

CLAIMS

What is claimed:

1. A process for the co-production of high purity isobutane and high purity 1-butene streams, the process comprising:
 - providing a first mixed C4 stream and a second mixed C4 stream, each comprising isobutene, isobutane, 1-butene, and 2-butene, and wherein the first mixed C4 stream has a higher concentration of isobutane than the second mixed C4 stream;
 - feeding the first mixed C4 stream and methanol, as a reactant or selectivator, to a first reaction system for converting isobutene contained therein to methyl tert butyl ether or isobutene dimers;
 - feeding the second mixed C4 stream and methanol, as a reactant or selectivator, to a second reaction system for converting isobutene contained therein to methyl tert butyl ether or isobutene dimers;
 - separating an effluent from the first reaction system in a first separation system, including a water wash system, to recover a first lights stream comprising 1-butene, 2-butene, isobutane, a first methanol+water stream, and a first heavy stream comprising the methyl tert butyl ether or the isobutene dimers;
 - separating an effluent from the second reaction system in a second separation system, including a water wash system, to recover a second lights stream comprising 1-butene, 2-butene, and isobutane, a second methanol+water stream, and a second heavy stream comprising the methyl tert butyl ether or the isobutene dimers;
 - feeding the first and second methanol+water streams to a methanol recovery system to separate methanol from the water and returning at least a portion of the methanol to either or both the first and second reaction systems;
 - feeding the second lights stream to a separation system for recovering an isobutane containing stream, a 1-butene stream, and a first heavy C4 stream comprising n-butanes and 2-butene;
 - feeding the isobutane containing stream and the first lights stream to a separation system for recovering an isobutane stream and a second heavy C4 stream comprising n-butanes and 2-butene.
2. The process of claim 1, further comprising separating dimethyl ether from the isobutane stream.

3. The process of claim 1, wherein the isobutane stream has a purity of at least 99 wt% and wherein the 1-butene stream has a purity of at least 99 wt%.
4. The process of claim 1, further comprising feeding a hydrocarbon stream to a fluid catalytic cracking process or a residue fluid catalytic cracking process and recovering the first mixed C4 stream, wherein the first mixed C4 stream has a concentration of isobutane of at least 20 wt%.
5. The process of claim 4, further comprising feeding a hydrocarbon stream to a steam cracking process and recovering the second mixed C4 stream, wherein the second mixed C4 stream has a concentration of isobutane of less than 5 wt%.
6. The process of claim 5, wherein the first mixed C4 stream has a concentration of isobutene of less than 25 wt%, and wherein the second mixed C4 stream has a concentration of isobutene of at least 30 wt%.
7. A system for the co-production of high purity isobutane and high purity 1-butene streams, the system comprising:
 - a first mixed C4 stream and a second mixed C4 stream, each comprising isobutene, isobutane, 1-butene, and 2-butene, and wherein the first mixed C4 stream has a higher concentration of isobutane than the second mixed C4 stream;
 - a first methanol stream and a second methanol stream;
 - a first reaction system configured to receive the first mixed C4 stream and the first methanol stream and to react the first mixed C4 stream and methanol, as a reactant or selectivator, converting isobutene contained therein to methyl tert butyl ether or isobutene dimers;
 - a second reaction system configured to receive the second mixed C4 stream and the second methanol stream and to react the second mixed C4 stream and methanol, as a reactant or selectivator, converting isobutene contained therein to methyl tert butyl ether or isobutene dimers;
 - a first separation system, including a water wash system, for separating an effluent from the first reaction system to recover a first lights stream comprising 1-butene, 2-butene, isobutane, a first methanol+water stream, and a first heavy stream comprising the methyl tert butyl ether or the isobutene dimers;
 - a second separation system, including a water wash system, for separating an effluent from the second reaction system to recover a second lights stream comprising 1-

- butene, 2-butene, isobutane, a second methanol+water stream, and a second heavy stream comprising the methyl tert butyl ether or the isobutene dimers;
- a common methanol recovery system for receiving the first and second methanol+water streams to separate methanol from the water and a flow line for returning at least a portion of the methanol to either or both the first and second reaction systems;
- a first lights separation system for receiving the second lights stream and recovering an isobutane containing stream, a 1-butene stream, and a first heavy C4 stream comprising n-butanes and 2-butene;
- a second lights separation system for receiving the first lights stream and for recovering an isobutane stream and a second heavy C4 stream comprising n-butanes and 2-butene.
8. The system of claim 7, further comprising a first mixer for mixing the first and second heavy C4 streams, and a second mixer for mixing the first and second heavy streams.
 9. The system of claim 7, wherein each of the first and second reaction systems is configured to produce isobutene dimers.
 10. The system of claim 7, wherein each of the first and second reaction systems is configured to produce methyl tert butyl ether.
 11. The system of claim 7, wherein the first reaction system includes a fixed bed reactor, or two or more fixed bed reactors in series or in parallel, followed by a catalytic distillation reactor.
 12. The system of claim 7, wherein the second reaction system includes a fixed bed reactor, or two or more fixed bed reactors in series or in parallel, followed by a catalytic distillation reactor.