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Zeolites as recyclable adsorbents/catalysts for biogas upgrading: removal of octamethylcyclotetrasiloxane

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ABSTRACT

Natural and synthetic zeolites with different properties (porous structure, SiO₂/Al₂O₃ ratio, acidity and Fe-loading) were evaluated as adsorbents/catalysts for octamethylcyclotetrasiloxane (D4) removal in dynamic adsorption tests. BEA type zeolites, with high content of Lewis and Brønsted sites, promoted the catalytic D4 ring-opening leading on the formation of smaller α - ω -silanediols, which are narrower molecules able to diffuse into the channel system.

Wet oxidation processes were used for the regeneration of a spent BEA zeolite, including ozonation and Fenton-like treatment. Both treatments were optimized to recover almost completely the D4 uptake of the iron-exchanged Fe-BEA in the first use. Thus, its feasibility to be reused was evaluated in successive adsorption/oxidation cycles, recovering up to 80% in at least three subsequent steps. However, in further cycles the accumulation of D4 and/or by-products led to a successive decline in the catalytic activity of the zeolites, hampering not only the capacity to transform D4 into lineal silanediols, thus reducing the adsorption capacity, but also the catalytic activity towards promoting Fenton-like reactions during regeneration.

KEYWORDS

Siloxane, Zeolite, Fenton, Ozone, AOP

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