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Novel method to address the environmental impact of nanomaterials in the use phase: the SUN approach

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It is now acknowledged that nanomaterials will experience several transformations along their life cycle, upon formulation, production processes, aging and disposal. However most efforts still focus on assessing the impact of pristine nanomaterials, while formulated and aged nanomaterials are rarely investigated, resulting in significant knowledge gap. This situation is due for a great part to the difficulty of preparing large amounts of aged materials. Indeed all published studies only report few amounts of released nanomaterials, which are insufficient for ecotoxicity testing. SUN project proposes a new approach to this issue. Based on the observation that nanomaterials are most often released within their product matrix, a cryo-milling protocol was developed to produce large quantities of fragmented products (FP) that can be aged afterwards to reproduce any transformation the material would normally experience under use. To validate this approach a case study was carried out on polyethylene with 1% Fe2O3 nanoparticles (Fe2O3_PE), serving as pigments with color index PR101 that achieves the longterm stability of pigment particles and yet is transparent in thin films due to a diameter of only 32nm. The response of Fe2O3_PE FP to 3 months weathering in a climatic chamber was investigated and compared to that of small plates of the same material, representative for the final product (car bumper). Release was quantified and transformations of solid matrix induced by weathering in both cases were monitored by IR spectroscopy and a combination of X-ray techniques (XRD, ÂµXRF, micro and nano X-ray tomography).

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