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Photocatalytic Disintegration of Naphthalene and Naphthalene Similar Compounds in Indoors Air

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Abstract : Naphthalene and naphthalene similar compounds are a common problem in the indoor air of buildings from the 1960s and 1970s in Germany. Often tar containing roof felt was used under the concrete floor to prevent humidity to come through the floor. This tar containing roof felt has high concentrations of PAH (Polycyclic aromatic hydrocarbon) and naphthalene. Naphthalene easily evaporates and contaminates the indoor air. Especially after renovations and energetically modernization of the buildings, the naphthalene concentration rises because no forced air exchange can happen. Because of this problem, it is often necessary to change the floors after renovation of the buildings. The MFPA Weimar (Material research and testing facility) developed in cooperation a project with LEJ GmbH and Reichmann Gebäudetechnik GmbH. It is a technical solution for the disintegration of naphthalene in naphthalene, similar compounds in indoor air with photocatalytic reforming. Photocatalytic systems produce active oxygen species (hydroxyl radicals) through trading semiconductors on a wavelength of their bandgap. The light energy separates the charges in the semiconductor and produces free electrons in the line tape and defect electrons. The defect electrons can react with hydroxide ions to hydroxyl radicals. The produced hydroxyl radicals are a strong oxidation agent, and can oxidate organic matter to carbon dioxide and water. During the research, new titanium oxide catalysator surface coatings were developed. This coating technology allows the production of very porous titan oxide layer on temperature stable carrier materials. The porosity allows the naphthalene to get easily absorbed by the surface coating, what accelerates the reaction of the heterogeneous photocatalysis. The photocatalytic reaction is induced by high power and high efficient UV-A (ultra violet light) Leds with a wavelength of 365nm. Various tests in emission chambers and on the reformer itself show that a reduction of naphthalene in important concentrations between 2 and 250 µg/m³ is possible. The disintegration rate was at least 80%. To reduce the concentration of naphthalene from 30 µg/m³ to a level below 5 µg/m³ in a usual 50 ² classroom, an energy of 6 kWh is needed. The benefits of the photocatalytic indoor air treatment are that every organic compound in the air can be disintegrated and reduced. The use of new photocatalytic materials in combination with highly efficient UV leds make a safe and energy efficient reduction of organic compounds in indoor air possible. At the moment the air cleaning systems take the step from prototype stage into the usage in real buildings.

Keywords : naphthalene, titandioxide, indoor air, photocatalysis
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