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Photocatalytic degradation of hexane vapors in batch and continuous systems using impregnated ZnO nanoparticles

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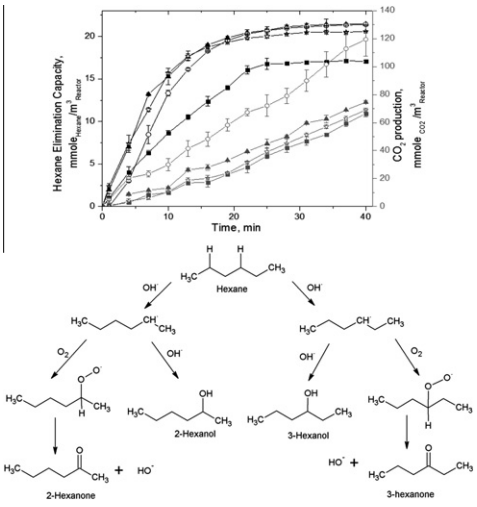
HIGHLIGHTS

- The systems ZnO/Po, ZnO_2/Pe and TiO_2/Pe showed the same performance in batch tests.
- The reaction pathway was deduced based on the intermediates in the batch process.
- ZnO catalyst was more effective for hexane degradation.
- The maximal EC of hexane in the continuous system was 0.9 $g/m^3_{reactor}$ min.
- Photolysis process had a high contribution in the photooxidation of hexane.

GRAPHICAL ABSTRACT



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ABSTRACT

The decomposition of gas-phase hexane in air streams by immobilized nanoparticles of TiO_2 and ZnO onto Perlite and Poraver® granules was studied. Photocatalytic degradation experiments were conducted in batch and plug flow continuous photoreactors at a UV irradiation of 254 nm. The TiO_2 and ZnO samples had similar hexane degradation rates and conversion percentages in batch tests. Photolysis contributed to 58% of the photodegradation phenomena. The hexane batch degradation velocities that normalized to impregnated support mass were similar for both semiconductors. When normalized to A_{BET} of the impregnated support, ZnO allowed a higher hexane degradation velocity than TiO_2. Maximal mineralization of hexane in batch tests was 98% and 57% for TiO_2 and ZnO sytems, respectively.

The production of by-products was identified at minute 30 and a pathway of hexane degradation was suggested, mainly ketones and secondary alcohols being identify.

For continuous experiments, the TiO_2 catalyst supported onto Perlite showed degradation velocities at least 74% greater than for the ZnO. However, in terms of the A_{BET} normalized velocities; the ZnO impregnated onto Poraver® resulted in a better performance than that obtained with TiO_2 and ZnO onto Perlite. The impregnated catalyst had favorable conversion rates, but the CO_2 produced was undetectable. Overall, the use of TiO_2 and ZnO for the degradation of high loads of hexane vapors exhibits good degradation rates in a relatively short time, as well as a high production of by-products.

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