C_4 olefin/paraffin separation over the metal organic framework material Cu_3BTC_2

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The separation of olefins and paraffins in refinery product streams is typically achieved by low-temperature distillation. While this process is by nature very energy-intensive, alternatives are sought for based on membrane or adsorptive separation. In the present work, the adsorptive separation of isobutene and isobutane is exemplary studied over porous coordination polymers (metal organic framework materials, MOFs).

Metal-organic frameworks (MOFs) are a new class of porous materials, which are believed to have large potential as adsorbents and catalysts. The materials are hybrid structures of organic and inorganic components. The inorganic part of the framework (a metal center, viz. copper, zinc or cobalt) is connected via an organic-linker possessing more than one coordinating group, viz. a carboxylate moiety. MOFs are interesting materials since they possess high specific pore volumes and in some cases free coordination sites. While most of the materials are prepared by hydrothermal synthesis methods, alternative procedures like electrochemical synthesis have also been suggested [1,2]. In this work, we explore the electrochemical synthesis as well as a novel synthesis under atmosphere pressure and reflux for Cu_3BTC_2. The chemical and physical properties of Cu_3BTC_2 obtained by the former methods are compared to the material which has been synthesized using the classical hydrothermal route described in [3].

The adsorption of isobutene and isobutane on the different C_3BTC_2 materials is measured at temperatures between 30 and 50 °C. While the isobutene adsorption isotherms are of type I according to the IUPAC classification, the shape of the isobutane isotherm is markedly different and closer to type III [4]. It is inferred that isobutene interacts strongly with the copper centers, which allows an efficient separation at low pressure. The results of the breakthrough experiments with the isobutene/isobutene mixture and further details of the physico-chemical characterization will be reported and discussed in the full paper.

References

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