Colloids and Surfaces A: Physicochem. Eng. Aspects 454 (2014) 159–171

Contents lists available at ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

journal homepage: www.elsevier.com/locate/colsurfa

Sorption of volatile organic compounds and their mixtures on montmorillonite at different humidity

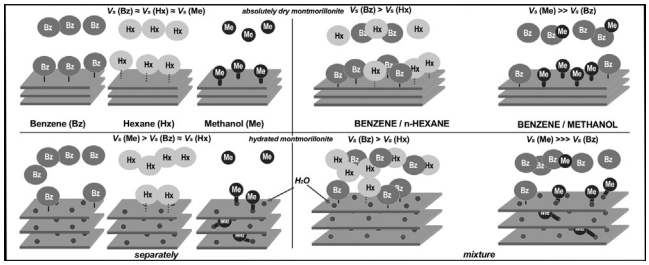
Georgiy Morozov, Vladimir Breus, Sergey Nekludov, Irina Breus *

Kazan Federal University, 18 Kremlevskaja Str., Kazan 420008, Russian Federation

HIGHLIGHTS

- Absolutely dry mineral was non-selective towards benzene, n-hexane and methanol.
- Hydration inhibited sorption of hydrocarbons and promoted that of methanol.
- Binary mixtures even hydrocarbon mixture equal by volume were sorbed competitively.
- Benzene in the mixture was more active than n-hexane at all humidity levels.
- Methanol was dominantly sorbed from benzene/methanol mixtures at all volume ratios.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 20 January 2014
Received in revised form 28 March 2014
Accepted 29 March 2014
Available online 12 April 2014

Keywords:
Vapor-phase sorption
Binary mixtures
Organic compounds
Montmorillonite
Humidity

ABSTRACT

The vapor-phase sorption of volatile organic compounds (VOCs), i.e. n-hexane, benzene and methanol, along with sorption of their binary mixtures, i.e. benzene/n-hexane and benzene-methanol, on montmorilllonite with different water content was studied. The absolutely dry mineral did not exhibit selectivity towards the studied VOCs sorbed separately. The hydration inhibited sorption of hydrocarbons and promoted that of methanol because of intercalation of its molecules to the interlayer space of the swelling mineral and dissolution in the water films on the external mineral surface. Unlike separate sorption of benzene and n-hexane, sorption of their binary mixture on the montmorillonite, even equal by volume, was selective. The components shared the same sorption sites with benzene being more active due to its ability to form the donor–acceptor complexes with the mineral surface in addition to Van-der-Waals interactions. Opposite, in the benzene/methanol mixture the undoubted predominance of hydrophilic methanol over benzene was revealed, which increased with increasing humidity and was significantly stronger compared to the differences in sorption of methanol and benzene sorbed separately. In the binary mixtures unequal by volume, preadsorption played an important role in VOCs competition with sorption of aliphatic n-hexane being suppressed stronger than that of aromatic benzene. In the benzene/methanol mixture, methanol was predominantly sorbed at all the studied volume ratios and hydration degrees, occupying its specific sorption sites. Hydration of the montmorillonite caused the reverse impact on the sorption of benzene and methanol. As a result, at the full hydration state methanol sorption in the mixture reached that of the pure methanol.

* Corresponding author. Tel.: +7 8432337381.
E-mail address: ibreus@ksu.ru (I. Breus).

http://dx.doi.org/10.1016/j.colsurfa.2014.03.104
0927-7757/