Precipitant savings through optimised phosphate elimination with integrated predictive diagnostics

Problem

Dosing of the precipitant was adjusted manually based on the laboratory measurement value of the daily composite sample and so was unable to respond to possible peaks. Although being compliant with the effluent limits, the values observed fluctuate between 0.2 and 0.8 mg/L.

Solution

A two-channel phosphate analyser with two sample preparation modules and the RTC-P control module for two dosing points was installed. The Prognosys predictive diagnosis system was then switched on to monitor measurement values.

Advantages

- Constant effluent values between 0.4 and 0.75 mg/L
- Optimised and lower precipitant consumption (-17%)
- Monitoring of PO_4-P values in the system
- Tool for checking the measuring instruments and the quality of the measurement values

System data

Total number of inhabitants and population equivalents	45,000
Volume of wastewater in dry weather	275 L/s
Maximum daily quantity	43,200 m^3/d
Volume of sewage in 2013	5,897,424 m^3
Alternating/Intermittent aeration with primary and final sedimentation and filtration	
Chemical phosphate elimination	

PROGNOSYS

Initial situation

The Bachwis wastewater treatment plant in Fällanden was last modernised in 2007 and has the task of continuing to maintain the good condition of the Glatt–a river that was once significantly contaminated–as it has done so in the past. The plant processes the wastewater of the four connected communities of Volketswil, Schwerzenbach, Fällanden and Maur. Designed for a population equivalent of 45,000, it treats a sewage volume of more than 5,500,000 m^3 per year. A mechanical cleaning system transports the wastewater into the two-line primary sedimentation system. The water is biologically cleaned in the anoxic tanks and the three downstream aeration tanks with a post-aeration tank using alternating/intermittent aeration. The treated water is pumped from final sedimentation into a filtration facility before it is finally introduced into the river Glatt (Fig. 1).

As a winner of the Medaille d'Eau in 2013–an award from the 'Verband Schweizer Abwasser- und Gewässerschutzfachleute' (VSA) [Swiss Water Association] and the InfraWatt/EnergieSchweiz associations–the Bachwis wastewater treatment plant is constantly striving to further optimise its operations. Following an accurate assessment of the potential in collaboration with Hach, it has been shown that further optimisation of the use and consumption of $FeCl_3$ is possible in the area of precipitant dosing.

The precipitant was added at two points–to the return activated sludge and upstream of the filter. Dosing of the precipitant into the return activated sludge was adjusted using the laboratory measurements of the daily composite samples. Where the last laboratory samples showed an increasing or decreasing trend, the dosing quantity was increased or decreased accordingly. The dosing quantity in the filter was consistently maintained at 2 L/h. Although being compliant with the effluent limits, the values were fluctuating between 0.2 and 0.8 mg/L.

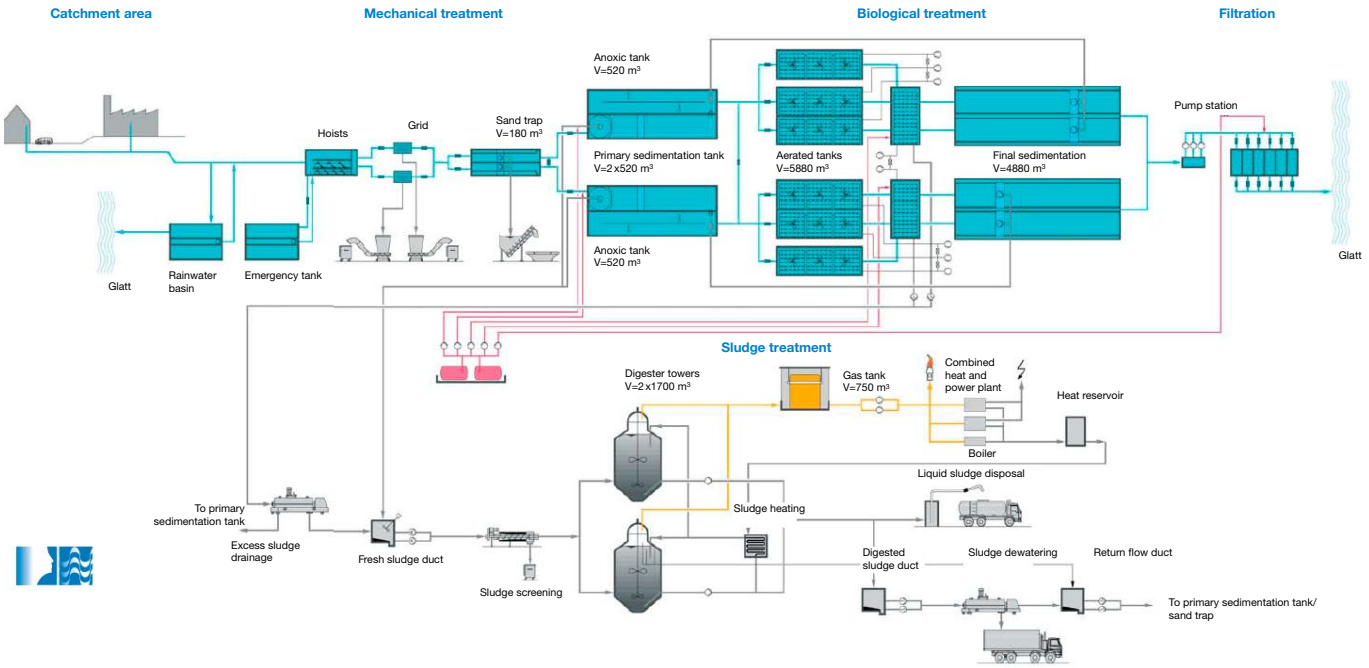

Figure 1: Bachwis wastewater treatment plant flowchart

Following an initial basic determination of the potential for optimisation, a more detailed analysis of the operating data was carried out in collaboration with Hach consultants. The plant was visited in order to gain an accurate insight into the current situation. An initial proposal was to shift the variable precipitant dosing from the return activated sludge to the final aeration of the alternating/intermittent tanks. As a result, initial optimisation and savings could be achieved even before the installation of the RTC-P control module.

The solution

A six-month test phase was agreed and the equipment required for the optimisation process was installed. The measured values and control values of the analyser and the RTC-P are first transmitted to the central control system where the dosing can be controlled. This has the advantage that, in addition to the existing fallback level of the RTC-P, control of dosing can also be activated or deactivated at the control system (e.g. when tanks are being cleaned). As the measurement is taken after dosing, the RTC-P was set to "feed-back control" with an initial set point of 0.5 mg/L.

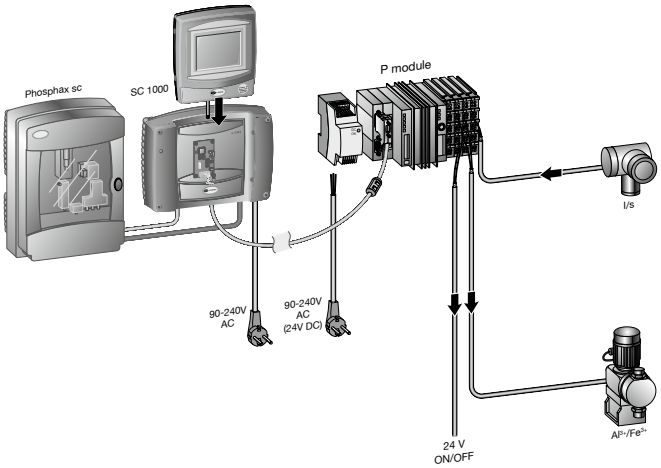

Figure 2: RTC-P setup diagram

Following the initial setup, parameterisation of the system was continuously monitored via the GSM module of the SC1000 controller and adapted in each case in consultation with personnel at the wastewater treatment plant. It quickly became evident that the PO_4-P measurement with the Phosphax sc analyser at the plant provided additional useful data which had not been available previously. The decision was therefore made to keep the measurement long before the test phase ended. After the parameterisation of the RTC-P module underwent additional adjustments, the module also demonstrated its usefulness and was acquired by the plant. The module has now been running successfully for three years and can be operated by the plant personnel themselves if the parameterisation needs to be adjusted. The final steps carried out by Hach included installing the predictive diagnostic system Prognosys, as well as the new software for the RTC-P module. The new version of the software fulfils the requirements of the operations manager who wanted the system to respond even more quickly to phosphate peaks – a specification that has been achieved with the update.

The Prognosys system is a beneficial tool for personnel insofar as it is quickly able to identify the condition of the measuring instrument and the quality of the measurement value and whether there is a need for action – for example, cleaning or the replacement of reagents.

Improvements

It became evident fairly quickly that there was potential for optimisation which has now been achieved. Since the P module controlled dosing at the final aeration stage turned out to be extremely effectively, dosing on the filter was initially reduced before finally being stopped completely. Compared with 2011, the 17 % saving* achieved in 2013 even exceeded the estimate made by Hach (10–15 %). The measurement values of the daily composite samples in the procedure vary within a much narrower range of around 0.4–0.75 mg/L compared to the previous range, which also means that the limits are always respected.

In the first year following the installation, the minimum dosing quantity was between 6 and 7 L/h. As personnel have built up their knowledge and gained experience of the module, this figure has now been reduced to 4.5 L/h, resulting in additional savings.

** Source: Annual report WWTP Bachwis 2013*

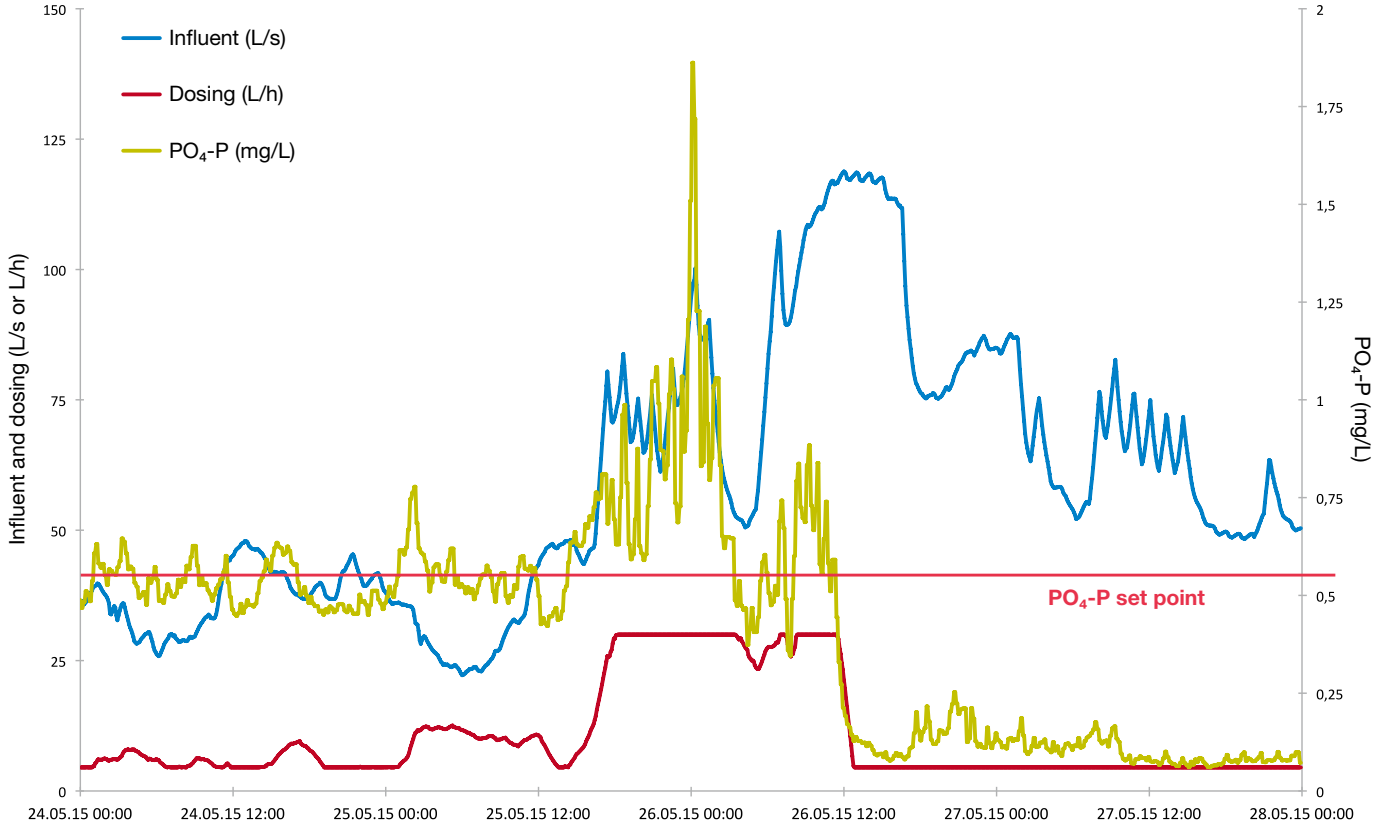

Figure 3: Time curves from Biology 1

Customer opinion

The module has now been operating at our plant for almost three years without any problems. Using the latest software, it now works even better than before and fully meets my expectations. The module is very intuitive to use and any necessary changes to the parameters can be carried out by my employees quite easily. The Phosphax sc analyser complies very well with the laboratory values and does not require any time-consuming maintenance. We have the equipment serviced by Hach twice a year, which further reduces the amount of work we have to do. When patrolling the plant, the Prognosys system enables us to see very quickly whether an instrument needs attention soon or whether everything is in order.

Martin Moos (Operations Manager)

Table 1: Equipment used for precipitant control

Product	Device type
SC1000 probe module	Controller
SC1000 display	Controller
Phosphax sc	Ortho-phosphate analyser
Filtrax	Sample preparation
RTC card	Communication card in SC1000
TBS external base module	SC1000-BUS switch cabinet module
TBS external output module	SC1000-BUS switch cabinet module

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