Adsorption of linear, monobranched and dibranched alkanes on pure silica STW zeolite as a promising material for their separation

Eduardo Pérez-Botella
Alechania Misturini, Andrés Sala, Miguel Palomino, Avelino Corma, German Sastre, Susana Valencia, Fernando Rey
Universitat Politècnica de València- Consejo Superior de Investigaciones Científicas, Instituto de Tecnología Química, 46022 Valencia, Spain
edpebo@upvnet.upv.es

Gasoline is a liquid mixture mainly consisting of hydrocarbons in the C4−C12 fractions and is one of the most used fuels worldwide. Its performance is evaluated in terms of the octane number (ON). Hydroisomerization of linear short chain paraffins is an effective method of obtaining higher-octane components for the gasoline blend, i.e. multibranched products. The linear components are separated from the effluent and recycled by means of an adsorption process that uses zeolite 5A as the adsorbent.[1] The ideal target, however, is the separation and recycling of both linear and monobranched hydrocarbons, as the latter ones also present low ON. Medium pore materials with several structures and compositions have been proposed for this separation, out of which silicalite-1 (Si-MFI) is most frequently addressed.[2] Here, we present pure silica STW zeolite (Si-STW) as a material which is superior to Si-MFI for the said separation. The adsorption of linear, monobranched and dibranched saturated hydrocarbons in the gasoline range has been studied on Si-STW by using pentane, hexane, and heptane isomers as model adsorbates. Significant differences in both the equilibrium adsorption and especially the adsorption kinetics were found. The diffusivity increases in the order dibranched quaternary <<< dibranched-α < dibranched-β < monobranched ≈ linear. Size exclusion of quaternary carbon dibranched isomers is demonstrated, with monobranched and linear isomers being preferentially adsorbed on this material. The adsorption capacities and selectivities surpass those of pure silica MFI (Si-MFI) in a factor of ca. 1.5. Altogether, Si-STW is presented as a promising adsorbent for increasing the octane number (ON) of the hydroisomerization product by selectively excluding quaternary carbon dibranched hydrocarbons.

REFERENCES

[1] Ruthven, D. M. Chemie-Ingenieur-Technik, 83 (2011) 44–52
[2] Laredo, G. C.; Trejo-Zarraga, F.; Jimenez-Cruz, F.; Garcia-Gutierrez, J. L., Recent Patents Chem. Eng., 5 (2012) 153–173

FIGURES

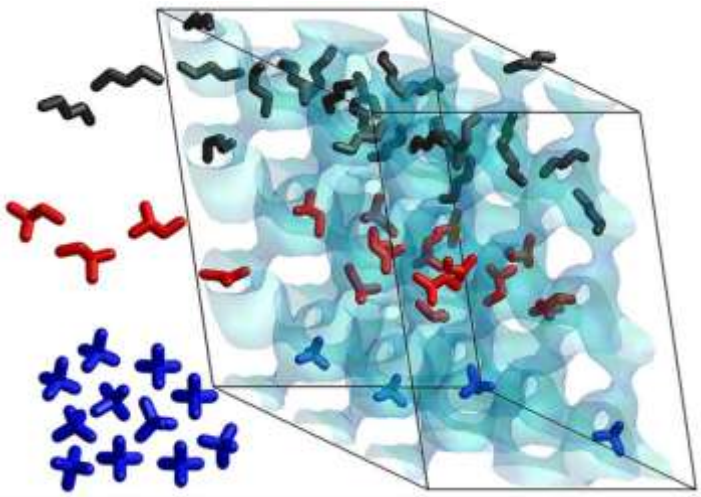

Figure 1: Schematic representation of the adsorptive separation of C5 isomers on Si-STW.