



Sanitaire ICEAS SBR

THE FULLY AUTOMATED, ADVANCED SBR TECHNOLOGY FOR
MUNICIPAL AND INDUSTRIAL WASTEWATER TREATMENT



The proven wastewater treatment process solution that allows continuous inflow of wastewater into all basins

It's time you get to know Sanitaire ICEAS: the enhancement of the conventional SBR. ICEAS is the only proven wastewater treatment solution that allows continuous inflow of wastewater into all basins. The influent flow to the ICEAS basin is not interrupted at all during the settle and decant phases or at any time during the operating cycle.

What does this mean for you?

Simplicity, efficiency and robustness.

Sanitaire ICEAS is a proven process that enhances the standard SBR system performance and delivers substantial costs, operational and maintenance advantages. The ICEAS does not need primary and secondary settlement tanks, like a conventional activated sludge plant, hence significantly reducing the complexity of mechanical equipment, piping and control. The continuous inflow provides equal loading and flow to all basins, thereby simplifying operation and process control while reducing costs. The process enables single basin operation that is particularly useful for maintenance and for taking basins out of operation in low flow conditions.

The continuous flow SBR system

Designed as an ICEAS continuous flow process, the system will deliver reduced capital costs. To begin with, as opposed to conventional SBR, the ICEAS process necessitates only one set of tanks. This means that up to 30% less basin volume is actually required to achieve the same operating performance as a conventional SBR with the same design conditions. Typically the ICEAS requires up to 30% less volume to achieve the same performance than a conventional SBR. This results in savings due to less concrete, reduced excavation and smaller required land area.

The ICEAS process design allows simplified expansion because each basin forms a modular treatment unit. This makes the ICEAS process ideal for growing communities requiring wastewater treatment.

The ICEAS process technology is applicable for both pre-treatment and complete secondary treatment. ICEAS has been applied in the treatment of several types of industrial effluent including: pulp and paper, meat packaging, pharmaceutical, food processing, dairy industry, textile, bottling plants and chemical and agricultural products.

The advantages of the robust, continuous flow ICEAS process

- Minimizes the decant volume requirements
- All peak and diurnal loadings are distributed equally in all tanks simplifying plant operation
- Organic load is available for nutrient removal through the react phase
- Load during settle and decant provides 'substrate gradient' through react phase to select away from filaments
- Improved maintenance operation since you can run a two-tank system with one tank out of operation
- Peak loads evenly spread out over all basins
- Peak influent flows attenuated across all basins, thereby reducing peak effluent flows

They liked the ICEAS so much they bought another one

Doha Wastewater Treatment Works, Qatar. Phase 4

The ICEAS basin

The ICEAS basin is divided into two zones, the pre-react zone and the main react zone. A non-hydrostatic baffle wall with openings at the bottom is constructed to divide the ICEAS basin into the two zones. These openings at the bottom help distribute flows evenly into the main zone. The influent flows continuously into the pre-react zone and is directed down through engineered orifice openings at the bottom of the baffle wall into the main react zone. The pre-react baffle evenly disperses the incoming flow through the sludge and prevents short-circuiting. The volume of the pre-react zone is typically 10 to 15 percent of the total basin volume.

The ICEAS hydraulics

Time based cycles are used in sizing the ICEAS process. A normal cycle is designed to handle the Average Dry Weather Flow (ADWF) and Peak Dry Weather Flow (PDWF) to the plant. A storm cycle is used to handle the storm flows. The storm cycle operates with a shorter duration compared to the normal cycle so that higher flows can be processed by the system. Typically, the ICEAS process can be designed to handle 3 to 6 times the average flow conditions, while maintaining the same hours of aeration per day in all cycles.

Basin layers

Three stratified layers are formed in each basin at the end of the settle phase and beginning of the decant phase. The sludge blanket forms on the bottom of the basin as the mixed liquor suspended solids (MLSS) settle. A buffer zone of one meter acts to buffer the sludge blanket from the volume that will be removed during the decant phase. The top layer of clear treated liquid is drawdown after the MLSS settles.

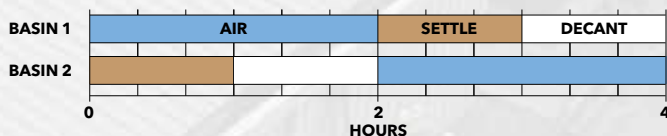
The advantage of the buffer zone is that it provides improved final effluent solids performance even in high flow operation, and at the end of the decant cycle.

Control features that enable more flow processing

ICEAS incorporates two or more hydraulic cycle control features that allow you to operate the system in two basic process modes: Nitrification (NIT) and Denitrification (NDNP).

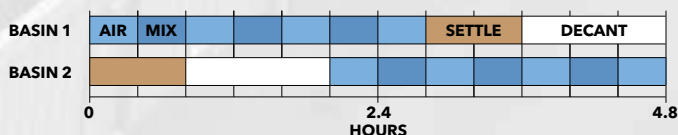
NIT Cycle

The simple cycle provides half the cycle for aeration and treatment of the sewage and a total of 2 hours for settle and decant. The cycles are staggered so one blower can provide air to a pair of basins while ensuring that only one basin is aerated at any time.



NDNP Cycle

If nutrient removal is required the cycle time is extended to provide time for anoxic periods to allow denitrification and Bio P removal. The continual feed provides BOD at all times to provide good denitrification rates at all points in the cycles and optimize nitrogen removal.



Today there are over 900 ICEAS installed all over the world

A time based control system for simple operation

Influent is received continuously during all phases of the cycle, including settle and decant. This allows the ICEAS process to be controlled on a time, rather than flow basis and ensures equal loading and flow to all basins at all times. Use of a time-based control system in the ICEAS process facilitates simple changes to the process control program, and makes it easier to control the process.

In a flow-based conventional SBR, cycle times and individual segments of each cycle may be different among basins due to diurnal flow variations. Thus, it may not be possible to simply affect a change to the entire system. In essence, separate control must be maintained over each basin in the SBR system.

Robust driven decanter design

High quality workmanship and advanced engineering provide a long-lasting decanter. The decanter itself is built to be highly resilient and features a rugged stainless steel construction.

- A proprietary scum exclusion float prevents the carryover of floating material with the treated effluent
- Flow over the decanter weir is visible providing a check of effluent quality
- VFD actuator provide a constant effluent discharge rate to downstream facilities

Reduced operating cost

- No return sludge (RAS) pumping requirements
- Proven control system for optimizing energy usage
- Highly efficient Sanitaire Fine Bubble Aeration minimizes energy used for aeration
- No supplemental mechanical mixing required for aeration system

Reduced maintenance cost

- No influent or effluent control valves
- Continuous flow enables shut down of one basin to facilitate maintenance of equipment when required
- Retrievable aeration facilities not required
- Decanter actuator is easy to service from walkway

Continuous flow delivers Biological Nutrient Removal (BNR)

- The ICEAS process can be designed for enhanced nitrogen and phosphorus removal
- Alternating periods of 'air on' and 'air off' during the react phase can produce aerobic/ anoxic/anaerobic conditions to promote nitrification / de-nitrification and enhanced biological phosphorus removal
- New and existing plants can be designed to accommodate future BNR effluent requirements

The ICEAS process is a fully automated and simple to operate biological treatment system that has multiple advantages over conventional activated sludge and SBRs

- Designed to handle flows from 100 m³/day to 300,000 m³/day
- High quality effluent (10/10/5/1 mg/l of BOD/TSS/TN/TP average)
- Smaller basin size and less equipment needed than conventional SBRs
- Eliminates primary and secondary clarifiers and return sludge pumps
- Reduced operating costs, since no mixers or pumps necessary for oxygen transfer or sludge recirculation

Simple civil construction

- The ICEAS does not require primary tanks or settlement tanks. All treatment is done in a single basin
- Construction is simple with a single set up structures and common wall construction, reducing construction cost and time
- Flexible basin configuration means rectangular or circular tanks can be used
- Significantly reduced foot print over conventional activated sludge

Pre-react zone process

The pre-react zone acts as a selector with high F:M to promote proper settling. It effectively disperses flow across the width of the tank with no disturbance of blanket during settle and decant. Short circuiting does not occur throughout the process.

- PRZ has usually a 3-hour retention time for a 2-hour settle and decant period
- Flow from the PRZ hydraulically displaces treated effluent in the main aeration zone

Continuous inflow design

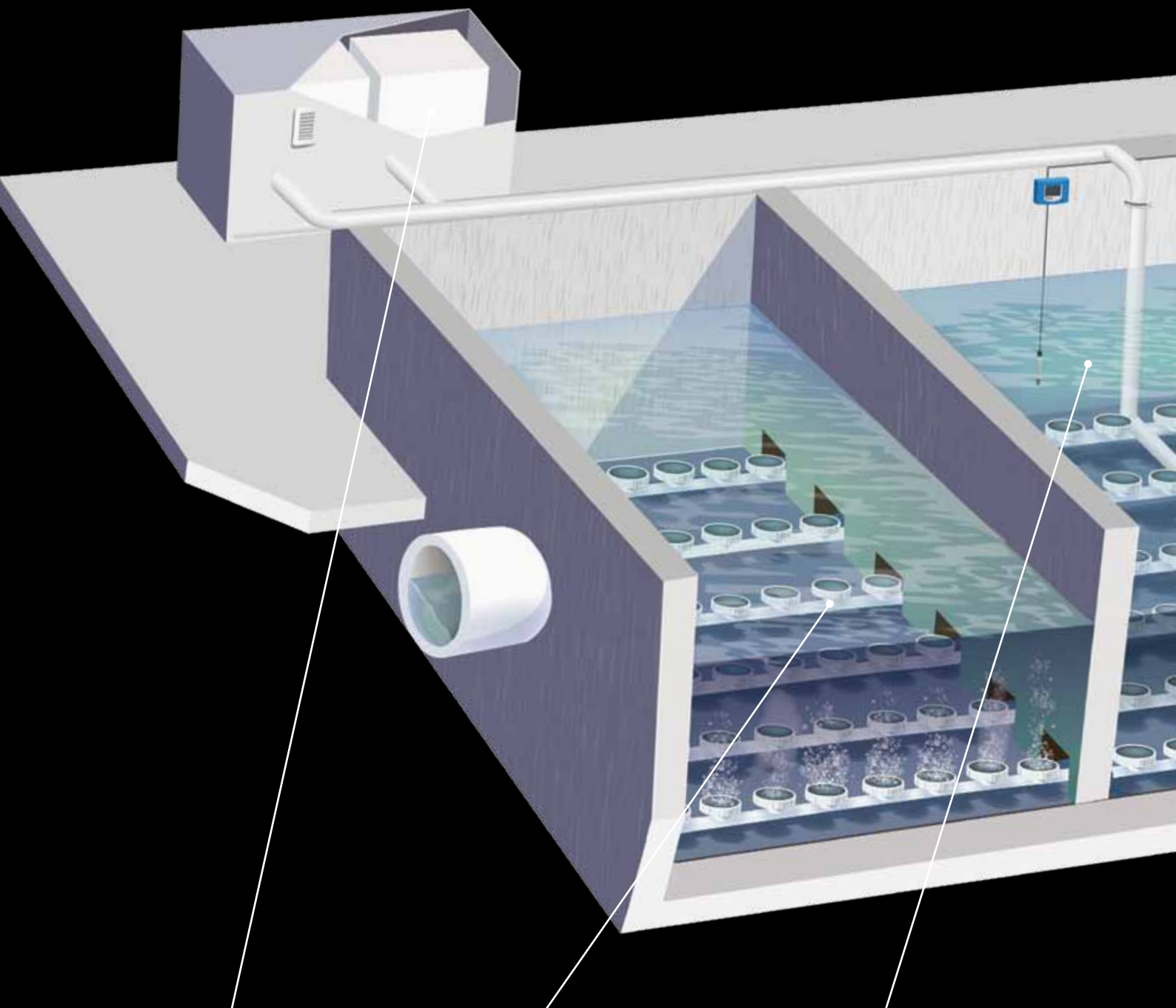
- Operates as a time-based control system for continuous inflow of wastewater
- Provides equal loading and flow to all basins, simplifying operation and process control
- Can be designed to accommodate up to six times average daily flow
- PLC based control and SCADA software can provide remote monitoring capabilities
- Capable of single basin operations

Energy efficient aeration systems

- Sanitaire diffusers provide high oxygen transfer efficiency
- Sanitaire Fine Bubble Membrane aeration systems are engineered for durability in domestic and industrial applications and require minimal maintenance
- Patented design of piping system accommodates thermal expansion and contraction
- Sanitaire aeration systems are one of the most energy efficient methods
- Aeration efficiencies of 4-6 kg O₂/ kWh possible including guarantees

Rugged decanter design

- Rugged, corrosion resistant stainless steel construction
- Decants from the top down visibly withdrawing only the uppermost clear water from the basin
- Variable frequency driven actuator provides control flexibility to change decant times and accommodate high flows
- Actuator drive mounted outside of the basin at walkway level for easy maintenance and access
- Parked above top water level during react and settle phases serving as an emergency overflow device in cases of extreme storm conditions or power failure



Blowers

Years of experience allow us to provide the correct blower type like centrifugal, rotary lobe, screw rotor etc. to match your operational aeration requirements



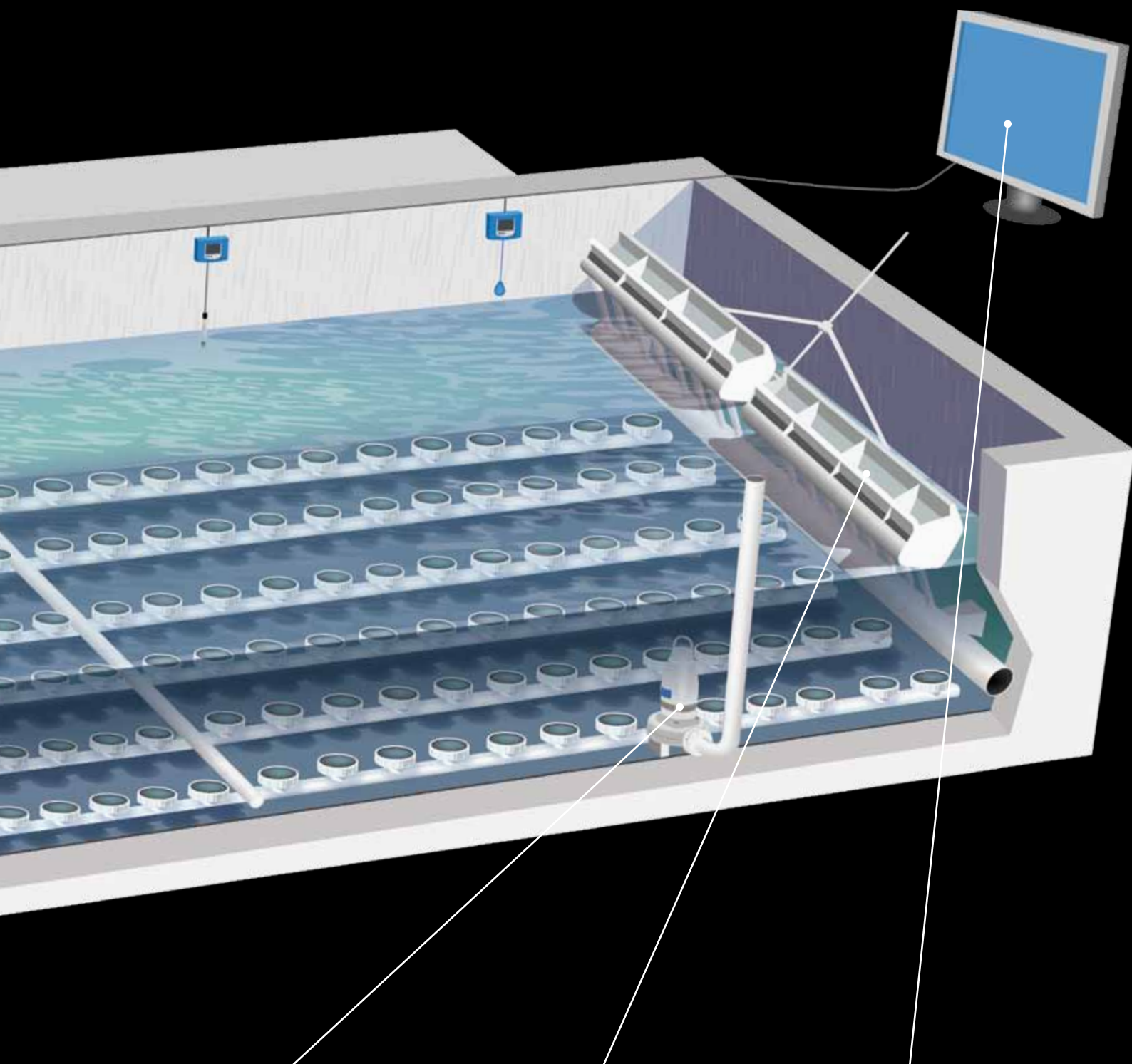
Aeration

Sanitaire Silver Series II is the most widely used fine bubble diffused aeration system available today, with millions installed worldwide



Mixers

Flygt compact mixers provide clog free, efficient hydraulics and reliable operation



Pumps

The Flygt proven submersible N-Pumps have been engineered to give highly efficient, reliable and trouble-free pumping over long duty periods



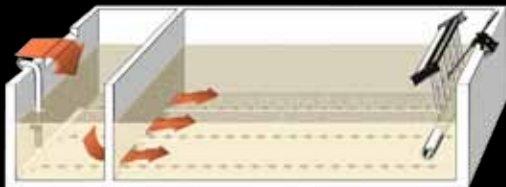
Decaners

The easy access to Sanitaire decaners makes maintenance straightforward. The resilient construction provides lifelong reliable operation



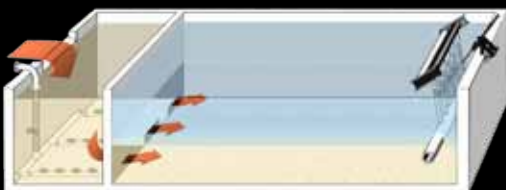
Control systems

The ICEAS control system makes it easy for the operator to understand and make cycle changes to optimise the plant performance



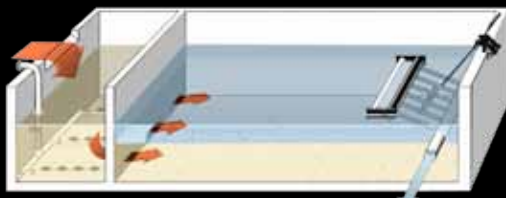
React

During the react phase, raw wastewater flows into the pre-react zone continuously to react with the mixed liquor suspended solids. The basin contents are aerated to remove pollutants, but depending on the process scheme, may also be anoxically mixed, allowed to react anaerobically, or a combination thereof. As the basin continues to fill, biological oxidation/reduction reactions take place simultaneously to treat the wastewater



Settle

During the settle phase, basin agitation from the react phase (i.e. aeration or mixing) is stopped to allow the solids to settle to the bottom of the basin. Raw wastewater continues to flow into the pre-react zone as the main-react zone settles. As the solids settle, a clear layer of water will remain on top of the basin



Decant

During the decant phase, the decanter rotates downward to draw off the clarified supernatant and discharge it to the effluent line. The decanter removes the top water and always reaches bottom water level at the end of the decant phase allowing maximum settlement time for optimal performance. Raw wastewater continues to flow into the pre-react zone displacing the treated effluent in the main-react zone over the decanter. Sludge is typically wasted from the basin during this phase in the cycle

Chengyang Wastewater Treatment Plant, Qingdao, China



"In choosing the ICEAS system, cost-saving was a priority for the project. As a city develops and expands, the size of their wastewater treatment plants also increases in turn."

When the Qingdao government announced plans to build a new wastewater treatment plant in the Chenyang District, they selected a Sequence Batch Reactor system from Sanitaire to help reduce energy costs in addition to providing advanced biological wastewater treatment. These plans were also established in response to China's revised National Integrated Wastewater Discharge Standard that place a more strict regulation on nitrogen and phosphorus removal of wastewater.

Originally the Qingdao Chengyang treatment plant intended to adopt a Sequence Batch Reactor (SBR) system treatment process. After further research and consideration, however, it was decided that the Sanitaire ICEAS system would be the best solution.

Sanitaire developed the technical system for the Chengyang Wastewater Treatment Plant, providing all the necessary equipment and services to the plant's bio-chemical section, including design, equipment supply and commission, guaranteeing that the plant's treated water would meet national discharge standards. The project included eight round bio-tanks, each 38 meters in diameter.

The ICEAS system shows great competence in technology and cost savings. The application of an improved design has greatly reduced pumping system requirement, saving nearly RMB 3 million in equipment investment and about RMB 1 million in annual operating cost.

The pumps and mixers used in Qingdao's ICEAS system are also from Xylem. They include a total of 14 Flygt brand submersible pumps in addition to 16 Flygt submersible mixers. Since the Chengyang Wastewater Treatment Plant was put into operation in October 2003, it has been using the ICEAS system, completely reaching its designed treatment capacity, reducing initial investment costs as well as operating and maintenance costs.

St. John's Wastewater Treatment Plant, Butler Township, Pennsylvania, USA

"ICEAS is a dream to operate. The control and process itself are simple. It is so intelligently designed that it practically runs itself. In my opinion, the system is really well worth the money."

Bill Denunzio, Butler Township, Pennsylvania.

There are many reasons for selecting a Sanitaire ICEAS SBR system, and this was certainly the case with the St. John's Wastewater Treatment Plant in Butler Township. The wastewater plant system was outdated and not operating to expected standards. Furthermore, Butler Township is a growing community and obviously the time was right to upgrade to a system that was capable of handling much higher capacities. The township was also under pressure to upgrade the wastewater plant to improve the quality of the effluent in line with the latest governmental treatment directives.

Sanitaire ICEAS SBR was the obvious choice because of the sound reputation the system had earned through various installations in the region. This was the only system to offer a continuous flow process which was found to be efficient and flexible because of the fact that it did not require any flow diversion.

Right from the very start, the ICEAS system proved to be a worthy investment. The process itself is simple to operate and required almost no interventions. The Sanitaire ICEAS system also lives up to its reputation of delivering true simplicity. The controls and decanters are logical and simple to handle. Sanitaire are also always at hand with their solid support, experience and service to ensure that the process is running smoothly and efficiently all the time. All in all, Butler Township now has a well running treatment plant that is equipped to take on not only today's needs, but of the future as well.

Sterling Wastewater Treatment Works, UK



Scottish Water were required to upgrade the Sterling Wastewater Treatment Plant to improve the quality of the effluent in line with the European Urban Wastewater Treatment Directive (UWWTD). The upgrade included the removal of ammonia from the effluent that the

existing treatment works was not able to achieve. The land owned by Scottish Water was not large enough to accommodate a traditional treatment plant and would mean the purchase of additional land and associated additional costs and potential delays to the project.

Sanitaire recommended to Scottish Water the ICEAS SBR. The ICEAS is a continuous flow SBR that treats the sewage to the required effluent in a single tank and therefore does not require separate settlement tanks. This feature significantly reduces the footprint of the plant, to such an extent that the ICEAS would fit on the existing site.

In working together with the main contractor, Sanitaire were able to construct the works on time, while still ensuring the continued operations of the existing works. The new ICEAS treated the same flow as the existing plant while occupying a significantly reduced area.

Jefferson City Regional Water Reclamation Facility, USA



"The plant has operated at a high level since it was built with very little labor needed to operate and maintain the plant. The service we receive from Xylem is second to no one. I have been in the wastewater business for 32 years and have never worked with a group of people that care more about their customers. You never get put off or "forgotten" when you call and ask for help. The answers they give are quick and accurate. I would highly recommend this type of plant and this company to anyone."

David F. Erwin, Plant Manager

By 1998 the existing facilities at Jefferson City Wastewater Treatment Plant were no longer effective in treating the increased flows from system growth, and City officials decided to upgrade the facility to meet current and future discharge standards and wet weather flows. In addition the city wanted to eliminate unpleasant odors that had become a concern over the years. The new treatment plant would serve 18,200 active customers and a daytime population exceeding 50,000. After evaluating several treatment options, SBR was chosen as the most effective system for treating wastewater to meet the City's objectives. The flexibility involved with process control of the ICEAS would allow increased reduction in BOD and total suspended solids (TSS), nutrient removal (nitrogen & phosphorus) and controlling high flow problems.

A conventional activated sludge plant would not fit within the existing centralized site's space constraints, and would increase project costs. The ICEAS technology saved about 30 percent in project costs and also offers an ongoing reduction in operations and maintenance expenses.

Doha Wastewater Treatment Works, Qatar. Phase 4 and 5



"The professional attitude, skills and expertise displayed by Sanitaire engaged as international process, mechanical and electrical specialist subcontractor (as Designer of Works and to coordinate the procurement and installation of the Mechanical and Electrical Installation) has been a significant factor contributing to the success of the recent Phase 4 Expansion to Doha South STW."

Doha Phase 4

Sanitaire was selected to upgrade a complete sewage system at the Doha South Sewage Treatment Works in Qatar. The selection criteria included the need for a

cost-effective wastewater treatment process that would meet strict effluent consent standards. Sanitaire proposed the installation of an ICEAS SBR system to manage the flow of wastewater for approximately 300,000 people. The scope of the project included the design, supply, installation and commission of an ICEAS SBR biological wastewater process extension to the existing conventional plant.

The complete solution comprised of SBR decanters, diffused aeration grids, blowers, air-main, interstage pumping stations and controls.

The project will also enhance the adjacent urban environment with access roads and street lighting. ICEAS is one of the most cost effective wastewater treatment processes that can consistently meet tight effluent consent standards.

So successful, they wanted another one!

Doha Phase 5

Xylem have won a second extension to Doha Treatment works to provide treatment capacity for an additional 400,000 population equivalent. This plant provides both nitrogen and phosphorus removal.

This was in conjunction with the development of an ultra filtration membrane plant for all the works for effluent reuse.

Manchay - Pachacamac Wastewater Treatment Plant, Peru



As part of the ambitious "Agua Para Todos" investment plan launched in Peru in 2006, the Manchay - Pachacamac

Wastewater Treatment Plant was proposed to treat the sewage from approximately 90,000 people and reuse the treated water for irrigation. The ICEAS process with Sanitaire fine bubble aeration system and Flygt Pumps followed by Xylem Leopold Rapid Gravity Sand Filtration concept was chosen over the aerated lagoon originally proposed at this site due to the overall cost and operational effectiveness in a very limited space.

Completed in 2009, the plant has been producing excellent effluent quality exceeding all the Reuse standards for irrigation. This is the first facility built successfully under the "Agua Para Todos" investment plan in Peru to date.

Xylem ['zīləm]

- 1) The tissue in plants that brings water upward from the roots
- 2) A leading global water technology company

We're 12,000 people unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

For more information on how Xylem can help you, go to xyleminc.com.



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