~~Processes for regenerating and maintaining the activityof an ionic liquid catalyst and for producing alkylate~~

METHODS FOR REGENERATING AND MAINTAINING ACTIVITY OF IONIC LIQUID CATALYST AND PRODUCING ALKYLATE

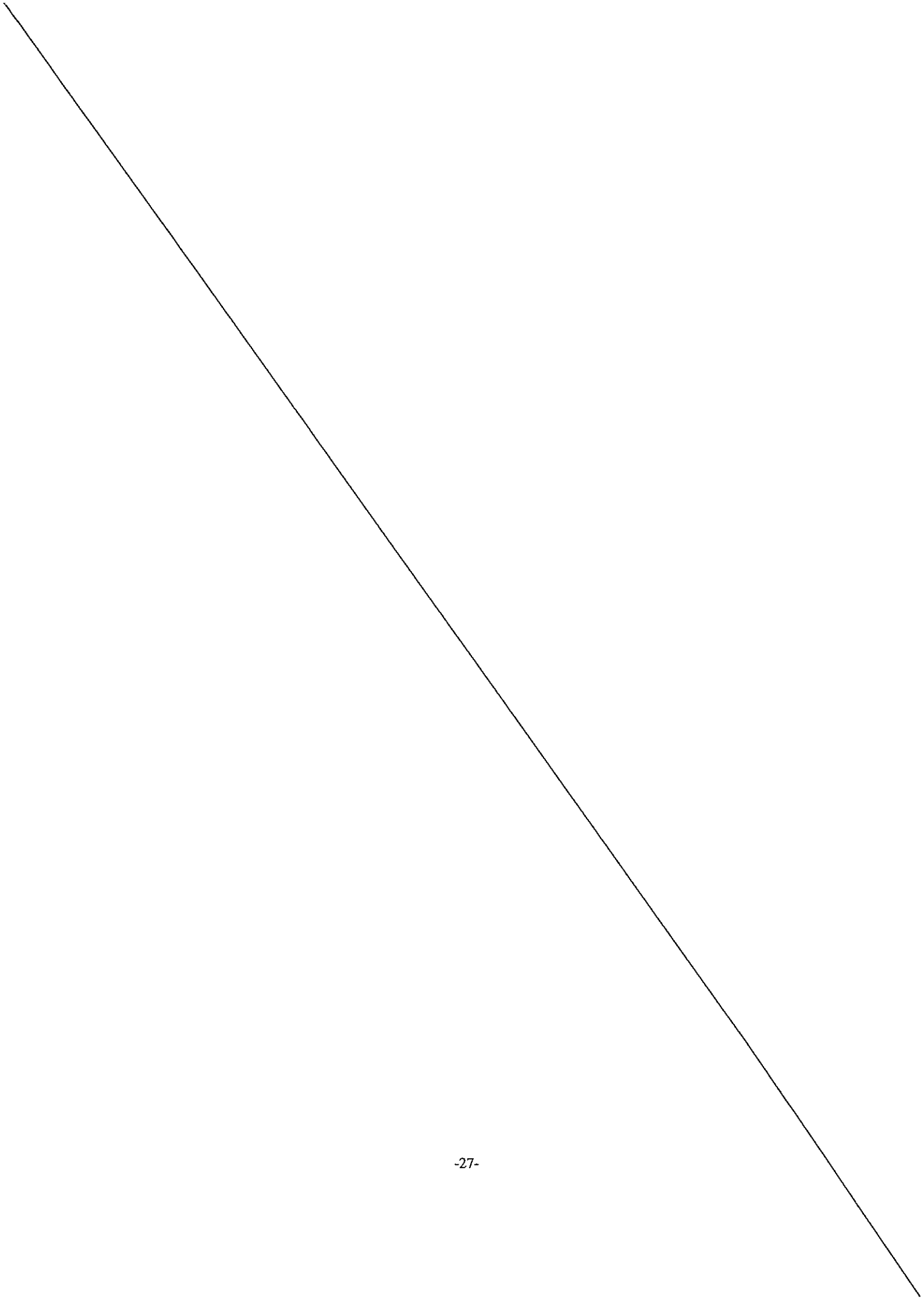
Field of the invention

The present invention is related to a process for regenerating catalyst, more specifically to a process for regenerating and maintaining the activity of an ionic liquid catalyst so that producing continuously alkylate. The present invention belongs to the petrochemical field.

Background of the invention

In petroleum refining industry, the alkylation reaction between alkane and alkene (also known as C4 alkylation, normally using more isobutane and also know as isobutane alkylation) is an important process for producing clean high-octane gasoline blending component. The alkylate obtained from said alkylation process is a fuel product, i.e. a liquid product derived from the catalytic reaction between C4 alkene and alkane by an acidic catalyst. In other words, it is a particular alkylation product, wherein C8 selectivity and TMP/DMH (trimethylpentane/dimethylhexane) ratio are important to evaluate the quality of alkylate product.

Hydrofluoric acid and concentrated sulfuric acid are conventional industrial catalysts for producing alkylate by alkylation reaction. Both of them exhibit satisfactory properties in terms of the activity, the selectivity and the catalyst lifetime, however, they may result in some problems such as environmental pollution, equipments corrosion as well as the personnels injuries etc. simultaneously, thus, the industrial



Claims

1. A process for regenerating and maintaining the activity of an ionic liquid catalyst, which is used to catalyze the alkylation reaction for producing alkylate, said process is characterized by supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst or the reaction feed during the alkylation reaction.

2. The process according to claim 1, wherein the hydrogen halide is supplied at an amount of 0.01-1wt% of the produced alkylate; and the halogenated hydrocarbon is supplied at an amount of 0.01-1wt% of the produced alkylate calculated as the mass of the halogen contained therein.

3. The process according to claim 1, wherein the acidic ionic liquid has a cation derived from hydrohalide of alkyl amine, hydrohalide of imidazole or hydrohalide of pyridine and an anion derived from one or more metallic compounds.

4. The process according to claim 3, wherein the acidic ionic liquid has anion derived from two or more metallic compounds, of which at least one metallic compound is aluminum chloride or aluminum bromide and the other metallic compounds are halide, sulphate or nitrate of copper, iron, zinc, nickel, titanium or silver.

5. The process according to claim 1, wherein the hydrogen halide is hydrogen chloride or hydrogen bromide, and the halogenated hydrocarbon is chlorohydrocarbon or bromohydrocarbon comprosing at least 4 carbons.

6. The process according to claim 5, wherein the halogenated

hydrocarbon is halogenated alkane having 4-8 carbons, and in the structure of the halogenated hydrocarbon the carbon having halogen atom attached thereto is secondary or tertiary carbon.

7. A process for producing alkylate by alkylation reaction using isobutene and C4 alkene as reaction feed and acidic ionic liquid as catalyst, said process is characterized by supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst or the reaction feed during the alkylation reaction to regenerate the acidic ionic liquid catalyst.

8. The process according to claim 7, wherein the hydrogen halide is supplied at an amount of 0.01-1wt% of the produced alkylate; and the halogenated hydrocarbon is supplied at an amount of 0.01-1wt% of the produced alkylate calculated as the mass of the halogen contained therein.

9. The process according to claim 7, wherein the acidic ionic liquid has a cation derived from hydrohalide of alkyl amine, hydrohalide of imidazole or hydrohalide of pyridine and an anion derived from one or more metallic compounds.

10. The process according to claim 9, wherein the acidic ionic liquid has anion derived from two or more metallic compounds, of which at least one metallic compound is aluminum chloride or aluminum bromide and the other metallic compounds are halide, sulphate or nitrate of copper, iron, zinc, nickel, titanium or silver.

11. The process according to claim 7, wherein the hydrogen halide is hydrogen chloride or hydrogen bromide, and the halogenated hydrocarbon is chlorohydrocarbon or bromohydrocarbon comprising at least 4 carbons.

12. The process according to claim 11, wherein the halogenated hydrocarbon is halogenated alkane having 4-8 carbons, and in the structure of the halogenated hydrocarbon the carbon having halogen atom attached thereto is secondary or tertiary carbon.

13. The process according to claim 7, wherein C4 alkene comprises 1-butene, 2-butene, iso-butene or mixture thereof.

14. The process according to claim 7 or 8, wherein supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst or the reaction feed comprises the following steps:

(i) Stopping feeding after the catalytic alkylation reaction using the acidic ionic liquid is proceeding for a period;

(ii) Supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst and intensively mixing the same;

(iii) Continuing the catalytic alkylation reaction using the acidic ionic liquid with hydrogen halide or halogenated hydrocarbon supplied thereinto and repeating steps (i) and (ii).

15. The process according to claim 7 or 8, wherein supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst or the reaction feed comprises the following step:

Continuously supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst or the reaction feed while the alkylation reaction is proceeding.

16. The process according to claim 7 or 8, wherein supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst or the reaction feed comprises the following steps:

(i) Separating a part of the acidic ionic liquid catalyst while the

catalytic alkylation reaction using the acidic ionic liquid catalyst is proceeding;

(ii) Supplying hydrogen halide or halogenated hydrocarbon to the separated acidic ionic liquid catalyst and intensively mixing the same;

(iii) Reinjecting the acidic ionic liquid with hydrogen halide or halogenated hydrocarbon supplied thereinto back to the reaction system and repeating steps (i) and (ii).

CLAIMS

1. A process for regenerating and maintaining the activity of an ionic liquid catalyst, which is used to catalyze the alkylation reaction for producing alkylate, said process is characterized by supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst during the alkylation reaction, wherein the acidic ionic liquid catalyst is separated from the reaction system for regeneration or the acidic ionic liquid catalyst is regenerated in the reactor after stopping feeding to the alkylation reaction.

2. The process according to claim 1, wherein the hydrogen halide is supplied at an amount of 0.01-1wt% of the produced alkylate; and the halogenated hydrocarbon is supplied at an amount of 0.01-1wt% of the produced alkylate calculated as the mass of the halogen contained therein.

3. The process according to claim 1, wherein the acidic ionic liquid has a cation derived from hydrohalide of alkyl amine, hydrohalide of imidazole or hydrohalide of pyridine and an anion derived from one or more metallic compounds.

4. The process according to claim 3, wherein the acidic ionic liquid has anion derived from two or more metallic compounds, of which at least one metallic compound is aluminum chloride or aluminum bromide and the other metallic compounds are halide, sulphate or nitrate of copper, iron, zinc, nickel, titanium or silver.

5. The process according to claim 1, wherein the hydrogen halide is

hydrogen chloride or hydrogen bromide, and the halogenated hydrocarbon is chlorohydrocarbon or bromohydrocarbon comprosing at least 4 carbons.

6. The process according to claim 5, wherein the halogenated hydrocarbon is halogenated alkane having 4-8 carbons, and in the structure of the halogenated hydrocarbon the carbon having halogen atom attached thereto is secondary or tertiary carbon.

7. A process for producing alkylate by alkylation reaction using isobutene and C4 alkene as reaction feed and acidic ionic liquid as catalyst, said process is characterized by supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst during the alkylation reaction to regenerate the acidic ionic liquid catalyst, wherein the acidic ionic liquid catalyst is separated from the reaction system for regeneration or the acidic ionic liquid catalyst is regenerated in the reactor after stopping feeding to the alkylation reaction.

8. The process according to claim 7, wherein the hydrogen halide is supplied at an amount of 0.01-1wt% of the produced alkylate; and the halogenated hydrocarbon is supplied at an amount of 0.01-1wt% of the produced alkylate calculated as the mass of the halogen contained therein.

9. The process according to claim 7, wherein the acidic ionic liquid has a cation derived from hydrohalide of alkyl amine, hydrohalide of imidazole or hydrohalide of pyridine and an anion derived from one or more metallic compounds.

10. The process according to claim 9, wherein the acidic ionic liquid has anion derived from two or more metallic compounds, of which at least

one metallic compound is aluminum chloride or aluminum bromide and the other metallic compounds are halide, sulphate or nitrate of copper, iron, zinc, nickel, titanium or silver.

11. The process according to claim 7, wherein the hydrogen halide is hydrogen chloride or hydrogen bromide, and the halogenated hydrocarbon is chlorohydrocarbon or bromohydrocarbon comprising at least 4 carbons.

12. The process according to claim 11, wherein the halogenated hydrocarbon is halogenated alkane having 4-8 carbons, and in the structure of the halogenated hydrocarbon the carbon having halogen atom attached thereto is secondary or tertiary carbon.

13. The process according to claim 7, wherein C4 alkene comprises 1-butene, 2-butene, iso-butene or mixture thereof.

14. The process according to claim 7 or 8, wherein supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst or the reaction feed comprises the following steps:

(i) Stopping feeding after the catalytic alkylation reaction using the acidic ionic liquid is proceeding for a period;

(ii) Supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst and intensively mixing the same;

(iii) Continuing the catalytic alkylation reaction using the acidic ionic liquid with hydrogen halide or halogenated hydrocarbon supplied thereinto and repeating steps (i) and (ii).

15. The process according to claim 7 or 8, wherein supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst comprises the following step:

Continuously supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst while the alkylation reaction is proceeding, in which process the acidic ionic liquid catalyst is separated from the reaction system for regeneration.

16. The process according to claim 7 or 8, wherein supplying hydrogen halide or halogenated hydrocarbon to the acidic ionic liquid catalyst or the reaction feed comprises the following steps:

(i) Separating a part of the acidic ionic liquid catalyst while the catalytic alkylation reaction using the acidic ionic liquid catalyst is proceeding;

(ii) Supplying hydrogen halide or halogenated hydrocarbon to the separated acidic ionic liquid catalyst and intensively mixing the same;

(iii) Reinjecting the acidic ionic liquid with hydrogen halide or halogenated hydrocarbon supplied thereinto back to the reaction system and repeating steps (i) and (ii).

17. An ionic liquid catalyst produced by the process of any one of claims 1 to 6.

18. Alkylate produced by the process of any one of claims 7 to 16.