Comparing Titanium Release from Ceramic Tiles using a waste material characterization test - Influence of Calcium and Organic Matter concentrations

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TH273 Comparing Titanium Release from Ceramic Tiles using a waste material characterization test - Influence of Calcium and Organic Matter concentrations L. Heggelund, Danish Technical University / Department of Environmental Engineering; S.F. Foss Hansen, Technical University of Denmark / DTU Environment; T.F. Astrup, Technical University of Denmark / Department of Environmental Engineering; A. Boldrin, Technical University of Denmark DTU / Department of Environmental Engineering.
Nanomaterials are beneficial in the building industry to enhance or add certain features to commonly used materials. One example is the use of nano-titanium dioxide in the surface coating of ceramic tiles, to make the tiles surface self-cleaning. At the end of life stage, ceramic tiles might be deposited in landfills for construction and demolition waste or other types of landfills, depending on the local waste management system. Hence, the potential release of nano-Ti under landfill conditions is relevant to investigate. In this study we used a standard waste material characterization method to assess if nano-titanium dioxide coated ceramic tiles are suitable for depositing in a landfill or not. Specifically, we used compliance batch test method, which is a simple test evaluating the release from a solid material to an aqueous media during 24 hrs. If nano-Ti particles are released from solid waste material to the landfill leachate, it is expected that the calcium and organic matter content in the liquid will affect the stability of the nanoparticles. The concentration of calcium in the landfill percolate is expected to decrease the stability of the particles due to compression of the electric double layer surrounding the particle, causing increased particle agglomeration and settling. Natural organic matter might have both a stabilizing and destabilizing effect on the released nano-Ti particles depending on the concentration, since this will specifically influence the ability of the organic matter to fully cover the surface of the particles. We evaluated the titanium release from identical ceramic tiles - with and without a nano-titanium dioxide coating - and varied the concentrations of calcium chloride (100-500 mg/l) and humic acid (25-100 mg/l). The titanium release was quantified immediately after the 24 hrs. test using single particle ICP-MS and Transmission Electron Microscopy imaging. The preliminary results suggest that nanoparticulate titanium is released from both tiles – with and without nano-titanium dioxide coating. The size distributions of the released particles are similar and show a high polydispersity. Further, the median size of the particles is generally above 100nm. However, the results suggest some effect of the humic acid on the particle size distribution, which needs to be investigated further. These results can aid the further development of models for environmental concentrations of nanomaterials, specifically concerning the life cycle of nano-enabled products.