BALAZS™ nanoanalysis

Water Analysis

Speciation of Organic Compounds in Municipal Wastewater

The need for wastewater treatment and reclamation is growing in order to support regional water limitations that are caused by low availability of water, lack of infrastructure, increased costs, and low quality water. Wastewater treatment plays a significant role in combating water limitations; organics analysis in wastewater can assist in monitoring different areas of treatment to improve performance.

Analyzing the composition of municipal wastewater influent can help understand the effect of industrial wastewater on the performance of bioreactors. Toxic compounds from industrial processes can affect the performance of biological treatment systems. Organics analysis can help identify the underlying causes of treatment issues and work towards effective solutions.

In addition, analyzing wastewater treatment effluent can help determine the need for tertiary treatment. Organics analysis in biologically treated wastewater can reveal the level of byproducts present and indicate a need for further treatment. This helps to design treatment systems and monitor performance. There are many methods for measurement of organic compounds, but they are limited in either the efficiency or specificity of their analyses. Some methods are very specific for identification of certain compounds, but limited in their ability to detect others.

Organic Speciation using LC-OCD

Balazs™ Nanoanalysis offers organic speciation using liquid chromatography-organic carbon detection (LC-OCD) which provides an effective analysis of organic compounds within the tested water. LC-OCD helps to better understand the composition of wastewater influent and effluent, allowing plants to improve treatment performance. LC-OCD allows for identification of biopolymers, humics, low molecular weight (LMW) acids, volatile organic compounds, and more, while characterizing nearly 100% of the organic composition. LC-OCD is a non-target complementary method to existing target methods for detection of synthetic compounds. When accurate determination of specific compounds is required, more specific techniques may need to be used. LC-OCD analysis can help design treatment systems, monitor changes in water quality, and define solutions for a large array of problems without the need for expensive specialized tests.

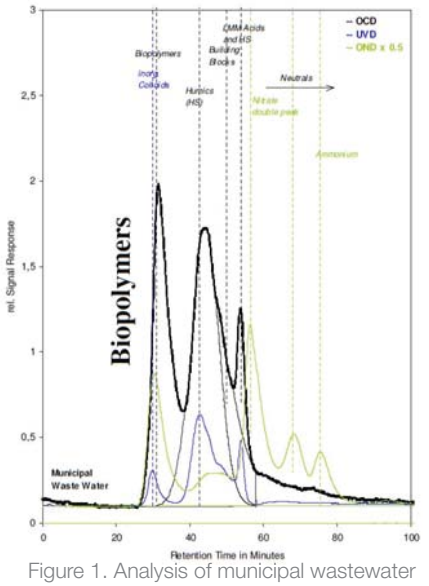

Figure 1. Analysis of municipal wastewater treatment feed

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Case Study

The content of the wastewater that is represented in figure 1 is high in biopolymers. This is expected for municipal wastewater and can pose problems for treatment systems. The organic content present in this feed water serves as nutrition for bacteria.

Membrane bioreactors (MBR) are also a common treatment method for industrial and municipal wastewater. MBRs remove dissolved biopolymers and other biological matter from the wastewater, making them prone to filter fouling. Figure 2 illustrates results from a standard MBR, where biopolymers are removed by 80%.

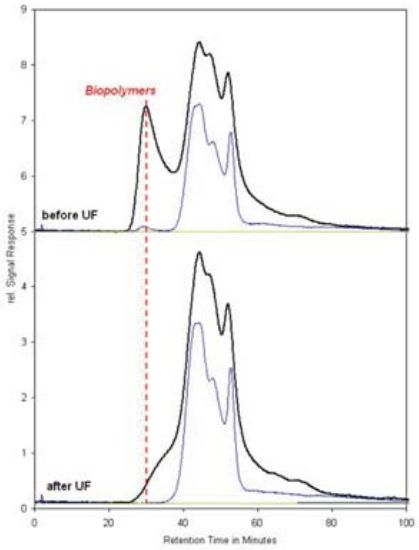

Figure 2. Typical analysis from a membrane bioreactor

LC-OCD Method Overview and Definitions

The LC-OCD process begins with the injection of a small sample into a size exclusion chromatography column where high molecule weight (HMW) compounds are separated from LMW compounds. The sample is then fed to UV and organic nitrogen detectors, where all compounds containing nitrogen will be analyzed. A UV thin film reactor serves as the heart of the process where organic compounds are oxidized producing carbon dioxide, whereas the originally present CO_2 is removed through acidification and N_2 sparging. The resulting CO_2 is measured using a non-dispersive infrared detector (NDIR). The output of this analysis is a report containing the chromatogram (see Figure 2) and the spreadsheet providing organic speciation to the following content:

DOC – Dissolved Organic Carbon
DON – Dissolved Organic Nitrogen
HOC – Hydrophobic Organic Carbon (organic compounds that do not elute during the period of time of the test)
CDOC – Chromatographic (hydrophilic) Dissolved Organic Carbon (organic compounds that elute completely during the period of time of the test)
NOM – Natural Organic Matter
SOM – Synthetic Organic Matter > 10 ppb

Quantification and Characterization of:

- Humics
- Biopolymers
- Building Blocks
- LMW-acids

In addition to the above categories, specific organic compounds are identified based on the instrument library, characterized by chromatography retention time, nitrogen content, and presence of unsaturated bonds (identified by UV detector). Balazs™ also includes interpretations help for practical conclusions.

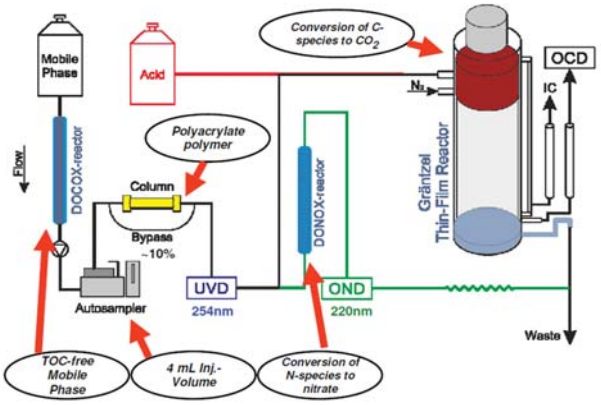

Figure 3. LC-OCD schematic diagram

References

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- Huber, S.A., Balz, A., Abert, M.: New method for urea analysis in surface and tap waters with LCOCD-OND (liquid chromatography-organic carbon detection-organic nitrogen detection). Aqua, 60.3, (2011), 159-165.
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