

Nationwide screening of trace elements and technology-critical elements in waste water in Switzerland

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Many trace elements are of increasing importance for a variety of applications in electronics, catalysts, ceramics, metallurgy and pharmaceuticals. Particularly in high-tech applications, these so-called *technology-critical trace elements* often fulfill crucial functions. Examples include Ga, Ge, In, Te, Nb, Ta, Tl, most rare earth elements, platinum group elements and certain other heavy metals. Although the global use and environmental fluxes of many of these trace elements have increased tremendously due to economic and population growth over the last decades, there is relatively little quantitative information about their industrial use and emissions and about their environmental fate. Since trace element contents in wastewaters and sewage are an indicator of their use in society, it may be assumed that the loads of these trace elements have risen correspondingly in waste waters and sewage sludges worldwide.

Therefore, we investigated the concentrations and fluxes of >60 major and trace elements in >50 waste water treatment plants (WWTP) in Switzerland. Multiple (microwave-assisted) acid digestion techniques and (collision/reaction cell) ICP-MS methods were developed and validated to quantify these elements at the trace level in sewage sludge and treated waste water samples.

We will present an overview of the measured elemental concentrations and their geographical distribution. These results will be put into context by correlating measured elemental concentrations and sludge/water ratios with relevant WWTP properties such as capacity and treatment type, with geographical information on population and industries in the catchment areas, as well as meteorological data. We will discuss in more detail those elements with elevated concentrations that warrant particular attention (e.g., Gd) and treatment options to increase the elimination and potential recovery of these elements from WWTPs.

This work is part of an ongoing effort to create a national inventory for trace element fluxes in WWTPs in Switzerland.