Studies on photocatalytic active concrete in the Leipzig Aerosolkammer (LEAK) 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. Beside the most problematic pollutants particulate matter and ozone, nitrous oxides (NO_x) gained more and more importance. The major sources of NO_x are high temperature combustion processes (e.g. from car engines and power plants). NO_x have widespread environmental and health effects. They contribute to the acidification of soil and surface water and furthermore to the formation of ozone and particulate matter with associated climate effects. Nitrogen dioxide (NO_2) can affect the liver and lung and leads to an increased susceptibility to respiratory infection. The limit of the annual mean NO_2 concentration is 40 µg m^{-3}. Especially in urban areas car emissions at traffic hotspots lead to more frequent transgression of the NO_2 limit values [1].
The PhotoPAQ project (Demonstration of PHOTOcatalytic remediation Processes on Air Quality) was designed to evaluate the feasibility of using TiO_2 based photocatalytic active material to alleviate the air pollution problem under atmospheric conditions. Before demonstrating the photocatalytic effect under realistic conditions it is necessary to identify gas phase and particulate compounds (tracers) for the photocatalytic heterogeneous reactions under laboratory conditions. In this study we used two different experimental setups. First experiments to investigate the degradation of NO_2 were done using a horizontal gas flow reactor (bench top reactor). Due to the successful degradation of NO_2 under irradiation of the photocatalytic active concrete provided by Italcementi, we developed a construction to investigate the effect in the Leipzig Aerosolkammer (LEAK). These experiments confirmed the results of the bench top reactor. However they showed that there are more reactions taking place that have to be considered if you want to use this material to improve urban air quality. The presented results give a detailed explanation on the fate of NO_x at the photocatalytic active concrete surface under irradiation with UV light.

[1] Air quality in Europe - 2011 report, EEA Technical report No 12/2011