HACH®

Be Right™

TOC & TN in Refinery Wastewater

Representative sampling directly from the aeration tank

Background

Refining processes require large quantities of water – for steam generation, for heating or cooling, for cleaning and rinsing. In times of increasing water scarcity and rising costs, companies are endeavouring to treat as much water as possible and return it to the water cycle (see page 4).

Nevertheless, large quantities of wastewater are continuously produced, which can be contaminated with a variety of compounds. Refinery wastewater contains substances from the blow-off of steam boilers or cooling towers, contaminated water from the various production processes such as desalination and desanding of crude oil, desulphurisation or the distillation process.

Corrosion on heat exchangers can lead to traces of hydrocarbons; after all, in addition to fuels, other aromatics and aliphatic compounds are also extracted from crude oil in today's refineries. It therefore makes sense not only to determine the TOC, i.e. the Total Organic Carbon, but also to monitor the Volatile Organic Carbon (VOC). This provides a deeper insight into the organic carbon load.

Problem

Due to new regulations, a German refinery had to upgrade its in-house wastewater treatment plant with downstream denitrification using adapted bacteria. The increased efficiency of the TOC and TN (Total Nitrogen) degradation performance was to be continuously monitored and documented. The challenge was to take a qualified and representative sample from the aeration tank.

Solution

The solution was found with a BioTector B7000 analyser and associated Venturi sampling system. The Venturi sampler is a compressed air-driven vacuum pump system system that can take samples over large distances and differences in height and prepare them in the right quantity. Both devices have been specially developed for industrial wastewater with a high particle content, as is typically found in the aerated zone of a refinery wastewater treatment plant.

Benefits

In combination with the high particle compatibility of the BioTector B7000 analyser, which can process soft particles up to 2 mm, the Venturi sampler is the solution to provide representative wastewater samples in sufficient quantity for analysis around the clock.

The integrated self-cleaning function prevents cross-contamination or carry-over and enables multi-channel operation. At the same time, it ensures low maintenance and very high availability.

Sampling from the aeration tank

The implementation of the denitrification process is intended to ensure compliance with environmental regulations. Sampling from the activated sludge tank is an important prerequisite for monitoring carbon and nitrogen degradation.

As a rule, complex filter systems with pumps are installed to ensure the sample flow to the analyser. However, the operation of these membrane filters is energy-intensive and requires a high level of maintenance.

The BioTector Venturi sampler, on the other hand, uses a stream of compressed air to create a vacuum to guide the sample contents to the analyser. Both are installed next to each other to save space, with the analyser supplying the sampler with power.

After each measurement cycle, the sample is removed from the Venturi sampler and the associated sampling lines and all components that come into contact with the sample are back-washed with a hot water microbubble mixture. The system is then dried with air and is ready for the next sampling.

The operator opted for a multi-channel solution in order to monitor two measuring points at once: the flotation process and the aeration tank.

The BioTector B7000 analyser determines the total nitrogen, TOC, TIC (Total Inorganic Carbon) and TC (Total Carbon). The volatile VOC is calculated automatically.

Advantages of the Venturi vacuum sampler

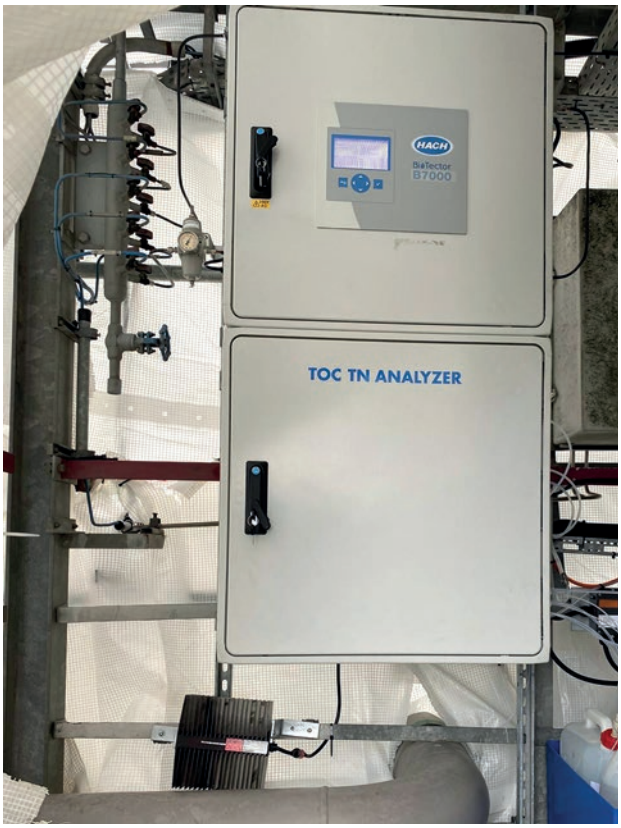
- Compressed air-driven Venturi pump
- Monitoring of the sample flow, no dry running
- Self-contained, self-cleaning system; backflush with air and water microbubbles after each cycle
- Easy-to-clean sample chamber (10.5 mm inner diameter) and sampling lines (3.2 mm)
- Air-dried sampling line between cycles to prevent dilution of the next sample
- Backwash keeps the sump pit free of sludge

Outlook

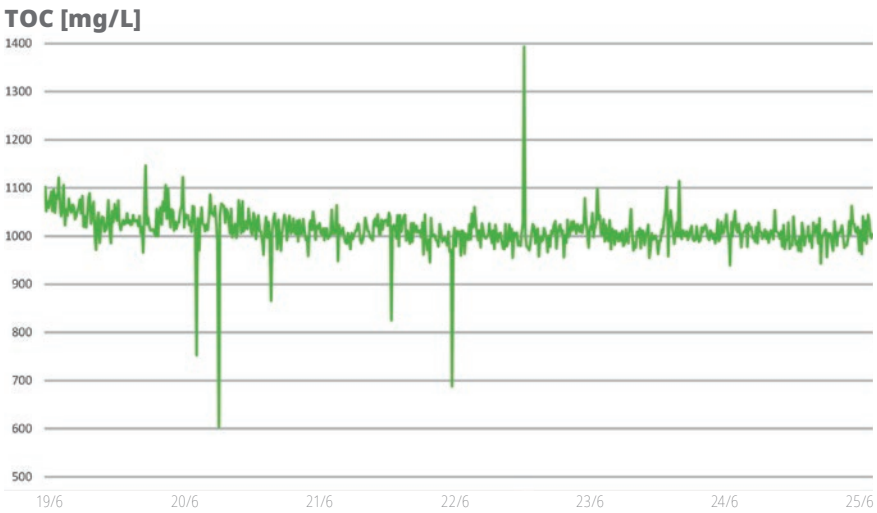
The operator is evaluating further options for his system, e.g. probes and analysers for monitoring dissolved and total nutrient parameters, sludge content and calculating sludge age, monitoring dissolved oxygen in the aeration tank, etc.

With the Hach® RTC-controlled automatic dosing system for nutrient adjustment, further optimisation of the system is possible. Last but not least, thanks to the wide range of service plans, the overall workload and responsibility of the maintenance team and operators can be further reduced.

Sample line at the aeration tank



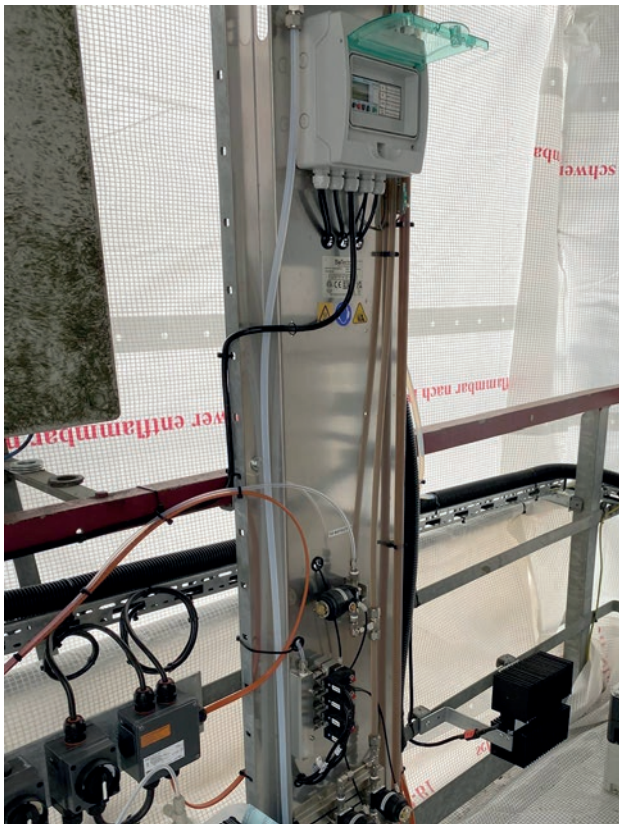
BioTector B7000 analyser for the determination of TOC, VOC and TN



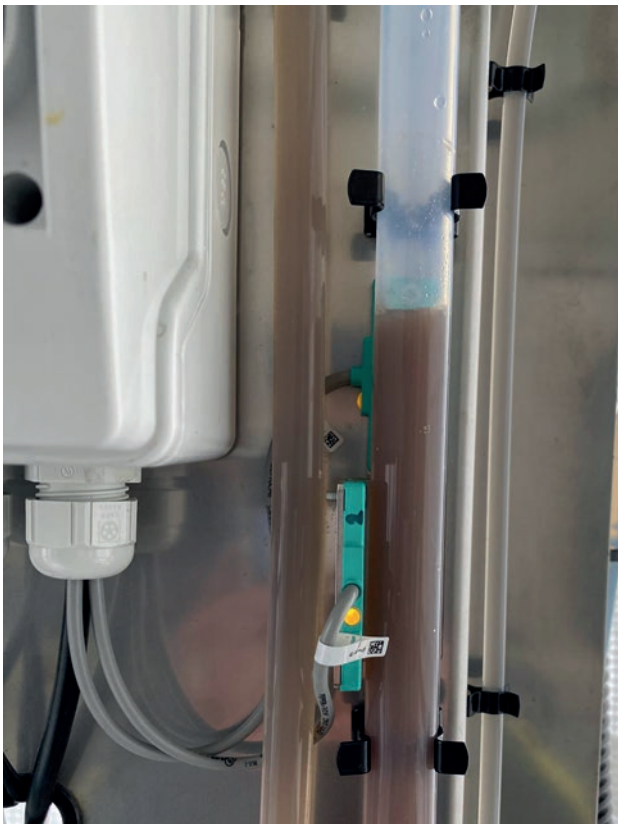
TOC results from the measuring point in the aeration tank over several days

Summary

Continuous monitoring of the TOC and total nitrogen load of the refinery wastewater with the BioTector B7000 TOC/TN analyser and Venturi sampling system leads to reliable compliance with regulations. The workload of the plant personnel is noticeably reduced by the automation with low-maintenance devices.



Venturi sampler on location



No clogging from activated sludge

Simplified diagram of water cycles in a refinery