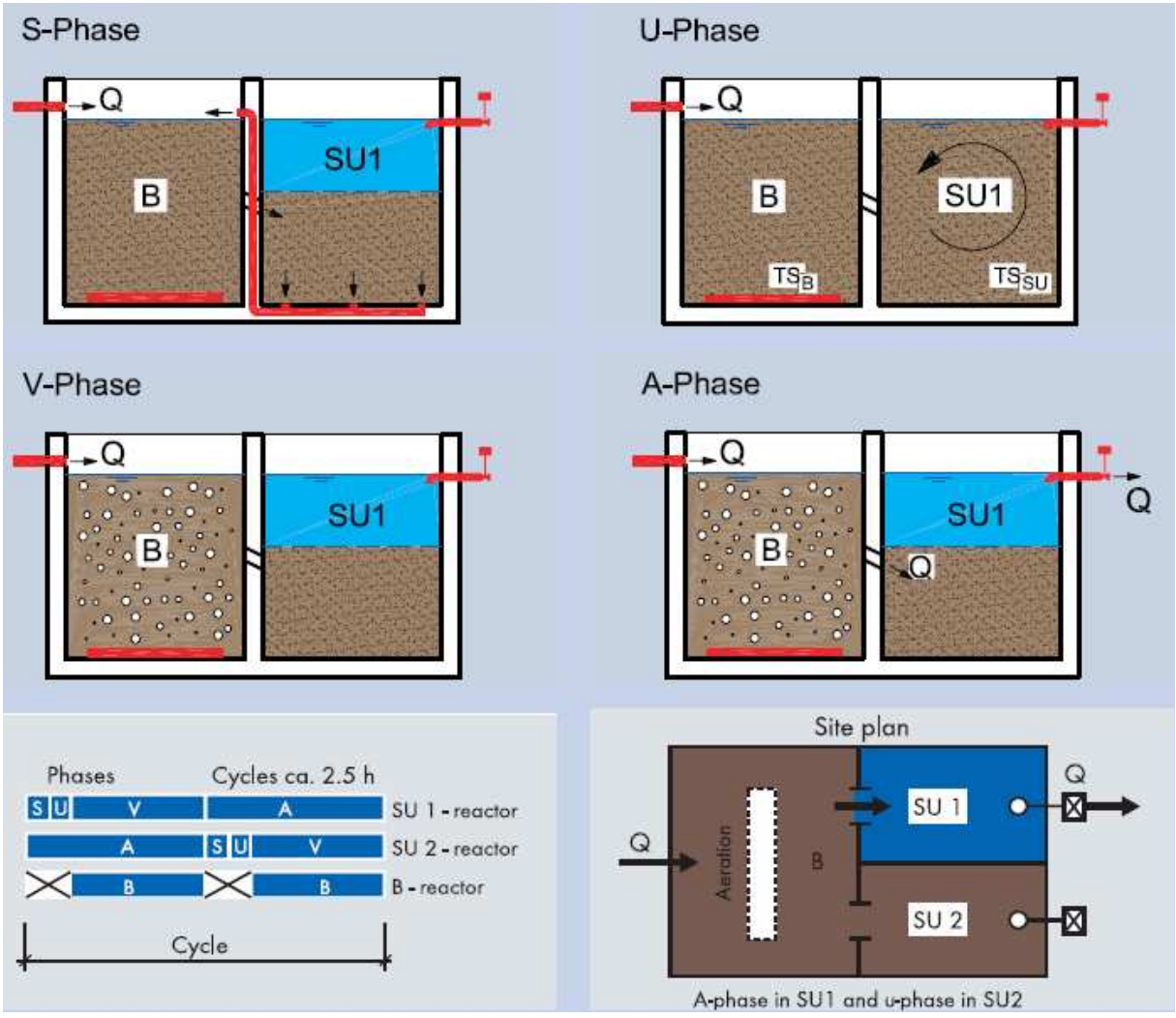
BIOCOS – combining benefits of continuous activated sludge systems and SBR-technology

Process description

The BIOCOS-process represents a cyclic activated sludge system that has been developed at the University of Innsbruck (Prof. Ingerle) throughout the last 15 years. Typically the aeration Tank (B-tank) is hydraulically connected to two alternating sludge recycling and – settling tanks (SU-tanks). A RAS pump-station or any electro-mechanical equipment for stirring or cycling are not required – all phases of the operation cycle are exclusively driven by pressurized air (see operation cycle in figure below):

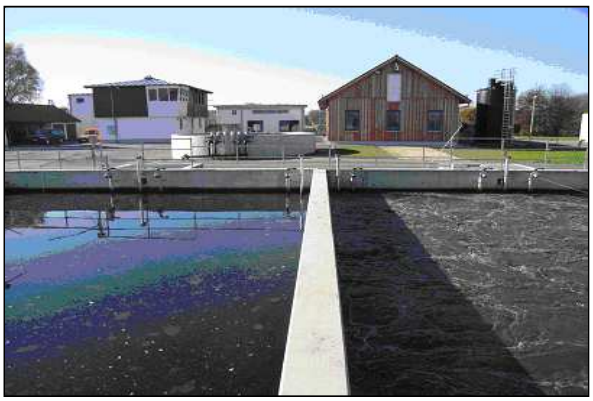
- Sludge recycle (**S-**) phase: Recycling of settled sludge (thickened bottom layer) to the B-tank by means of an air-lift.
- Mixing (**U-**) phase: Mixing of the SU-tank by a roll current induced by coarse bubble aeration.
- Discharge (**A-**) phase: Intermittent aeration in the B-tank for nitrogen removal and continuous discharge of supernatant water from a SU-tank (no water-level variation).
- Settling (**V-**) phase: Settling sludge layer – formation of a floc-filter and a dense bottom sludge layer.



Process application

BIOCOS-plants have been implemented mainly in Germany (> 50 BIOCOS plants), but also in Austria (e.g. WWTP Zeltweg and WWTP Schladming, each 30.000 PE, under construction) and Spain (e.g. WWTP Sagra, 60.000 PE and Puertollano, 175.000 PE, under construction).





Further BIOCOS reference plants are WWTP Petershausen (Bavaria, 9.500 PE, 2001, top left), Schierling (Bavaria, 17.000 PE, 2007, top right) and Villarrobledo (Spain, 80.000 PE, 2009, below).





The picture above shows the main equipment of an SU-tank.

- Left: On the bottom there are 3 pre-cast concrete sludge recycle lines connected to an air-lift and 2 perforated steel-pipes for coarse bubble aeration to provide mixing.
- Right: Effluent ball-valves connected to the effluent pipe (inside the concrete wall) leading to a over-flow weir-shaft

So far BIOCOS has been mainly used for small plants in the range of 1000 – 20.000 PE, typically with one or 2 lanes each comprising 1 B-tank and 2 SU-tanks. For larger plants several of such modules are arranged in a close configuration side by side without spacing, thus allowing a very compact footprint with reduced piping.

Process results and benefits

Solids distribution – high in reactor and low in the settler

The BIOCOS-system targets the process engineering goal of achieving high solids concentration in the aeration tank (high biological process rates) and relatively low solids

concentration in the settling tank (improved settling). However, in comparison to a conventional continuous clarifier the available amount of anoxic biomass in the sludge blanket in the SU-tanks allows substantial endogenous denitrification. Beside this post-denitrification process the main contribution to the overall nitrogen removal performance occurs in the B-tank during aeration breaks.

100% of required energy used for aeration

All processes are driven by pressurized air and no energy is wasted to operate any mechanical equipment in the tanks. Sludge recycling by an air-lift and mixing by coarse bubble line-aeration provides oxygen transfer to micro organisms.

	unit	Jun-08	Jul-08
sludge parameters			
SVI	[ml/g]	60	58
TSS (B-tank)	[g/L]	7.2	6.9
TSS (SU-tank)	[g/L]	4.1	4.6
total mass	[t TSS]	25.4	25.3
effluent values			
BOD	[mg/L]	2	2
COD	[mg/L]	16.5	15.1
total N	[mg/L]	1.3	1.2
NH4-N	[mg/L]	0.1	0.2

Operational results of the BIOCOS-plant Schierling (17.000 PE; simultaneous aerobic stabilization; monthly average values); from “Korrespondenz Abwasser” (Ingerle, 2008)

Main benefits of the BIOCOS-process

- Endogenous denitrification performed by the anoxic biomass in the SU-tanks
- Due to cyclic settling the sludge blanket serves as a floc-filter reducing fine particle concentration in the effluent
- Air-driven sludge recycling and mixing prevents disruption of sludge agglomeration and achieves good settling properties (low SVI)
- High energy efficiency since all air-driven recycling- and mixing processes provide oxygen transfer
- Low demand in maintenance and re-investment due to lack of electro-mechanical equipment