Small footprint technologies combine for high-rate wastewater plant efficiency

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Stricter treatment and discharge regulations are forcing wastewater treatment plants in urban and high-growth areas to consider expanding or upgrading their systems. Even if extra land is available, it is often not economically feasible to use this. Fortunately, certain small-footprint technologies now provide efficient high-rate wastewater treatment.

For example, the compact moving bed biofilm reactor (MBBR) process, coupled with a unique sand-ballasted clarification and flocculation water treatment system, will yield a very flexible wastewater treatment plant in just a fraction of the space required by conventional treatment technologies.

Figure 1. Skreia WWTP in Norway.

Wastewater treatment using biofilm processing has become popular in recent years. One method, the AnoxKaldnes™ MBBR technology, is a continuously operating, fully biological treatment process based on biofilm processing.

The processes use plastic media to grow the biofilm, which is retained in reactors using media retention sieves while an aeration system allows the bacteria/biofilm to provide the treatment required. Effective biomass within the bioreactor is augmented through growth on the media, and nearly all of the biomass is resident on the media.

The carrier elements provide a large protected surface area for the biofilm as well as optimal conditions for the bacteria culture to grow and thrive in the reactor tank. The process can be designed for any shape or size of tank and can also be retrofitted into existing tanks. Because the biofilm created around each carrier element provides a more stable environment for the bacteria to grow, less footprint space is required.

Treatment Results 2007-2008	Avg. removal (%)	Avg. concentration (mg/l)
BOD_5	89,0	15,6
COD	82,3	62,8
TOT-P	85,3	0,830
TSS	86,7	20,2

Figure 2. Treatment results for Handeland WWTP in Norway.

The MBBR biofilm carriers are suspended and thoroughly mixed throughout the water phase where they move freely in the tanks. Excess biofilm is continuously sloughed from the media and carried out with the effluent. In addition to increasing treatment capacity, the MBBR system has demonstrated ef-

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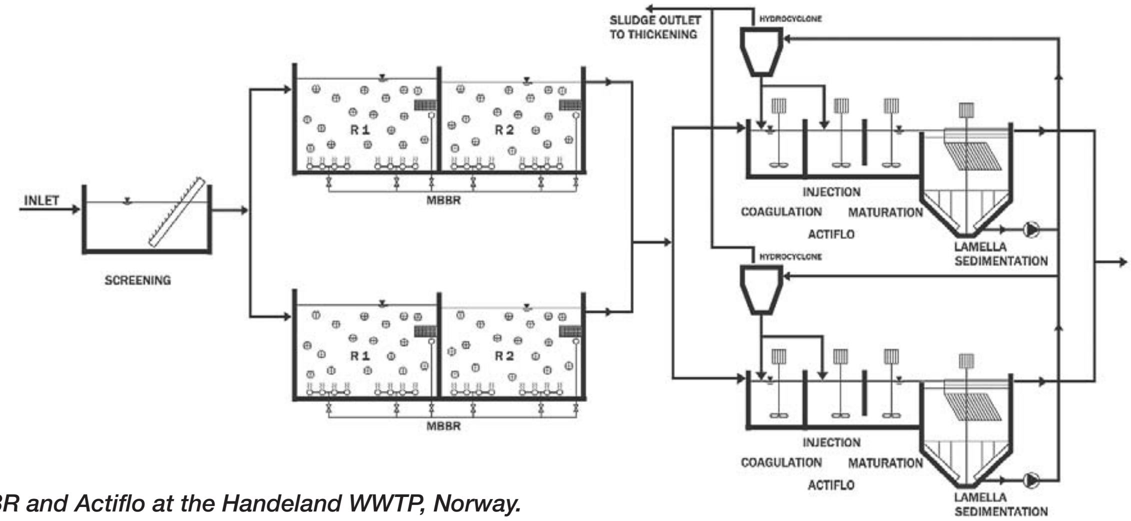

MBBR and Actiflo at the Handeland WWTP, Norway.

fective biochemical oxygen demand (BOD) removal efficiency as well as effective ammonia and nitrogen removal.

It can be used as a stand-alone process without the need for backwashing, returning sludge or recycling wastewater. It is designed to handle extremely high loading conditions, yet function within a relatively small footprint.

MBBR systems have been successfully implemented in more than 500 locations worldwide. The first MBBR, installed 19 years ago, is still using its same biomedia and aeration system.

Sand-ballasted clarification and flocculation

The high-rate, sand-ballasted clarification and flocculation treatment process, called ACTIFLO®, provides increased capacity without the large surface area requirements of traditional flocculation/sedimentation systems. These systems are typically one-fifth to 1/20th the size of conventional clarification systems offering similar capacity.

In the sand-ballasted flocculation process, raw water is first mixed with a coagulant in a high-shear environment. In the next tank, the water is injected with a polymer and microsand and mixed aggressively before it enters the "maturation zone," where gentle shear is applied. The microsand-ballasted flocs increase in size, trapping smaller flocs before the water enters the sedimentation tank, where the large flocs immediately begin to settle.

At this stage, the clarified water then flows upward through lamellar settling tubes to collection troughs where it can be diverted to various applications. The microsand and other solids in the ballasted flocs that settled in the bottom of the tank are then pumped to a hydrocyclone, where the microsand is cleaned and reinjected for reuse and the waste solids are removed.

The technology has proven both flexible and versatile. The coagulation phase works on total suspended solids as well as on chemically active contaminants. The polymer flocculent ensures that the microsand bonds strongly to the flocculated solids. The flocs, by themselves, are typically at or near the density of water, so they cannot settle rapidly without the added weight of the microsand (specific gravity of 2.65). Once ballasted with the tiny microsand particles, the flocs sink immediately in the settling tank.

ACTIFLO is a multi-task technology,

serving as an effective high-rate clarifier and a versatile chemical reaction vessel. Depending on pH conditions, colloidal and particulate pollutants in the influent can be precipitated using classic chemical methods for efficient, sand-ballasted removal in the settling step. Virtually any constituent of raw feed water or wastewater that can be coagulated through physico-chemical means can be effectively processed through the system.

Combining high-rate technologies

Limited space for wastewater treatment plant expansion is an ongoing challenge for urban areas or constrained peri urban installations. Being able to combine two high-rate wastewater treatment technologies would prove a major benefit for municipal decision-makers.

Two municipal plants in Norway are leading by example. Water treatment officials in Skreia wanted to upgrade its 20-year-old conventional activated sludge treatment plant to increase capacity by 80% to manage an increasing load from a local potato processor. However, the plant is situated close to Lake Mjosa and the area available for facility expansion was restricted by farmland and a wildlife reserve. Hence, it was necessary to look for a compact treatment solution that could be easily retrofitted with the existing plant.

The integration of AnoxKaldnes MBBR and ACTIFLO technologies into the existing Skreia WWTP (Figure 1) allows for wide variations in both hydraulic and organic loads. The MBBR technology was chosen for high-rate biological treatment, to remove soluble organic matter and to increase and enhance the biological treatment capacity. Effluent from the MBBR treatment is then routed to the ACTIFLO unit for final sludge separation and high quality effluent discharge. The plant also has the option of routing MBBR effluent to the plant's settling tank.

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Using the two high-rate, small-footprint technologies has resulted in excellent removal efficiencies, and the expanded plant conforms well to the space limitations presented by the site.

The rural area of Handeland, also in Norway, has a small residential population but increasing seasonal tourist activity. The municipality expects even further significant tourist growth in the near future. To meet the challenge, the municipality chose to build a new treatment plant to serve the entire community.

The new wastewater treatment plant consists of screening, an MBBR for biological wastewater treatment and the high-rate sand-ballasted clarification and flocculation technology for sludge separation. The new plant is meeting the needs, requirements and expectations of the municipality (Figure 2). The treatment units consist of two interchangeable trains, providing operational flexibility in handling large variations in flow and load.

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