Ammonia removal with activated carbon/metal oxides nanocomposites

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Résumé

One of the main industrial air pollutants is ammonia (NH3) which damages ecosystems by eutrophicating them, making them acidic, and contaminating groundwater and soil, it can potentially be harmful for human beings (1). Several methods have been investigated to reduce ammonia emission, but thanks to its high activity at low temperature, low energy consumption and simplicity of use, adsorption garnered much interest (2).
In this work, we will investigate the removal of ammonia using nanocomposites elaborated from activated carbon and titanium oxide nanoparticles AC/TiO2. To do that, two activated carbons were made from Algerian olive waste through chemical activation. The precursor was dried after being washed with water. It was then crushed and a grain size ranging between 0.3 and 1.0 mm was selected by sieving. For activation, ZnCl2 and H3PO4 are used in two different mass ratios 1:1 and 1:3, respectively. The mixtures were carbonized at 450∘C for 1h with a heating rate of 10∘C/min. The resulted materials were washed thoroughly with distilled water until neutral pH (3). These two samples, named ACZn and AC3P have specific surface area over 1400 m2.g-1. Moreover, AC3P contains a significant fraction of mesopores. AC/TiO2 nanocomposites with different TiO2 loadings (1, 5, 10 and 15wt%) were successfully prepared by performing the hydrothermal synthesis of TiO2 NPs (4) in presence of AC: effective loadings (estimated based on TGA) are close to theoretical values; TiO2 crystalline phase are not detected (based on XRD), which indicates that the TiO2 NPs are well dispersed in the AC (including inside the pores).
These samples were tested for NH3 adsorption by measuring their breakthrough curves for this gas. The results showed that the presence of TiO2 significantly increased the ammonia uptake in the case of ACZn (17.03 mg/g) sample where it doubled forACZn-15%TiO2 (30.49 mg/g). However, it had a slightly negative effect for AC3P (45.30) mg/g sample. Other characterizations will be performed to understand the difference in these two series of samples.

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