

PROCESS FOR MAKING XYLENE ISOMER USING
A DEHEPTANIZER WITH A SIDE DRAW RECYCLE

BACKGROUND OF THE INVENTION

[0001] This invention pertains to processes for making xylene isomer using a side draw
5 from a deheptanizer distillation column to provide a high quality xylene isomer product while
achieving at least one of debottlenecking, energy savings and capital savings.

[0002] The xylenes, para-xylene, meta-xylene and ortho-xylene, are important
intermediates which find wide and varied application in chemical syntheses. Para-xylene
upon oxidation yields terephthalic acid which is used in the manufacture of synthetic textile
10 fibers and resins. Meta-xylene is used in the manufacture of plasticizers, azo dyes, wood
preservers, etc. Ortho-xylene is feedstock for phthalic anhydride production. See, for
instance, Robert A. Meyers, HANDBOOK OF PETROLEUM REFINING PROCESSES, Second
Edition, McGraw-Hill, 1997, Part 2, for a discussion regarding making xylenes.

[0003] Xylene isomers from catalytic reforming or other sources generally do not match
15 demand proportions as chemical intermediates, and further comprise ethylbenzene which is
difficult to separate or to convert. Para-xylene in particular is a major chemical intermediate.
Adjustment of isomer ratio to demand can be effected by combining xylene-isomer recovery,
such as adsorption for para-xylene recovery, with isomerization to yield an additional
quantity of the desired isomer. Isomerization converts a non-equilibrium mixture of the
20 xylene isomers which is lean in the desired xylene isomer to a mixture which approaches
equilibrium concentrations. The isomerization results in by-products such as benzene, toluene
and C₉+ aromatics being co-produced. In typical processes, the isomerate is distilled in a
deheptanizer column to provide an overhead containing benzene and toluene and a bottoms
stream containing para-xylene and other C₈ aromatics as well as C₉+ aromatics. The bottoms
25 stream is passed to a xylene distillation column for separation of the C₈ aromatics from the
C₉+ aromatics. The C₈ aromatics are passed to the xylene isomer recovery.

[0004] The feed to the xylene-isomer recovery must be highly free of C₉+ aromatics in
order to meet product quality. Currently, the feed can contain no more than 500 ppm-mass
(mass parts per million) C₉+ hydrocarbons, and preferably less than 100 ppm-mass 1,4-
30 methylethylbenzene. Usually the xylene-containing feeds as well as the recycle from the
deheptanizer column contain significant amounts of C₉+ hydrocarbons, e.g., often in excess

of 2000, or even 3000, ppm-mass. Accordingly, a xylene column is used to separate these C₉+ hydrocarbons from the C₈ aromatics stream to be fed to the xylene-isomer recovery operation. Due to the proximity of the boiling points of C₈ aromatics and C₉ aromatics such as 1,4-methylethylbenzene, the xylene column can be quite large, often with over 90
5 theoretical plates, and involve a high reflux to feed ratio and thus substantial reboiler energy consumption.

[0005] Due to the large scale of commercial facilities to produce xylenes, especially para-xylene, even small improvements in capacity, capital costs or variable costs, such as reboiler energy consumption, can represent a material economic benefit to the xylene-isomer
10 producer.

SUMMARY OF THE INVENTION

[0006] In accordance with this invention, processes for making xylene-isomers are provided in which a deheptanizer is used not only to separate benzene and toluene from a xylene-containing isomer stream, but also to provide a mid-boiling fraction that can be
15 recycled to a xylene-isomer recovery operation while still enabling the xylene product to meet commercial specifications. By so using the deheptanizer, one or more benefits can be obtained including the ability to debottleneck an existing facility, the ability to reduce reboiler energy consumption for the aggregate of xylene column and the deheptanizer, and the ability, in some instances, to eliminate the need for a xylene column.

[0007] In the broad aspects, the processes of this invention comprise: (a) separating at
20 least one xylene isomer from a separation feed stream that contains para-xylene, ortho-xylene, meta-xylene and ethylbenzene and up to 500 ppm-mass C₉+ aromatics, to provide a product fraction containing at least 90 mass-percent of said at least one xylene isomer and a depleted fraction containing ethylbenzene, C₉+ aromatics and at least one other xylene
25 isomer; (b) withdrawing at least a portion, preferably all, of the product fraction; (c) isomerizing at least a portion, preferably all, of the depleted fraction to provide an isomerate containing lower boiling, by-product hydrocarbons, para-xylene, meta-xylene, ortho-xylene, ethylbenzene and C₉+ aromatics; (d) fractionating by distillation at least a portion, preferably
30 all, of the isomerate to provide a lower boiling fraction containing said lower boiling, by-product hydrocarbons and at least one mid-boiling fraction containing para-xylene, meta-xylene, ortho-xylene, ethylbenzene and C₉+ aromatics, and at least one higher boiling

fraction containing para-xylene, meta-xylene, ortho-xylene, ethylbenzene and C₉+ aromatics wherein said at least one higher boiling fraction contains a greater mole percent of C₉+ aromatics than said at least one mid-boiling fraction, and preferably, at least 10, say, 10 to 90, more preferably 20 to 80, mass-percent of the total para-xylene, meta-xylene, ortho-xylene and ethylbenzene in the isomerate is contained in the mid-boiling fraction; (e) recycling at least a portion of said at least one mid-boiling fraction as a recycle stream to step (a); and (f) providing to step (a) at least one C₈ aromatic feed stream that contains between 15 to 25 mass-percent para-xylene, ortho-xylene, meta-xylene and ethylbenzene and C₉+ aromatics, wherein the separation feed stream comprises the recycle stream of step (e) and the at least one C₈ aromatic feed stream.

[0008] In a preferred embodiment, at least one of the recycle stream of step (e) and at least one of the at least one C₈ aromatic feed stream of step (f) has greater than 500 ppm-mass of C₉+ aromatics, and at least one of the recycle stream of step (e) and at least one of the at least one C₈ aromatic feed stream of step (f) has less than 500 ppm-mass of C₉+ aromatics.

[0009] In one embodiment, the recycle stream of step (e) contains less than 1500, say, 500 or 700 to 1000, ppm-mass C₉+ aromatics, and the at least one aromatic feed stream contains up to 500 ppm-mass C₉+ aromatics. In another embodiment, the recycle stream of step (e) contains less than 500, say, between 100 and 400, ppm-mass C₉+ aromatics. In this embodiment, the at least one C₈ aromatic feed stream may contain more or up to 500 ppm-mass C₉+ aromatics, e.g., between 100 and 1500, preferably between 100 and 1200, ppm-mass C₉+ aromatics.

[0010] In another broad aspect of the processes of this invention, at least a portion of the C₈ aromatic feed stream is derived from the disproportionation of toluene where the disproportionation product is separated by distillation into at least one lower boiling toluene fraction, at least one higher boiling xylene-containing disproportionation fraction by distillation, and at least one mid-boiling disproportionation fraction containing para-xylene, meta-xylene, ortho-xylene, ethylbenzene and less than 2500, preferably between 500 and 1500, preferably 600 to 1200, ppm-mass C₉+ aromatics. In this aspect of the invention, the separation feed comprises at least a portion, preferably all, of the mid-boiling disproportionation fraction. In one more preferred embodiment of this aspect of the invention, the separation feed consists essentially of the mid-boiling disproportionation fraction and the recycle stream of step (e). Accordingly, no xylene column is required.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Figure 1 is a schematic depiction of a process in accordance with the invention wherein a xylene column is used.

[0012] Figure 2 is a schematic depiction of a process in accordance with the invention wherein no xylene column is used.

[0013] Figure 3 is a schematic depiction of a dividing wall distillation assembly useful in the processes of this invention.

[0014] Figure 4 is a schematic depiction of another type of dividing wall distillation assembly useful in the practice of this invention.

DETAILED DESCRIPTION OF THE INVENTION

[0015] The raw material for making xylenes is usually derived from naphtha or pygas. Normally, a raw material stream is subjected to pretreatments such as hydrotreating to remove sulfur and nitrogen compounds, and then the stream is subjected to reforming to generate aromatic compounds. The reforming is under sufficiently severe conditions that a wide range of aromatic compounds is produced including sought xylenes as well as benzene, toluene and C₉+ aromatics. The reformate is usually subjected to olefin saturation conditions. Lights such as butanes are removed by distillation, and higher molecular weight aliphatics are removed by extraction. The resulting aromatics-containing stream can be separated by distillation into various components. For instance, the C₈ aromatics (xylenes and ethylbenzene) can be fed to a xylene isomer recovery unit. Benzene may be recovered as a raw material for other petrochemical processes, and toluene can be subjected to disproportionation to generate C₈ aromatics and benzene. The generated C₈ aromatics can be used as feed to the xylene isomer recovery unit.

[0016] With reference to Figure 1, apparatus 100 receives a C₈ aromatic feed stream via line 102 which is passed to xylene column 104. The C₈ aromatic feed stream is substantially devoid of toluene and lower boiling components but contains xylenes and ethylbenzene as well as C₉+ aromatics. Xylene column 104 is adapted via distillation to separate as an overhead, C₈ aromatics, and as a bottoms stream, C₉+ aromatics. If desired, the bottoms stream which is withdrawn via line 106, may be further separated into a C₉ and 10-containing

stream and a C₁₁₊-containing stream, and the C₉ and 10-containing stream can be subjected to transalkylation conditions to generate C₈ aromatics.

[0017] The overhead from xylene column 104 is passed via line 108 to xylene isomer recovery unit 110. The isomers having the greatest commercial value are ortho-xylene and especially para-xylene. Ortho-xylene can usually be recovered from the C₈ aromatics-containing stream fed to the xylene isomer recovery unit by distillation. Para-xylene is typically removed by either a sorption process or a crystallization process. Because of the nature of the downstream uses of para-xylene, the para-xylene product must meet stringent specifications, including for C₉₊ aromatics. Whether the para-xylene recovery unit operation is sorption or crystallization, some C₉ aromatics, such as 1,4-methylethylbenzene are difficult to remove from para-xylene. Accordingly, the feed stream to the xylene isomer recovery unit (the separation feed) should contain up to 500 ppm-mass C₉₊ aromatics, and preferably should contain less than 100 ppm-mass 1,4-methylethylbenzene. As shown, para-xylene is withdrawn from xylene isomer recovery unit 110 via line 112. The remaining xylene isomers and ethylbenzene pass from xylene isomer recovery unit 110 to isomerization unit 116 via line 114.

[0018] Because the selective removal of one or more xylene isomers in xylene isomer recovery unit 110 results in a non-equilibrium xylene composition, the isomerization unit can serve to re-establish a near equilibrium composition of xylene isomers. The isomerization may also isomerize ethylbenzene, or, the ethylbenzene may be selectively dealkylated. Regardless of the type of isomerization, at least some C₉₊ aromatics are generated. Often the isomerate contains between 2000 and 10,000 ppm-mass C₉₊ aromatics. Benzene and toluene are also contained in the isomerate. Para-xylene is usually in an amount of 20 to 25, more often 21 to 23, mass-percent of total xylenes in the isomerate.

[0019] The isomerate passes via line 118 to deheptanizer distillation assembly 120. If desired, one or more intervening distillation columns may be used to remove lights and benzene such that the feed to deheptanizer distillation assembly 120 is substantially C₇₊ aromatics. Deheptanizer distillation assembly may be in one or more vessels, and may contain trays or structure packing or both. Deheptanizer distillation assembly 120 is adapted to provide an overhead containing toluene and benzene and any lighter components which is withdrawn via line 122, a mid-boiling fraction which is withdrawn via line 124 for recycle to

xylene isomer recovery unit 110 to form part of the separation feed, and a bottoms fraction which is withdrawn via line 126 and recycled to xylene column 104.

[0020] The particular design of deheptanizer distillation assembly 120 will depend upon the sought amount of the mid-boiling fraction and the concentration of C₉+ aromatics that can be tolerated in the mid-boiling fraction such that the separation feed comprises up to 500 ppm-mass of C₉+ aromatics. Usually deheptanizer distillation assembly 120 will comprise between 15 and 70, more frequently, between 20 and 60, theoretical distillation trays. With greater numbers of theoretical distillation trays, it is feasible to achieve lower concentration of C₉+ aromatics in the mid-boiling fraction. The processes of this invention may be operated such that the mid-boiling fraction contains greater than 500 ppm-mass of C₉+ aromatics, and is admixed with the C₈ aromatic feed stream to provide a separation feed having up to 500 ppm-mass C₉+ aromatics. In this mode of operation, the primary benefit of the processes of this invention is to reduce the load on the xylene column. Thus, the capacity of the xylene column to handle more fresh feed can be increased, thereby increasing the capacity of apparatus 100, or reducing the aggregate boiler energy requirements for xylene column 104 and deheptanizer distillation assembly 120. Normally in this mode of operation, the mid-boiling fraction will contain 10 to 70 mass percent of the C₈ aromatics in the isomerate, and preferably between 10 and 50 mass-percent of the C₈ aromatics in the isomerate. Due to the relative mass of the xylenes in the isomerate that will be recycled for xylene isomer recovery as compared to fresh feed introduced via line 102, which is usually at least 2:1, say 2.5:1 to 5:1, at higher concentrations of C₉+ aromatics, e.g., above 750 ppm-mass, the amount of mid-boiling fraction that can be recycled while still meeting the separation feed C₉+ aromatics specification, is limited.

[0021] An alternative mode of operation is to provide a mid-boiling fraction from deheptanizer distillation assembly 120 that contains up to 500 ppm-mass C₉+ aromatics. Not only can benefits of increasing the capacity of the xylene column and reducing aggregate reboiler energy consumption for the xylene column and the deheptanizer distillation assembly, be achieved, but also, potentials exist for capital saving. Where the C₉+ aromatics concentration is well below 500 ppm-mass, the mid-boiling fraction can be used to offset higher C₉+ aromatics concentrations in other components to the separation feed. Again, the higher mass of the xylenes in the isomerate to that in the fresh feed, enables the fresh feed to

contain 750 or more ppm-mass C₉+ aromatics while still being able to achieve the C₉+ aromatics specification for the separation feed.

[0022] In this alternative mode of operation, the mid-boiling fraction typically contains at least 10, preferably at least 20, mass-percent of the xylenes in the isomerate. While the mid-boiling fraction can contain up to 90 or more mass percent of the xylenes in the isomerate, the size of the deheptanizer distillation assembly and aggregate reboiler energy requirements increase. Thus, often the mid-boiling fraction contains up to 80 mass percent, and more preferably 25 to 75 mass-percent, of the xylenes in the isomerate.

[0023] The mid-boiling fraction is a side draw from deheptanizer distillation assembly 120. Where more than one distillation column is used such as is discussed below in conjunction with Figure 2, the side draw can be the overhead from a second column. The side draw can be from a single distillation column. In such case, the composition of the mid-boiling fraction will be dependent upon the level in the column from which the draw is taken. A particularly beneficial design for deheptanizer distillation assembly 120 is a dividing wall column. See, for instance, the article appearing at page s14 of a SUPPLEMENT TO THE CHEMICAL ENGINEER, August 27, 1992, and US 4,230,533.

[0024] Figures 3 and 4 depict types of dividing wall distillation columns. In Figure 3, distillation assembly 300 comprises feed inlet 302 to column 304. Overhead conduit at the top of column 304 directs the vapor phase to condenser 308 for recycle as reflux to the top portion of column 304. Conduit 310 is adapted to withdraw a portion of the condensate from condenser 308. Within column 304 is baffle 312 which is only open at its upper portion. Consequently, essentially only liquid phase enters the distillation zone defined by baffle 312. Hence, the concentration of C₉+ aromatics within this distillation zone will be less than that at the same height in the column outside this distillation zone. However, since essentially all the fluid in and outside this defined distillation zone is C₆ to C₈ aromatics, the temperature profiles in the defined zone and outside the zone, are substantially the same.

[0025] As shown, a bottoms stream is withdrawn from the defined zone via line 314 and directed to reboiler 316 and returned to the zone via line 318. Line 320 is adapted to remove as the mid-boiling fraction, liquid phase in line 314.

[0026] Line 322 withdraws a bottoms stream from column 304, a portion of which is passed to line 326 and the remaining portion is passed through reboiler 324 and reintroduced into column 304.

[0027] Figure 4 depicts another type of dividing wall distillation assembly 400. Conduit 402 is adapted to supply feed to column 404. Column 404 is provided with baffle 406 defining two distillation zones in column 404. Baffle 406 provides for fluid flow between the two sides of column 404 defined by baffle 406 only at the top and bottom of the column.

5 Conduit 408 is adapted to withdraw vapor phase from the top of column 404 and pass it through condenser 410 with the resultant liquid being reintroduced as reflux to the top of column 404. A portion of the condensate is removed from conduit 408 via line 412.

[0028] Conduit 414 is provided on the side of column 404 for the purpose of withdrawing a side draw fraction. Conduit 414 is in communication with the zone defined by baffle 406 that is opposite the zone into which conduit 402 supplies feed. Conduit 416 is adapted to 10 withdraw a bottoms liquid stream, pass it through reboiler 418 for reintroduction into the bottom portion of column 404. Conduit 420 is adapted to withdraw a portion of the bottoms stream from dividing wall distillation assembly 400.

[0029] The following simulation data are provided to further illustrate the principles of 15 the processes of this invention but are not in limitation thereof. Using a process such as described in connection with Figure 1 but with an intervening distillation to remove benzene and lower boiling species, a feed as set forth below is introduced into deheptanizer distillation assembly 120:

	<u>Component</u>	<u>Mass-percent</u>
20	Toluene	0.4
	Para-xylene	18.2
	Ortho-xylene	21.4
	Meta-xylene	45.3
	Ethylbenzene	7.8
25	C ₉ + aromatics	3500 ppm-mass
	Other	6.7

[0030] Deheptanizer distillation assembly 120 has 32 theoretical distillation stages. A dividing wall column design is not used. A side draw is taken at stage 12. Table 1 summarizes the operation of the deheptanizer distillation assembly and the xylene column at 30 various rates of side draw to provide a separation feed having 500 ppm-mass C₉+ aromatics.

TABLE 1

Mass-percent total C ₈ aromatics recovery in side draw	C ₉ + aromatics in side draw, ppm-mol	C ₉ + aromatics in bottoms, ppm-mol	Deheptanizer Reboiler Heat Requirement, calories per gram of para-xylene product	Xylene Column Reboiler Heat Requirement, calories per gram of para-xylene product
0	0	3646	172	819
10	377	4020	174	776
20	695	4400	175	727

[0031] The use of a dividing wall column for the deheptanizer distillation assembly substantially increases the portion of the C₈ aromatics that can be recovered in the side draw while maintaining the C₉+ aromatics in the side draw below 500 ppm-mass. This principle is illustrated in connection with the following simulation.

[0032] Deheptanizer distillation assembly 120 comprises a dividing wall column as depicted in Figure 4. The design of the deheptanizer distillation column and the xylene column are such that the separation feed contains 500 ppm-mass C₉+ aromatics, at different draws of mid-boiling fraction. The simulation is summarized in Table 2.

TABLE 2

Mass-percent total C ₈ aromatics recovery in side draw	Number of theoretical distillation stages in deheptanizer	Theoretical distillation stage at point of side draw in deheptanizer	Aggregate reboiler heat consumption for deheptanizer and xylene column, calories per gram of para-xylene product
0	16	none	1050
25	19	15	990
50	23	11	960
75	25	8	920
99.5	50	8	1010

[0033] Figure 2 depicts a para-xylene production facility 200 in which C₈ aromatics are generated by toluene disproportionation and the xylene column is eliminated. A toluene-containing feed is supplied by line 202 to disproportionation reactor 204 in which toluene is converted to C₈ aromatics and benzene. The disproportionation product is passed via line 206

to benzene distillation column 208 to provide a benzene-containing overhead that is withdrawn via line 210 and a xylene and toluene-containing bottoms stream that is directed by line 212 to toluene column 214.

[0034] Toluene column 214 may be in one or more vessels, and may contain trays or structure packing or both, and, preferably, is a dividing wall column. The overhead from toluene column is toluene which is recycled to disproportionation reactor 204 via line 216. Toluene column 214 is operated to provide a mid-boiling disproportionation fraction and a bottoms fraction. The bottoms fraction will contain C₉+ aromatics as well as some C₈ aromatics and is withdrawn via line 218. Typically the bottoms fraction is treated in a heavies distillation column to recover an additional portion of the C₈ aromatics and, if desired, C₉₋₁₀ aromatics for transalkylation to recover additional C₈ aromatics. The mid-boiling disproportionation fraction is withdrawn via line 220 and is subjected to xylene isomer recovery in xylene isomer recovery unit 222.

[0035] The particular design of toluene column will depend upon the sought amount of the mid-boiling disproportionation fraction and the concentration of C₉+ aromatics that can be tolerated such that the separation feed comprises up to 500 ppm-mass of C₉+ aromatics. Usually toluene column will comprise between 20 and 120, more frequently, between 30 and 100, theoretical distillation trays. With greater numbers of theoretical distillation trays, it is feasible to achieve lower concentration of C₉+ aromatics in the mid-boiling disproportionation fraction as well as increase the relative amount of C₈ aromatics contained in the mid-boiling disproportionation fraction as opposed to the bottoms stream. The processes of this invention is usually operated such that the mid-boiling fraction contains greater than 500 ppm-mass of C₉+ aromatics while the deheptanizer distillation assembly, as discussed later, is operated to provide up to 500 ppm-mass C₉+ aromatics in its mid-boiling fraction. In some embodiments of the processes of this invention, the mid-boiling disproportionation fraction contains up to 2500, preferably between 700 and 2000, ppm-mass C₉+ aromatics. Normally the mid-boiling disproportionation fraction will contain at least 40, preferably between 50 and 99, mass percent of the C₈ aromatics in the disproportionation product.

[0036] The xylene isomer recovery unit may be the same as described in conjunction with Figure 1. As depicted, a para-xylene product stream is withdrawn via line 223. The

remaining xylene isomers and ethylbenzene pass from xylene isomer recovery unit 222 to isomerization unit 226 via line 224.

[0037] Because the selective removal of one or more xylene isomers in xylene isomer recovery unit 222 results in a non-equilibrium xylene composition, the isomerization unit can serve to re-establish a near equilibrium composition of xylene isomers. The isomerization may also isomerize ethylbenzene, or, the ethylbenzene may be selectively dealkylated. Regardless of the type of isomerization, at least some C₉+ aromatics are generated. Often the isomerate contains between 2000 and 10,000 ppm-mass C₉+ aromatics. Benzene and toluene are also contained in the isomerate. Para-xylene is usually in an amount of 20 to 25, more often 21 to 23, mass-percent of total xylenes in the isomerate.

[0038] The isomerate passes via line 228 to a deheptanizer distillation assembly which employs two distillation columns, 230 and 236. If desired, one or more intervening distillation columns may be used to remove lights and benzene such that the feed to deheptanizer distillation assembly 230 and 236 is substantially C₇+ aromatics. As discussed in connection with Figure 1, deheptanizer distillation assembly may be in one vessel, may be a dividing wall column, and may contain trays or structure packing or both.

[0039] Column 230 is adapted to provide an overhead containing C₈ aromatics, toluene and benzene which is passed via line 232 to distillation column 236. The bottoms in column 230 will contain C₉+ aromatics as well as some of the C₈ aromatics and is passed via line 234 to heavies distillation column 242.

[0040] Distillation column 236 provides an overhead containing toluene and lower boiling components that is withdrawn via line 238. The bottoms fraction contains C₈ aromatics and is recycled via line 240 to xylene isomer recovery unit 222.

[0041] As stated above, the particular design of deheptanizer distillation assembly 120 will depend upon the sought amount of the mid-boiling fraction and the concentration of C₉+ aromatics that can be tolerated in the mid-boiling fraction such that the separation feed comprises up to 500 ppm-mass of C₉+ aromatics. Usually deheptanizer distillation assembly will comprise between 15 and 70, more frequently, between 20 and 60, theoretical distillation trays. With greater numbers of theoretical distillation trays, it is feasible to achieve lower concentration of C₉+ aromatics in the mid-boiling fraction. In the embodiment of this invention where the xylene column is eliminated, the deheptanizer assembly is operated such that the mid-boiling fraction contains less than 500, preferably less than 400, say 100 to 400,

ppm-mass of C₉+ aromatics. Normally in this mode of operation, the mid-boiling fraction will contain at least 30, preferably between 60 to 99 mass percent of the C₈ aromatics in the isomerate. The relative mass of the xylenes in the isomerate that will be recycled for xylene isomer recovery as compared to the mid-boiling disproportionation fraction introduced via line 220 is usually at least 2:1, say 2.5:1 to 5:1.

[0042] Returning to heavies distillation column 242, as depicted, the bottoms stream from toluene column 214 is also a feed. The overhead contains C₈ aromatics and can be directed to xylene isomer recovery unit 222 via line 246. A bottoms fraction which contains heavy aromatics, e.g., C₁₀+, is withdrawn via line 248. In preferred aspects of the processes of this invention, less than 0.5, preferably less than 0.2, mass-percent of the C₈ aromatics contained in the disproportionation product is contained in this bottoms fraction. As shown, a side draw is taken via line 250 from heavies distillation column 242 and is C₉ and 10-containing stream that may be used for transalkylation.

[0043] The following simulation is provided to further illustrate the principles of this aspect of the invention. For this simulation, dividing wall columns such as depicted in Figure 4 are used for both the toluene column and the deheptanizer distillation assembly. The feed composition to the toluene column is:

<u>Component</u>	<u>Mass-percent</u>
Toluene	27.8
C ₈ aromatics	38.4
C ₉ + aromatics	0.328
Other	0.9

[0044] The feed composition to the deheptanizer distillation assembly is:

<u>Component</u>	<u>Mass-percent</u>
Toluene	0.4
Para-xylene	7.8
Ortho-xylene	21.4
Meta-xylene	45.3
Ethylbenzene	7.8
C ₉ + aromatics	3500 ppm-mass
Other	6.7

[0045] The total feed to xylene isomer recovery unit contains 500 ppm-mass C₉+ aromatics, and the mass ratio of the mid-boiling fraction from the deheptanizer distillation assembly to mid-boiling disproportionation fraction from the toluene fraction is 3:1. Table 3 summarizes the simulation of this embodiment without a xylene column with a typical process using a xylene column and no side draws on either the toluene column or the deheptanizer distillation assembly. The aggregate reboiler heat is for the xylene column (if used), and the toluene column and deheptanizer distillation assembly.

TABLE 3

	Xylene Column, theoretical Stages	Deheptanizer, theoretical stages (stage of side draw)	Deheptanizer side draw C ₉ + aromatics, ppm-mass	Toluene column, theoretical stages (stage of side draw)	Toluene column side draw C ₉ + aromatics, ppm-mass	Aggregate reboiler heat, calories per gram of para-xylene product
Base case	94	16 (0)	n/a	30 (0)	n/a	1347
Invention	None	54 (12)	274	95 (26)	1000	1206

CLAIMS:

1. A process for making xylene isomer comprising:

- (a) separating at least one xylene isomer from a separation feed stream that contains para-xylene, ortho-xylene, meta-xylene and ethylbenzene and up to 500 ppm-mass C₉+ aromatics, to provide a product fraction containing at least 90 mass-percent of said at least one xylene isomer and a depleted fraction containing ethylbenzene, C₉+ aromatics and at least one other xylene isomer;
- (b) withdrawing at least a portion of the product fraction;
- (c) isomerizing at least a portion of the depleted fraction to provide an isomerate containing lower boiling, by-product hydrocarbons, para-xylene, meta-xylene, ortho-xylene, ethylbenzene and C₉+ aromatics;
- (d) fractionating by distillation at least a portion of the isomerate to provide a lower boiling fraction containing said lower boiling, by-product hydrocarbons and at least one mid-boiling fraction containing para-xylene, meta-xylene, ortho-xylene, ethylbenzene and C₉+ aromatics, and at least one higher boiling fraction containing para-xylene, meta-xylene, ortho-xylene, ethylbenzene and C₉+ aromatics wherein said at least one higher boiling fraction contains a greater mole percent of C₉+ aromatics than said at least one mid-boiling fraction;
- (e) recycling at least a portion of said at least one mid-boiling fraction as a recycle stream to step (a); and
- (f) providing to step (a) at least one C₈ aromatic feed stream that contains between 15 to 25 mass-percent para-xylene, ortho-xylene, meta-xylene and ethylbenzene and C₉+ aromatics,

wherein the separation feed stream comprises the recycle stream of step (e) and the at least one C₈ aromatic feed stream.

2. The process of claim 1 wherein at least 10 mass-percent of the total para-xylene, meta-xylene, ortho-xylene and ethylbenzene in the isomerate is contained in the mid-boiling fraction.

3. The process of claim 2 wherein the recycle stream of step (e) contains less than 1500 ppm-mass C₉+ aromatics, and the at least one C₈ aromatic feed stream contains up to 500 ppm-mass C₉+ aromatics.

4. The process of claim 2 wherein the recycle stream of step (e) contains less than 500 ppm-mass C₉+ aromatics, and at least one C₈ aromatic feed stream contains more than 500 ppm-mass C₉+ aromatics.

5 5. The process of claim 2 wherein the fractionating of step (d) is by a dividing wall distillation column.

6. The process of claim 1 wherein at least one at least one C₈ aromatic feed stream is obtained by a distillation to separate C₈ aromatics from C₉+ aromatics, and at least one higher boiling fraction from the distillation of step (d) is fed to the distillation.

10 7. The process of claim 1 wherein at least a portion of the C₈ aromatic feed stream is derived from the disproportionation of toluene where the disproportionation product is fractionated by distillation into at least one lower boiling toluene fraction, at least one higher boiling xylene-containing disproportionation fraction, and at least one mid-boiling disproportionation fraction containing para-xylene, meta-xylene, ortho-xylene, ethylbenzene and less than 2500 ppm-mass C₉+ aromatics, and at least a portion of the mid-boiling
15 disproportionation fraction is passed to step (a).

8. The process of claim 7 wherein the distillation of the disproportionation product is by a dividing wall column.

9. The process of claim 7 wherein the recycle stream of step (e) contains less than 500 ppm-mass C₉+ aromatics.

20 10. The process of claim 7 wherein the separation feed consists essentially of the mid-boiling disproportionation fraction and the recycle stream of step (e).