

has an advantage over a conventional single bed xylene isomerization catalyst in that it affords lower xylene losses. However, in order to maximize p-xylene yields from dual bed catalyst systems, the xylene isomerization component should demonstrate high xylene isomerization activity, but low xylene loss activity to prevent degradation of catalytic selectivity.

MFI aluminosilicate molecular sieves are employed commercially for hydrocarbon conversion reactions including isomerization of xylenes in xylene isomers and C₈ aromatics to produce p-xylene. Commercial MFI aluminosilicate molecular, however, also typically catalyze transalkylation side-reactions, and in particular transmethylation reactions of xylenes that reduce the yield of p-xylene product. For example, typical MFI aluminosilicate molecular sieves cause some degree of xylene-xylene transmethylation and xylene-ethylbenzene transmethylation, resulting in undesirable conversion of xylenes to C₇ and C₉ products. In addition, typical commercial MFI aluminosilicate molecular sieves have difficulty achieving a high degree of xylene isomerization such that the product xylene mixture is below thermodynamic equilibrium. Thus, there continues to be a need for improved xylene isomerization catalysts that can maximize yields of p-xylene while minimizing xylene loss to transmethylation reactions.

BRIEF SUMMARY OF THE INVENTION

The present ~~invention-disclosure~~ provides MFI aluminosilicate molecular sieves having unexpectedly high xylene isomerization activity while simultaneously yielding less transmethylation byproducts (C₇ and C₉ aromatics) compared to industry standard catalysts. Also provided are methods for use of these MFI aluminosilicate molecular sieves for enriching the p-xylene content of a hydrocarbon-containing feed stream comprising xylene isomers. Such catalysts include MFI aluminosilicate molecular sieves that can be prepared, for example, from tetra-functional orthosilicate precursors, such as tetraethylorthosilicate.

Accordingly, in one aspect, ~~the invention provides~~ there is provided a method for increasing the proportion of p-xylene (pX) in a hydrocarbon-containing feed stream comprising xylene isomers. The method includes contacting the hydrocarbon-containing feed stream with an isomerization catalyst under conditions suitable to yield a stream enriched in p-xylene with respect to the hydrocarbon-containing feed stream, in which the isomerization catalyst includes a MFI aluminosilicate molecular sieves prepared using a silicon source ~~including, for example, comprising~~ a compound of the formula, Si(OR₁)(OR₂)(OR₃)(OR₄), wherein R₁R₂R₃R₄ is each independently C₁₋₁₀alkyl or aryl.

In another aspect, ~~the invention provides~~ there is provided a methods for of increasing the proportion of p-xylene (pX) in a hydrocarbon-containing feed stream comprising xylene isomers, said method comprising: contacting the hydrocarbon-containing feed stream with an isomerization catalyst under conditions suitable to yield a stream enriched in p-xylene with respect to the hydrocarbon-containing feed stream, in which the isomerization catalyst includes a MFI aluminosilicate molecular sieve; and the pX enriched stream contains at least 23.5 wt.% pX/X and less than 1.5 wt.% net toluene byproduct, ~~where pX/X is the ratio of p-xylene to total xylenes in the stream, as defined below,~~ ~~and less than 1.5 wt.% net toluene byproduct.~~

In yet another aspect, ~~the invention provides~~ there is provided a methods for of increasing the proportion of p-xylene (pX) in a hydrocarbon-containing feed stream including xylene isomers, said method including: contacting the hydrocarbon-containing feed stream with an isomerization catalyst under conditions suitable to yield a stream enriched in p-xylene with respect to the hydrocarbon-containing feed stream, in which the isomerization catalyst includes a MFI aluminosilicate molecular sieve; and the pX enriched stream contains at least 23.8 wt.% pX/X and less than 0.6 wt.% net trimethylbenzene byproduct.

In another aspect, ~~the invention provides~~ there is provided a methods for of increasing the proportion of p-xylene (pX) in a hydrocarbon-containing feed stream including xylene isomers, said method including: contacting the hydrocarbon-containing feed stream with an isomerization catalyst under conditions suitable to yield a stream enriched in p-xylene with respect to the hydrocarbon-containing feed stream, in which the isomerization catalyst includes a MFI aluminosilicate molecular sieve; and the pX enriched stream contains at least 23.5 wt.% pX/X and a ratio of pX/X to the sum of net wt.% trimethylbenzene byproduct and net wt.% toluene byproduct of greater than 4.0.

In another aspect, ~~the invention provides~~ there is provided a catalyst systems for enriching a xylene isomers feed in p-xylene including a first bed including an ethylbenzene (EB) conversion catalyst and a second bed including an isomerization catalyst that is a MFI aluminosilicate catalyst, such as a MFI aluminosilicate molecular sieve, prepared using a silicon source that includes a compound of the formula, $\text{Si}(\text{OR}_1)(\text{OR}_2)(\text{OR}_3)(\text{OR}_4)_4$, wherein $\text{R}_1\text{R}_2\text{R}_3\text{R}_4$ is each independently a C₁₋₁₀alkyl or aryl.

In another aspect, ~~the invention provides~~ there is provided a xylene isomerization reactor having a reaction zone containing a catalyst system as described above.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1a is a flow diagram illustrating one illustrative embodiment of a method for xylene isomerization.