relative to rectilinear cylindrical pores with the same mean pore diameter. Kärger states (ibid., page 96) that the tortuosity factor τ values measured experimentally are typically between 2 and 5.

[0016] Optimum diffusion properties (i.e. optimum mass transfer), optimum adsorption capacities, while at the same time conserving maximum mechanical strength for adsorbents of zeolite structure in the form of agglomerates were obtained by specifically selecting both the porosity and the tortuosity factor.

Object of the invention

[0017] A first object of the present invention is thus to propose zeolite-based adsorbents in the form of agglomerates with optimized properties for the separation of gaseous or liquid mixtures of isomers and more particularly for the gas-phase or liquid-phase separation of xylenes, especially of para-xylene from C8 aromatic fractions. The zeolite-based adsorbents of the invention especially have maximum selectivity properties for para-xylene and maximum mass transfer properties, while at the same time having improved strength and a high adsorption capacity per unit volume of adsorbent, and are particularly suitable for use in a process for the liquid-phase separation of para-xylene, preferably of simulated counter-current type.

Summary

[0017a] In one aspect of the present disclosure, there is provided a zeolite-based adsorbent in the form of agglomerates, said adsorbent having:

- a tortuosity factor τ, calculated from the pore distribution determined by mercury intrusion porosimetry, strictly greater than 1 and strictly less than 3;

- a porosity $\varepsilon_p = \frac{Vma + Vme}{Vg}$, determined by mercury intrusion porosimetry, in which V_{ma} denotes the macropore volume, V_{me} denotes the mesopore volume and Vg denotes the grain volume, of between 25% and 35%, the volumes being expressed in $cm^3.g^{-1}$.

[0017b] In another aspect of the present disclosure, there is provided a process for preparing a zeolite-based adsorbent as disclosed herein, comprising at least following steps:

a) a step of mixing crystals of at least one zeolite with an agglomeration binder containing at least 80%, preferably at least 90% and more preferably at least 95% by weight of zeolitizable clay, and optionally a source of silica, followed by forming and a firing step at a temperature of between 500 and 700°C,

b1) a first step of zeolitization by placing the material obtained in step a) in contact with an alkaline basic solution, with a concentration of between 0.2 M and 0.9 M, limits inclusive,

b2) a second step of zeolitization by placing the material obtained in step b1) in contact with an alkaline basic solution, with a concentration of between 1.2 M and 4.0 M, limits inclusive,

b1 and b2 possibly being performed in any order and b1 and/or b2 possibly being repeated,

c) an optional step of cationic exchange of the cations contained in the reaction medium obtained from the zeolitization steps by placing in contact with a solution of barium ions or of barium ions and potassium ions,

d) a step of washing and drying the material thus obtained, and

e) a step of activation of the material obtained in step d), by heating to a temperature of between 100°C and 400°C, and recovery of the zeolite-based adsorbent in the form of agglomerates.

[0017c] In a further aspect of the present disclosure, there is provided a process for separating *para*-xylene from aromatic hydrocarbon isomer fractions containing 8 carbon atoms, in the liquid phase, by absorption of *para*-xylene using an adsorbent as disclosed herein or which may be prepared by a process as disclosed herein, in the presence of a desorbent.

[0017d] In another aspect of the present disclosure, there is provided a process for separating *para*-xylene from aromatic hydrocarbon isomer fractions containing 8 carbon atoms, in the gaseous phase, by absorption of *para*-xylene using an adsorbent as disclosed herein or which may be prepared by a process as disclosed herein, in the presence of a desorbent.

[0018] The present disclosure relates to a zeolite-based adsorbent in the form of agglomerates, said adsorbent having:

- a tortuosity factor τ, calculated from the pore distribution determined by mercury intrusion porosimetry, strictly greater than 1 and strictly less than 3;

- a porosity $\varepsilon_p = \frac{Vma + Vme}{Vg}$, determined by mercury intrusion porosimetry, in which V_{ma} denotes the macropore volume, V_{me} denotes the

mesopore volume and Vg denotes the grain volume, of between 25% and 35%, the volumes being expressed in $cm^3.g^{-1}$.

[0019] Preferably, the tortuosity factor τ is between 1.5 and 2.7.

[0020] The high mechanical bulk crushing strength (BCS), measured via the Shell method series SMS1471-74 adapted for agglomerates less than 1.6 mm in size, is generally greater than or equal to 1.0 MPa.

[0021] Said adsorbent advantageously has a size of between 0.1 mm and 1 mm, limits inclusive.

[0022] Said adsorbent may comprise a zeolite chosen from zeolites of FAU structure, preferably zeolite X, alone or as a mixture with other zeolites.

[0023] Said adsorbent may comprise more than 90% by weight of zeolite(s).

[0024] Said zeolite(s) are advantageously in the form of crystals between 10 nm and 1500 nm in size. Preferably, the pore distribution satisfies the inequalities a) and/or b) below:

a) $$\frac{Vme}{Vme + Vma} \leq 0.1,$$

b) $$0.4 \leq \frac{Vmi}{Vma + Vme + Vmi}.$$

Vmi denoting the micropore volume expressed in $cm^3.g^{-1}$, determined by nitrogen adsorption.

[0025] The zeolite-based adsorbent may also comprise barium and/or potassium.

[0026] The present disclosure also relates to a process for preparing said zeolite-based adsorbent, comprising at least the following steps:

a) a step of mixing crystals of at least one zeolite with an agglomeration binder containing at least 80%, preferably at least 90% and more preferably at least 95% by weight of zeolitizable clay, and optionally a source of silica, followed by forming and firing the agglomerates at a temperature of between 500 and 700°C;

b1) a first step of zeolitization by placing the zeolite-based agglomerates obtained in step a) in contact with an alkaline basic solution, with a concentration of between 0.2 M and 0.9 M, limits inclusive;

b2) a second step of zeolitization by placing the zeolite-based agglomerates obtained in step b1) in contact with an alkaline basic solution, with a concentration of between 1.2 M and 4.0 M, limits inclusive;

b1 and b2 possibly being performed in any order and b1 and/or b2 possibly being repeated;

c) an optional step of cationic exchange of the cations contained in the reaction medium obtained from the zeolitization steps by placing in contact with a solution of barium ions or of barium ions and potassium ions;

d) a step of washing and drying the zeolite-based agglomerates thus obtained; and

e) a step of activation by heating to a temperature of between 100°C and 400°C of the zeolite-based adsorbent in the form of agglomerates obtained in step d).

[0027] The process may comprise one or more additional forming steps performed after any one of steps a), b1)/b2), c), d) or e).

[0028] The present disclosure also relates to a process for separating *para*-xylene from aromatic hydrocarbon isomer fractions containing 8 carbon atoms, in the liquid phase, by absorption of *para*-xylene using said adsorbent or an adsorbent that may be prepared according to the preparation process in the presence of a desorbent.

[0029] The present disclosure also relates to a process for separating *para*-xylene from aromatic hydrocarbon isomer fractions containing 8 carbon atoms, in the gaseous phase, by adsorption of the *para*-xylene using said adsorbent or an adsorbent that may be prepared according to the preparation process in the presence of a desorbent.