ABSTRACT

Undesirable natural or anthropogenic compounds are commonly present in drinking water supplies. An ongoing challenge for water treatment is algal organic matter (AOM) produced by phytoplankton. A part of this thesis is devoted to the coagulation of AOM, specifically cellular organic matter (COM) and its peptide/protein and non-proteinaceous fraction. Besides investigating the coagulation in relation to the COM character, attention was paid to its interactions with other compounds and to the subsequent impacts on coagulation. Additionally, the involvement of an ozonation step was assessed. Another part of the thesis is focused on emerging anthropogenic water pollutants microplastics (MPs), particularly on their quantification and characterization at drinking water treatment plants (DWTPs).

It has shown that the optimum coagulation conditions differ for the COM peptides/proteins and the non-proteinaceous fraction. While the former were effectively removed at slightly acidic coagulation pH, the latter required coagulation pH around neutral and much higher doses of coagulant. The maximum removal efficiency for the non-proteinaceous fraction was much lower compared to that of the peptides/proteins (25% versus 75%), owing mainly to the high content of low-molecular weight (< 10 kDa) compounds. Further, it was found that when COM, namely the peptide/protein fraction, occurs in water together with other organic or inorganic compounds such as humic substances or clay colloids, deterioration in coagulation can be avoided by optimization of coagulation conditions, especially of the coagulation pH. In case of the organic compounds mixture, even better coagulation efficiency and lower coagulant demand (compared to coagulation of the compounds alone) was achieved. Mutual coagulation optimum was determined also for a mixture of cyanobacterial cells and COM, while the removal of 99% and 57% was attained, respectively. When pre-ozonation was applied prior to coagulation of the non-proteinaceous COM, either increased or decreased removal was observed depending on the pre-ozonation conditions, i.e., O_3 dose and ozonation pH, while aldehydes were found to be formed as ozonation by-products.

With regard to MPs, their occurrence was revealed in both raw and treated water of different DWTPs supplied by surface water. The average numbers ranged from 1473 ± 34 MPs L^{-1} to 3605 ± 497 MPs L^{-1} in raw water and from 338 ± 76 MPs L^{-1} to 628 ± 28 MPs L^{-1} in treated water, depending on the DWTP; the removal was 70-83%. The prevailing shapes were fibres and fragments, major materials were polyethylene terephthalate, polypropylene, and polyethylene, and the vast majority of MPs was < 10 μm in size.