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Potential of front-face fluorescence to monitor OM reduction in drinking water during potabilization process

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Elimination of OM in drinking water represents a great challenge for municipalities and technical actors to ensure that it can be safely used for consumption purposes. Indeed, current indicators such as Total Organic Carbon (TOC), turbidity or UV-Absorbance at 254 nm (UVA254) enable only non-specific overview of the amount of organic residuals in water. Fluorescence EEMs are a potent tool for discrimination and deep analysis of OM detailed composition and behaviour. It has been shown that several forms of OM co-exist in raw water, and come from various origins (bacteria, humic compounds…). Potabilization operation is composed of different steps that aim at decreasing all forms of OM using chemical as well as physical methods (ozone oxidation, filtration on activated carbon or sand, flocculation etc.). Unfortunately, it has been observed that reduction of OM during this process was not identical for all the forms, and the process showed a particular lack of efficiency during raining periods.
130 samples of water at various stages of potabilization were analyzed using home-made compact fluorometer, an apparatus composed of UV excitation LEDs. Using chemometrical treatment of spectral data, we put into highlight 5 different forms of OM that were identified according to litterature data. We evidenced the critical steps of the purification on OM reduction, as well as the relative content of each form from raw to product water. In particular, we showed that two forms were less reduced than the other three, so that progressive enrichment of total OM in the former was observed throughout the process.
Moreover, a study was carried out in order to establish calibration models over conventional analyses using the spectral information. Highly satisfying models were thus obtained over TOC, turbidity and UVA254, with average RMSEC values of 13%, 7% and 16% respectively. These results demonstrate the potential of the fluorescence analyzer to simultaneously predict three major OM-related quality parameters of water.
Finally, study of relationships between the different OM forms, climate parameters (temperature, raw water flow, rainfall) and coagulant amounts showeds that each OM form was specifically linked to these parameters. In particular, we were able to pinpoint one of the five forms that was most associated with the water flow, and also the most flocculated by the coagulant.
In conclusion, this work demonstrates that our fluorescence analyzer helps to get improved knowledge of OM behavior during potabilization process. Five different OM forms were identified and their respective evolution was characterized. Furthermore, we evidenced a potential use of a compact and small-size analyzer to monitor water purification steps through simultaneous prediction of quality parameters related to OM content.