The Lineardecanter

Advanced Clear Water Extraction device for Sequencing Batch Reactors (SBR)

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In the last twenty years municipal wastewater treatment advanced from a static to a dynamic process in order to obtain higher environmental standards at lower economic expenditures. This development was mainly introduced by the Sequencing Batch Reactor (SBR) technology, which substitutes the older continuous flow plants successively by its advanced operation capabilities. SBR technology enables the purification of municipal wastewater at high quality standards due to the interaction of programmable logic control systems, sensor technology and specific SBR hardware, like G.A.A.´s Lineardecanter. This key technology accomplishes the important separation of purified water from activated sludge since almost 20 years in order to achieve highest effluent standards.

Decantation requirements

In sequencing batch reactor processes wastewater is purified by bacteria, which form the so called activated sludge. At the end of the purification process, when all mixing and aeration devices are switched off, the activated sludge settles down and the remaining water at the top has to be removed. This removal is more than simple water removal through an opening in a tank wall, because the sludge must not be remixed into the water due to uncontrolled flow. Therefore, purified water removal in sequencing batch processes is performed during the so called decantation, which describes the water draw off starting from the water surface in direction to the sludge blanket. Within the decantation process a maximum flow under strict separation of water from solids has to be fulfilled at the same time. To this effect in front of the decantation process the sludge settles down in a sedimentation step, which leaves a water layer behind bordered by two sludge phases. The lower edge of this layer is the sludge blanket and the upper edge is marked by the water surface including floating solids. These solids are made of dust, fat or sludge and must not enter the purified water during runoff. The compliance to this requirement at the upper edge depends on the decanting device in the same way like at the lower edge, the sludge blanket. This appears more as a diffuse and easily disturbable layer than a sharp edge and it is the decanters function to approach to this edge at maximum degree in order to remove as much purified water as possible.

Linear technology substitutes rotary joint arrangements

G.A.A.´s Lineardecanter was developed in order to fulfill the requirement of optimized water and sludge separation and to eliminate several disadvantages from swing joint decanting technologies. In this older decanter design the water is carried over a swing pipe, which is fixed at the ground at a rotary joint. The rotary joint design contains essential disadvantages regarding the overall process reliability. The first disadvantage is the uplift force, which occurs when the diagonally fixed discharge pipes are partially or even completely empty. This buoyancy leads not only to an unsteadiness of the discharge behavior; it also demands high expenditures to submerge or to lift the decanter in front of or after the decantation step. Therefore, rotary joint technologies are always equipped with mechanical punches or hoists, which demand an energy consumption fivefold higher than G.A.A.´s linear technology. Another disadvantage of swing joint systems is the horizontal movement of the pipe in correlation with the water level fluctuation. This horizontal displacement demands several square meters of tank surface, which cannot be used for other installations like mixers or other typical SBR devices. Moreover, the horizontal displacement from the tank wall prevents the installation of wired measurement sensors at the decanters top or maintenance work during decantation. G.A.A. eliminated the disadvantages of rotary joint arrangements by its linear technology, which bases on a telescope system (figure 1). In opposite to the rotary joint system, the telescope system shortens exactly in accordance with the drawdown of the water level without any changing of the water flow velocity.

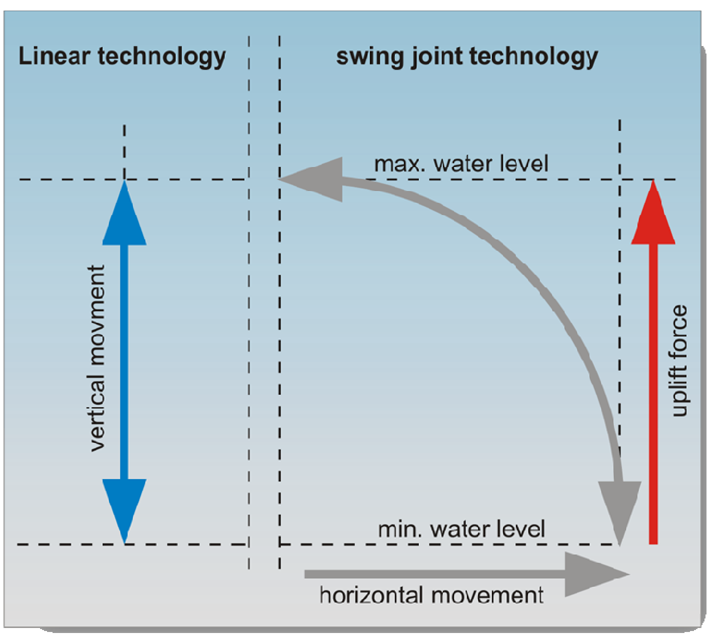

Figure 1: Swing joint technology vs. Linear technology

The horizontal movement of the pipe during swing joint decantation wastes reactor area and must be protected against collision with other SBR devices.

PLEASE TRANSLATE THE FIGURE, WE WILL CHANGE IT SUBSEQUENTLY!

The Lineardecanter

The Lineardecanters telescope system starts at the topsite with the decanter head (figure 2). This floating unit is equipped with PE-floaters submitting a consistent position of the decanter on the water surface. The decanters head opens at the bottom under a submerged scumboard, which prevents the ingress of floating solids and sludge from the water surface to a thickness of up to 300 mm. The opening procedure of the Lineardecanter starts the decantation phase without any suction or vortex but at a regular and spherical inlet of water over the plate's edge at the decanters bottom side. The perimeter of this plate determines the inflow velocity of purified water and the selectivity of sludge and water separation. The decantation ends when the plate closes the decanters head again. Like the opening procedure also the closing is performed smooth in order to avoid vibrations and disturbances of the sludge blanket, which could provoke sludge ingress into the purified water. Finally closed, the waterproofed decanter head returns to its starting position passively during the backfilling of the reactor.

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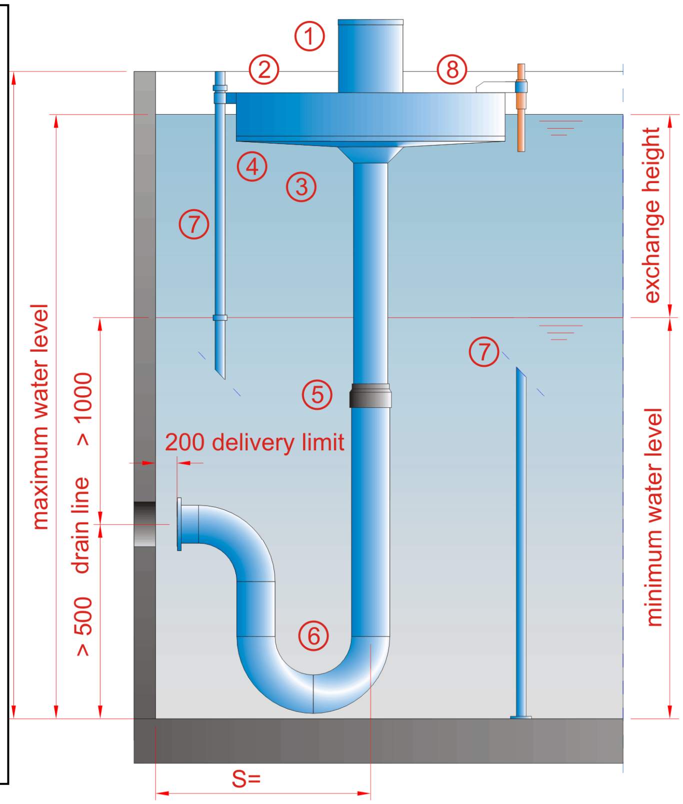
Figure 2: The Lineardecanter schematic diagram.

1: Lineardecanters head
2: Scum board
3: Base plate
4: Guide rod
5: Sensor
6: Telescope Sealing
7: Outlet pipe
8: Minimum Water level
9: Exchange height
10: Maximum water level
11: tank height



Since 1996 G.A.A.´s Lineardecanter is installed worldwide in hundreds of SBR plants. The device is manufactured from stainless steel (AISI 316 or 304) as standard. In cases of high corrosive waters, like in industrial applications, material adjustments can be made. The smallest Lineardecanter starts at a throughput of 60 m^3/h, the largest device enables a water removal of 1,400 m^3/h as single installation. The decanter design will always be adapted to the customer's requirement. These requirements focus mainly upon the breakthrough of the discharge pipe through the tank, which takes place either through the sole or the wall.

G.A.A.´s Linear Technology is unique within the decanters market, free of leverage, inner buoyancy or vibration. The area consumption of the device is set to a minimum and bears no conflict of collision with mixing devices due to displacements of pipe components during water draw off (figure 3). To avoid abrasive wear the application of plastic components is reduced to minimum, rotary joints are not used at all. Including the walk on ability and the usage of high grade stainless steel materials, the main machinery properties are easy to maintain also during an operating SBR processes.

Figure 3: Lineardecanters (1,400 m^3/h) during installation. The decanter heads are always floating in correspondence to the water level. The devices are closed during the SBR process and only opened to start the decantation step. The water removal is free of any suction, vortex or sludge ingress.

Linear Technology Proceedings: Integrated sludge blanket detection

Since several years SBR developers and experts of automated control systems choose the Lineardecanter as a central carrier unit for different sensors (pH, ORP, turbidity, conductivity, oxygen, temperature). The decanters consistent floating ability enables a data record at a representative water depth. The linear technology grants a simple protection of the sensor connection cables against demolition, because the decanter head does not move horizontally during decantation like rotary joint arrangements. The installation of the electrodes in the water-traversed area of the decanter inlet ensures a proper electrode operation. At the periphery of the decanter´s head, flow rates of 0.25 m/s are typical during decantation and fulfill sensor demands perfectly.
The Lineardecanters attribute to provide an optimal separation of water from sludge was used in the past frequently to remove a maximum amount of water during decantation. For this purpose the decanters head has to approach to the sludge blanket at minimum proximity without causing sludge suction. This demand could be fulfilled by combining the Lineardecanter with a turbidity measurement at the bottom side of the decanters head (Figure 4). The turbidity sensor was used to specify the distance of the decanter head from the sludge blanket in order to stop decantation before suction from the blanket could occur. This measurement is not only feasible to enhance the overall decantation step; it also provides data about the sludge status of the entire SBR process.

Figure 4: The Lineardecanter head during mixing

The Lineardecanters head is a floating, walk on able device, which can be maintained from the tank edge at all water levels. The head is waterproofed and opens only during the decantation process. The linear movement of the telescope system corresponding to the water level enables the installation of sensor technology for online monitoring functions.

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