Chamber studies on photocatalytic active material in the context of PhotoPAQ

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Abstract

Air pollution is a local, regional and transboundary problem caused by the emission of specific pollutants. Due to their adverse environmental and health effects nitrogen oxides ($NO_x = NO+NO_2$) and volatile organic compounds (VOCs) play an important role, especially, for urban air quality. The major sources of NO_x are high temperature combustion processes (e.g., from car engines and power plants). They contribute to the acidification of soil and surface water and furthermore also to the formation of secondary pollutants, for example ozone and particulate matter with associated climate effects [EEA, 2012]. To protect human health, the EU introduced threshold values (e.g., 40 µg m^{-3} for NO_2), which are often exceeded by car emissions at traffic hotspots in urban areas. Therefore, the interest in new methods to improve urban air quality is increasing. To use photocatalytic active materials is one idea in addition to reduce the direct emissions of the pollutants. Semiconductor photocatalysts such as titanium dioxide (TiO_2) are added to different materials (e.g., paints or mortars). These materials are able to convert pollutants into less harmful products on their surfaces under actinic irradiation (UV-range). The Life+ project PhotoPAQ (Demonstration of PHOTOcatalytic remediation Processes on Air Quality) wants to evaluate the feasibility of using such TiO_2 based photocatalytic active materials to alleviate the air pollution problem under real atmospheric conditions. TROPOS (chemistry department) as one partner in the project has set up a variety of laboratory and chamber experiments where such materials can be investigated in detail to characterize their performance before demonstrating the photocatalytic effect in field experiments. In addition to lab experiments with established ISO standard reactors, a construction is used, to investigate the efficiency of the photocatalytic material in an aerosol chamber (LEipziger AerosolKammer-LEAK). In this study the depollution ability of a photocatalytic active coating was compared with an inactive one (both provided by Italcementi), which had the same composition as the active, but without TiO_2. Using this experimental approach it was possible to clearly identify the photocatalytic reaction products. The presented results will provide an overview on the behavior of nitrogen oxides and selected VOCs on these surfaces under irradiation with UV light and allow an initial assessment of this material with respect to the goal of "improving urban air quality."

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