CLAIMS

What is claimed:

1. A process for recovering 1,3-butadiene from a C_4 fraction, comprising:

   feeding a feed hydrocarbon fraction containing butanes, butenes, 1,2-butadiene, 1,3-butadiene, C_4 acetylenes, C_3 acetylenes, and C_{5+} hydrocarbons to a butadiene extraction unit;

   recovering from the butadiene extraction unit a 1,3-butadiene fraction, a C_3 acetylene fraction, a C_4 acetylene fraction, one or more fractions comprising the butanes and butenes, and a fraction comprising the 1,2-butadiene and the C_{5+} hydrocarbons;

   selectively hydrogenating at least one of the C_3 acetylene fraction and the C_4 acetylene fraction to produce a hydrogenated effluent comprising olefins, dienes, and oligomer byproducts;

   feeding the hydrogenated effluent and the fraction comprising the 1,2-butadiene and the C_{5+} hydrocarbons to a separator to recover a heavies fraction comprising the C_{5+} hydrocarbons and the oligomer byproducts and a lights fraction comprising the olefins, dienes, and 1,2-butadiene; and

   feeding the lights fraction to the butadiene extraction unit.

2. The process of claim 1, wherein the C_4 acetylene fraction comprises C_4 acetylenes and 1,2-butadiene.

3. The process of claim 2, wherein an amount of 1,2-butadiene in the C_4 acetylene fraction is approximately equal to an amount of the 1,2-butadiene in the feed hydrocarbon fraction.

4. The process of claims 2 or 3, wherein the C_4 acetylene fraction is fed to the selectively hydrogenating step, and wherein an amount of 1,2-butadiene consumed via the selectively hydrogenating is approximately equal to an amount of the 1,2-butadiene in the feed hydrocarbon fraction.

5. The process of any one of claims 1 to 4, wherein vinylcyclohene is produced in the butadiene extraction unit or is present in the feed hydrocarbon fraction, the process further comprising:

recovering a fraction comprising the vinylcyclohexene from the butadiene extraction unit; and

feeding the vinylcyclohexene fraction to the separator, wherein the vinylcyclohexene is recovered from the separator in the heavies fraction.

6. The process of any one of claims 1 to 5, further comprising:

feeding at least a portion of the feed hydrocarbon fraction to the separator as a reflux;

vaporizing at least a portion of the feed hydrocarbon fraction fed to the separator;

recovering the vaporized portion with the lights fraction for feed to the butadiene extraction unit.

7. The process of claim 6, wherein the reflux comprises only the feed hydrocarbon fraction or a portion thereof and wherein the lights fraction is recovered as a vapor phase fed to the butadiene extraction unit.

8. The process of any one of claims 1 to 7, further comprising:

vaporizing a portion of the feed hydrocarbon fraction in a vaporization system;

recovering a vapor fraction from the vaporization system;

recovering a liquid fraction from the vaporization system;

feeding the recovered liquid fraction to the separator as a reflux.

9. The process of claim 8, further comprising:

vaporizing at least a portion of the liquid fraction fed to the separator; and

recovering the vaporized portion with the lights fraction for feed to the butadiene extraction unit.

10. The process of any one of claims 1 to 9, wherein the fraction comprising 1,2-butadiene and C_{5+} hydrocarbons further comprises at least one of N-methylpyrrolidone (NMP) and tertiary butyl catechol (TBC).

11. The process of any one of claims 1 to 10, wherein the butadiene extraction unit comprises one or more of the following:

a pre-absorber;

a pre-fractionation column;

a feed scrubber / stripper system

a main wash column;

a rectifier;

an afterwash column;

an acetylene fractionator;

a butadiene fractionator;

an acetylene washer;

a solvent purification system; and

a degasser and cooling column.

12. A process for recovering 1,3-butadiene from a C_4 fraction, comprising:

feeding a feed hydrocarbon fraction containing butanes, butenes, 1,2-butadiene, 1,3-butadiene, C_4 acetylenes, C_3 acetylenes, and C_{5+} hydrocarbons to a vaporization system;

recovering a vapor fraction from the vaporization system;

recovering a liquid fraction from the vaporization system;

feeding the recovered vapor fraction to a butadiene extraction unit;

recovering from the butadiene extraction unit a 1,3-butadiene fraction, a C_3 acetylene fraction, a C_4 acetylene fraction, one or more fractions comprising the butanes and butenes, and a fraction comprising the 1,2-butadiene and the C_{5+} hydrocarbons;

selectively hydrogenating at least one of the C_3 acetylene fraction and the C_4 acetylene fraction to produce a hydrogenated effluent comprising olefins, dienes, and oligomer byproducts;

feeding the hydrogenated effluent and the fraction comprising the 1,2-butadiene and the C_{5+} hydrocarbons to a separator to recover a heavies fraction comprising the C_{5+} hydrocarbons and the oligomer byproducts and a lights fraction comprising the olefins, dienes, and 1,2-butadiene;

feeding the recovered liquid fraction to the separator as a reflux; and

feeding the lights fraction to the butadiene extraction unit.

13. The process of claim 12, wherein the C_4 acetylene fraction comprises C_4 acetylenes and 1,2-butadiene.

14. The process of claim 13, wherein an amount of 1,2-butadiene in the C_4 acetylene fraction is approximately equal to an amount of the 1,2-butadiene in the feed hydrocarbon fraction.

15. The process of claims 13 or 14, wherein an amount of 1,2-butadiene consumed via the selectively hydrogenating is approximately equal to an amount of the 1,2-butadiene in the feed hydrocarbon fraction.
16. The process of any one of claims 12 to 15, wherein vinylcyclohene is produced in the butadiene extraction unit or is present in the feed hydrocarbon fraction, the process further comprising:
    recovering a fraction comprising the vinylcyclohexene from the butadiene extraction unit; and
    feeding the vinylcyclohexene fraction to the separator, wherein the vinylcyclohexene is recovered from the separator in the heavies fraction.

17. A system for for recovering 1,3-butadiene from a C_4 fraction, comprising:
    a feed line for providing a feed hydrocarbon fraction containing butanes, butenes, 1,2-butadiene, 1,3-butadiene, C_4 acetylenes, C_3 acetylenes, and C_{5+} hydrocarbons;
    a butadiene extraction unit for receiving at least a portion of the feed hydrocarbon fraction and separating the feed hydrocarbon fraction into a 1,3-butadiene fraction, a C_3 acetylene fraction, a C_4 acetylene fraction, one or more fractions comprising the butanes and butenes, and a fraction comprising the 1,2-butadiene and the C_{5+} hydrocarbons;
    a reactor for selectively hydrogenating at least one of the C_3 acetylene fraction and the C_4 acetylene fraction to produce a hydrogenated effluent comprising olefins, dienes, and oligomer byproducts;
    a separator for receiving the hydrogenated effluent and the fraction comprising the 1,2-butadiene and the C_{5+} hydrocarbons and to recover a heavies fraction comprising the C_{5+} hydrocarbons and the oligomer byproducts and a lights fraction comprising the olefins, dienes, and 1,2-butadiene; and
    a flow line for feeding the lights fraction to the butadiene extraction unit.

18. The system of claim 17, wherein the C_4 acetylene fraction comprises C_4 acetylenes and 1,2-butadiene.

19. The system of claim 17 or 18, further comprising a flow line for feeding the C4 acetylene fraction to the reactor for selectively hydrogenating.

20. The system of any one of claims 17 to 19, wherein the butadiene extraction nit is further configured to recover a vinylcyclohexene fraction.

21. The system of claim 20, further comprising a flow line for feeding the vinylcyclohexene fraction to the separator, configured to recover the vinylcyclohexene in the heavies fraction.

22. The system of any one of claims 17 to 21, wherein the butadiene extraction unit receives a portion of the feed hydrocarbon fraction, and the separator is configured to receive a remaining portion of the feed hydrocarbon fraction as a reflux.

23. The system of any one of claims 17 to 22, further comprising a flow line for feeding at least a portion of the fede hydrocarbon fraction to the separator as a reflux.

24. The system of claim 23, wherein the separator is configured to operate where the reflux comprises only the feed hydrocarbon fraction or a portion thereof.

25. The system of any one of claims 17 to 24, further comprising a vaporization system for vaporizing a portion of the feed hydrocarbon fraction to produce a vapor fraction and a liquid fraction.

26. The system of claim 25 further comprising a flow line for feeding the liquid fraction to the separator as a reflux.

27. The system of any one of claims 17 to 26, wherein the butadiene extraction unit comprises one or more of the following:

a pre-absorber;

a pre-fractionation column;

a feed scrubber / stripper system

a main wash column;

a rectifier;

an afterwash column;

an acetylene fractionator;

a butadiene fractionator;

an acetylene washer;

a solvent purification system; and

a degasser and cooling column.

28. A system for recovering 1,3-butadiene from a C_4 fraction, comprising:

a vaporization system for receiving a feed hydrocarbon fraction containing butanes, butenes, 1,2-butadiene, 1,3-butadiene, C_4 acetylenes, C_3 acetylenes, and C_{5+} hydrocarbons and producing a vapor fraction and a liquid fraction;

a butadiene extraction unit for receiving the vapor fraction and recovering a 1,3-butadiene fraction, a C_3 acetylene fraction, a C_4 acetylene fraction, one or more fractions comprising the butanes and butenes, and a fraction comprising the 1,2-butadiene and the C_{5+} hydrocarbons;

a reactor for selectively hydrogenating at least one of the C_3 acetylene fraction and the C_4 acetylene fraction to produce a hydrogenated effluent comprising olefins, dienes, and oligomer byproducts;

a separator for receiving the hydrogenated effluent and the fraction comprising the 1,2-butadiene and the C_{5+} hydrocarbons to a separator to recover a heavies fraction comprising the C_{5+} hydrocarbons and the oligomer byproducts and a lights fraction comprising the olefins, dienes, and 1,2-butadiene;

a flow line for feeding the liquid fraction to the separator as a reflux; and

a flow line for feeding the lights fraction to the butadiene extraction unit.

29. The system of claim 28, wherein the butadiene extraction nit is further configured to recover a vinylcyclohexene fraction.

30. The system of claim 28 or 29, further comprising a flow line for feeding the vinylcyclohexene fraction to the separator, configured to recover the vinylcyclohexene in the heavies fraction.