

TiO₂ nanoparticles-containing materials in our cities: Impacts are difficult to predict

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Materials with de-polluting and de-soiling properties are used in, for example, pavement blocks. These materials contain titanium dioxide nanoparticles (TiO₂ NPs). Could these TiO₂ NPs be released into the environment and if so, could they have a negative impact?

Dr. Anne Beeldens and colleagues at the Belgian Road Research Centre have tested air purification efficiency by TiO₂ NP-containing pavement blocks on parking lanes in Antwerp. Continuous Improvement Officer Peter Van Mierloo at CRH Landscaping Europe is working with the concrete used by this research centre. “The TiO₂ we use for our concrete applications originally has a size of 15 nanometers. In order to increase the photo-catalytic effect we make a slurry in which the TiO₂ molecules

agglomerates to a larger molecule with a size of 1.5 micrometers. This agglomeration process is very important for the efficiency of our photocatalytic product. This new agglomerates product becomes a sponge with many internal cavities. These cavities create a large surface area of the TiO₂, 225m²/gr, in which the airborne pollutants are being transported and decomposed. If the particles would remain nano we would not obtain the desired results.”

It could still be problematic even though TiO₂ NPs form agglomerates considering that G?nter Oberd?rster and colleagues at the University of Rochester in the U.S. found that TiO₂ NPs agglomerates of about 700 nm appeared to dissociate into smaller parts in the lungs. However, the concrete’s larger molecule is more than twice the size and according to Peter Van Mierloo the TiO₂ NPs will remain in the pavement blocks. “TiO₂ is one of the products used in industrial processes to clean water. Our product focus is on the decomposition of airborne pollutants and the nano-sized TiO₂ is bounded with a binder in the cement matrix of the paver and no longer free. The TiO₂ will work as a catalyst and stays in the paver.”

If weathering of TiO₂ NP-containing [materials](#) would release TiO₂ NPs into the environment, could there be any negative effects? Assessing the toxicity of TiO₂ NPs is not an easy task. Dr. Anil Kumar Suresh and colleagues at the Biological and Nanoscale Systems Group, Oak Ridge National Laboratory in the U.S., has studied the toxicity of different NPs such as Ag, ZnO, CeO₂ along with TiO₂.

“How toxic the nanoparticles really are depend on so many factors, for example how the particles are being made, what kind of chemicals have been used in the production, what’s on the nanoparticles surface, not every particle is the same. There are many ways to make nanoparticles. The particles that I work with might be different from the particles that a certain company produces. Most of the TiO₂ nanoparticles that have

been studied are toxic to some degree, except for the ones produced by the aid of bacteria or fungi that make the particles inert and might be due to the peptide or protein coat or crystal defects. At the moment, nanoparticles are produced by chemical processes. It has been reported many times that radiation can enhance certain kind of TiO₂ nanoparticles' toxicity 20 to 40-fold. The companies often do not provide information about the toxicity and nature of nanoparticles they use in their products. There's not much known about the fate, transport and transformation of these particles in the environment. The area is not so explored and we cannot tell what will happen if the concentration of nanoparticles increases in the atmosphere. We have to be very careful. People working for these industries producing tons and tons of TiO₂ nanoparticles and releasing them into the environment should think twice," he said. In addition to pavement blocks, TiO₂-containing materials are also used for other applications such as facades, floor carpets, indoor walls and ceilings, cars, buses and trains.

Although TiO₂ NPs most probably will stay in the concrete or in agglomerates, it is unclear what happens during many years of weathering of TiO₂ NP-containing materials in different application areas under various conditions. Since there are few studies about the environmental effects of TiO₂ NPs, it is difficult to estimate long-term environmental consequences of widespread TiO₂ NP-containing materials in our cities.

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