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HYDROLYSIS OF USED IONIC LIQUID CATALYST FOR DISPOSAL

TECHNICAL FIELD

This application is directed to a process and apparatus for preparing a used ionic liquid catalyst for disposal.

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BACKGROUND

Ionic liquid catalysts need to be safely disposed of after use. Without treatment, they can be highly water reactive and unsafe to handle or dispose of.

SUMMARY

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This application provides a process and apparatus for preparing a used catalyst for disposal, comprising:

a. hydrolyzing a used ionic liquid catalyst comprising an anhydrous metal halide to produce a hydrolyzed product; and

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b. separating the hydrolyzed product into a liquid phase and a solid phase; wherein the liquid phase comprises a non-water-reactive aqueous phase and a hydrocarbon phase; and wherein the solid phase comprises a solid portion of the hydrolyzed product, that is not water reactive. The apparatus comprises a vessel used to hydrolyze the used ionic liquid catalyst and a separator.

This application also provides a process for preparing a used ionic liquid catalyst for safe disposal, comprising:

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hydrolyzing the used ionic liquid catalyst comprising an anhydrous metal halide with a basic solution at a temperature from -20°C to 90°C to produce a hydrolyzed product, evolve a hydrogen halide gas;

wherein as the hydrogen halide gas is evolved it is dissolved into the basic solution and is neutralized to produce a hydrolysed slurry with a pH of 4 to 10 for safe disposal.

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This application also provides a process of any one of the preceding claims, wherein the anhydrous metal halide is selected from the group consisting of $AlCl_3$, $AlBr_3$, $GaCl_3$, $GaBr_3$, $InCl_3$, $InBr_3$, and mixtures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

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FIG 1 is a diagram of a flow chart with one embodiment for hydrolysis of ionic liquid catalyst.

DETAILED DESCRIPTION

Anhydrous metal-halide-containing used ionic liquid catalyst is treated for safe and economic disposal by hydrolyzing the used ionic liquid catalyst followed by separation which produces a non-water-reactive aqueous phase, a hydrocarbon phase and a solid phase.

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Prior to the treatment by the process the used catalyst is water reactive and unsuitable for disposal by usual methods. "Water reactive" means that the composition will violently react with moisture, sometimes leading to release of toxic gases, explosions, or fire. Water reactive substances are dangerous when wet because they undergo a chemical reaction with water. This reaction can release a gas that presents a toxic health hazard. In addition, the heat

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5 IT IS CLAIMED:

1. A process for preparing a used catalyst for disposal, comprising:
 - a. hydrolyzing a used ionic liquid catalyst comprising an anhydrous metal halide to produce a hydrolyzed product; and
 - b. separating the hydrolyzed product into a liquid phase and a solid phase; wherein
10 the liquid phase comprises a non-water-reactive aqueous phase and a hydrocarbon phase; and wherein the solid phase comprises a solid portion of the hydrolyzed product, that is not water reactive.
2. The process of claim 1, wherein the used ionic liquid catalyst is selected from the group consisting of a hydrocarbyl-substituted-pyridinium chloroaluminate, a hydrocarbyl-
15 substituted-imidazolium chloroaluminate, a quaternary amine chloroaluminate, a trialkyl amine hydrogen chloride chloroaluminate, an alkyl pyridine hydrogen chloride chloroaluminate, and mixtures thereof.
3. The process of claim 1, wherein the anhydrous metal halide is selected from the group consisting of AlCl_3 , AlBr_3 , GaCl_3 , GaBr_3 , InCl_3 , InBr_3 , and mixtures thereof.
- 20 4. The process of claim 1, wherein the hydrolyzing is done with a basic solution comprising a base selected from the group consisting of LiOH , NaOH , KOH , CsOH , RbOH , $\text{Mg}(\text{OH})_2$, $\text{Ca}(\text{OH})_2$, $\text{Sr}(\text{OH})_2$, NH_4OH , $\text{Ba}(\text{OH})_2$, and mixtures thereof.
5. The process of claim 1, wherein less than a full charge of the used ionic liquid catalyst is removed from a hydrocarbon conversion process unit such that the hydrocarbon
25 conversion process unit operates continuously.
6. The process of claim 1, wherein the used ionic liquid catalyst comprises conjunct polymer.
7. The process of claim 1, additionally comprising separating the non-water-reactive aqueous phase from the hydrocarbon phase.
- 30 8. The process of claim 1, wherein a hydrogen halide gas is evolved during the hydrolyzing and the hydrogen halide gas is dissolved into a basic solution used for the hydrolyzing and is neutralized.
9. The process of claim 1, wherein the hydrolyzing proceeds continuously by adding the used ionic liquid catalyst to a hydrolysis vessel while the hydrolyzed product is taken out of the
35 hydrolysis vessel.
10. The process of claim 1, wherein the used ionic liquid catalyst comprises one or more corrosion metals and the one or more corrosion metals, or products thereof, are collected in the solid phase.

- 5 11. The process of claim 1, wherein greater than 80 wt% of the anhydrous metal halide is hydrolyzed and collected in the solid phase.
12. An apparatus for preparing a used catalyst for disposal, comprising:
- 10 a. a vessel used to hydrolyze a used ionic liquid catalyst comprising an anhydrous metal halide, to produce a hydrolyzed product; and
- b. a separator used to separate a liquid phase and a solid phase from the hydrolyzed product; wherein the liquid phase comprises a non-water-reactive aqueous phase and a hydrocarbon phase; and wherein the solid phase comprises a solid portion of the hydrolyzed product, that is not water reactive.
13. The apparatus of claim 12, wherein the vessel used to hydrolyze holds a basic solution
- 15 comprising a base selected from the group consisting of LiOH, NaOH, KOH, CsOH, RbOH, Mg(OH)₂, Ca(OH)₂, Sr(OH)₂, NH₄OH, Ba(OH)₂, and mixtures thereof.
14. The apparatus of claim 12, additionally comprising a liquid/liquid separator used to separate the liquid phase into the non-water-reactive aqueous phase from the hydrocarbon phase.
- 20 15. The apparatus of claim 14, wherein the liquid/liquid separator is a dropping funnel, a separatory funnel, or a centrifuge.

CLAIMS

1. A process for preparing a used ionic liquid catalyst for safe disposal, comprising:
hydrolyzing the used ionic liquid catalyst comprising an anhydrous metal halide with a
basic solution at a temperature from -20°C to 90°C to produce a hydrolyzed product, evolve a
5 hydrogen halide gas;
wherein as the hydrogen halide gas is evolved it is dissolved into the basic solution and
is neutralized to produce a hydrolysed slurry with a pH of 4 to 10 for safe disposal.
2. The process of claim 1, wherein the used ionic liquid catalyst is a chloroaluminate.
3. The process of claim 2, wherein the used ionic liquid catalyst is selected from the group
10 consisting of a hydrocarbyl-substituted-pyridinium chloroaluminate, a hydrocarbyl-substituted-
imidazolium chloroaluminate, a quaternary amine chloroaluminate, a trialkyl amine hydrogen
chloride chloroaluminate, an alkyl pyridine hydrogen chloride chloroaluminate, and mixtures
thereof.
4. The process of any one of the preceding claims, wherein the anhydrous metal halide is
15 selected from the group consisting of AlCl_3 , AlBr_3 , GaCl_3 , GaBr_3 , InCl_3 , InBr_3 , and mixtures
thereof.
5. The process of any one of the preceding claims, wherein the hydrolyzing is done with a
basic solution comprising a base selected from the group consisting of LiOH , NaOH , KOH ,
 CsOH , RbOH , $\text{Mg}(\text{OH})_2$, $\text{Ca}(\text{OH})_2$, $\text{Sr}(\text{OH})_2$, NH_4OH , $\text{Ba}(\text{OH})_2$, and mixtures thereof.
- 20 6. The process of any one of the preceding claims, wherein less than a full charge of the
used ionic liquid catalyst is removed from a hydrocarbon conversion process unit such that the
hydrocarbon conversion process unit operates continuously.
7. The process of any one of the preceding claims, wherein the used ionic liquid catalyst
comprises conjunct polymer.
- 25 8. The process of any one of the preceding claims, additionally comprising separating the
non-water-reactive aqueous phase from the hydrocarbon phase.
9. The process of any one of claims 1 to 5, wherein the hydrolyzing proceeds continuously
by adding the used ionic liquid catalyst to a hydrolysis vessel while the hydrolyzed product is
taken out of the hydrolysis vessel.
- 30 10. The process of any one of the preceding claims, additionally comprising adjusting a pH of
the basic solution to produce the hydrolysed slurry having the pH of 4 to 10 for disposal.
11. The process of any one of the preceding claims, wherein the pH for disposal is 5 to 9.

12. The process of any one of the preceding claims, wherein the used ionic liquid catalyst and the basic solution are mixed together at a molar ratio of used ionic liquid catalyst to a base of 0.5:1 to 1:20.

13. The process of any one of the preceding claims, wherein the hydrolyzed product is sent to a non-hazardous waste handling facility.

14. An apparatus when used to prepare a used catalyst for safe disposal, according to the process of any one of the preceding claims.