

59 Potential impact of micro- and nanoplastic particles on metal speciation and bioavailability in aquatic media R.M. Town,

Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Department of Biology (SPHERE Research Group); H.P. van Leeuwen, Wageningen University and Research / Physical Chemistry and Soft Matter; R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group). Plastic particles collected from aquatic systems are typically found to carry a range of associated metal species, some of which are potentially toxic to biota, e.g. Cd^{2+} and Pb^{2+} . The metal content of microplastics (MPs) and nanoplastics (NPs) arises from a combination of the inherent components of the original polymer formulation (stabilizers, pigments, etc.) as well as the sorption of metal species from the environment onto and into the polymer matrix. Metal species may also be associated with organic matter that is sorbed on the surface of the particles. It follows that the amount of metals associated with MPs and NPs will evolve as a function of their residence time in the water column, with consequences for the chemical speciation, bioavailability and potential toxicity of trace metals in aquatic ecosystems. As a first step to gaining mechanistic insights into the involved processes, we present an elementary model, based on spherical geometry, to describe the association and release kinetics of metal species from MPs and NPs. The focus is on release kinetics of metal ions from MPs and NPs that have been immersed/suspended in an aquatic system for an extended period, in the context of their ingestion by biota. Within the body of the plastic particle, metals may be present as e.g. free (partially hydrated) ions and inner-sphere complexes with the polymer backbone and/or various additives. The overall release kinetics of metal species from the plastic particles is governed by the relative magnitude of the rate of diffusion within the particle body as compared to the rate of dissociation of inner-sphere complexes. The effective diffusion coefficients for metal species within plastic polymers are many orders of magnitude lower than those applicable for hydrated metal ions in bulk aqueous media. Thus, for not too strong inner-sphere complexes, the rate of diffusion of metal ions within the particle body will largely govern the overall release kinetics. We analyse practical examples in this context. The outcomes highlight the significance of particle size and residence time within biota for predictions of the potential bioavailability of metal species associated with MPs and NPs.