Abstract

Nowadays, drinking water treatment (DWT) is becoming more and more challenging due to the increasing anthropogenic pollution as well as due to the impacts of climate change. Water sources commonly comprise a cocktail of undesirable substances, the removal of which by the conventional DWT process based on coagulation/flocculation is often insufficient. This dissertation deals with advanced removal methods, particularly adsorption, usable for difficult to coagulate substances during DWT. Particular emphasis is placed on removing manganese, algal organic matter (AOM), and per– and polyfluorinated alkyl substances (PFAS). Additionally, in the case of emerging anthropogenic pollutants, attention was also paid to their occurrence and interactions in water.

As part of the research, a new TiO_2-based adsorbent was synthesized for Mn^{2+} removal. Since the prepared adsorbent showed high Mn^{2+} removal efficiency in a much wider range of pH values compared to the conventional demanganization method, which requires very high pH values, it could serve as a suitable alternative demanganization method. Regarding the removal of AOM, the influence of solution properties on its adsorption onto different types of granular activated carbon (GAC) was thoroughly investigated. It was found that the efficiency of AOM adsorption is governed not only by the nature of the adsorbate and the used adsorbent, but also by the pH value, ionic strength, and temperature of the solution, or the presence of other substances. The extent to which these factors affect adsorption efficiency depends on the applicable mechanisms and interactions between the adsorbate and the used adsorbent. In addition to the research on manganese and AOM removal, attention was also paid to the occurrence of PFAS and the assessment of their removal efficiency. It was found that these micropollutants are present not only in surface waters but also in underground water resources and that the efficiency of PFAS removal during conventional DWT is very low. An integral part of research on removing problematic substances from water is the investigation of emerging micropollutants. In this regard, the leaching of diverse substances from microplastics (MPs) to water was investigated. The results revealed the release of both organic and inorganic carbon and a range of metals from MPs, while some of the compounds tentatively identified in the leachates are considered harmful to human health, e.g., bisphenol A or phthalate esters.

Keywords

adsorption, manganese, algal organic matter (AOM), per– and polyfluorinated alkyl substances (PFAS), microplastics (MPs), drinking water treatment (DWT)