CLAIMS

1. A method for the transalkylation of a heavy reformate, the method comprising the steps of:

providing a heavy reformate comprising at least 90% by weight C9+ aromatics and hydrogen gas to a transalkylation reactor, the transalkylation reactor being charged with a transalkylation catalyst to selectively convert the C9+ aromatics to a xylene-rich product stream, the transalkylation catalyst comprising at least two zeolites selected from the group consisting of mordenite, beta zeolite, ZSM-5, ZSM-11, ZSM-12, ZSM-22, ZSM-23, MFI topology zeolite, NES topology zeolite, EU-1, MAPO-36, SAPO-5, SAPO-11, SAPO-34 and SAPO-41, and at least three metal **components** selected from the Group 4 Lanthanoids, Group 6, and Group 10 of the Periodic Table of the Elements;

separating the product stream into a light gas recycle stream, a C9+ heavy aromatic recycle stream and a mixed aromatics product stream;

separating the mixed aromatics product stream into a benzene stream, a toluene stream and a xylenes stream; and

separating light alkanes from the light gas recycle stream and supplying the light alkanes to a steam cracker, where the light alkanes are converted to mixed olefins.

2. The method of claim 1 further comprising the step of separating hydrogen gas from the light gas recycle stream and recycling the hydrogen gas to the transalkylation reactor.

3. The method of claim 1 or claim 2 where the transalkylation reaction zone is maintained at a temperature in a range of from 200 °C to 540 °C.

4. The method of any one of claims 1 to 3 where the transalkylation reaction zone is maintained at a pressure in a range of from 1 MPa to 5 MPa.

5. The method of any one of claims 1 to 4 wherein the ratio of hydrogen to heavy reformate is in a range of from 0.1:1 to 10:1.

6. The method of any one of claims 1 to 5 wherein the steam cracker includes a reaction zone that is maintained at a temperature in a range of from 600 °C to 850 °C.

7. The method of any one of claims 1 to 6 wherein the residence time of the light alkanes in the steam cracker reaction zone is less than 0.1 seconds.

8. The method of any one of claims 1 to 7 wherein the two solid acid zeolite components of the catalyst have different physical and chemical characteristics.

9. The method of any one of claims 1 to 8 wherein the transalkylation catalyst includes a first solid acid zeolite that is present in an amount in a range of from 10 % to 90% by weight of the total catalyst weight.

10. The method of any one of claims 1 to 9 where the transalkylation catalyst includes a second solid acid zeolite that is present in an amount in a range of from 10 % to 90% by weight of the total catalyst weight.

11. The method of any one of claims 1 to 10 where the transalkylation catalyst further includes a binder selected from inorganic oxides.

12. The method of any one of claims 1 to 11 where the metal components are present in an amount in a range of from 0.01 % to 5% by weight of the total catalyst weight.

13. A transalkylation catalyst for the conversion of a heavy reformate feedstock into a xylenes-rich product stream and a C2 through C4 hydrocarbon product stream, the transalkylation catalyst consisting of:

a beta zeolite in ammonium form containing Na2O present in an amount of 0.05% by weight based on the total weight of the beta zeolite in ammonium form;

ZSM-5;

nickel;

platinum;

cerium; and

alumina;

wherein the beta zeolite in ammonium form, ZSM-5 and alumina are present in a ratio of 3:1:1.

14. The catalyst of claim 13 wherein the pore size of the beta zeolite in ammonium form and the ZSM-5 are different.

15. The catalyst of claim 13 wherein the beta zeolite in ammonium form is present in an amount of between about 10% and 90% by weight of the total transalkylation catalyst weight.

16. The catalyst of claim 13, wherein the ZSM-5 is present in an amount of between about 10% and 90% by weight of the total transalkylation catalyst weight.

17. The catalyst of claim 13, wherein the nickel, platinum and cerium components are each present in an amount of between about 0.01% and 5% by weight of the total transalkylation catalyst weight.

18. The catalyst of claim 13, wherein the catalyst operates in a transalkylation reaction zone at a temperature of between about 200 °C and 540 °C.

19. The catalyst of claim 13, wherein the catalyst operates in a transalkylation reaction zone at a pressure of between about 1 MPa and 5 MPa.

20. The catalyst of claim 13, wherein the catalyst operates in a transalkylation reaction zone wherein the ratio of hydrogen to heavy reformate is between about 0.1:1 and 10:1.

CLAIMS

1. A method for the transalkylation of a heavy reformate, the method comprising the steps of:

providing a heavy reformate comprising at least 90% by weight C9+ aromatics and hydrogen gas to a transalkylation reactor, the transalkylation reactor being charged with a transalkylation catalyst to selectively convert the C9+ aromatics to a xylene-rich product stream, the transalkylation catalyst consisting of:

a beta zeolite in ammonium form containing Na2O present in an amount of 0.05% by weight based on the total weight of the beta zeolite in ammonium form;

ZSM-5;

nickel;

platinum;

cerium; and

alumina;

wherein the beta zeolite in ammonium form, ZSM-5 and alumina are present in a ratio of 3:1:1;

separating the product stream into a light gas recycle stream, a C9+ heavy aromatic recycle stream and a mixed aromatics product stream;

separating the mixed aromatics product stream into a benzene stream, a toluene stream and a xylenes stream; and

separating light alkanes from the light gas recycle stream and supplying the light alkanes to a steam cracker, where the light alkanes are converted to mixed olefins.

2. The method of claim 1 further comprising the step of separating hydrogen gas from the light gas recycle stream and recycling the hydrogen gas to the transalkylation reactor.

3. The method of claim 1 or claim 2 where the transalkylation reaction zone is maintained at a temperature in a range of from 200 °C to 540 °C.

4. The method of any one of claims 1 to 3 where the transalkylation reaction zone is maintained at a pressure in a range of from 1 MPa to 5 MPa.

5. The method of any one of claims 1 to 4 wherein the ratio of hydrogen to heavy reformate is in a range of from 0.1:1 to 10:1.

6. The method of any one of claims 1 to 5 wherein the steam cracker includes a reaction zone that is maintained at a temperature in a range of from 600 °C to 850 °C.

7. The method of any one of claims 1 to 6 wherein the residence time of the light alkanes in the steam cracker reaction zone is less than 0.1 seconds.

8. The method of any one of claims 1 to 7 wherein the two solid acid zeolite components of the catalyst have different physical and chemical characteristics.

9. The method of any one of claims 1 to 8 wherein the transalkylation catalyst includes a first solid acid zeolite that is present in an amount in a range of from 10 % to 90% by weight of the total catalyst weight.

10. The method of any one of claims 1 to 9 where the transalkylation catalyst includes a second solid acid zeolite that is present in an amount in a range of from 10 % to 90% by weight of the total catalyst weight.

11. The method of any one of claims 1 to 10 where the transalkylation catalyst further includes a binder selected from inorganic oxides.

12. The method of any one of claims 1 to 11 where the metal components are present in an amount in a range of from 0.01 % to 5% by weight of the total catalyst weight.

13. A transalkylation catalyst for the conversion of a heavy reformate feedstock into a xylenes-rich product stream and a C2 through C4 hydrocarbon product stream, the transalkylation catalyst consisting of:

a beta zeolite in ammonium form containing Na2O present in an amount of 0.05% by weight based on the total weight of the beta zeolite in ammonium form;

ZSM-5;

nickel;

platinum;

cerium; and

alumina;

wherein the beta zeolite in ammonium form, ZSM-5 and alumina are present in a ratio of 3:1:1.

14. The catalyst of claim 13 wherein the pore size of the beta zeolite in ammonium form and the ZSM-5 are different.

15. The catalyst of claim 13 wherein the beta zeolite in ammonium form is present in an amount of between about 10% and 90% by weight of the total transalkylation catalyst weight.

16. The catalyst of claim 13, wherein the ZSM-5 is present in an amount of between about 10% and 90% by weight of the total transalkylation catalyst weight.

17. The catalyst of claim 13, wherein the nickel, platinum and cerium components are each present in an amount of between about 0.01% and 5% by weight of the total transalkylation catalyst weight.

18. The catalyst of claim 13, wherein the catalyst operates in a transalkylation reaction zone at a temperature of between about 200 °C and 540 °C.

19. The catalyst of claim 13, wherein the catalyst operates in a transalkylation reaction zone at a pressure of between about 1 MPa and 5 MPa.

20. The catalyst of claim 13, wherein the catalyst operates in a transalkylation reaction zone wherein the ratio of hydrogen to heavy reformate is between about 0.1:1 and 10:1.