GWS Technology

GERMAN WASTE WATER SYSTEMS

Constant Waterlevel SBR (CWSBR®)

New Arrival on the New Zealand Waste Water Market

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SBR (sequential batch reactor technology) is widely introduced in New Zealand and overseas as a modern wastewater treatment process. The SBR process enjoys growing popularity worldwide and is based on the principle that treatment of wastewater works significantly better under defined volume conditions. Classic sewage plant technologies (i.e. continuous flow plants) cannot provide the same process stability. The more reliable operational performance of SBR plants can cover a wider range of dynamic wastewater discharges arriving at the plant.

So far sewage lagoons and ponds were exempt from the benefits of the SBR technology as constant SBR process volumes were not achievable due to pond geometry and process. Ten years ago, the German Company GAA mbH near Hamburg, created a Constant-Waterlevel-SBR process (CWSBR®) for waste water ponds, introducing a fully operational SBR system for any type of sewage pond. Due to the reduced structural costs and state of the art construction, savings are substantial and can be up to 50%. Distributed through GWS - Technologies, Taupo, CWSBR® pond systems are now also available in New Zealand and Australia.

In the past the main discussion about wastewater treatment was focused on the amount of concrete, and machinery required for building a plant. Remembering the early 1990's, waste water treatment was back then characterized by continuous flow plants. Although the principle of SBR was known since the early 20th century, the development of programmable logic control (PLC) systems enabled the SBR technology to finally take off and say good bye to continuous flow plants as the only way of treating sewage effluent. However in rural areas wastewater was still treated in simple ponds and lagoons but the quality of treatment was not sufficient to comply with high environmental standards. Hence the construction of new pond systems even for rural communities was discarded as the applying standards could no longer be met. This has now changed with the introduction of the CWSBR® Technology.

CWSBR® (Constant Water level SBR)

CWSBR® contains the original SBR process including all operational advantages. Like the original SBR system, CWSBR® is based on modern PLC-technology and also was made possible through the development of modern synthetic materials and geotextiles, creating the tools for a dynamic pond technology. CWSBR® combines the principles of a standard above ground SBR plant with the low cost installation of a traditional lagoon type treatment plant.

Since batch processes are characterized by periodic changing water levels, common SBR-plants use solid tanks or containers as reactors to handle large sewage quantities. In order to transfer SBR technology to a pond structure, replacing concrete walls with an earthworked lagoon, naturally supported by surrounding soils, the initial requirement was to eliminate fluctuations in water level. The CWSBR® system is equipped with "Hydrosails", which are attached to the pond floor. Fixed floats on the top edge are keeping the sails always upright enabling the Hydrosails to separate the pond volume into the different SBR reactor zones with the simple difference that the volume changes are operated vertically compared to the horizontal changes in a standard SBR configuration (Figure 1).

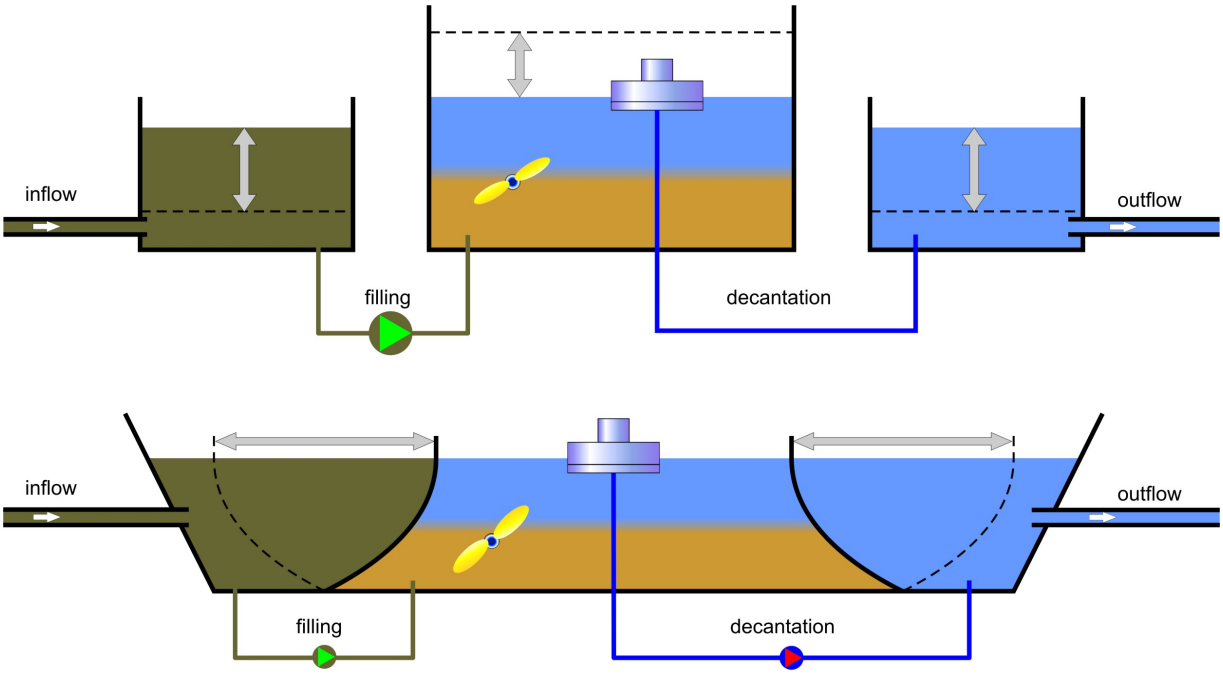

Figure 1: Comparison of water volume changes of CWSBR® and standard SBR.

From the primary treatment zone, the CWSBR® system pumps the water into the activated sludge zone. The Hydrosails follow the change in volume passively. With balanced water tables on both sides of the sails, tension and stress is not a problem as the Hydrosails just move with the alternating flows. As the water table throughout the pond maintains a constant level at all times buoyancy problems for the pond liner caused by fluctuating volumes are unknown and slope stability is not an issue. The invention of the CWSBR® system was not an easy task but with twenty years of experience in SBR engineering GAA managed to create a low cost sewage treatment system with the ability of high Nitrogen elimination and Phosphorus removal. The CWSBR® system complies with the latest German and European standards for wastewater treatment (ATV Standards) which are acknowledged as a high industry standard allowing for comparability and adaptability of SBR plants worldwide. A full animation of the CWSBR® cycle is presented at www.g-a-a.de.

Development and plants constructed to date

The first CWSBR®-plant was built in Germany in 2000 in order to retrofit an existing sewage pond system. After ten years GAA's knowledge and experience with pond retrofitting can be summarized as follows:

CWSBR® grants full SBR performance including nitrification, denitrification, phosphorus removal by Bio-P and fully stabilized sludge. The attribute typical for SBR technology, highlighting that the treatment success is independent from the plant size also applies for the CWSBR® systems. To date new plants sizing from 800 PE to 210.000 PE were designed and constructed. Upgrades of existing ponds and lagoons were carried out from 5.000 PE to 10.000 PE by retrofitting and extending existing wastewater ponds (figure 2/3).

Figure 2 : CWSBR® is a full performance SBR process in the shape of a pond technology, which grants highest wastewater treatment standards.

Figure 3 : CWSBR® System under running conditions, showing aerated zone.

Short Time of Construction - Usage of existing Structures

For retrofitting projects, an average construction time of 3 months has been established. New CWSBR® plants are typically constructed within 3 to 6 months depending on size and local conditions.

As the CWSBR® system is a high-end wastewater treatment process, increasing the treated volume per time ratio substantially, approximately 70% of the total pond area will be available after the upgrade for other tasks like stormwater retention or further sludge stabilization processes. Existing buildings and structures will be incorporated in the design and will be used for the installation of the plant equipment.

Costs

The decisive argument for a CWSBR® installation is the low investment to establish a state of the art, full-scale SBR technology, where costs can be less than 50% compared to a standard above ground SBR plant. Other cost advantages derive from OM advantages like the elimination of expensive pond sludge removal every 5 to 7 years, which is replaced by continuous sludge stacking in a separate bed. Whereas the energy demand for wastewater aeration is comparable to standard SBR plants, the cost for circulation pumping is reduced by 35%. This reduction is deriving from the constant water level which requires the pumps to only overcome friction losses with no static head involved. Also an important advantage of CWSBR® compared to classic SBR is the decrease of the required time for sedimentation and decantation. In the classic batch process the SBR zone is a homogenous mixture of water and activated sludge. After the treatment process, the sludge settles and above a clear water zone is consequently established. This clear water zone is separated from the sludge zone by a floating decanter, which follows the sludge level until it has reached the minimum level of fill in the SBR reactor. However in a CWSBR® plant with constant water level the decantation is performed without changes in the water level. As a result the decantation device operates at a greater distance from the sludge zone and a very good water-sludge separation can be achieved even at a high flow decanting velocity.

CWSBR® Performance

The stability of the microbiological mixture in a CWSBR® system allows complete nitrogen elimination even at low BOD intakes (Table 1). CWSBR® systems are operating well within New Zealand standards for COD, BOD and Nitrogen reduction and are showing a constant high level of performance at substantially less CE and OM cost.

	Influent [mg/l]				Effluent [mg/l]			
	COD	**BOD**	**NH_4-N**	**NO_3-N**	**COD**	**BOD**	**NH_4-N**	**NO_3-N**
August 6	240	128	39,1	2,1	19,6	4	1,3	2,2
August 13	398	363	32,1	2,5	21,0	6	1,3	2,8
August 20	344	122	32,0	2,6	14,9	4	0,6	4,6
August 26	105	52	11,2	1,7	20,8	11	0,9	3,1

Table 1: Stability of nitrogen elimination within a CWSBR® plant in Nauroth-Mörlen, Germany (August 2010).

Large CWSBR® plants

The largest CWSBR® plants to date have been built in China for up to 210.000 population equivalents (PE). The latest plant was commissioned end of 2010. With the size of those plants the CWSBR® system is now established as one of the world largest built SBR systems, and has found its way from use in rural environments into the wastewater management of big cities. The decision to construct large size plants was naturally made in China where pond technologies have a long tradition. The next plant with a capacity of 130.000 PE was ordered recently and is currently in the design stage. As already established for the smaller plants, the large plants are constantly showing the same treated effluent quality.

Figure 4 : Large CWSBR® Plant under construction

Figure 5 : CWSBR® Control Bridge and Hydrosail separating activated sludge zone from clear water zone

Summary

CWSBR® systems are the first choice when it comes to building new plants or retrofitting and upgrading existing sewage ponds and lagoons to the standards of the largest SBR-plants at low cost. Ten years experience in building and operating CWSBR® plants have shown that this low price SBR alternative meets all expectations of modern wastewater treatment. CWSBR® applications are now established throughout the world ranging from 800 PE up to 210.000 PE demonstrating that the CWSBR® system and its simple form of construction can be adapted to all rural and municipal waste water treatment applications. The efficiency of wastewater treatment including the elimination of all relevant wastewater components was continuously demonstrated at a high level of reliability.