Claims

1. A system of converting alkyl-bridged non-condensed alkyl multi-aromatic compounds to alkyl mono-aromatic compounds, the system comprising:

a hydrodearylation reactor adapted to receive a hydrogen stream and a feed stream from a xylene rerun column bottoms product stream and to produce under hydrodearylation reaction conditions a reactor effluent stream in presence of a catalyst, wherein the feed stream contains one or more of heavy alkyl aromatic compounds and one or more alkyl-bridged non-condensed alkyl multi-aromatic compounds having at least two benzene rings connected by an alkyl bridge group with at least two carbons and the benzene rings being connected to different carbons of the alkyl bridge group, and wherein the reactor effluent stream contains one or more alkyl mono-aromatic compounds;

a first separator fluidly coupled to the hydrodearylation reactor, the first separator adapted to receive the reactor effluent stream and to produce a hydrodearylated gas stream and a hydrodearylated liquid stream; and

a second separator fluidly coupled to the first separator, the second separator adapted to receive a portion of the hydrodearylated gas stream and to produce a hydrocarbon liquid stream and a vapor stream rich in hydrogen.

2. The system of claim 1, wherein the hydrodearylated gas stream contains one or more of hydrogen, methane, ethane, and C_{3+} hydrocarbons.

3. The system of claim 1, wherein the hydrodearylated liquid stream contains one or more alkyl mono-aromatic compounds.

4. The system of claim 1, wherein the hydrocarbon liquid stream contains one or more alkyl mono-aromatic compounds.

5. The system of claim 1, wherein the vapor stream rich in hydrogen is recycled to the hydrodearylation reactor.

6. The system of claim 1, further comprising: a fractionator fluidly coupled to the first separator and the second separator, the fractionator adapted to receive the hydrodearylated liquid stream and the hydrocarbon liquid stream and to produce a light stream containing xylene and a heavy stream containing unreacted alkyl-bridged non-condensed alkyl multi-aromatic compounds.

7. The system of claim 6, wherein the light stream containing xylene is supplied to a para-xylene complex to recover a stream rich in para-xylene.

8. The system of claim 6, wherein a portion of the heavy stream is recycled to the hydrodearylation reactor.

9. The system of claim 1, wherein the catalyst includes a support being at least one member of the group consisting of silica, alumina, and combinations thereof, and further includes an acidic component being at least one member of the group consisting of amorphous silica-alumina, zeolite, and combinations thereof.

10. The system of claim 9, wherein the catalyst further includes an IUPAC Group 8-10 metal being at least one member of the group consisting of iron, cobalt, and nickel, and further includes an IUPAC Group 6 metal being at least one member of the group consisting of molybdenum and tungsten.

11. The system of claim 10, wherein the IUPAC Group 8-10 metal is 2 to 20 percent by weight of the catalyst and the IUPAC Group 6 metal is 1 to 25 percent by weight of the catalyst.

12. The system of claim 1, wherein the catalyst comprises nickel, molybdenum, ultrastable Y-type zeolite, and γ-alumina support.

13. The system of claim 1, wherein an operating temperature in the hydrodearylation reactor is in a range of 200 to 450ºC.

14. The system of claim 1, wherein a hydrogen partial pressure in the hydrodearylation reactor is in a range of 5 to 50 bar gauge.

15. The system of claim 14, wherein the hydrogen partial pressure in the hydrodearylation reactor is less than 20 bar gauge.

16. The system of claim 1, wherein an operating temperature of the first separator is in a range of 200ºC to 400ºC.

17. The system of claim 1, wherein an operating temperature of the second separator is in a range of 40ºC to 80 ºC.

18. The system of claim 1, wherein the feed stream contains C_{9+} alkyl multi-aromatic compounds from a xylene rerun column of a petroleum refinery.

19. The system of claim 18, wherein the feed stream contains C_9 to C_{16} diaromatics, triaromatics, and polyaromatics.

20. The system of claim 1, wherein the hydrogen stream comprises at least 70 mole percent of hydrogen.