Applicability of Excitation-emission matrix Fluorescence spectroscopy to monitor variations of dissolved organic matter quality and quantity in wastewater treatment process to prevent upset in the receiving water

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Management of urban wastewater treatment requires a high level of technical-scientific expertise and an adapted metrology. For example, biological treatment step represent a sensible point of the wastewater treatment process as its efficiency is dependent of biodegradable dissolved organic matter (DOM) quantity available in the process influent. To improve treatment processes, DOM characterisation and monitoring represent a crucial issue. But current methods used to characterize DOM quality, like biological oxygen demand, are laborious, time consuming, and not applicable to monitor organic matter in situ. This stresses the need of a new methodology which helps to better follow variations of DOM quality and quantity at different wastewater treatment steps. In the context of MOCOPEE research program (www.mocopee.com), this study aims to assess the use of optical techniques, such as UV-Visible absorbance and fluorescence spectroscopy in order to better monitoring and optimizing process efficiency in WWTP.

First, Excitation-emission matrix (EEM) Fluorescence spectroscopy was employed to characterize dissolved organic matter in different effluents of the WWTP Seine Centre (240,000 m^3/day) in Paris, France. Secondly, 62 sewage water influent samples were collected during 10 days in April 2015 and between June and July 2016, at different hours in order to highlight temporal variation (daily and hourly) of DOM fluorescence. Global parameters as dissolved biological oxygen demand, dissolved chemical demand and ammonium concentration was also measured. Fluorescence data treatment were performed by parallel factor analysis (PARAFAC). An evolution of DOM quality (position of excitation – emission peaks) and quantity (intensity of fluorescence) was observed between the different treatment steps (influent, primary treatment, biological treatment, effluent).

This study highlight the benefit of using EEM Fluorescence spectroscopy to characterise DOM in raw sewage wastewater as daily variation in quality and quantity was observed. Correlations were found between fluorescence indicators and different water quality key parameters in the sewage influents. We developed different multivariate linear regression models in order to predict a variety of water quality parameters by fluorescence intensity at specific excitation-emission wavelengths. For example, dissolved biological oxygen demand (r^2=0.820; $p<0.0001$) and ammonium concentration (r^2=0,825; $p<0.0001$) present good correlation with specific fluorescence peaks and indicators. These indicators derived from EEM Fluorescence spectroscopy could be used in order to characterize DOM online and thus to optimize process efficiency.