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The extended statistical entropy analysis: a quantitative evaluation tool to support decision making; case study: wastewater treatment plants

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The extended statistical entropy analysis (eSEA) is a quantitative evaluation method for technologies which considers individual chemical compounds. It is applied to nitrogen (N)-compounds in different wastewater treatment plants (WWTPs). The results offer a comprehensive evaluation of WWTP technology through consideration of individual chemical compounds and their optimal distribution in environmental compartments such as the atmosphere, the hydrosphere and the soil. In this sense the results from the eSEA verify that WWTPs which apply both nitrification and denitrification at best available technology (BAT) are favourable. To validate these results four methods (CML, Impact2002+, EDIP (2003) and Heijungs' impact factors) from life cycle impact assessment (LCIA) are applied with regards to aquatic eutrophication, which is the primary impact category for N-compounds. The results from LCIA with Heijungs' impact factors show that a lower environmental impact coincides with a reduction in statistical entropy. CML, Impact2002+ and EDIP (2003) do not favour the BAT WWTPs. This can be explained partly from the lack of impact factors for gaseous N-emissions in these LCIA methods, and the lowest impact factor for NO3- emission in water. In reality, the conversion of N in wastewater to N2 is most desirable for minimal water pollution. The eSEA also demonstrates the potential relationship between mandatory emission limits and statistical entropy. For NH4+ the current emission limit of 5mg (N)/L corresponds to an increase in statistical entropy by 5%. The eSEA is potentially useful for improving the evaluation of WWTPs with respect to N-compounds and appears to be a reasonable amendment to LCIA. These aspects suggest that it is valuable for management decisions regarding WWTPs. Further research is being conducted to explore its potential for WWTP benchmarking.