

CLAIMS

What is claimed is:

1. A method of producing a fuel additive, comprising:
passing a feed stream comprising C4 hydrocarbons through a methyl tertiary butyl ether unit producing a first process stream;
passing the first process stream through a selective butadiene hydrogenation unit transforming greater than or equal to 90% by weight of the butadiene to 1-butene and 2-butene, preferably greater than or equal to 93%, preferably, greater than or equal to 94%, more preferably, greater than or equal to 95% producing a second process stream;
passing the second process stream through a hydration unit producing a third process stream and the fuel additive;
passing the third process stream through a total hydrogenation unit producing a hydrogenated stream; and
passing the hydrogenated stream to a cracker unit.
2. The method of Claim 1, wherein a source of the feed stream comprises a product of an olefin cracking process and/or an olefin production process.
3. The method of any of the preceding claims, wherein the feed stream comprises propane, propylene, ethyl acetylene, vinyl acetylene, 1,3-butadiene, 1,2-butadiene, isobutylene, cis-2-butene, trans-2-butene, 1-butene, isobutane, n-butane, or a combination thereof.
4. The method of any of the preceding claims, further comprising contacting the feed stream with a catalyst within the methyl tertiary butyl ether unit, wherein the catalyst comprises an acid-type ion-exchange resin.
5. The method of any of the preceding claims, wherein a temperature within the methyl tertiary butyl ether unit is 15°C to 150°C and a pressure within the methyl tertiary butyl ether unit is 500 kiloPascals to 2800 kiloPascals.
6. The method of any of the preceding claims, wherein methanol and isobutylene are present in the methyl tertiary butyl ether unit in a molar ratio of one mole of isobutylene to 0.1 mole to 5 moles of methanol.

7. The method of any of the preceding claims, wherein greater than or equal to 0.1 % by weight of any isobutylene present in the feed stream is converted to methyl tertiary butyl ether within the methyl tertiary butyl ether unit.

8. The method of Claim 7, further comprising withdrawing a methyl tertiary butyl ether product from the methyl tertiary butyl ether unit.

9. The method of any of the preceding claims, wherein the second process stream comprises less than or equal to 5.0% by weight, preferably less than or equal to 3.0%, more preferably less than or equal to 1.0% by weight butadiene prior to passing through the hydration unit.

10. The method of any of the preceding claims, further comprising contacting the second process stream with a catalyst within the hydration unit, wherein the catalyst comprises phosphoric acid, hypophosphorous acid, ion-exchange resin, sulfur, polystyrene, polymer, niobium oxide, or a combination thereof.

11. The method of any of the preceding claims, wherein a temperature within the hydration unit is 30°C to 250°C and a pressure within the hydration unit is 500 kiloPascals to 20,000 kiloPascals.

12. The method of any of the preceding claims, wherein greater than or equal to 0.10% of any butene present in the second process stream is converted to butanol within the hydration unit, preferably 1% to 90% of any butadiene present in the second process stream is converted to butanol within the hydration unit.

13. The method of any of the preceding claims, further comprising withdrawing a fuel additive product from the hydration unit.

14. The method of Claim 13, wherein the fuel additive product comprises 1-butanol, 2-butanol, tert-butyl alcohol, di-isobutene, or a combination thereof.

15. The method of Claim 13, wherein a research octane number of the fuel additive product is greater than or equal to 80, preferably, greater than or equal to 82, more preferably, greater than or equal to 85.

16. The method of Claim 13, wherein a Reid vapor pressure of the fuel additive product is less than or equal to 55 kiloPascals, preferably, less than or equal to 45 kiloPascals, more preferably, less than or equal to 35 kiloPascals, most preferably, less than or equal to 25 kiloPascals.

17. The method of any of the preceding claims, wherein greater than or equal to 0.01%, preferably greater than or equal to 90%, of any butene present in the third process stream is converted to butane within the hydrogenation unit.

18. A method of producing a fuel additive, comprising:

- passing a feed stream comprising hydrocarbons through a cracker unit producing a cracked stream;
- passing the cracked stream through a methyl tertiary butyl ether unit to produce a first process stream, wherein methanol and isobutylene are present in the methyl tertiary butyl ether unit in a molar ratio of one mole of isobutylene to 0.1 mole to 5 moles of methanol;
- withdrawing a methyl tertiary butyl ether product from the methyl tertiary butyl ether unit;
- passing the first process stream through a selective butadiene hydrogenation unit to produce a second process stream;
- passing the second process stream through a hydration unit producing a third process stream, wherein a temperature within the hydration unit is 30°C to 190°C, a pressure within the hydration unit is 500 kiloPascals to 20,000 kiloPascals, and wherein greater than or equal to 0.10% of any butene present in the third process stream is converted to butanol within the hydration unit;
- withdrawing a fuel additive product from the hydration unit, wherein the fuel additive product comprises 1-butanol, 2-butanol, tert-butyl alcohol, di-isobutene, or a combination thereof;
- passing the third process stream through a total hydrogenation unit producing a hydrogenated process stream; and
- recycling the hydrogenated process stream to a cracker unit.