Flotation for biomass separation replacing secondary settling tanks and secondary treatment systems

Not only for critical wastewater but also as an alternative to overloaded aeration tanks and secondary settling tanks of municipal and industrial wastewater treatment plants

Secondary settling tanks have to manage the important task of separating activated sludge. With diameters of sometimes more than 50 metres, most of them are horizontal flow systems. The sludge can settle inside while the virtually solids-free clear water runs off through a channel. The control and monitoring of such separation stages is still done visually in most cases through cyclic visibility depth measurement. If such measurement shoes that the sludge level height is outside the control range, the countermeasures taken are frequently either adjusting the return sludge ratio or increasing the volume of excess sludge discharged. If, however, these measures remain without effect, cost-intensive addition of precipitants and flocculants or other additives is frequently the only means left to eliminate operational problems caused by the continuous overflow of biomass and fine suspended matter.

Such operational problems caused by a poor settling behaviour of the activated sludge are primarily due to overload in the secondary settling tank, strongly varying inlet conditions, changing nutrient ratios due to industrial dischargers and ineffective separation of grease and other flotating particles.

Moreover, the overflow of 1 mg/L filterable solids increases the concentration of COD by 0.8 to 1.4 mg/L and the concentration of phosphorus by 0.02 to more than 0.04 mg/L.

Activated sludge – let settle or let float?

The microorganisms performing the biological processes in the aeration tank settle inside the activated sludge flocks and adhere to the finely dispersed suspended matter and solids that are adsorbed to the activated sludge flocks. It is owing to this characteristic of the bacteria that they can be separated from the treated wastewater with the use of sedimentation processes.

An unfortunately relatively small difference in density between the activated sludge flocks and the treated wastewater results in a low settling velocity. Large secondary settling tanks are therefore necessary to provide the large tank surfaces required for the separation process. Or to summarise in simple terms: the separation efficiency of a secondary settling tank is limited by the slow settling velocity of the activated sludge flocks.

An alternative to secondary settling tanks offering itself is flotation with additionally improved separation efficiency. Very small gas bubbles of only few thousands of a millimetre attach to the activated sludge flocks and very fine turbidities. These gas-solids agglomerates become much lighter in density than water and therefore float quite fast to the water surface in the flotation tank. Such very small gas bubbles are generated by the principle of dissolved air flotation. They are produced by injecting air under pressure into a recycle water flow where they become completely dissolved before they are released again through pressure relief in a flotation cell. Due to the small size of the bubbles, even turbidities can be transported to the surface of the flotation tank that could not be separated

Clear flow without turbidities

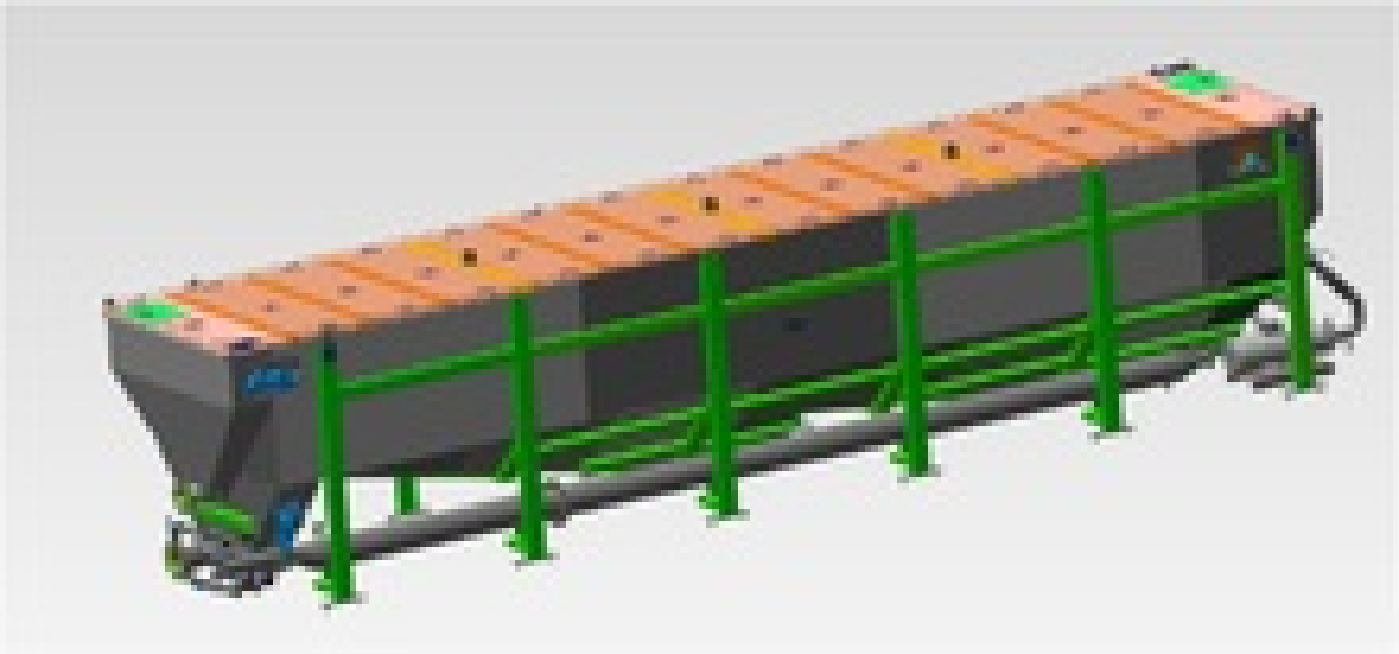
during their residence time in a secondary settling tank.

Improved process and energy balance of the overall plant

The solids rising with the gas bubbles accumulate at the surface of the flotation tank to up to 5% solids content and can be returned to the system as return sludge. Alternatively, the thickened sludge can be removed as surplus sludge and passed on to downstream treatment stages.

A sludge flotation plant can be fed with up to 5m³ activated sludge per m² surface and hour. In practice, significantly better effluent values are achieved than with secondary settling tanks. Moreover, flotation plants need much less space. The slightly higher energy costs for operating a dissolved air flotation plant relativise due to the improved overall process.

Flotation systems are optimally suitable especially as retrofits where space is limited or for the refurbishment of existing plants without any major construction work. Flotation plants are also increasingly applied as tertiary treatment stage for so-called ‘polishing / P-reduction’.



HUBER Dissolved Air Flotation Plant HDF S 8 for the removal of up to 80m³/h activated sludge

HUBER HDF and HDF S – two different designs for individual requirements

As a manufacturer of flotation plants (HDF) with many years of experience, primarily in industrial preliminary treatment, HUBER has now developed also high-efficiency flotation systems for the separation of activated sludge and implemented them successfully (HDF S). The difference between the innovative HDF S plants and the conventional HDF units is mainly their special design. Instead of high-rise tanks with integrated lamella units, one-part tanks with flow guiding devices and adapted scraper systems are used to separate the activated sludge. This still relatively little-known alternative to secondary settling tanks is enjoying increasing demand. Several customers from different branches have already understood the benefits activated sludge flotation offers compared to conventional secondary clarification and profit from significantly increased process safety and reduced current costs after the successful installation and start-up of a flotation system.

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