HYDROGEN RECYCLE AND HYDROGEN CHLORIDE RECOVERY IN AN ALKYLATION PROCESS

This application relates to co-filed applications titled, "ALKYLATION PROCESS WITH RECYLE OF HYDROGEN AND RECOVERY OF HYDROGEN CHLORIDE", and "EXTRACTED CONJUNCT POLYMER NAPHTHA", herein incorporated in their entireties.

TECHNICAL FIELD

This application is directed to a process and process unit for improved hydrogen chloride and hydrogen recycling in an alkylation process using hydrogenation.

BACKGROUND

Improved processes and process units for recycling hydrogen and hydrogen chloride are desired in alkylation processes using hydrogenation.

SUMMARY

This application provides an alkylation process, comprising: separating and recycling a hydrogen gas and a hydrogen chloride from an offgas of a hydrogenation reactor; wherein the hydrogen gas is recycled to the hydrogenation reactor; and wherein the hydrogen chloride is recycled to an alkylation reactor.

This application provides an alkylation process, comprising: separating and recycling a hydrogen gas and a hydrogen chloride from an offgas of a hydrogenation reactor used to regenerate a used alkylation catalyst; wherein the hydrogen gas is recycled to the hydrogenation reactor; and wherein the hydrogen chloride is recycled to an alkylation reactor .

This application also provides an alkylation process unit, comprising:

a. a fractionation unit for separating a hydrogen gas and a hydrogen chloride from an offgas of a hydrogenation reactor that regenerates a used ionic liquid catalyst; and

b. a first connection between the fractionation unit and the hydrogenation reactor for transmitting at least a portion comprising the hydrogen gas to the hydrogenation reactor; and

c. a second connection between the fractionation unit and an alkylation reactor to transmit at least a second portion comprising the hydrogen chloride to the alkylation reactor.

This application provides an alkylation process unit, comprising:

a. a fractionation unit for separating a hydrogen gas and a hydrogen chloride from an offgas of a hydrogenation reactor that regenerates a used ionic liquid catalyst; and

b. a first connection between the fractionation unit and the hydrogenation reactor for transmitting at least a portion comprising the hydrogen gas to the hydrogenation reactor; and

c. a second connection between the fractionation unit and an alkylation reactor to transmit at least a second portion comprising the hydrogen chloride to the alkylation reactor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a diagram of an alkylation process unit with catalyst hydro-regeneration, hydrogen recycle and hydrogen chloride recovery; the comprehensive case.

FIGURE 2 is a diagram of an alkylation process unit with catalyst hydro-regeneration, hydrogen recycle, and hydrogen chloride removal by caustic scrubbing; the comparison case.

IT IS CLAIMED:

1. An alkylation process, comprising: separating and recycling a hydrogen gas and a hydrogen chloride from an offgas (50) of a hydrogenation reactor (100); wherein the hydrogen gas is recycled to the hydrogenation reactor (100); and wherein the hydrogen chloride is recycled to an alkylation reactor (300).
2. The alkylation process of claim 1, wherein the hydrogen chloride is extracted from the offgas (50) of the hydrogenation reactor (100) using a hydrocarbon extraction solvent (25).
3. The alkylation process of claim 2, wherein the hydrocarbon extraction solvent (25) comprises an isomerized olefin.
4. The alkylation process of claim 1, wherein the alkylation reactor (300) uses an alkylation catalyst comprising a chloride.
5. The alkylation process of claim 4, wherein the alkylation catalyst is an ionic liquid catalyst.
6. The alkylation process of claim 5, wherein a hydrocarbon extraction solvent (25) is fed into a stream selected from the group consisting of a hydrogenated effluent (10), the offgas (50) of the hydrogenation reactor (100) that was separated in a separator (400), and a combination thereof.
7. The alkylation process of claim 6, wherein the hydrocarbon extraction solvent (25) is fed at a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst from 1.0 to 100.
8. The alkylation process of claim 6, wherein a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst is selected to provide a level of hydrogen chloride less than 600 wppm in a gas fraction comprising a hydrogen (20).
9. The alkylation process of claim 6, wherein a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst is selected to provide at least 85 wt% of the hydrogen chloride produced in the hydrogenation reactor (100), which is recovered and recycled to the alkylation reactor (300).
10. The alkylation process of claim 1, wherein the hydrogenation reactor (100) is used to regenerate a used alkylation catalyst.

11. The alkylation process of claim 1, wherein a hydrocarbon extraction solvent (25) is fed into a fractionation unit (200), used for the separating, at a location above where the offgas (50) of the hydrogenation reactor (100) is fed into the fractionation unit (200).
12. The alkylation process of claim 11, wherein the hydrocarbon extraction solvent (25) comprises an olefin and an isoparaffin to be alkylated to make an alkylate gasoline blending component.
13. The alkylation process of claim 1, additionally comprising separating an extracted conjunct polymer naphtha (45) from an effluent (10) of the hydrogenation reactor (100) and blending the extracted conjunct polymer naphtha (45) into an alkylate gasoline.
14. An alkylation process unit, comprising:
    a. a fractionation unit (200) for separating a hydrogen gas and a hydrogen chloride from an offgas (50) of a hydrogenation reactor (100) that regenerates a used ionic liquid catalyst; and
    b. a first connection between the fractionation unit (200) and the hydrogenation reactor (100) for transmitting at least a portion comprising the hydrogen gas to the hydrogenation reactor (100); and
    c. a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least a second portion comprising the hydrogen chloride to the alkylation reactor (300).
15. The alkylation process unit of claim 14, additionally comprising an inlet wherein a hydrocarbon extraction solvent (25) is fed to the fractionation unit (200) or to a separator (400) that is located between the hydrogenation reactor (100) and the fractionation unit (200).
16. The alkylation process unit of claim 15, wherein the inlet is at a location above where the hydrogen gas and the hydrogen chloride are fed to the fractionation unit (200).
17. The alkylation process unit of claim 14, additionally comprising a separator (400) between the hydrogenation reactor (100) and the fractionation unit (200).
18. The alkylation process unit of claim 14, additionally comprising an ionic liquid catalyst and hydrocarbon separator (500) which separates the offgas (50) into a light hydrocarbon fraction comprising the hydrogen chloride (30), an extracted conjunct polymer naphtha (45), and an ionic liquid catalyst stream (60).
19. The alkylation process unit of claim 14, additionally comprising a third connection between a product treatment unit and the second connection, wherein the second portion

is mixed with a recycled stream, from the product treatment unit, comprising a mixture of a gaseous hydrogen chloride and a propane.

AMENDED CLAIMS
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1. An alkylation process, comprising: separating and recycling a hydrogen gas and a hydrogen chloride from an offgas (50) of a hydrogenation reactor (100) used to regenerate a used alkylation catalyst; wherein the hydrogen gas is recycled to the hydrogenation reactor (100); and wherein the hydrogen chloride is recycled to an alkylation reactor (300).

2. The alkylation process of claim 1, wherein the hydrogen chloride is extracted from the offgas (50) of the hydrogenation reactor (100) using a hydrocarbon extraction solvent (25).

3. The alkylation process of claim 2, wherein the hydrocarbon extraction solvent (25) comprises an isomerized olefin.

4. The alkylation process of claim 1, wherein the alkylation reactor (300) uses an alkylation catalyst comprising a chloride.

5. The alkylation process of claim 4, wherein the alkylation catalyst is an ionic liquid catalyst.

6. The alkylation process of claim 5, wherein a hydrocarbon extraction solvent (25) is fed into a stream selected from the group consisting of a hydrogenated effluent (10), the offgas (50) of the hydrogenation reactor (100) that was separated in a separator (400), and a combination thereof.

7. The alkylation process of claim 6, wherein the hydrocarbon extraction solvent (25) is fed at a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst from 1.0 to 100.

8. The alkylation process of claim 6, wherein a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst is selected to provide a level of hydrogen chloride less than 600 wppm in a gas fraction comprising a hydrogen (20).

9. The alkylation process of claim 6, wherein a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst is selected to provide at least 85 wt% of the hydrogen chloride produced in the hydrogenation reactor (100), which is recovered and recycled to the alkylation reactor (300).

10. The alkylation process of claim 1, wherein the hydrogenation reactor (100) is operated in the presence of a hydrogenation catalyst containing Pt and Pd.

11. The alkylation process of claim 1, wherein a hydrocarbon extraction solvent (25) is fed into a fractionation unit (200), used for the separating, at a location above where the offgas (50) of the hydrogenation reactor (100) is fed into the fractionation unit (200).

12. The alkylation process of claim 11, wherein the hydrocarbon extraction solvent (25) comprises an olefin and an isoparaffin to be alkylated to make an alkylate gasoline blending component.

13. The alkylation process of claim 1, additionally comprising separating an extracted conjunct polymer naphtha (45) from an effluent (10) of the hydrogenation reactor (100) and blending the extracted conjunct polymer naphtha (45) into an alkylate gasoline.

14. An alkylation process unit, comprising:

    a. a fractionation unit (200) for separating a hydrogen gas and a hydrogen chloride from an offgas (50) of a hydrogenation reactor (100) that regenerates a used ionic liquid catalyst; and

    b. a first connection between the fractionation unit (200) and the hydrogenation reactor (100) for transmitting at least a portion comprising the hydrogen gas to the hydrogenation reactor (100); and

AMENDED SHEET (ARTICLE 19)

c. a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least a second portion comprising the hydrogen chloride to the alkylation reactor (300).

15. The alkylation process unit of claim 14, additionally comprising an inlet wherein a hydrocarbon extraction solvent (25) is fed to the fractionation unit (200) or to a separator (400) that is located between the hydrogenation reactor (100) and the fractionation unit (200).

16. The alkylation process unit of claim 15, wherein the inlet is at a location above where the hydrogen gas and the hydrogen chloride are fed to the fractionation unit (200).

17. The alkylation process unit of claim 14, additionally comprising a separator (400) between the hydrogenation reactor (100) and the fractionation unit (200).

18. The alkylation process unit of claim 14, additionally comprising an ionic liquid catalyst and hydrocarbon separator (500) which separates the offgas (50) into a light hydrocarbon fraction comprising the hydrogen chloride (30), an extracted conjunct polymer naphtha (45), and an ionic liquid catalyst stream (60).

19. The alkylation process unit of claim 14, additionally comprising a third connection between a product treatment unit and the second connection, wherein the second portion is mixed with a recycled stream, from the product treatment unit, comprising a mixture of a gaseous hydrogen chloride and a propane.

CLAIMS

1. An alkylation process, comprising: separating and recycling a hydrogen gas and a hydrogen chloride from an offgas (50) of a hydrogenation reactor (100) used to regenerate a used alkylation catalyst; wherein the hydrogen gas is recycled to the hydrogenation reactor (100); and wherein the hydrogen chloride is recycled to an alkylation reactor (300).

2. The alkylation process of claim 1, wherein the hydrogen chloride is extracted from the offgas (50) of the hydrogenation reactor (100) using a hydrocarbon extraction solvent (25).

3. The alkylation process of claim 2, wherein the hydrocarbon extraction solvent (25) comprises an isomerized olefin.

4. The alkylation process of claim 1, wherein the alkylation reactor (300) uses an alkylation catalyst comprising a chloride.

5. The alkylation process of claim 4, wherein the alkylation catalyst is an ionic liquid catalyst.

6. The alkylation process of claim 5, wherein a hydrocarbon extraction solvent (25) is fed into a stream selected from the group consisting of a hydrogenated effluent (10), the offgas (50) of the hydrogenation reactor (100) that was separated in a separator (400), and a combination thereof.

7. The alkylation process of claim 6, wherein the hydrocarbon extraction solvent (25) is fed at a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst from 1.0 to 100.

8. The alkylation process of claim 6, wherein a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst is selected to provide a level of hydrogen chloride less than 600 wppm in a gas fraction comprising a hydrogen (20).

9. The alkylation process of claim 6, wherein a vol/vol ratio of the hydrocarbon extraction solvent (25) to the ionic liquid catalyst is selected to provide at least 85 wt% of the hydrogen chloride produced in the hydrogenation reactor (100), which is recovered and recycled to the alkylation reactor (300).

10. The alkylation process of claim 1, wherein the hydrogenation reactor (100) is operated in the presence of a hydrogenation catalyst containing Pt and Pd.

11. The alkylation process of claim 1, wherein a hydrocarbon extraction solvent (25) is fed into a fractionation unit (200), used for the separating, at a location above where the offgas (50) of the hydrogenation reactor (100) is fed into the fractionation unit (200).

12. The alkylation process of claim 11, wherein the hydrocarbon extraction solvent (25) comprises an olefin and an isoparaffin to be alkylated to make an alkylate gasoline blending component.

13. The alkylation process of claim 1, additionally comprising separating an extracted conjunct polymer naphtha (45) from an effluent (10) of the hydrogenation reactor (100) and blending the extracted conjunct polymer naphtha (45) into an alkylate gasoline.

14. An alkylation process unit, comprising:

    a. a fractionation unit (200) for separating a hydrogen gas and a hydrogen chloride from an offgas (50) of a hydrogenation reactor (100) that regenerates a used ionic liquid catalyst; and

    b. a first connection between the fractionation unit (200) and the hydrogenation reactor (100) for transmitting at least a portion comprising the hydrogen gas to the hydrogenation reactor (100); and

c. a second connection between the fractionation unit (200) and an alkylation reactor (300) to transmit at least a second portion comprising the hydrogen chloride to the alkylation reactor (300).

15. The alkylation process unit of claim 14, additionally comprising an inlet wherein a hydrocarbon extraction solvent (25) is fed to the fractionation unit (200) or to a separator (400) that is located between the hydrogenation reactor (100) and the fractionation unit (200).

16. The alkylation process unit of claim 15, wherein the inlet is at a location above where the hydrogen gas and the hydrogen chloride are fed to the fractionation unit (200).

17. The alkylation process unit of claim 14, additionally comprising a separator (400) between the hydrogenation reactor (100) and the fractionation unit (200).

18. The alkylation process unit of claim 14, additionally comprising an ionic liquid catalyst and hydrocarbon separator (500) which separates the offgas (50) into a light hydrocarbon fraction comprising the hydrogen chloride (30), an extracted conjunct polymer naphtha (45), and an ionic liquid catalyst stream (60).

19. The alkylation process unit of claim 14, additionally comprising a third connection between a product treatment unit and the second connection, wherein the second portion is mixed with a recycled stream, from the product treatment unit, comprising a mixture of a gaseous hydrogen chloride and a propane.

20. The alkylation process of claim 1, wherein the hydrogen chloride is extracted from the offgas (50) of the hydrogenation reactor (100) using a hydrocarbon extraction solvent (25) that comprises an olefin and an isoparaffin to be alkylated.