CLAIMS

1. A process for operating a reforming reactor system, the process comprising:

operating a first series of reactors, wherein the first series of reactors comprises a plurality of reactors, and wherein each reactor within the plurality of reactors in the first series of reactors contains a catalyst comprising at least one Group VIII metal, a zeolitic support, and at least one halogen and capable of catalyzing the reaction of at least a portion of hydrocarbons in a hydrocarbon feed into aromatic hydrocarbons, thus providing a first reactor series effluent comprising the aromatic hydrocarbons, unreacted hydrocarbons, and hydrogen;

separating hydrogen from the first reactor series effluent, thus providing hydrogen and a reduced-hydrogen first reactor series effluent; and

operating a second series of reactors;

wherein the second series of reactors comprises a plurality of reactors,

wherein each reactor within the plurality of reactors in the second series of reactors contains a catalyst comprising at least one Group VIII metal, a zeolitic support, and at least one halogen capable of converting unreacted hydrocarbons in the reduced-hydrogen first reactor series effluent into the aromatic hydrocarbons, and

wherein a fouling rate of the catalyst in any one of the reactors within the plurality of reactors in the first series of reactors is less than a fouling rate of the catalyst in any one of the reactors within the plurality of reactors in the second series of reactors.

2. The process of claim 1, further comprising operating at least one of the reactors within the plurality of reactors in the first series of reactors at a lower severity than at least one of the reactors within the plurality of reactors in the second series of reactors;

wherein the lower severity is selected from the group consisting of a lower average catalyst bed temperature, a lower reactor endotherm for at least one reactor of the plurality of reactors in the first series of reactors over the course of a run that is at least 40° C. less than an average catalyst bed temperature, and a lower reactor endotherm for at least one reactor within the plurality of reactors in the second series of reactors over the course of the run.

3. The process of claim 1, wherein the hydrocarbon feed comprises greater than about 10 volume percent of hydrocarbons containing eight or more carbon atoms (C_8^+).

4. The process of claim 1, wherein a molar ratio of hydrogen to hydrocarbon in at least one of the reactors within the plurality of reactors of the second series of reactors is less than a molar ratio of hydrogen to hydrocarbon in a corresponding reactor of a process employing a reforming reactor system comprising a single series of reactors operated without inter-series hydrogen separation.

5. The process of claim 4, wherein the molar ratio of hydrogen to hydrocarbon in a final reactor of the second series of reactors is less than about 3:1, at constant conversion, and wherein the molar ratio of hydrogen to hydrocarbon to a first reactor of the first series of reactors is in the range of from about 1.5:1 to about 2:1.

6. The process of claim 1, wherein a partial pressure of hydrogen in at least one of the reactors within the plurality of reactors of the second series of reactors is less than a partial pressure of hydrogen in a corresponding reactor of a process employing a

reforming reactor system comprising a single series of reactors operated without inter-series hydrogen separation.

7. The process of claim 1, wherein a selectivity to benzene, toluene, and xylenes (BTX) is greater than a selectivity to BTX provided by an equivalent process employing a reforming reactor system comprising a single series of reactors operated without inter-series hydrogen separation.

8. The process of claim 1, wherein the reduced-hydrogen first reactor series effluent comprises a non-convertible C_6 hydrocarbon, and wherein the process further comprises:

separating the non-convertible C_6 hydrocarbon from the reduced-hydrogen first reactor series effluent to produce a second hydrocarbon stream;

introducing the second hydrocarbon stream to the second series of reactors via a charge pump, wherein the second hydrocarbon stream comprises a greater concentration of convertible C_6 hydrocarbons than the reduced-hydrogen first reactor series effluent; and

heating the second hydrocarbon stream via heat exchange with the first reactor series effluent prior to introduction of the second hydrocarbon stream into the second series of reactors and prior to separating hydrogen from the first reactor series effluent.

9. A reforming reactor system comprising:

a first reactor series comprising a plurality of reactors, wherein each of the reactors within the plurality of reactors of the first reactor series contains a catalyst comprising at least one Group VIII metal, a zeolitic support, and at least one halogen and capable of catalyzing the reaction of at least a portion of a hydrocarbon in a hydrocarbon feed into

an aromatic hydrocarbon, thus providing a first reactor series effluent comprising the aromatic hydrocarbon, unreacted hydrocarbon, and hydrogen;

a low-pressure separator configured to separate hydrogen from the first reactor series effluent, thus providing hydrogen and a reduced-hydrogen first reactor series effluent; and

a second reactor series comprising a plurality of reactors, and

an apparatus configured to separate a non-convertible C_6 hydrocarbon from the reduced-hydrogen first reactor series effluent to produce a second hydrocarbon stream,

wherein the second hydrocarbon stream comprises a greater concentration of convertible C_6 hydrocarbons than the reduced-hydrogen first reactor series effluent, and (a) a charge pump operable to introduce the second hydrocarbon stream to the second reactor series; (b) a heat exchange apparatus configured to transfer heat between the second hydrocarbon stream and the first reactor series effluent prior to introduction of the second hydrocarbon stream into the second reactor series and prior to separating hydrogen from the first reactor series effluent via the hydrogen separation apparatus; or both (a) and (b), and

wherein each reactor of the second reactor series contains a catalyst comprising at least one Group VIII metal, a zeolitic support, and at least one halogen and capable of catalyzing the reaction of at least a portion of the unreacted hydrocarbon in the reduced-hydrogen first reactor series effluent into the aromatic hydrocarbon.

10. The reforming reactor system of claim 9, wherein at least one of the reactors within the plurality of reactors in the first series of reactors is configured to operate at a lower severity than at least one of the reactors within the plurality of reactors in the second series of reactors;

wherein the lower severity is selected from the group consisting of a lower average catalyst bed temperature, a lower reactor endotherm for at least one reactor of the plurality of reactors in the first series of reactors over the course of a run that is at least 40° C. less than an average catalyst bed temperature, and a lower reactor endotherm for at least one reactor within the plurality of reactors in the second series of reactors over the course of the run.

11. The reforming reactor system of claim 9, wherein a fouling rate of the catalyst in any one of the reactors within the plurality of reactors in the first series of reactors is less than a fouling rate of the catalyst in any one of the reactors within the plurality of reactors in the second series of reactors.

12. A process for operating a reforming reactor system, the process comprising:

operating a plurality of reactors in a reactor series to produce a reactor series effluent comprising an aromatic hydrocarbon from a hydrocarbon feed comprising a hydrocarbon, wherein operating the plurality of reactors comprises directing a portion of the hydrocarbon feed to form a supplemental feed, introducing the supplemental feed into at least one reactor downstream of the first reactor in the reactor series, thus bypassing the first reactor with the portion of the hydrocarbon feed, and introducing a remainder portion of the hydrocarbon feed into the first reactor of the reactor series, wherein each of the reactors within the plurality of reactors contains a catalyst comprising at least one Group VIII metal, a zeolitic support, and at least one halogen and capable of catalyzing the reaction of at least a portion of the hydrocarbon in the hydrocarbon feed into the aromatic hydrocarbon, thus providing the reactor series effluent.

13. The process of claim 12, wherein each reactor of the reactor series is preceded by an associated furnace, and wherein the supplemental feed is introduced upstream of the furnace preceding the at least one downstream reactor into which the supplemental feed is introduced.

14. The process of claim 12, wherein each reactor of the reactor series is preceded by an associated furnace, and wherein operating the plurality of reactors further comprises introducing the supplemental feed directly upstream of each furnace associated with each reactor downstream of the first reactor.

15. The process of claim 12, further comprising controlling a portion of the supplemental feed introduced to each reactor downstream of the first reactor such that an influent to each reactor of the plurality of reactors has a desired molar ratio of hydrogen to hydrocarbon, the effluent from each reactor of the plurality of reactors has a desired molar ratio of hydrogen to hydrocarbon, or both.

16. The process of claim 15, wherein the desired molar ratio of the influent is in the range of from about 1.5:1 to about 2:1, wherein the desired molar ratio of the effluent is less than about 3:1, or both.

17. The process of claim 12, wherein directing a portion of the hydrocarbon feed to form the supplemental feed is performed upstream of a sulfur removal apparatus, and further comprising introducing the remainder of the hydrocarbon feed to the sulfur removal apparatus prior to introduction thereof into the first reactor.

18. The process of claim 12, further comprising separating hydrogen from the reactor series effluent, and combining a portion of the separated hydrogen with the remainder portion of the hydrocarbon feed, after compressing the separated hydrogen, such that the combination provides a first reactor feed having a molar ratio of hydrogen to hydrocarbon in the range of from about 1.5:1 to about 2.0:1.

19. The process of claim 18, wherein compressing the separated hydrogen and combining the portion of the separated hydrogen with the remainder portion of the hydrocarbon feed, after compressing the separated hydrogen, requires less compressor capacity than an equivalent process employing a reforming reactor system in which all of the hydrocarbon feed is introduced into the first reactor of the reactor series.

20. A process for operating a reforming reactor system, the process comprising:

operating a first series of reactors, wherein the first series of reactors comprises a plurality of reactors, and wherein each reactor within the plurality of reactors in the first series of reactors contains a catalyst comprising at least one Group VIII metal, a zeolitic support, and at least one halogen and capable of catalyzing the reaction of at least a portion of hydrocarbons in a hydrocarbon feed into aromatic hydrocarbons, thus providing a first reactor series effluent comprising the aromatic hydrocarbons, unreacted hydrocarbons, and hydrogen;

separating hydrogen from the first reactor series effluent, thus providing hydrogen and a reduced-hydrogen first reactor series effluent; and

operating a second series of reactors;

wherein the second series of reactors comprises a plurality of reactors,

wherein each reactor within the plurality of reactors in the second series of reactors contains a catalyst comprising at least one Group VIII metal, a zeolitic support, and at least one halogen capable of converting unreacted hydrocarbons in the reduced-hydrogen first reactor series effluent into the aromatic hydrocarbons,

wherein the reduced-hydrogen first reactor series effluent comprises a non-convertible C_6 hydrocarbon, and

wherein the process further comprises: separating the non-convertible C_6 hydrocarbon from the reduced-hydrogen first reactor series effluent to produce a second hydrocarbon stream;

introducing the second hydrocarbon stream to the second series of reactors via a charge pump, wherein the second hydrocarbon stream comprises a greater concentration of convertible C_6 hydrocarbons than the reduced-hydrogen first reactor series effluent; and

heating the second hydrocarbon stream via heat exchange with the first reactor series effluent prior to introduction of the second hydrocarbon stream into the second series of reactors and prior to separating hydrogen from the first reactor series effluent.