CLAIMS

1. A heavy reformate processing system for producing benzene and *para*-xylene from a heavy reformate, the heavy reformate processing system comprising:

a reformate splitter operable to receive a feed stream, the feed stream comprising heavy reformate, the reformate splitter further operable to produce benzene, toluene, and a C8+ aromatics product, the C8+ aromatics product provided to a xylene splitter;

a *para*-xylene separator operable to receive a C8 aromatic product from the xylene splitter and produce a first xylene product comprising *para*-xylene and a second xylene product comprising *ortho*-xylene and *meta*-xylene;

a first dealkylation reactor operable to receive a C10+ aromatics product from the xylene splitter and produce the first dealkylation product, the first dealkylation reactor further operable to:

produce alkanes from the C10+ aromatics product and hydrogen, or

produce olefins from the C10+ aromatic product in the absence of hydrogen;

a second dealkylation reactor operable to receive a C9 aromatics product from the xylene separator and produce a second dealkylation product, the second dealkylation reactor further operable to:

produce alkanes from the C9 aromatics product and hydrogen; or

produce olefins from the C9 aromatic product in the absence of hydrogen. a transalkylation reactor operable to receive the second dealkylation product from the second dealkylation reactor and produce the transalkylation product, the transalkylation reactor further operable to:

produce alkanes from the second dealkylation product and hydrogen; or

produce olefins from the second dealkylation product in the absence of hydrogen.

2. The heavy reformate processing system of claim 1, wherein the feed stream further comprises the transalkylation product and the first dealkylation product.

3. The heavy reformate processing system of claim 1, the transalkylation reactor further operable to perform isomerization of xylene to promote the formation of *para*-xylene.

4. The heavy reformate processing system of claim 1, comprising a pressure swing adsorption (PSA) unit operable to:

receive alkanes and unreacted hydrogen from the first dealkylation reactor, the second dealkylation reactor, and the transalkylation reactor.

5. The heavy reformate processing system of claim 4, wherein the first dealkylation reactor is further operable to receive recovered hydrogen from the PSA unit.

6. The heavy reformate processing system of claim 4, wherein the transalkylation reactor is further operable to receive recovered hydrogen from the PSA unit.

7. The heavy reformate processing system of claim 1, comprising a C9/C10+ splitter downstream from the transalkylation reactor, the C9/C10+ splitter operable to receive a portion of the transalkylation product from the transalkylation reactor and produce a C9 aromatics stream and a C10+ aromatics stream.

8. The heavy reformate processing system of claim 7, wherein the transalkylation reactor is further operable to receive the C9 aromatics stream produced by the C9/C10+ splitter.

9. The heavy reformate processing system of claim 7, wherein the first dealkylation reactor is further operable to receive the C10+ aromatics stream produced by the C9/C10+ splitter.

10. The heavy reformate processing system of claim 1, wherein the transalkylation reactor is further operable to receive toluene produced by the reformate splitter.

11. The heavy reformate processing system of claim 1, wherein the second dealkylation reactor is further operable to receive the second xylene product comprising *ortho*-xylene and *meta*-xylene produced by the xylene splitter.

12. The heavy reformate processing system of claim 1, wherein the alkanes comprise ethane and propane.

13. The heavy reformate processing system of claim 1, wherein the olefins comprise ethylene and propylene.

14. A method for producing benzene and *para*-xylene from a heavy reformate, the method comprising:

receiving a feed stream at a reformate splitter, the feed stream comprising heavy reformate;

operating the reformate splitter to produce benzene, toluene, and C8+ aromatics from the feed stream;

operating a xylene splitter to receive the C8+ aromatics and produce C8 aromatics, C9 aromatics, and C10+ aromatics;

operating a *para*-xylene separator to receive the C8 aromatics from the xylene splitter and produce a first xylene product comprising *para*-xylene and a second xylene product comprising *ortho*-xylene and *meta*-xylene;

operating a first dealkylation reactor to receive the C10+ aromatics from the xylene separator and produce the first dealkylation product;

operating a second dealkylation reactor operable to receive the C9 aromatics from the xylene separator and produce a second dealkylation product; and

operating a transalkylation reactor to receive the second dealkylation product from the second dealkylation reactor and produce the transalkylation product.

15. The method of claim 14, comprising:

operating the first dealkylation reactor to produce alkanes from the C10+ aromatics product and hydrogen;

operating the second dealkylation reactor to produce alkanes from the C9 aromatics product and hydrogen; and

operating the transalkylation reactor to produce alkanes from the second dealkylation product and hydrogen.

16. The method of claim 15, wherein the alkanes comprise ethane and propane.

17. The method of claim 14, comprising operating a pressure swing adsorption (PSA) unit to receive alkanes and unreacted hydrogen from the first dealkylation reactor, the second dealkylation reactor, and the transalkylation reactor.

18. The method of claim 14, comprising operating a C9/C10+ splitter downstream from the transalkylation reactor to receive a portion of the transalkylation product from the transalkylation reactor and produce a C9 aromatics stream and a C10+ aromatics stream.

19. The method of claim 18, comprising operating the transalkylation reactor to receive the C9 aromatics stream produced by the C9/C10+ splitter.

20. The method of claim 18, comprising operating the first dealkylation reactor to receive the C10+ aromatics stream produced by the C9/C10+ splitter.

21. The method of claim 14, comprising operating the second dealkylation reactor to receive the second xylene product comprising *ortho*-xylene and *meta*-xylene produced by the xylene splitter.

22. The method of claim 14, comprising:

operating the first dealkylation reactor to produce olefins from the C10+ aromatic product in the absence of hydrogen;

operating the second dealkylation reactor to produce olefins from the C9 aromatic product in the absence of hydrogen; and

operating the transalkylation reactor to produce olefins from the second dealkylation product in the absence of hydrogen.

23. The method of claim 22, wherein the olefins comprise ethylene and propylene.

24. The method of claim 14, comprising operating the transalkylation reactor to perform isomerization of xylene to promote the formation of *para*-xylene.