Propeller pumps ensure a constant flow of waste water

Grundfos waste water technology at the Lauben Central Waste Water Treatment Plant

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Possibility in every drop

Denitrification with recirculation and discharge from process water treatment. Tank size: 3,750 m³

The Kempten Waste Water Association (AZV Kempten) operates a central waste water treatment plant (CWWTP) in Lauben, which has a total capacity of 460,000 PE. Waste water from households and industry in the independent town of Kempten and from 11 other municipalities in the Oberallgäu district is collected and treated here. After being treated, the waste water is discharged into the receiving water of the Iller river. The waste water from the association's members is cleaned in the CWWTP using state-of-the-art technology chosen to ensure environmental and water protection.

The process steps

The waste water enters the CWWTP via three main sewer inlets, where it first undergoes mechanical treatment. This stage consists of a sediment trap, spiral feed pumping station, step screen, aerated grit chamber, primary clarifiers (2 x 1,540 m³) and phosphate precipitation. This pre-treatment is followed by the first biological treatment stage,
which comprises two procedural components:

- Denitrification of NO3-N from the recirculation and the discharge from process water treatment in the denitrification tank (3,750 m³)
- Intermediate treatment (2 x 7,230 m³ intermediate treatment tanks) to separate biomass and waste water.

The activated sludge process is used in the biological stage to separate the dissolved contaminants. Microorganisms break down high-molecular-weight compounds. To remove the nitrogen, the waste water first flows into the anoxic zone. To achieve the reduction, the oxygen is removed from the nitrate (NO3). The remaining nitrogen escapes from the waste water as a gas. One special feature of this process step is the denitrification combi-tank with plug flow. Two substreams containing
nitrate are fed into this tank. The first is a substream from the recirculation and the second the discharge from process water treatment. The combi-tank is designed to be flexible and can adapt to different situations. Depending on the load in the inlet area, it can be fully aerated or just stirred. In the second biological treatment stage, trickling filters are used. The waste water is pumped through four nitrifying trickling filters via a pumping station. The fixed-bed reactors are filled with plastic packing to which microorganisms are attached as biofilters.

Lauben Central Waste Water Treatment Plant: designed for 460,000 PE.
The KPL 700 propeller pumps installed are highly efficient and therefore very low in energy consumption

The waste water is enriched with oxygen by distributing it evenly over the trickling filters. The attached microorganisms ensure that the nitrogen compounds oxidise to nitrate. Any remaining contaminants are usually consumed in parallel to this process step. The second biological treatment stage is downstream two-line secondary clarification (2 x 1,100 m^3). Any remaining floating tertiary sludge is removed from the water surface using screw conveyors/pumps and fed back to the biological treatment stage. The treated waste water is finally discharged into the receiving water (Iller) via a collection sump.

An important process step solves many problems

In order to ensure that the flow into the denitrification tank (first biological treatment stage) is as constant as possible, the waste water from the trickling filter discharge (second biological treatment stage) is fed back into the denitrification inlet via a collection sump and special pump technology. Two propeller pumps with automatic control are used for this purpose. The reason for recirculating the waste water is to ensure that the flow into the denitrification tank is as constant as possible (depending of the quantity and quality of the waste water).

This sort of task would push many waste water pumps to their technical limits. Energy utilisation and energy efficiency are also important factors to consider. When choosing the right pump technology to use, the operators of the CWWTP believed that the decision should not just be based on the pure investment costs but should also factor in the costs for servicing and maintenance and – very importantly – energy!
After taking all factors into account, the investment itself played a rather minor role. Operating costs – primarily for energy – accounted for a good 80% of the total costs. The decision-makers therefore specified that the energy efficiency of the pumps should be guaranteed for five years.

Propeller pumps used for the first time in Europe

Propeller pumps are typically used primarily for flood control. They offer a high flow rate and can be adapted to customer requirements. An optimised pump solution tailored to the customer's needs is developed based on individual local conditions. It is especially important that subsequent costs – in particular energy costs – are reduced as a result. In other words, the pump technology used needs to be extremely energy-efficient. In this case, the efficiency of the pumps was guaranteed for five years.

Sharing knowledge and experience at the CWWTP – from left to right: Franz Beer, Managing Director of GKW Lauben; Christian Kuhl, Senior Key Account Manager at Grundfos GmbH; Martin Bodenmüller, Waste Water Manager at GKW Lauben

Two propeller pumps are installed in the fixed anchorage points/fittings.

KPL 700 pumps are axial-flow propeller pumps that have a high level of hydraulic efficiency (up to 86%). They are equipped with high-voltage motors that have low installation costs and an extremely precise, one-piece propeller with a backswept design to avoid blockages. The Turbulence Optimizer reduces turbulence in the gap between the pump housing and the column pipe, providing an additional increase in efficiency. In this use case, a CFD (computation fluid dynamics) analysis was performed. CFD calculations are used to simulate complex flow processes in a computer model. Ultimately, the above factors all lead to an increase in performance along with an increase in operational reliability. The Lauben CWWTP currently uses two KPL 700.22.8.T.50.17.E.40 pumps. A third pump is provided as a reserve. It is only used if a pump has to be replaced during maintenance work. Analyses and evaluations by the Technical University of Berlin show that energy consumption and thus energy efficiency have been within the specified parameters since 2019. It's good news all round!

Facts and Figures

Customer: ***Abwasserverband Kempten (Allgäu)***
Operator: ***Gruppenklärwerk (GKW) Lauben***
Location: ***Griesösch 1, Lauben, Germany***
Time: ***October 2019***
Pump technology used: 3 (2 + 1) propeller pumps KPL 00.22.8.T.50.17.E.40
Pump technology: Grundfos GmbH, Schlüterst. 33, Erkrath, Germany

Customer benefits:

- ***Extremely energy-efficient pump technology that is guaranteed for five years***
- ***CFD analysis***
- ***Hydraulic efficiency: up to 86%***
- ***Unique compact design***
- ***Highly reliable***

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