Lifecycle of commercial photocatalytic nanocoatings: Nanoparticles aerosol emission during mechanical and environmental stresses application

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The application of the photocatalytic nanocoatings on external walls of buildings is ever increasing due to their anti-bacterial and self cleaning properties. Such properties are ensured by the photocatalytic action of titanium dioxide (TiO_2) nanoparticles. Resting on the external surfaces, these nanocoatings are frequently subjected to various mechanical solicitations and environmental weathering in real life conditions (Shandilya et al., 2014a). As a result, the consequent loss in their structural integrity leads to their disintegration which, in turn, may lead to the exposure of embedded nanoparticles and thus their possible release too. For a durable development, understanding their ecological and human health effects is important. In the last decade, slowly though, this concern has started gaining attention. Various studies have demonstrated toxic effects of TiO_2 nanoparticles.

In the present work, a parametric study on the emission of TiO_2 nanoparticles from two commercial photocatalytic nanocoatings is carried out (Shandilya et al., 2014b). For this, abrasion tests are performed on them (Morgeneyer et al., 2015) inside a background particles free work post (Morgeneyer et al., 2014). The effects of varying contact pressure during abrasion (Shandilya et al., 2014c) and number of layers of the nanocoating on the number concentration, size distribution, shape and chemical composition of the generated aerosol particles are studied. To study the effect of the accelerated weathering on the nanoparticles emission into air and water, one of these two nanocoatings is chosen and exposed to UV rays and humidity from 1 to 7 months under standardized conditions (Shandilya et al., 2015).

The two nanocoatings appear to exhibit contrastingly opposite behavior in terms of the aerosol particles emission inhibition. Irrespective of the type of nanocoating and weathering, the aerosol particles always possess irregular shapes with unimodal size distributions. In terms of Ti content, while the non-weathered nanocoating samples generate aerosol particles with 1.5–3.5% (in mass) of Ti content, the aerosol generated from weathered nanocoating samples have dramatically increased Ti content (~52%) by the end of 6 months of weathering. By 7 months, a considerable presence of free TiO_2 nanoparticles starts to appear too. The presence of TiO_2 in the leachate water samples is not detected under present experimental conditions.

Three indicators - *Emission Transition Pace* (ETP), *Stable Emission Level* (SEL) and *Stable Emission Duration* (SED) are evaluated and found to be pertinent to qualitatively assess a nanocoating's useful life and monitor the particles emission from it.

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