ALKYLATION PROCESS WITH RECYLE OF HYDROGEN AND RECOVERY OF HYDROGEN CHLORIDE

This application relates to co-filed applications titled, "HYDROGEN RECYCLE AND HYDROGEN CLORIDE RECOVERY IN AN ALKYLATION PROCESS" and "EXTRACTED CONJUNCT POLYMER NAPHTHA", herein incorporated in their entireties.

TECHNICAL FIELD

This application is directed to processes and process units for improved hydrogen chloride recovery in an ionic liquid alkylation plant using hydro-regeneration of the ionic liquid catalyst.

BACKGROUND

Improved alkylation processes and equipment are needed to provide more efficient operation, including recycling of hydrogen to a hydrogenation reactor, and recovery and recycling of hydrogen chloride to an alkylation reactor.

SUMMARY

This application provides an alkylation process, comprising:

a. regenerating a used catalyst comprising an ionic liquid catalyst and a chloride, from an alkylation reactor, in a hydrogenation reactor to produce a regenerated catalyst effluent;

b. separating at least a portion of the regenerated catalyst effluent into a gas fraction comprising a hydrogen gas and into a light hydrocarbon fraction comprising a hydrogen chloride;

c. recycling at least a part of the gas fraction comprising the hydrogen gas to the hydrogenation reactor; and

d. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor.

This application provides an alkylation process, comprising:

a. alkylating a reactant in an alkylation reactor (300);

b. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from the alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);

c. separating at least a portion of the regenerated catalyst effluent (10), using a hydrocarbon extraction solvent (25) comprising an isomerized olefin, into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);

d. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100); and

e. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride (30) and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300);

wherein the gas fraction comprising the hydrogen gas (20) has a lower level of the hydrogen chloride that is from 72 to 99 wt% lower than a level of the hydrogen chloride in the regenerated catalyst effluent (10).

This application also provides an alkylation process, comprising:

a. regenerating a used catalyst comprising an ionic liquid catalyst and a chloride, from an alkylation reactor, in a hydrogenation reactor to produce a regenerated catalyst effluent;

b. mixing a hydrocarbon extraction solvent with the regenerated catalyst effluent to make a mixture;

c. separating at least a portion of the mixture into a gas fraction comprising a hydrogen gas and into a light hydrocarbon fraction comprising a hydrogen chloride, the hydrocarbon extraction solvent, and a regenerated ionic liquid catalyst;

d. recycling at least a part of the gas fraction comprising the hydrogen gas to the hydrogenation reactor;

e. recycling the regenerated ionic liquid catalyst to the alkylation reactor; and

f. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor.

This application provides and alkylation process, comprising:

a. alkylating a reactant in an alkylation reactor (300);

b. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from the alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);

c. mixing a hydrocarbon extraction solvent (25) comprising an isomerized olefin, with the regenerated catalyst effluent (10) to make a mixture;

d. separating at least a portion of the mixture into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30), the hydrocarbon extraction solvent (25), and a regenerated ionic liquid catalyst;

e. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100);

f. recycling the regenerated ionic liquid catalyst to the alkylation reactor (300); and

g. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride (30) and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300);

wherein the gas fraction comprising the hydrogen gas (20) has a lower level of the hydrogen chloride that is from 72 to 99 wt% lower than a level of the hydrogen chloride in the regenerated catalyst effluent (10).

This application also provides an alkylation process, comprising:

a. regenerating a used catalyst comprising an ionic liquid catalyst and a chloride, from an alkylation reactor, in a hydrogenation reactor to produce a regenerated catalyst effluent;

b. separating at least a portion of the regenerated catalyst effluent into an offgas comprising a hydrogen gas and into a separated liquid;

c. mixing a hydrocarbon extraction solvent with the offgas to make a mixture;

d. separating the mixture into a gas fraction comprising the hydrogen gas and into a light hydrocarbon fraction comprising a hydrogen chloride;

e. recycling at least a part of the gas fraction comprising the hydrogen gas to the hydrogenation reactor;

f. further separating the separated liquid, in the presence of a conjunct polymer extraction solvent, into an extracted conjunct polymer naphtha and an ionic liquid catalyst stream; and

g. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor.

This application provides an alkylation process, comprising:

a. alkylating a reactant in an alkylation reactor (300);

b. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from the alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);

c. separating at least a portion of the regenerated catalyst effluent (10) into an offgas (50) comprising a hydrogen gas and into a separated liquid (85);

d. mixing a hydrocarbon extraction solvent (25) comprising an isomerized olefin, with the offgas (50) to make a mixture;

e. separating the mixture into a gas fraction comprising the hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);

f. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100);

g. further separating the separated liquid (85), in a presence of a conjunct polymer extraction solvent (55), into an extracted conjunct polymer naphtha (45) and an ionic liquid catalyst stream (60); and

h. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300);

wherein the gas fraction comprising the hydrogen gas (20) has a lower level of the hydrogen chloride that is from 72 to 99 wt% lower than a level of the hydrogen chloride in the offgas (50).

In addition, this application also provides an alkylation process unit, comprising:

a) a hydrogenation reactor, wherein a used catalyst comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent;

b) a fractionation unit fluidly connected to the hydrogenation reactor, that separates at least a portion of the regenerated catalyst effluent into a gas fraction

comprising a hydrogen gas and into a light hydrocarbon fraction comprising a hydrogen chloride;

c) a first connection between the fractionation unit and the hydrogenation reactor for transmitting at least a part of the gas fraction to the hydrogenation reactor; and

d) a second connection between the fractionation unit and an alkylation reactor to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor.

This application provides an alkylation process unit, comprising:

a) a hydrogenation reactor (100), wherein a used catalyst (70) comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent (10);

b) a fractionation unit (200) fluidly connected to the hydrogenation reactor (100), that separates at least a portion of the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);

c) a first connection between the fractionation unit (200) and the hydrogenation reactor (100) for transmitting at least a part of the gas fraction to the hydrogenation reactor (100); and

d) a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor (300).

This application also provides an alkylation process unit, comprising:

a) a hydrogenation reactor, wherein a used catalyst comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent;

b) a separator, fluidly connected between the hydrogenation reactor and a fractionation unit; wherein the separator separates the regenerated catalyst effluent into a gas fraction comprising a hydrogen gas and into a separated liquid; and wherein the fractionation unit separates a hydrocarbon stream from the separated liquid into a light hydrocarbon fraction comprising a hydrogen chloride and an extracted conjunct polymer naphtha;

c) a first connection between the separator and the hydrogenation reactor for transmitting at least a part of the gas fraction to the hydrogenation reactor; and

d) a second connection between the fractionation unit and an alkylation reactor to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor.

This application provides an alkylation process unit, comprising:

a) a hydrogenation reactor (100), wherein a used catalyst (70) comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent (10);

b) a separator (400), fluidly connected to the hydrogenation reactor (100) and a fractionation unit (200); wherein the separator (400) separates the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a separated liquid (85); and wherein the fractionation unit (200) separates a hydrocarbon stream (52) from the separated liquid (85) into a light hydrocarbon fraction comprising a hydrogen chloride and an extracted conjunct polymer naphtha (45);

c) a first connection between the separator and the hydrogenation reactor (100) for transmitting at least a part of the gas fraction to the hydrogenation reactor (100); and

d) a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor (300).

IT IS CLAIMED:

1. An alkylation process, comprising:
    a. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from an alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);
    b. separating at least a portion of the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);
    c. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100); and
    d. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride (30) and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300).

2. An alkylation process, comprising:
    a. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from an alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);
    b. mixing a hydrocarbon extraction solvent (25) with the regenerated catalyst effluent (10) to make a mixture;
    c. separating at least a portion of the mixture into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30), the hydrocarbon extraction solvent (25), and a regenerated ionic liquid catalyst;
    d. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100);
    e. recycling the regenerated ionic liquid catalyst to the alkylation reactor (300); and
    f. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride (30) and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300).

3. An alkylation process, comprising:

a. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from an alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);

b. separating at least a portion of the regenerated catalyst effluent (10) into an offgas (50) comprising a hydrogen gas and into a separated liquid (85);

c. mixing a hydrocarbon extraction solvent (25) with the offgas (50) to make a mixture;

d. separating the mixture into a gas fraction comprising the hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);

e. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100);

f. further separating the separated liquid (85), in a presence of a conjunct polymer extraction solvent (55), into an extracted conjunct polymer naphtha (45) and an ionic liquid catalyst stream (60); and

g. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300).

4. The alkylation process of claim 2 or claim 3, wherein the hydrocarbon extraction solvent (25) is selected from the group consisting of an isoparaffin, an alkylate gasoline, an isomerized olefin, and mixtures thereof.

5. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the amount of the light hydrocarbon fraction additionally comprises an isoparaffin and an olefin.

6. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the amount of the light hydrocarbon fraction comprising the hydrogen chloride is not pre-treated, other than optional separating, before recycling.

7. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the part of the gas fraction comprising the hydrogen gas (20) is not dried before recycling.

8. The alkylation process of claim 1, claim 2, or claim 3, wherein at least 80 wt% of the hydrogen chloride, produced in the hydrogenation reactor (100), is recovered and recycled to the alkylation reactor (300).

9. The alkylation process of claim 1, claim 2, or claim 3, additionally comprising: removing a recycle gas purge (15) from the at least the part of the gas fraction comprising the hydrogen gas (20) prior to its recycling.

10. The alkylation process of claim 1, wherein the separating is done in a distillation column, into which is fed reactants to be alkylated in the alkylation reactor (300).

11. The alkylation process of claim 10, wherein the reactants are fed to the distillation column at one or more locations above where the at least the part of the gas fraction is fed to the distillation column.

12. The alkylation process of claim 1, or claim 2, wherein the regenerated catalyst effluent (10) comprises an extracted conjunct polymer naphtha (45).

13. The alkylation process of claim 1, claim 2, or claim 3, wherein the ionic liquid catalyst is selected from the group consisting of hydrocarbyl-substituted-pyridinium chloroaluminate, hydrocarbyl-substituted-imidazolium chloroaluminate, quaternary amine chloroaluminate, trialkyl amine hydrogen chloride chloroaluminate, alkyl pyridine hydrogen chloride chloroaluminate, and mixtures thereof.

14. The alkylation process of claim 1, claim 2, or claim 3, wherein a propane product, an n-butane product, and an alkylate gasoline blending component product are separated from an effluent from the alkylation reactor (300).

15. An alkylation process unit, comprising:

a) a hydrogenation reactor (100), wherein a used catalyst (70) comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent (10);

b) a fractionation unit (200) fluidly connected to the hydrogenation reactor (100), that separates at least a portion of the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);

c) a first connection between the fractionation unit (200) and the hydrogenation reactor (100) for transmitting at least a part of the gas fraction to the hydrogenation reactor (100); and

d) a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor (300).

16. An alkylation process unit, comprising:

a) a hydrogenation reactor (100), wherein a used catalyst (70) comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent (10);

b) a separator (400), fluidly connected to the hydrogenation reactor (100) and a fractionation unit (200); wherein the separator (400) separates the regenerated catalyst

effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a separated liquid (85); and wherein the fractionation unit (200) separates a hydrocarbon stream (52) from the separated liquid (85) into a light hydrocarbon fraction comprising a hydrogen chloride and an extracted conjunct polymer naphtha (45);

c) a first connection between the separator and the hydrogenation reactor (100) for transmitting at least a part of the gas fraction to the hydrogenation reactor (100); and

d) a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor (300).

17. The alkylation process unit of claim 15, additionally comprising one or more separators between the hydrogenation reactor (100) and the fractionation unit (200), fluidly connected to the hydrogenation reactor (100) and the alkylation reactor (300); wherein the one or more separators produce an offgas (50) that is fed to the fractionation unit (200) and also produce an ionic liquid catalyst stream (60) that is fed to the alkylation reactor (300).

18. The alkylation process unit of claim 15 or claim 16, additionally comprising a compressor located before the hydrogenation reactor (100), that compresses the at least the part of the gas fraction comprising the hydrogen gas (20) before recycling the at least the part of the gas fraction to the hydrogenation reactor (100).

19. The alkylation process unit of claim 15, additionally comprising a third connection between a product treatment unit and the second connection wherein the light hydrocarbon fraction is mixed with a recycled stream from the product treatment unit comprising a mixture of a light hydrogen chloride and a propane.

20. The alkylation process unit of claim 15 or 16, additionally comprising a selective olefin isomerization reactor (800), fluidly connected to the fractionation unit (200), that produces isomerized olefins (12) that are fed to the fractionation unit (200).

AMENDED CLAIMS
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IT IS CLAIMED:

1. An alkylation process, comprising:
    a. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from an alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);
    b. separating at least a portion of the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);
    c. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100); and
    d. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride (30) and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300);
    wherein the light hydrocarbon fraction comprising the hydrogen chloride (30) contains greater than 90 wt% of the hydrogen chloride generated in the hydrogenation reactor (100).

2. An alkylation process, comprising:
    a. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from an alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10) comprising an extracted conjunct polymer naphtha (45) produced in the hydrogenation reactor (100);
    b. mixing a hydrocarbon extraction solvent (25) with the regenerated catalyst effluent (10) to make a mixture;
    c. separating at least a portion of the mixture into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon

fraction comprising a hydrogen chloride (30), the hydrocarbon extraction solvent (25), and a regenerated ionic liquid catalyst;

d. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100);
e. recycling the regenerated ionic liquid catalyst to the alkylation reactor (300); and
f. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride (30) and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300);

wherein the light hydrocarbon fraction comprising the hydrogen chloride (30) contains greater than 90 wt% of the hydrogen chloride generated in the hydrogenation reactor (100).

3. An alkylation process, comprising:
   a. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from an alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10) comprising an extracted conjunct polymer naphtha (45) produced in the hydrogenation reactor (100);
   b. separating at least a portion of the regenerated catalyst effluent (10) into an offgas (50) comprising a hydrogen gas and into a separated liquid (85);
   c. mixing a hydrocarbon extraction solvent (25) with the offgas (50) to make a mixture;
   d. separating the mixture into a gas fraction comprising the hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);
   e. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100);

f. further separating the separated liquid (85), in a presence of a conjunct polymer extraction solvent (55), into the extracted conjunct polymer naphtha (45) and an ionic liquid catalyst stream (60); and

g. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300).

4. The alkylation process of claim 2 or claim 3, wherein the hydrocarbon extraction solvent (25) is selected from the group consisting of an isoparaffin, an alkylate gasoline, an isomerized olefin, and mixtures thereof.
5. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the amount of the light hydrocarbon fraction additionally comprises an isoparaffin and an olefin.
6. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the amount of the light hydrocarbon fraction comprising the hydrogen chloride is not pre-treated, other than optional separating, before recycling.
7. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the part of the gas fraction comprising the hydrogen gas (20) is not dried before recycling.
8. The alkylation process of claim 1, claim 2, or claim 3, wherein at least 80 wt% of the hydrogen chloride, produced in the hydrogenation reactor (100), is recovered and recycled to the alkylation reactor (300).
9. The alkylation process of claim 1, claim 2, or claim 3, additionally comprising: removing a recycle gas purge (15) from the at least the part of the gas fraction comprising the hydrogen gas (20) prior to its recycling.
10. The alkylation process of claim 1, wherein the separating is done in a distillation column, into which is fed reactants to be alkylated in the alkylation reactor (300).
11. The alkylation process of claim 10, wherein the reactants are fed to the distillation column at one or more locations above where the at least the part of the gas fraction is fed to the distillation column.

12. The alkylation process of claim 1, or claim 2, wherein the regenerated catalyst effluent (10) comprises an extracted conjunct polymer naphtha (45) having a final boiling point less than 246°C.
13. The alkylation process of claim 1, claim 2, or claim 3, wherein the ionic liquid catalyst is selected from the group consisting of hydrocarbyl-substituted-pyridinium chloroaluminate, hydrocarbyl-substituted-imidazolium chloroaluminate, quaternary amine chloroaluminate, trialkyl amine hydrogen chloride chloroaluminate, alkyl pyridine hydrogen chloride chloroaluminate, and mixtures thereof.
14. The alkylation process of claim 1, claim 2, or claim 3, wherein a propane product, an n-butane product, and an alkylate gasoline blending component product are separated from an effluent from the alkylation reactor (300).
15. An alkylation process unit, comprising:
    a) a hydrogenation reactor (100), wherein a used catalyst (70) comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent (10);
    b) a fractionation unit (200) fluidly connected to the hydrogenation reactor (100), that separates at least a portion of the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);
    c) a first connection between the fractionation unit (200) and the hydrogenation reactor (100) for transmitting at least a part of the gas fraction to the hydrogenation reactor (100);
    d) a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor (300); and
    e) a third connection that feeds a hydrocarbon extraction solvent (25) to the fractionation unit (200) such that the light hydrocarbon fraction comprising the hydrogen chloride (30) contains greater than 90 wt% of the hydrogen chloride generated in the hydrogenation reactor (100).
16. An alkylation process unit, comprising:

a) a hydrogenation reactor (100), wherein a used catalyst (70) comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent (10) comprising an extracted conjunct polymer naphtha (45) produced in the hydrogenation reactor (100);

b) a separator (400), fluidly connected to the hydrogenation reactor (100) and a fractionation unit (200); wherein the separator (400) separates the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a separated liquid (85); and wherein the fractionation unit (200) separates a hydrocarbon stream (52) from the separated liquid (85) into a light hydrocarbon fraction comprising a hydrogen chloride and the extracted conjunct polymer naphtha (45);

c) a first connection between the separator and the hydrogenation reactor (100) for transmitting at least a part of the gas fraction to the hydrogenation reactor (100); and

d) a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor (300).

17. The alkylation process unit of claim 15, additionally comprising one or more separators between the hydrogenation reactor (100) and the fractionation unit (200), fluidly connected to the hydrogenation reactor (100) and the alkylation reactor (300); wherein the one or more separators produce an offgas (50) that is fed to the fractionation unit (200) and also produce an ionic liquid catalyst stream (60) that is fed to the alkylation reactor (300).

18. The alkylation process unit of claim 15 or claim 16, additionally comprising a compressor located before the hydrogenation reactor (100), that compresses the at least the part of the gas fraction comprising the hydrogen gas (20) before recycling the at least the part of the gas fraction to the hydrogenation reactor (100).

19. The alkylation process unit of claim 15, additionally comprising a fourth connection between a product treatment unit and the second connection wherein the light hydrocarbon fraction is mixed with a recycled stream

from the product treatment unit comprising a mixture of a light hydrogen chloride and a propane.

20. The alkylation process unit of claim 15 or 16, additionally comprising a selective olefin isomerization reactor (800), fluidly connected to the fractionation unit (200), that produces isomerized olefins (12) that are fed to the fractionation unit (200).

21. The alkylation process of claim 3, wherein the light hydrocarbon fraction comprising the hydrogen chloride (30) contains greater than 90 wt% of the hydrogen chloride generated in the hydrogenation reactor (100).

22. The alkylation process unit of claim 16, additionally comprising a third connection that feeds a hydrocarbon extraction solvent (25) to the fractionation unit (200) such that the light hydrocarbon fraction comprising the hydrogen chloride (30) contains greater than 90 wt% of the hydrogen chloride generated in the hydrogenation reactor (100).

CLAIMS

1. An alkylation process, comprising:
    a. alkylating a reactant in an alkylation reactor (300);
    b. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from the alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);
    c. separating at least a portion of the regenerated catalyst effluent (10), using a hydrocarbon extraction solvent (25) comprising an isomerized olefin, into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);
    d. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100); and
    e. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride (30) and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300);
    wherein the gas fraction comprising the hydrogen gas (20) has a lower level of the hydrogen chloride that is from 72 to 99 wt% lower than a level of the hydrogen chloride in the regenerated catalyst effluent (10).

2. An alkylation process, comprising:
    a. alkylating a reactant in an alkylation reactor (300);
    b. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from the alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);
    c. mixing a hydrocarbon extraction solvent (25) comprising an isomerized olefin, with the regenerated catalyst effluent (10) to make a mixture;
    d. separating at least a portion of the mixture into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30), the hydrocarbon extraction solvent (25), and a regenerated ionic liquid catalyst;
    e. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100);
    f. recycling the regenerated ionic liquid catalyst to the alkylation reactor (300); and

g. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride (30) and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300);

wherein the gas fraction comprising the hydrogen gas (20) has a lower level of the hydrogen chloride that is from 72 to 99 wt% lower than a level of the hydrogen chloride in the regenerated catalyst effluent (10).

3. An alkylation process, comprising:

a. alkylating a reactant in an alkylation reactor (300);

b. regenerating a used catalyst (70) comprising an ionic liquid catalyst and a chloride, from the alkylation reactor (300), in a hydrogenation reactor (100) to produce a regenerated catalyst effluent (10);

c. separating at least a portion of the regenerated catalyst effluent (10) into an offgas (50) comprising a hydrogen gas and into a separated liquid (85);

d. mixing a hydrocarbon extraction solvent (25) comprising an isomerized olefin, with the offgas (50) to make a mixture;

e. separating the mixture into a gas fraction comprising the hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);

f. recycling at least a part of the gas fraction comprising the hydrogen gas (20) to the hydrogenation reactor (100);

g. further separating the separated liquid (85), in a presence of a conjunct polymer extraction solvent (55), into an extracted conjunct polymer naphtha (45) and an ionic liquid catalyst stream (60); and

h. recovering at least an amount of the light hydrocarbon fraction comprising the hydrogen chloride and recycling the at least the amount of the light hydrocarbon fraction to the alkylation reactor (300);

wherein the gas fraction comprising the hydrogen gas (20) has a lower level of the hydrogen chloride that is from 72 to 99 wt% lower than a level of the hydrogen chloride in the offgas (50).

4. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the amount of the light hydrocarbon fraction additionally comprises an isoparaffin and an olefin.

5. The alkylation process of claim 1, wherein the at least the amount of the light hydrocarbon fraction is mixed with a recycled stream comprising a mixture of a second hydrogen chloride and a propane, from the alkylation reactor (300).
6. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the amount of the light hydrocarbon fraction comprising the hydrogen chloride is not pre-treated, other than optional separating, before recycling.
7. The alkylation process of claim 1, claim 2, or claim 3, wherein the at least the part of the gas fraction comprising the hydrogen gas (20) is not dried before recycling.
8. The alkylation process of claim 1, claim 2, or claim 3, wherein at least 80 wt% of the hydrogen chloride, produced in the hydrogenation reactor (100), is recovered and recycled to the alkylation reactor (300).
9. The alkylation process of claim 1, claim 2, or claim 3, additionally comprising: removing a recycle gas purge (15) from the at least the part of the gas fraction comprising the hydrogen gas (20) prior to its recycling.
10. The alkylation process of claim 1, additionally comprising compressing the at least the part of the gas fraction comprising the hydrogen gas (20) before recycling the at least the part of the gas fraction to the hydrogenation reactor (100).
11. The alkylation process of claim 1, wherein the separating is done in a distillation column, into which is fed the isomerized olefin and an isoparaffin to be alkylated in the alkylation reactor (300).
12. The alkylation process of claim 11, wherein the isomerized olefin comprises 2-butene and the isoparaffin comprises isobutane.
13. The alkylation process of claim 11, wherein the isomerized olefin and the isoparaffin are fed to the distillation column at one or more locations above where the at least the part of the gas fraction is fed to the distillation column.
14. The alkylation process of claim 1, claim 2, or claim 3, wherein the ionic liquid catalyst is recycled to the alkylation reactor (300).
15. The alkylation process of claim 1, or claim 2, wherein the regenerated catalyst effluent (10) comprises an extracted conjunct polymer naphtha (45).
16. The alkylation process of claim 1, claim 2, or claim 3, wherein the ionic liquid catalyst is selected from the group consisting of hydrocarbyl-substituted-pyridinium chloroaluminate, hydrocarbyl-substituted-imidazolium chloroaluminate, quaternary amine chloroaluminate, trialkyl amine hydrogen chloride chloroaluminate, alkyl pyridine hydrogen chloride chloroaluminate, and mixtures thereof.

17. The alkylation process of claim 1, claim 2, or claim 3, wherein a propane product, an n-butane product, and an alkylate gasoline blending component product are separated from an effluent from the alkylation reactor (300).

18. An alkylation process unit, comprising:

a) a hydrogenation reactor (100), wherein a used catalyst (70) comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent (10);

b) a fractionation unit (200) fluidly connected to the hydrogenation reactor (100), that separates at least a portion of the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a light hydrocarbon fraction comprising a hydrogen chloride (30);

c) a first connection between the fractionation unit (200) and the hydrogenation reactor (100) for transmitting at least a part of the gas fraction to the hydrogenation reactor (100); and

d) a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor (300).

19. An alkylation process unit, comprising:

a) a hydrogenation reactor (100), wherein a used catalyst (70) comprising an ionic liquid catalyst and a chloride produces a regenerated catalyst effluent (10);

b) a separator (400), fluidly connected to the hydrogenation reactor (100) and a fractionation unit (200); wherein the separator (400) separates the regenerated catalyst effluent (10) into a gas fraction comprising a hydrogen gas (20) and into a separated liquid (85); and wherein the fractionation unit (200) separates a hydrocarbon stream (52) from the separated liquid (85) into a light hydrocarbon fraction comprising a hydrogen chloride and an extracted conjunct polymer naphtha (45);

c) a first connection between the separator and the hydrogenation reactor (100) for transmitting at least a part of the gas fraction to the hydrogenation reactor (100); and

d) a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least an amount of the light hydrocarbon fraction to the alkylation reactor (300).

20. The alkylation process unit of claim 18, additionally comprising one or more separators between the hydrogenation reactor (100) and the fractionation unit (200), fluidly connected to the hydrogenation reactor (100) and the alkylation reactor (300); wherein the one or more separators produce an offgas (50) that is fed to the fractionation unit (200)

and also produce an ionic liquid catalyst stream (60) that is fed to the alkylation reactor (300).

21. The alkylation process unit of claim 18 or claim 19, additionally comprising a compressor located before the hydrogenation reactor (100), that compresses the at least the part of the gas fraction comprising the hydrogen gas (20) before recycling the at least the part of the gas fraction to the hydrogenation reactor (100).
22. The alkylation process unit of claim 18, additionally comprising a third connection between a product treatment unit and the second connection wherein the light hydrocarbon fraction is mixed with a recycled stream from the product treatment unit comprising a mixture of a light hydrogen chloride and a propane.
23. The alkylation process unit of claim 18 or 19, additionally comprising a selective olefin isomerization reactor (800), fluidly connected to the fractionation unit (200), that produces isomerized olefins (12) that are fed to the fractionation unit (200).
24. The alkylation process of claim 1, or claim 2, wherein the gas fraction comprising the hydrogen gas (20) has the lower level of the hydrogen chloride that is from 85 to 99 wt% lower than the level in the regenerated catalyst effluent (10).
25. The alkylation process of claim 3, wherein the gas fraction comprising the hydrogen gas (20) has the lower level of the hydrogen chloride that is from 85 to 99 wt% lower than the level in the offgas (50).
26. The alkylation process of claim 1, claim 2, or claim 3, wherein the hydrocarbon extraction solvent additionally comprises an alkylate gasoline.
27. The alkylation process of claim 1, claim 2, or claim 3, wherein the hydrocarbon extraction solvent comprises the isomerized olefin and an isoparaffin that are alkylated to make an alkylate gasoline blending component.
28. The alkylation process of claim 27, wherein the isoparaffin comprises an isobutane.