d. a connection between the hydrogenation reactor and the dechlorination reactor that feeds an off-gas comprising from 70-99.9 vol% hydrogen from the dechlorination reactor to the hydrogenation reactor.

In another aspect, there is provided an integrated process to produce an alkylate gasoline, comprising:

a. alkylating a mixture of hydrocarbons including isoparaffin and olefin using a chloride-containing ionic liquid catalyst in an alkylation reactor to produce the alkylate gasoline comprising a chloride contaminant;

b. hydro-regenerating the chloride-containing ionic liquid catalyst in a hydrogenation reactor;

c. hydro-dechlorinating the alkylate gasoline comprising the chloride contaminant in a dechlorination reactor at a dechlorination pressure that is 138 to 1207 kPa (20 to 175 psig) higher than a hydrogenation pressure used in the hydrogenation reactor, to produce a dechlorinated alkylate gasoline; and

d. feeding an off-gas, comprising 70 to 99.9 vol.% hydrogen, from the dechlorination reactor to the hydrogenation reactor; wherein a hydrogenation catalyst used in the hydrogenation reactor and a dechlorination catalyst used in the dechlorination reactor both comprise Pt, Pd, or mixture thereof on an alumina support; wherein the off-gas requires no pre-treatment before feeding to the hydrogenation reactor; and wherein the off-gas additionally comprises from 100 to 50,000 wppm of a HCl produced during the hydro-dechlorinating.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1 is a diagram of an integrated alkylation process unit used to make high quality alkylate gasoline.

DETAILED DESCRIPTION

Description of Figure 1

One embodiment of how this method can be practiced is shown in Figure 1. A mixture of hydrocarbons (5) is fed to an alkylation reactor (100). The alkylation reactor effluent (10) is fed to a liquid/liquid separator (400). The liquid/liquid separator (400) separates the alkylation reactor effluent (10) into an alkylate gasoline comprising a chloride contaminant (20) and a chloride-containing ionic liquid catalyst (30). The alkylate gasoline comprising a chloride contaminant (20) is fed to a dechlorination reactor (300). The chloride-containing ionic liquid catalyst is fed to a hydrogenation reactor (200). A regenerated ionic liquid catalyst (40) from the hydrogenation reactor (200) is fed to the alkylation reactor (100). The dechlorination reactor (300) and the hydrogenation reactor (200) are in a single pressurized zone (600). The dechlorination reactor effluent (50) is fed to

a gas/liquid separator (500). The gas/liquid separator (500) separates the dechlorination reactor effluent (50) into HCl (70), a separated liquid (80) and an off-gas (60). The off-gas (60) comprises hydrogen and is fed to the hydrogenation reactor (200). The HCl(70) is fed to the alkylation reactor (100). The separated liquid (80) comprises a dechlorinated alkylate gasoline (90).

Alkylating

The alkylating of the mixture of hydrocarbons is performed in an alkylation reactor under conditions known to produce alkylate gasoline. The alkylation conditions in the alkylation reactor are selected to provide the desired product yields and quality. The alkylation reaction in the alkylation reactor is generally carried out in a liquid hydrocarbon phase, in a batch system, a semi-batch system, or a continuous system. Catalyst volume in the alkylation reactor is in the range of 1 vol % to 80 vol %, for example from 2 vol % to 70 vol %, from 3 vol % to 50 vol %, or from 5 vol % to 25 vol %. In some embodiments, vigorous

IT IS CLAIMED:

1. An integrated process to produce an alkylate gasoline, comprising:

   a. alkylating a mixture of hydrocarbons using a chloride-containing ionic liquid catalyst in an alkylation reactor to produce the alkylate gasoline comprising a chloride contaminant;

   b. hydro-regenerating the chloride-containing ionic liquid catalyst in a hydrogenation reactor;

   c. hydro-dechlorinating the alkylate gasoline comprising the chloride contaminant in a dechlorination reactor at a dechlorination pressure from 0 to 6895 kPa (0 to 1000 psig) of a hydrogenation pressure used in the hydrogenation reactor, to produce a dechlorinated alkylate gasoline; and

   d. feeding an off-gas, comprising 70 to 99.9 vol% hydrogen, from the dechlorination reactor to the hydrogenation reactor.

2. The integrated process of claim 1, wherein a hydrogenation catalyst used in the hydrogenation reactor and a dechlorination catalyst used in the dechlorination reactor both comprise Pt and Pd on an alumina support.

3. The integrated process of claim 1, wherein the hydrogenation reactor and the dechlorination reactor are in a common pressurized zone.

4. The integrated process of claim 1, wherein the off-gas comprises from 90 to 99.9 vol% hydrogen.

5. The integrated process of claim 1, wherein the off-gas comprises from 0.5 to 9.5 vol% C4+ hydrocarbons.

6. The integrated process of claim 1, wherein the off-gas comprises from 0.5 to 20 vol% C4- hydrocarbons.

7. The integrated process of claim 1, wherein the off-gas comprises from 0 to 0.05 vol% C1-C3 hydrocarbons.

8. The integrated process of claim 1, wherein the off-gas requires no pre-treatment before feeding to the hydrogenation reactor.

9. The integrated process of claim 1, wherein the off-gas additionally comprises from 100 to 50,000 wppm of a HCl.

10. The integrated process of claim 1, wherein the dechlorination pressure is within 3447 kPa (500 psig) of the hydrogenation pressure.

11. The integrated process of claim 1, wherein the dechlorination pressure is at least 207 kPa (30 psig) above the hydrogenation pressure.

12. The integrated process of claim 1, wherein the hydro-dechlorinating reduces a total halide from greater than 50 wppm in the alkylate gasoline comprising the chloride contaminant to less than 10 wppm in the dechlorinated alkylate gasoline.

13. The integrated process of claim 1, wherein the chloride contaminant comprises a C4+ organic chloride.

14. The integrated process of claim 1, wherein an HCl is produced during the hydro-dechlorinating and the HCl is recycled to the alkylation reactor.

15. The integrated process of claim 14, wherein the HCl from the dechlorination reactor is mixed with a hydrogenation HCl from the hydrogenation reactor to make a mixed HCl feed that is recycled to the alkylation reactor.

16. The integrated process of claim 1, wherein the dechlorinated alkylate gasoline retains from 97 to 100 wt% of a TMP in a C8 fraction of the alkylate gasoline comprising the chloride contaminant.

17. The integrated process of claim 1, wherein a temperature in the dechlorination reactor is maintained below an elevated temperature, wherein the elevated temperature causes a total chloride in the dechlorinated alkylate gasoline to be above 15 wppm.

18. The integrated process of claim 1, wherein a temperature in the dechlorination reactor is from 300°F (148.9 degree Celsius) to 600°F (315.6 degree Celsius).

19. The integrated process of claim 1, wherein a LHSV in the dechlorination reactor is from 0.5 to 20 hr^{-1}.

20. An integrated alkylation process unit, comprising:

a. an alkylation reactor comprising a chloride-containing ionic liquid catalyst that produces an alkylate gasoline comprising a chloride contaminant;

b. a hydrogenation reactor that receives a used chloride-containing ionic liquid catalyst from the alkylation reactor and regenerates the chloride-containing ionic liquid catalyst;

c. a dechlorination reactor that hydro-dechlorinates the alkylate gasoline at a pressure from 0 to 6895 kPa (0 to 1000 psig) of a hydrogenation pressure used in the hydrogenation reactor, to produce a dechlorinated alkylate gasoline; and

d. a connection between the hydrogenation reactor and the dechlorination reactor that feeds an off-gas comprising from 70-99.9 vol% hydrogen from the dechlorination reactor to the hydrogenation reactor.

21. The integrated alkylation process unit of claim 20, additionally comprising a recycle line from a gas/liquid separator that recycles a HCl from the dechlorination reactor to the alkylation reactor.

22. The integrated alkylation process unit of claim 20, additionally comprising a pressurized zone comprising both the hydrogenation reactor and the dechlorination reactor.

Claims

1. An integrated process to produce an alkylate gasoline, comprising:

a. alkylating a mixture of hydrocarbons including isoparaffin and olefin using a chloride-containing ionic liquid catalyst in an alkylation reactor to produce the alkylate gasoline comprising a chloride contaminant;

b. hydro-regenerating the chloride-containing ionic liquid catalyst in a hydrogenation reactor;

c. hydro-dechlorinating the alkylate gasoline comprising the chloride contaminant in a dechlorination reactor at a dechlorination pressure that is 138 to 1207 kPa (20 to 175 psig) higher than a hydrogenation pressure used in the hydrogenation reactor, to produce a dechlorinated alkylate gasoline; and

d. feeding an off-gas, comprising 70 to 99.9 vol.% hydrogen, from the dechlorination reactor to the hydrogenation reactor; wherein a hydrogenation catalyst used in the hydrogenation reactor and a dechlorination catalyst used in the dechlorination reactor both comprise Pt, Pd, or mixture thereof on an alumina support; wherein the off-gas requires no pre-treatment before feeding to the hydrogenation reactor; and wherein the off-gas additionally comprises from 100 to 50,000 wppm of a HCl produced during the hydro-dechlorinating.

2. The integrated process of claim 1, wherein a hydrogenation catalyst used in the hydrogenation reactor and a dechlorination catalyst used in the dechlorination reactor both comprise Pt and Pd on an alumina support.

3. The integrated process of claim 1, wherein the off-gas comprises from 90 to 99.9 vol % hydrogen.

4. The integrated process of claim 1, wherein the off-gas comprises from 0.5 to 9.5 vol % C4+ hydrocarbons.

5. The integrated process of claim 1, wherein the off-gas comprises from 0.5 to 20 vol % $C4^-$ hydrocarbons.

6. The integrated process of claim 1, wherein the off-gas comprises from 0 to 0.05 vol % C1-C3 hydrocarbons.

7. The integrated process of claim 1, wherein the dechlorination pressure is at least 30 psig above the hydrogenation pressure.

8. The integrated process of claim 1, wherein the dechlorination pressure is from 50 to 175 psig higher than the hydrogenation pressure.

9. The integrated process of claim 1, wherein the hydro-dechlorinating reduces a total halide from greater than 50 wppm in the alkylate gasoline comprising the chloride contaminant to less than 10 wppm in the dechlorinated alkylate gasoline.

10. The integrated process of claim 1, wherein the chloride contaminant comprises a C4+ organic chloride.

11. The integrated process of claim 1, wherein an HCl is produced during the hydro-dechlorinating and the HCl is recycled to the alkylation reactor.

12. The integrated process of claim 11, wherein the HCl from the dechlorination reactor is mixed with a hydrogenation HCl from the hydrogenation reactor to make a mixed HCl feed that is recycled to the alkylation reactor.

13. The integrated process of claim 1, wherein the dechlorinated alkylate gasoline retains from 97 to 100 wt % of a TMP in a C8 fraction of the alkylate gasoline comprising the chloride contaminant.

14. The integrated process of claim 1, wherein a temperature in the dechlorination reactor is maintained below an elevated temperature, wherein the elevated temperature causes a total chloride in the dechlorinated alkylate gasoline to be above 15 wppm.

15. The integrated process of claim 1, wherein a temperature in the dechlorination reactor is from 300° F. (148.9 degree Celsius) to 600° F. (315.6 degree Celsius).

16. The integrated process of claim 1, wherein a LHSV in the dechlorination reactor is from 0.5 to 20 hr^{-1}.