Chemical Papers
https://doi.org/10.1007/s11696-019-00938-z

ORIGINAL PAPER

Application of cyanated asphaltenes in gas-phase adsorption processes for removal of volatile organic compounds

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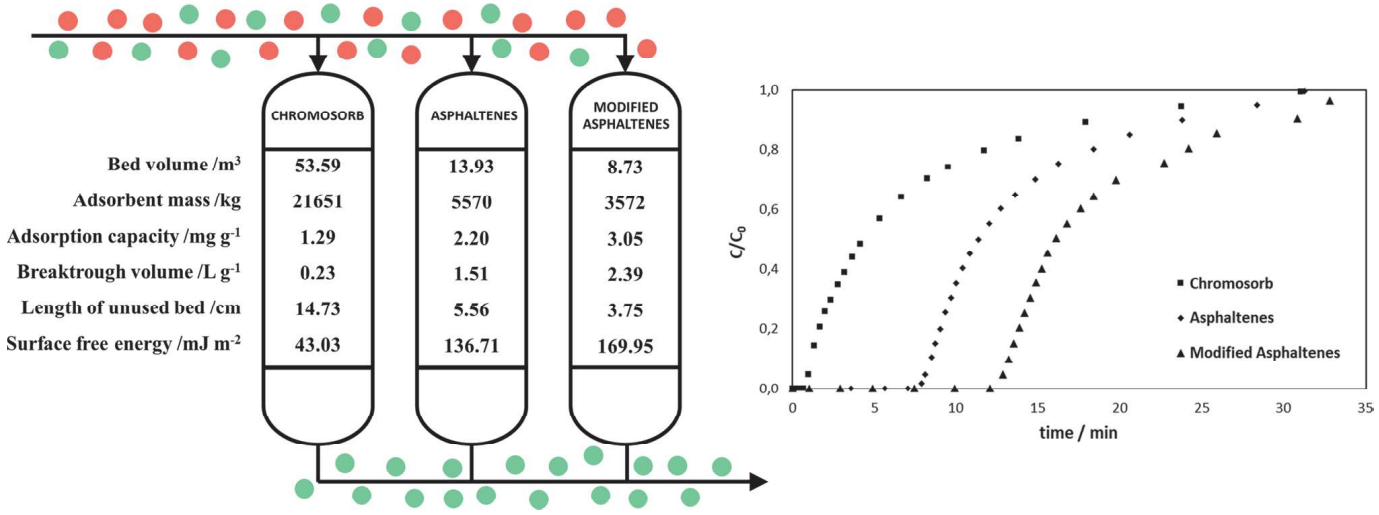
Received: 4 June 2019 / Accepted: 14 September 2019

Abstract

The paper presents an innovative, chemically modified (methylcyanated) asphaltene-based adsorbent that can be an interesting low-cost alternative for traditional adsorbents. Adsorption properties of adsorbents were examined by inverse gas chromatography technique, adsorption isotherms, and breakthrough curves. A significant increase in retention volume for pyridine, 2-pentanone, nitropropane, toluene, and 1-butanol was observed. Rohrschneider–McReynolds constants revealed an increase in strength of interactions as a result of the modification, especially in strong proton–acceptor interaction (by a factor of 4.6). The surface-free energy of asphaltene adsorbents increased from 136.71 to 169.95 mJ m^{-2} after modification. It is similar to the surface-free energy of silica or alumina. Moreover, modified adsorbent shows very high adsorption potential for pyridine. Adsorption isotherms revealed that monolayer adsorption capacity for pyridine increased 1.5 times after modification. Breakthrough curves of pyridine indicate that chemical modification increased the adsorption capacity, removal efficiency, and throughput. Scale-up calculations revealed that adsorption column packed with modified asphaltene adsorbent would be almost two times smaller compared to a column packed with unmodified one.

Graphic abstract



This work was presented at the 44th International Conference of Slovak Society of Chemical Engineering held in Tatranské Matliare on May 21–25, 2018.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s11696-019-00938-z) contains supplementary material, which is available to authorized users.

Extended author information available on the last page of the article

Published online: 21 September 2019