

Water Analysis



Speciation of Organic Compounds in Electronics Wastewater

The water required to support the fast growing electronics industry is limited in certain regions due to:

- Low availability of water
- Lack of infrastructure
- Increased costs of water
- Lower quality of water

These limitations pose problems for the electronics industry, which consumes large amounts of water for its production processes. Wastewater treatment and reclamation has become an important part of the industry. However, contaminants in electronics wastewater can be unique and difficult to treat. Organic compounds can be present within electronics wastewater and originate largely from cleaners, solvents, developers, and drying agents. Analysis of organics helps electronics companies to remain in compliance with Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) regulations for their wastewater and to effectively treat and validate reclaimed wastewater. However, many methods for measurement of organic compounds are limited in the efficiency and 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. This method 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.

Case Study

Figure 1 illustrates the composition of an electronics wastewater feed and the effects of oxidation treatment. In this case, oxidation caused the target compound in the wastewater to decrease and LMW acids to increase.

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 molecular 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 CO₂ is removed through acidification and N₂ sparging. The resulting CO₂ 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.

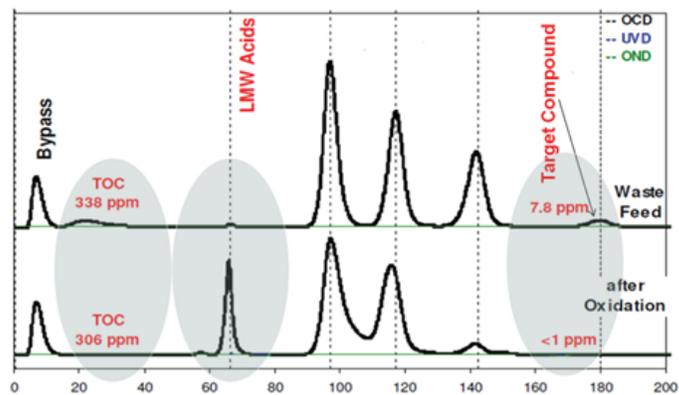


Figure 1. Analysis of electronics wastewater feed before and after oxidation

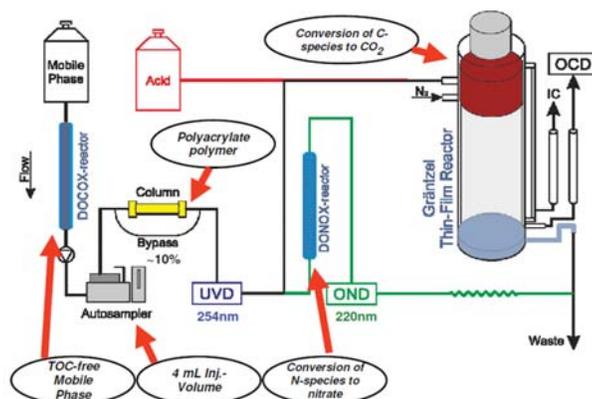


Figure 2. LC-OCD schematic diagram

References

- Huber, S.A.; Balz, A.; Abert, M., Pronk, W.: Characterisation of aquatic humic and non-humic matter with size-exclusion chromatography - Organic Carbon Detection - Organic Nitrogen Detection (LC-OCD-OND). Water Research 45 (2011), 879-885.
- 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.
- Libman V. and Huber S. Part 1: An Overview of LC-OCD - Organic Speciation For Critical Analytical Tasks In the Semiconductor Industry ULTRAPURE WATER®, May/June 2014