(12) PATENT ABRIDGMENT (11) Document No. AU-B-43772/89
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 614676

(54) Title
PROCESS FOR THE PRODUCTION OF ALKYLBENZENES USING A CATALYST BASED ON MODIFIED MORDENITE

(51)[4] International Patent Classification(s)
C07C 002/66 C07C 015/073 C07C 015/085

(21) Application No. : **43772/89** (22) Application Date : **25.10.89**

(30) Priority Data

(31) Number	(32) Date	(33) Country
88 14099	**26.10.88**	**FR FRANCE**

(43) Publication Date : **03.05.90**

(44) Publication Date of Accepted Application : **05.09.91**

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(56) Prior Art Documents
AU 25517/88 C07C
US 3849340
US 3763260

(57) Claim

1. Process for the production of at least one alkylbenzene, in which benzene is reacted with a charge containing at least one aliphatic monoolefin in the presence of at least one catalyst, characterized in that said catalyst is based on a dealuminated mordenite with a total Si/Al atomic ratio between 30 and 80.

614676

AUSTRALIA

PATENTS ACT 1952

Form 10

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

Short Title:

Int. Cl:

Application Number:
Lodged:

Complete Specification-Lodged:
Accepted:
Lapsed:
Published:

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

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Complete Specification for the invention entitled:
PROCESS FOR THE PRODUCTION OF ALKYLBENZENES USING A CATALYST BASED ON MODIFIED MORDENITE.

The following statement is a full description of this invention including the best method of performing it known to me:-

The present invention relates to a process for the production of at least one alkylbenzene by the alkylation of benzene by means of monoolefin(s). The starting monoolefin or monoolefin mixture can come from any known source, e.g. catalytic cracking or steam cracking units.

The use of H zeolites, in particular ZSM5 (EP 0,104,729) has already been proposed for carrying out this reaction. More recently other zeolites have been advanced and in particular certain mordenites, alone or mixed with faujasite (US Patent 3 436 432), optionally with a metal of group VIII deposited above it (US Patent 3 851 004). Japanese Patents 58-216128 and 58-159427 recommend mordenites alone, which have a low Si/Al ratio (of 4.5 to 5) and which contain metal ions such as Mg, K, Ca or in the form of H^+ (JP 041670).

The object of the present invention is to improve the alkylation yield of mono alkylbenzenes by reducing the proportion of polyalkyl benzenes formed.

According to this process, benzene is reacted with a charge containing at least one aliphatic monoolefin in contact with at least one catalyst based on dealuminated mordenite with a total Si/Al atomic ratio between 30 and 80 and preferably 40 and 80, the product being fractionated to collect at least one mono alkylbenzene. This reaction will be called "alkylation" hereinafter.

According to a preferred variant of this process, benzene is firstly reacted (first stage or alkylation stage) with a charge containing at least one aliphatic monoolefin in contact with at least one catalyst based on dealuminated mordenite having a total Si/Al atomic ratio between 30 and 80 and preferably 40 and 80, the product is fractionated so as to separately collect a first fraction containing unconverted benzene and at least one mono alkylbenzene and a second polyalkylbenzene fraction (i.e. a fraction containing at least one polyalkylbenzene).

In a second stage (transalkylation stage), at least part of said polyalkylbenzene fraction is reacted with benzene, e.g. with benzene, whereof at least part is constituted by benzene unconverted in the first stage (i.e. unconverted benzene from the first fraction obtained in the first stage), or e.g. with benzene, whereof at least part is not constituted by benzene unconverted in the first stage, in contact with at least one catalyst based on a dealuminated mordenite with a total Si/Al atomic ratio between 30 and 80, preferably 40 and 80 and at least one mono alkylbenzene is collected (the catalyst of the second stage generally being different from that of the first stage).

The excess benzene of the first stage which is not supplied to the second stage is advantageously recycled in the first stage, whilst, after the second stage, the unconverted polyalkylbenzenes can be recycled in said same second stage.

Thus, the mono alkylbenzenes obtained by the preferred two-stage variant of the process according to the invention on the one hand come from the first fraction obtained in the first stage (whereby said fraction can itself be fractionated into unconverted benzene and into at least one mono alkylbenzene) and, on the other hand, from the reaction (second stage) of the second fraction obtained in the first stage with benzene.

The dealuminated mordenite is used alone or mixed with a binder or a matrix generally chosen from the group formed by clays, aluminas, silica, magnesia, zirconia, titanium dioxide, boron oxide and any combination of at least two of the aforementioned compounds such as silica-alumina, silica-magnesia, etc. All the known agglomeration and shaping methods can be used, such as e.g. extrusion, pelleting, coagulation into droplets, etc.

The process according to the invention uses thus at least one catalyst based on dealuminated mordenite with a total Si/Al atomic ratio between 30 and 80 and preferably between 40 and 80, generally containing 1 to 100% , preferably 20 to 98% and e.g. 40 to 98% by weight of said dealuminated mordenite and 0 to 99%, preferably 2 to 80% and e.g. 2 to 60% by weight of a matrix.

Dealuminated mordenites and their preparation are known. Reference can e.g. be made to European Patents 84748, 97552 and 196965 and to French patent application 87/12932. The dealumination

method of the aforementioned Patents and patent application consists of subjecting the H form of the mordenite or the H form precursor (e.g. the NH_4 form) to a series of heating operations in a steam atmosphere and acid treatments. However, unlike in the case of the treatments of the aforementioned specifications, the dealumination rate is limited here to a total Si/Al atomic ratio between 30 and 80. Page 4 of European Patent 84748 also describes preparations leading to total Si/Al atomic ratios of 46 and 82. The preferred method is the following one :

In a first stage the non-decomposible cations, generally Na^+, present in the starting mordenite are eliminated. For this purpose, it is possible to carry out one or more exchanges in dilute solutions of acids such as HCl or in solutions of NH_4^+, optionally followed by one or more washing operations (e.g. using water). The important point is that, following said first stage, which can be called decationization, almost all the alkaline cations are eliminated (Na content e.g. between 150 and 2000 ppm by weight and preferably between 300 and 1200 ppm by weight) and the solid obtained is in the H form or in the form of a H form precursor (e.g. NH_4^+), which is not substantially dealuminated (dealumination rate generally below 10% and preferably 5%). In preferred manner, the H form precursor is NH_4^+. In a second stage, the H form or H form precursor undergoes a treatment under water vapour or steam at a temperature above 450°C, e.g. between 450 and 650°C and preferably between 550 and 600°C. The volume water content

of the calcination atmosphere advantageously exceeds 20% and, in preferred manner, 40%. Acid attack constitutes the third stage of preparing catalysts. For skeleton Si/Al atomic ratios (of the solid after calcination) up to approximately 50, preferably use is made of concentrations of acid solutions (HCl, H_2SO_4, HNO_3, etc..) between 0.5 and 5 N and preferably between 1 and 4N. For higher skeleton Si/Al atomic ratios, use is made of concentrations of acid solutions between 5 and 20 N and preferably between 7 and 12 N (the skeleton Si/Al atomic ratios can be determined by infrared spectroscopy for ratios between 10 and 50 and by NMR of ^{29}Si for higher ratios). Moreover, in order to obtain high Si/Al atomic ratios, i.e. higher than approximately 50 and more specifically higher than approximately 60, advantageously several steam calcination-acid attack cycles are performed.

The thus prepared solids advantageously have total Si/Al atomic ratios between 30 and 80 and preferably between 40 and 80. They have a unit cell volume between 2.755 and 2.730 nm^3 ($1nm = 10^{-9}m$) and preferably between 2.745 and 2.735 nm^3. They preferably have an adequate acid strength to enable the structural Al-OH to interact with a weak base such as ethylene (infrared measurement at 77K), or a compound with a weakly acid character such as H_2S (infrared measurement at 25°C). These solids must also preferably be free from extra-network cationic species which can be detected by a fine or precision signal (mid-height width below 5 ppm and preferably below 2 ppm) located at 0 ppm (refer-

ence $Al(H_2O)_6^{3+}$) on a NMR spectrum of ^{27}Al measured by the magic angle rotation method,

The alkylation reaction is normally performed in the liquid phase, supercritical phase or gas phase, in the presence of at least one catalyst based on dealuminated mordenite as defined hereinbefore, arranged in a fixed bed, at a temperature of approximately 50 to 450°C (preferably approximately 100 to 350°C), under a pressure of 1 to 10 MPa (preferably 2 to 7 MPa), with a liquid hydrocarbon flow rate (space velocity) of approximately 0.5 to 50 volumes per catalyst volume and per hour and with a benzene/monoolefin molar ratio between 1 and 20 (preferably between 3 and 7 for propene and between 5.5 and 12 for ethylene).

The transalkylation reaction of the polyalkyl benzenes formed during the alkylation stage is normally carried out in the presence of at least one catalyst based on dealuminated mordenite defined hereinbefore, disposed in the form of a fixed bed, at a temperature of approximately 200 to 500°C (preferably approximately 280 to 400°C), under a pressure of 2 to 10 MPa (preferably 3 to 7 MPa), with a liquid hydrocarbon flow rate (space velocity) of approximately 0.5 to 5 volumes per catalyst volume and per hour and with a benzene/polyalkylbenzene molar ratio of 0.2 to 10.

The transalkylation stage can optionally be performed in the presence of hydrogen (hydrogen/hydrocarbon molar ratio e.g.

between 2 and 6).

Although the invention can be carried out with a mixture of mono olefins, e.g. a catalytic cracking effluent, preference is given, for facilitating fractionation between monoalkylbenzenes and polyalkylbenzenes when carrying out a subsequent transalkylation, to working with a single monoolefin, e.g. ethylene, propylene, a n-butene or isobutene and more generally with an aliphatic monoolefin having e.g. 2 to 20 carbon atoms.

The treatment of the mixture of monoolefins containing carbon monoxide, e.g. 0.1 to 2.0% by weight, which is often the case with cracking effluents is of particular interest. Thus, the presence of carbon monoxide has no prejudicial effect, contrary to what has been observed with conventional nickel-containing catalysts.

On using a transalkylation for simplifying the performance of the invention, it is possible to use a single distillation zone for the effluents of the two possible stages of the process (alkylation and transalkylation) according to any procedure well known to the person skilled in the art.

The following examples illustrate the invention without limiting its scope.

Example 1A: Preparation of three catalysts B1, B2 and B3.

The starting material used for preparing these various catalysts is a small-pore mordenite manufactured by Société Chimique de la Grande Paroisse, reference Alite 150. In the anhydrous state, its chemical formula is Na, $AlO_2(SiO_2)_{5.5}$ and it contains 5.3% by weight sodium. 500 grammes of this powder are immersed in a 2 M ammonium nitrate solution and the suspension is heated to 95°C for 2 hours. The volume of the ammonium nitrate solution used is equal to 4 times the dry mordenite weight (vol/wt = $4 g/cm^3$). This cation exchange operation is repeated three times. After the third exchange, the product is washed with water at 20°C for 20 minutes, with a vol/wt ratio equal to $4 g/cm^3$. The sodium content expressed as a percentage by weight relative to the dry mordenite is now only 0.1%. The product is then filtered and different batches undergo calcination under steam in a confined atmosphere (self-steaming), at a temperature which varies as a function of the degree of dealumination of the skeleton which it is wished to obtain (table 1). The calcination time is 2 hours. The (volume) water content of the calcination atmosphere is approximately 90%. The crystallinity of the different solids, following said calcination stage, is equal to or higher than 90%.

On each of the solids, an acid attack is then carried out with the aid of a nitric acid solution, whose concentration rises

in proportion to the dealumination rate of the skeleton obtained during the preceding stage (table 1). During the acid attack, the solid is refluxed in the nitric acid solution for 2 hours with a vol/wt ratio of 8 g/cm^3. The product is then filtered and abundantly washed with distilled water. The Si/Al atomic ratios obtained for each of the mordenites appear in table 1.

Each mordenite is then shaped by kneading with alumina and then by passing through a die. The diameter 1.2 mm extrudates obtained are then dried and calcined at between 150 and 500°C per approximately one hour stage. Mordenite-based catalysts B1, B2 and B3 are then obtained, which contain 80% by weight mordenite and 20% by weight alumina.

TABLE 1

CATALYST	B1	B2	B3
Calcination temperature (°C)	510	560	600
Total Si/Al atomic ratio * of the mordenite	5.5	5.5	5.5
Skeleton Si/Al IV atomic ratio of the mordenite	11	49	86
Normality of the nitric acid solution	1N	3.5N	10N
Total Si/Al atomic ratio ** of the mordenite	11	49	86

* after calcination

** after acid attack

Example 1B: Preparation of 3 catalysts B'1, B'2 and B'3.

These catalysts differ from those described in Example 1A, in that the starting material used for preparing them is no longer the Alite 150 mordenite of the Société Chimique de la Grande Paroisse, but a wide-pore mordenite of TOYO-SODA, designated TSZ 600 NAA. In the anhydrous state, its chemical formula is Na, $AlO_2(SiO_2)_{5.1}$ and it contains 5.7% by weight sodium.

The exchange, calcination, acid attack, shaping and calcination stages are all performed under the same conditions as described in Example 1A. The atomic Si/Al ratios obtained differ only very slightly (table 2). The catalysts obtained (B'1, B'2 and B'3) also contain 80% by weight mordenite and 20% by weight alumina.

TABLE 2

CATALYST	B'1	B'2	B'3
Calcination temperature (^{o}C)	510	560	600
Total Si/Al atomic ratio * of the mordenite	5.1	5.1	5.1
Skeleton Si/Al IV atomic ratio of the mordenite	10	47	83
Normality of the nitric acid solution	1N	3.5N	10N
Total Si/Al atomic ratio ** of the mordenite	10	47	83

* after calcination

** after acid attack

Example 2A:

The three catalysts B1, B2 and B3, prepared in Example 1A, are each tested in alkylation of the benzene by propene under the following operating conditions (in a so-called alkylation reactor):

temperature: 160^{o}C

pressure: 4.5 MPa

hourly weight flow of benzene equal to 2.5 times the catalyst weight.

benzene/propene molar ratio = 5.

The weight composition of the charge is 0.22% propane, 9.78% propene and 90% benzene.

On leaving the reactor, the products obtained with each of the catalysts B1, B2 and B3 have the weight composition in table 3. Each product is then fractioned by distillation and two fractions are collected :

a starting point fraction under 160°C containing unconverted benzene and cumene,

a boiling point fraction above 160°C containing the polyisopropyl benzenes and heavy aromatic hydrocarbons (or HC).

Each fraction with a boiling point above 160°C then undergoes a transalkylation treatment in the presence of the same catalysts B1, B2 or B3 (different from that used in alkylation) under the following operating conditions (in a so-called transalkylation reactor):

temperature: 330°C

pressure: 4.5 MPa

charge weight flow (polyisopropylbenzenes + heavy aromatic hydrocarbons + additional benzene (obtained from the alkylation reaction product)) equal to 2.5 times the catalyst weight.

The results obtained (for the transalkylation-dealkylation treatment) are given in table 4. The overall results combining the two stages of alkylation on the one hand and transalkylation on the other are given in table 5. The tests are then continued for a long period in order to prove the evolution of the

performances as a function of time. The results combining the two stages are given in table 6.

On considering these results, it can be seen that it is preferable to work with the catalysts recommended by the invention (both with regards to the overall results and with regards to the particular results obtained in the two stages of the process), i.e. it is necessary to use dealuminated mordenites with a total Si/Al atomic ratio between 30 and 80 and preferably between 40 and 80 (case of catalyst B2). Thus, the mordenites with a total Si/Al atomic ratio below 30 (case of catalyst B1) are slightly more active, but decidedly less selective and not very stable. However, the mordenites with a total Si/Al atomic ratio above 80 (case of catalyst B3) are slightly more selective, but much less active and have a lower stability.

With regards to the industrial performance of this type of process, the diisopropylbenzenes and triisopropylbenzenes not transformed after the transalkylation stage are recycled to extinction in the transalkylation reactor. In this case, using catalyst B2 (in two stages) the ultimate performances are as follows:

1) Conversion rate:

benzene : 18.7%

propene : 100%

2) Selectivity:

cumene relative to transformed benzene : 99.4%

cumene relative to transformed propene : 93.2%.

TABLE 3

CONSTITUENTS (% by weight) \ CATALYSTS		B1	B2	B3
	CHARGE			
Methane	-	0.20	-	-
Ethane	-	0.22	-	-
Propane	0.22	0.65	0.22	0.22
Propene	9.78	-	-	2.09
Butanes	-	0.09	-	-
Benzene	90	74.91	73.61	76.35
Cumene	-	21.34	23.22	20.25
Diisopropylbenzenes	-	1.08	1.89	0.76
Triisopropylbenzenes	-	1.01	0.66	0.20
Heavy aromatic HC	-	0.50	0.40	0.13
	100	100	100	100
Conversion rate per pass				
Propene		100%	100%	78.6%
Benzene		16.8%	18.2%	15.2%
Selectivities				
$\frac{\text{Cumene}}{\text{transformed propene}} \times 100$		76.4%	83.1%	92.2%
$\frac{\text{Cumene}}{\text{transformed benzene}} \times 100$		91.9%	92.1%	96.4%

TABLE 4

CATALYSTS / CONSTITUENTS (% by weight)	B1	B2	B3
CHARGE			
Hydrogen	0.22	0.27	0.10
Benzene	1.09	1.31	0.49
Diisopropyl benzenes	1.08	1.89	0.76
Triisopropyl benzenes	1.01	0.66	0.20
Heavy aromatic HC	0.50	0.40	0.13
	3.90	4.53	1.68
PRODUCT			
Hydrogen	0.22	0.27	0.10
Methane	0.01	-	-
Ethane	0.02	0.02	-
Propane	0.12	0.03	0.01
Butanes	0.01	-	-
Benzenes	0.76	0.97	0.39
n propyl benzene	0.02	-	-
Cumene	1.93	2.18	0.66
Trimethyl benzenes	0.05	-	-
Diisopropyl benzenes	0.03	0.32	0.28
Triisopropyl benzenes	0.18	0.28	0.11
Heavy aromatic HC	0.55	0.40	0.13
	3.90	4.53	1.68
Conversion rate per pass			
Benzene	30.3%	26%	20.4%
Diisopropyl benzenes	97.2%	83.1%	63.2%
Triisopropyl benzenes	82.2%	57.6%	45 %
Selectivity: $\frac{\text{Cumene formed}}{\text{benzene+diisopropyl benzenes+ transformed triisopropyl benzens}} \times 100$	87.3%	95.2%	98.5%

TABLE 5

RESULTS \ CATALYSTS	B1	B2	B3
TRANSFORMED REAGENTS (% by weight)			
Benzene	15.42	16.73	13.75
Propene	9.78	9.78	7.69
TOTAL	25.20	26.51	21.44
PRODUCTS FORMED (% by weight)			
Methane	0.21	-	-
Ethane	0.24	0.02	-
Propane	0.55	0.09	0.01
Butanes	0.10	-	-
n propyl benzene	0.02	-	-
Cumene	23.27	25.40	20.91
Trimethyl benzenes	0.05	-	-
Diisopropyl benzenes	0.03	0.32	0.28
Triisopropyl benzenes	0.18	0.28	0.11
Heavy aromatic HC	0.55	0.40	0.13
TOTAL	25.20	26.51	21.44
CONVERSION RATE			
Benzene	17.1%	18.6%	15.3%
Propene	100%	100%	78.6%
SELECTIVITY			
1) Cumene formed relative to the transformed benzene	98.1%	98.7%	98.9%
2) Cumene formed relative to the transformed propene	83.3%	90.0%	95.2%

TABLE 6

CATALYST AGE IN HOURS / RESULTS	24	144	528	1296
CATALYST B1				
1) CONVERSION RATE				
Benzene	17.1%	16.6%	16 %	7.6%
Propene	100%	100%	99.2%	78.8%
2) SELECTIVITY				
Cumene formed relative to the transformed benzene	98.1%	98.4%	98.8%	99.3%
Cumene formed relative to the transformed propene	83.3%	83.9%	84.2%	85.2%
CATALYST B2				
1) CONVERSION RATE				
Benzene	18.6%	18.5%	18.4%	18.2%
Propene	100%	100%	100%	100%
2) SELECTIVITY				
Cumene formed relative to the transformed benzene	98.7%	98.9%	99.1%	99.4%
Cumene formed relative to the transformed propene	90.9%	91 %	91.4%	92.2%
CATALYST B3				
1) CONVERSION RATE				
Benzene	15.3%	15.1%	14.5%	13.2%
Propene	78.6%	77.9%	76.9%	72 %
2) SELECTIVITY				
Cumene formed relative to the transformed benzene	98.9%	99 %	99.2%	99.5%
Cumene formed relative to the transformed propene	95.2%	95.6%	95.8%	96.6%

Example 2B

The three catalysts B'1, B'2 and B'3, prepared in Example 1B, are also in each case tested under the same operating conditions and with the same charge as catalysts B1, B2 and B3, the overall results combining the two stages of the process (alkylation and transalkylation) are given in table 7.

TABLE 7

CATALYSTS / RESULTS	B'1	B'2	B'3
CONVERSION RATE			
Benzene	17.8%	18.9%	16.5%
Propene	100%	100%	83.8%
SELECTIVITY			
1) Cumene formed relative to the transformed benzene	94.6%	98.5%	98.7%
2) Cumene formed relative to the transformed propene	81.7%	90.7%	95.9%

As in the case of example 2A, it can be seen that it is preferable to work with the catalysts recommended by the invention, i.e. it is necessary to use mordenites with a total Si/Al atomic ratio between 30 and 80 and preferably between 40 and 80.

Example 3

Using catalyst B2 of example 1A and the operating conditions of example 2A in the alkylation and transalkylation sections, the benzene/propene molar ratio is varied on entering the alkylation reactor, in order to demonstrate the importance of this parameter on the activity and in particular on the selectivity of the catalyst. The overall results combining the two stages of alkylation on the one hand and transalkylation on the other are given in table 8.

It is possible to see the considerable influence of this parameter on the catalyst selectivity. As recommended by the invention, it is preferable to work with a benzene/propene molar ratio between 3 and 7. Thus, for benzene/propene molar ratios below 3, the selectivity is relatively low. For benzene/propene molar ratios higher than 7, if the selectivity is good, it is necessary to adopt very high benzene recycling levels, which is highly prejudicial to the total economy of the process.

TABLE 8

BENZENE / PROPENE molar — RESULTS	1.11	2.49	4.96	7.92
CONVERSION RATE				
Benzene	71%	35.1%	18.6%	12.4%
Propene	100%	100%	100%	100%
SELECTIVITY				
1) Cumene formed relative to the transformed benzene	94.2%	97.5%	98.7%	99.3%
2) Cumene formed relative to the transformed propene	74.4%	85.3%	90.9%	97.5%

EXAMPLE 4

The three catalysts B1, B2 and B3, prepared in example 1A, are in each case tested in alkylation of the benzene by ethylene under the following operating conditions (in an alkylation reactor):

temperature : 200°C

pressure: 4.5 MPa

benzene weight ratio equal to 2.5 times the catalyst weight;

benzene/ethylene molar ratio equal to 6.7.

The charge has the following weight composition:

ethylene: 5.07%

benzene: 94.93%

On leaving the reactor, each product obtained is fractionated and two fractions are collected:

a fraction with an initial point of under 140°C containing the unconverted benzene and the ethyl benzene,

a fraction with a boiling point above 140°C containing the polyethyl benzenes and heavy aromatic hydrocarbons (or HC).

Each fraction with a boiling point of above 140°C then undergoes a transalkylation treatment in the presence of the same catalyst B1, B2 or B3 (different from that used in alkylation) under the following operating conditions (in a transalkylation reactor):

temperature: 370°C

pressure: 4.5 MPa

charge weight flow (polyethyl benzenes + heavy aromatic hydrocarbons + additional benzene coming from the alkylation reaction product) equal to 1.4 times the catalyst weight.

The overall results combining the two stages of alkylation on the one hand and transalkylation on the other are given in table 9.

TABLE 9

CATALYSTS / RESULTS	B1	B2	B3
TRANSFORMED REAGENTS (% by weight)			
Benzene	13.02	11.90	6.99
Ethylene	5.07	5.07	3.04
Total	18.09	16.97	10.03
CONVERSION RATE			
Benzene	13.7%	12.5%	7.4%
Ethylene	100%	100%	60%
SELECTIVITY			
1) Ethyl benzene formed relative to the transformed benzene	80.6%	94.8%	96%
2) Ethyl benzene formed releative to the transformed ethylene	74.3%	79.9%	79.2%

EXAMPLE 5:

The three catalysts B1, B2 and B3, prepared in example 1A, are in each case tested in alkylation of the benzene by gases from a catalytic cracking unit. These gases have the following composition (% by weight):

hydrogen:	0.46
carbon monoxide (CO)	4.49
carbon dioxide (CO_2):	0.36

nitrogen:	15.09
oxygen:	0.26
methane:	23.18
ethane:	23.62
ethylene:	16.50
propane:	2.89
propene:	5.88
butanes:	1.58
butenes:	3.31
pentanes:	0.76
pentenes:	1.62

The operating conditions are as follows (in an alkylation reactor):

temperature : 220°C

pressure : 4.5 MPa

hourly weight flow of benzene equal to 2.5 times the catalyst weight;

benzene/olefin (C2 + C3 + C4 + C5) molar ratio = 7.2.

On leaving the alkylation reactor, and after operating for 24 hours, the results of table 10 are obtained.

TABLE 10

CATALYSTS	B1	B2	B3
CONVERSION RATE PER PASS			
Ethylene	100%	100%	60%
Propene	100%	100%	88.6%
butenes	100%	100%	93%
Pentenes	100%	100%	87%
Benzene	8.6%	11.8%	8.5%
SELECTIVITY			
$\frac{\text{Ethyl benzene + cumene}}{\text{transformed ethylene + propene}} \times 100$	47.9%	70.4%	79.3%
$\frac{\text{Ethyl benzene + cumene}}{\text{transformed benzene}} \times 100$	80.4%	84.6%	89.6%

The product obtained with catalyst B2 is then fractionated by distillation and two fractions were collected:

a fraction with an initial point below 160°C containing the unconverted benzene, ethyl benzene and cumene,

a fraction with a final point above 160°C containing the higher alkyl benzenes and polyalkyl benzenes. This fraction has an ASTM 95% boiling point equal to 224°C. Its octane numbers measured on the CFR engine were as follows:

RON clear : 124

MON clear : 107

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Process for the production of at least one alkylbenzene, in which benzene is reacted with a charge containing at least one aliphatic monoolefin in the presence of at least one catalyst, characterized in that said catalyst is based on a dealuminated mordenite with a total Si/Al atomic ratio between 30 and 80.

2. Process according to claim 1, characterized in that said catalyst is based on a dealuminated mordenite with a total Si/Al atomic ratio between 40 and 80.

3. Process according to one of the claims 1 and 2, characterized in that the reaction product is then fractionated, so as to separately collect a first fraction containing unconverted benzene and at least one monoalkyl benzene and a second fraction containing at least one polyalkyl benzene and in that at least part of said second fraction is reacted with benzene in contact with at least one catalyst based on dealuminated mordenite with a total Si/Al atomic ratio between 30 and 80, and at least one monoalkyl benzene is collected.

4. Process according to claim 3, wherein at least part of the benzene with which said second fraction has been reacted is constituted by unconverted benzene from the first fraction.

5. Process according to one of the claims 3 and 4, wherein the polyalkyl benzenes unconverted during the reaction of the benzene with at least part of said second fraction are recycled in said stage.

6. Process according to one of the claims 1 to 5, wherein each catalyst is placed in a fixed bed.

7. Process according to one of the claims 1 to 6, wherein each charge contains 0.1 to 2.0% by weight of carbon monoxide.

8. Process according to one of the claims 1 to 7, wherein said charge is a catalytic cracking effluent.

9. Process for the production of ethyl benzene according to one of the claims 1 to 8, wherein, during the reaction of the benzene with an ethylene-containing charge, the benzene/ethylene molar ratio is between 5.5 and 12.

10. Process for the production of cumene according to one of the claims 1 to 8 wherein, during the reaction of the benzene with a propene-containing charge, the benzene/propene molar ratio is between 3 and 7.

DATED THIS 25TH DAY OF OCTOBER 1989

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