CLAIMS

What is claimed is:

1. A process for the production of para-xylene comprising:

passing a toluene stream (30) comprising toluene and a methanol stream (40) comprising methanol to a toluene methylation zone (42) having a catalyst configured to, under alkylation conditions, alkylate toluene with methanol and providing a toluene methylation effluent stream (44) comprising greater than 24% weight para-xylene in a xylene fraction, oxygenates, and olefins and wherein the toluene methylation effluent stream comprises a Bromine Index of more than 200;

passing at least a portion of the toluene methylation effluent stream (44) to a hydrogenation zone (48) comprising a catalyst configured to, under hydrogenation conditions, selectively saturate olefins and convert unsaturated oxygenates into alcohols and providing an olefin lean toluene methylation effluent stream (52) comprising para-xylene and trace oxygenates and wherein a Bromine Index of the olefin lean toluene methylation effluent stream is less than 100;

passing at least a portion of the olefin lean effluent stream (52) to an oxygenate removal zone (50) comprising an acidic material comprising polymeric resins, clays, or mixtures thereof configured to, under removal conditions at a temperature between 150 to 190 °C, selectively remove trace oxygenates and providing an oxygenate and olefin lean toluene methylation effluent stream (54);

passing at least a portion of the oxygenate and olefin lean toluene methylation effluent stream (54) to an adsorptive separation zone (66) comprising an adsorbent configured to, under adsorptive separation conditions, selectively adsorb and desorb para-xylene and providing a para-xylene product stream (68).

2. The process of claim 1 wherein the toluene stream (30) comprising toluene is provided from a benzene/toluene fractionation zone (26), and wherein the process further comprises:

passing the toluene methylation effluent stream (44) to the benzene/toluene fractionation zone (26);

separating at least the toluene methylation effluent stream (44) in the benzene/toluene fractionation zone (26) into at least the toluene stream (30) and a bottoms stream (32); and,

passing, as the portion of the toluene methylation effluent stream (44), the bottoms stream (32) from the benzene/toluene fractionation zone (26) to the hydrogenation zone (48).

3. The process of claim 2 wherein the bottoms stream (32) from the benzene/toluene fractionation zone (26) is combined with a reformate splitter bottoms stream (22) prior to the hydrogenation zone (48).

4. The process of claim 1 wherein the toluene stream (30) comprising toluene is provided from a benzene/toluene fractionation zone (26), and wherein the process further comprises:

passing the toluene methylation effluent stream (44) to the benzene/toluene fractionation zone (26);

separating at least the toluene methylation effluent stream (44) in the benzene/toluene fractionation zone (26) into at least the toluene stream (30) and a bottoms stream (32);

passing the bottoms stream (32) from the benzene/toluene fractionation zone (26) to a xylene fractionation column (56); and,

separating, in the xylene fractionation column (56), the bottoms stream (32) from the benzene/toluene fractionation zone (26) into a xylene stream (58) and at least one other stream (60), wherein the xylene stream (58) comprises the portion of the toluene methylation effluent stream (44) passed to the hydrogenation zone (48).

5. The process of claim 1 further comprising:

separating, in a reformate splitter (20), a reformate effluent (18) into an overhead stream (24) comprising toluene and benzene and a bottoms stream (22); and,

passing the toluene methylation effluent stream (44) to the reformate splitter (20).

6. The process of claim 5 further comprising:

passing, as the portion of the toluene methylation effluent stream (44), the bottoms stream (22) from the reformate splitter (20) to the hydrogenation zone (48).

7. The process of claim 6 further comprising:

passing the bottoms stream (22) from the reformate splitter (20) to a xylene fractionation column (56); and,

separating, in the xylene fractionation column (56), the bottoms stream (22) from the reformate splitter (20) into a xylene stream (58) and at least one other stream (60), wherein the xylene stream (58) comprises the portion of the oxygenate and olefin lean toluene methylation effluent stream (54) passed to the adsorptive separation zone (66).

8. The process of claim 1 further comprising:

combining the toluene methylation effluent stream (44) with a reformate stream (18) to form a combined effluent stream;

passing the combined effluent stream to the hydrogenation zone (48) as the portion of the toluene methylation effluent stream (44) passed to the hydrogenation zone (48); and,

passing the oxygenate and olefin lean toluene methylation effluent stream (54) from the oxygenate removal zone (50) to a reformate splitter (20) configured to provide at least an overhead stream (24) comprising toluene and a bottoms stream (22) comprising para-xylene.

9. The process of claim 1, wherein the toluene methylation effluent stream (44) is passed directly to the hydrogenation zone (48) without being combined with any process stream.

10. An aromatics complex for producing para-xylene comprising:

a toluene methylation zone (42) having a reactor with a catalyst, the toluene methylation zone (42) configured to receive a toluene stream (30) and a methanol stream (40) and configured to provide a toluene methylation effluent stream (44) comprising greater than 24% weight para-xylene in a xylene fraction, oxygenates, and olefins, wherein the toluene methylation effluent stream (44) comprises a Bromine Index of more than 200;

a hydrogenation zone (48) having a reactor with a catalyst, the hydrogenation zone (48) configured to receive a least a portion of the toluene methylation effluent stream (44) and configured to provide an olefin lean toluene methylation effluent stream (52) comprising para-xylene and trace unsaturated oxygenates, wherein a Bromine Index of the olefin lean toluene methylation effluent stream (52) is less than 100;

an oxygenate removal zone (50) comprising a reactor with an acidic material comprising polymeric resins, clays, or mixtures thereof, the oxygenate removal zone (50) configured to receive at least a portion of the olefin lean toluene methylation effluent stream (52) and configured to provide an oxygenate and olefin lean toluene methylation effluent stream (54), wherein a Bromine Index of the oxygenate and olefin lean toluene methylation effluent stream (54) is between 0 and 1; and,

an adsorptive separation zone (66) comprising a reactor with an adsorbent, the adsorptive separation zone (66) configured to receive at least a portion of the oxygenate and olefin lean toluene methylation effluent stream (54) and configured to provide a para-xylene product stream (68).