SN applied sciences

Characterisation of titanium oxide nanomaterials in sunscreens obtained by extraction and release exposure scenarios

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Abstract

The application of titanium oxide engineered nanomaterials (TiO2 (sub 2) ENMs) in products is dominant in sunscreens and can be release into water systems with relative ease during sunscreen use. The current study examined the physico-chemical properties of the TiO2 (sub 2) ENMs extracted from three sunscreens (SUN A, B, and C) and also released during bathing into deionised and tap water. The TiO2 (sub 2) ENMs were identified in all the sunscreen extract samples using scanning and transmitting electron microscopy (SEM and TEM). The mode length of the ENMs measured with SEM were 67.6, 69.8, and 51.8 nm for SUN A, B, and C respectively whereas their width were 31.3, 38.7, and 27.7 nm. From TEM analysis the ENMs length and width mode sizes respectively were 73.9 and 14.5 nm for SUN A, 81.5 and 16.3 nm for SUN B, and 44.7 and 14.0 nm for SUN C. The Ti content of the sunscreens was 1.9, 0.6, and 0.5% w/w respectively for SUN A, B, and C. During bathing TiO2 (sub 2) ENMs were released into wastewater and were in the size range of 47–218, 102–153, and 92–138 nm for SUN A, B, and C respectively in DI wastewater. In tap wastewater they were 100–241, 100–477, and 67–150 nm SUN A, B, and C respectively. The determined environmental concentrations for the ENMs in DI wastewater ranged 0.2–1.16 µg/L, whereas in tap wastewater it was 0.16–0.17 µg/L. The morphologies of the extracted and released ENMs were a mixture of rods, plates, irregular, and near spherical. The released Ti quantity significantly differed between DI and tap wastewater for SUN B and C, indicating the influence of wastewater quality in the exposure profile of ENMs in water