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Application of TiO_2 nanoparticles in conventional water treatment

Worldwide population growth and climate change are closely linked to the increase of water scarcity. The demand for freshwater is growing intensely and even developed and industrialized countries are affected, since more water is extracted from the reservoirs than refilled, leading to their exhaustion. In this context, novel innovative solutions are required to ensure the supply of potable drinking water to populations. Therefore, the adaption of nanotechnologies to the traditional water treatment process could be a good solution. Some nanoparticles (NPs), like titanium dioxide (TiO_2), are already being tested to be applied in the photocatalytic reduction of nitrate [1] and photodegradation of organic compounds [2]. In addition, several authors have demonstrated that titanium compounds have a coagulant character being effective on the removal of particles, nutrients and natural organic matter (NOM) [3, 4]. However, despites the promising enhancement there are several concerns associate to the application of NPs to water treatment related with their toxicity and potential health and environmental risks as well as regulation limitations. Thus, if nanomaterials were applied to water treatment it is necessary to ensure that at the end of the process all of them were removed and the final treated water is safe to human health as well as to the environment. In this work, we pretended to demonstrate that the presence of TiO_2 NPs associated to an Al-base coagulant have a positive impact on the reduction of NOM from drinking water during the conventional coagulation, flocculation and sedimentation (C/F/S). Since the presence of NOM affect water quality relatively to taste, odour and colour as well as negatively affect the treatment process, increasing the demand of chemicals, forming harmful by-products like trihalomethanes, fouling membranes and promoting biological growth in the distribution system, their removal is imperative. Our results showed that the presence of 10 mg/L of TiO_2 NPs increased the removal of NOM (showed by DOC, dissolved organic carbon and absorption to UV_{254nm}) to the same Al-base coagulant dose tested (fig. 1). The results also showed that in the presence of TiO_2 NPs the Al-base coagulant dose can be reduced, since higher removals of DOC and UV_{254nm} were achieved with lower concentrations of Al_2O_3 (fig. 2). This is an important achievement since aluminium residuals are related with diseases like Alzheimer's. Finally, in the treated water the concentration of Ti was lower that the legal guideline, which means that the treatment tested also remove the NPs from the water to a safe value for human consumption.

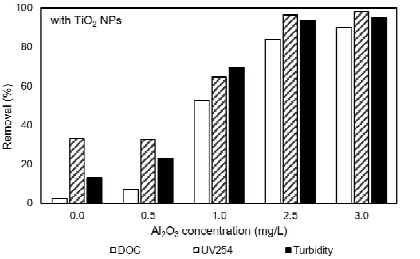

Figure 1: NOM and turbidity removals with TiO_2 NPs (10 mg/L).

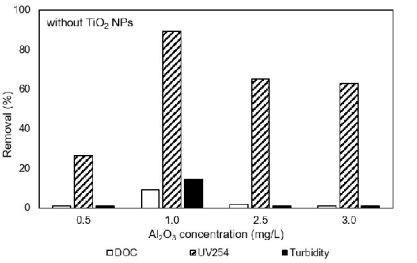

Figure 2: NOM and turbidity removals without TiO_2 NPs.

References

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