Claims

1. Method for removal and recovery of an organic amine from a hydrocarbon stream containing the amine, comprising the steps of:

   i) mixing the hydrocarbon stream containing the amine with an aqueous inorganic acid in a volumetric ratio of hydrocarbon stream:aqueous inorganic acid of >1:1-5:1, preferably 1.5:1-4:1, more preferably 3:1,

   ii) phase separating of hydrocarbon and aqueous phase;

   iii) removing the hydrocarbon phase and optionally further purifying thereof,

   iv) optionally recycling at least a part of the hydrocarbon phase obtained in step (iii) into mixing step (i),

   v) mixing the aqueous phase obtained in step (iii) with an aqueous alkaline solution,

   vi) phase separating of an aqueous phase and an organic phase formed,

   vii) removing the organic phase obtained in step (vi) and optionally further purifying thereof.

2. Method according to claim 1, wherein the hydrocarbon stream containing the amine is an outlet stream from a reactor for preparing linear alpha-olefins (LAO) by oligomerization of ethylene or a fraction of such an outlet stream.

3. Method according to claim 2, wherein the fraction is a product fraction in the range of C_{10} to C_{18}.

4. Method according to any of the preceding claims, wherein the aqueous inorganic acid is aqueous HCl in a concentration of 10 wt.%, preferably in a concentration of 5 wt.%, or aqueous sulfuric acid.

5. Method according to any of the preceding claims, wherein removal of the hydrocarbon phase in step (iii) is by decanting.

6. Method according to any of the preceding claims, wherein further purification in step (iii) is by washing the hydrocarbon phase with water and passing the hydrocarbon phase obtained through an absorbing agent, the absorbing agent preferably being selected from the group of inorganic compounds, such as silica gel, alumina and molecular sieve.

7. Method according to any of the preceding claims, wherein purification of the organic phase in step (vii) is by washing with water, removing the aqueous phase and/or distilling any residual water from the organic phase.

8. Method according to any of the preceding claims, wherein the organic phase obtained in step (vii) is recycled into the hydrocarbon stream containing the amine before step (i).

9. Method according to any of the preceding claims, wherein the aqueous phase obtained in step (vi) is transferred to a catalyst removal and deactivation section of a plant for oligomerization of ethylene.

10. Method according to any of the preceding claims, wherein the pH in step (v) is basic.

CLAIMS

What is claimed is:

1. A method for removal and recovery of an organic amine from a hydrocarbon stream containing the amine, comprising the steps of:

    i) mixing the hydrocarbon stream containing the amine with an aqueous inorganic acid in a volumetric ratio of hydrocarbon stream:aqueous inorganic acid of >1:1-5:1,

    ii) phase separating the hydrocarbon and the aqueous phase;

    iii) removing the hydrocarbon phase and optionally further purifying thereof,

    iv) optionally recycling at least a part of the hydrocarbon phase obtained in step (iii) into mixing step (i),

    v) mixing the aqueous phase obtained in step (iii) with an aqueous alkaline solution,

    vi) phase separating of an aqueous phase and an organic phase formed,

    vii) removing the organic phase obtained in step (vi) and optionally further purifying thereof.

2. The method according to claim 1, wherein the hydrocarbon stream containing the amine is an outlet stream from a reactor for preparing linear alpha-olefins (LAO) by oligomerization of ethylene or a fraction of such an outlet stream.

3. The method according to claim 2, wherein the fraction is a product fraction in the range of C_{10} to C_{18}.

4. The method according to claim 1, wherein the aqueous inorganic acid is aqueous HCl or aqueous sulfuric acid.

5. The method according to claim 1, wherein removal of the hydrocarbon phase in step (iii) is by decanting.

6. The method according to claim 1, wherein further purification in step (iii) is by washing the hydrocarbon phase with water and passing the hydrocarbon phase obtained through an absorbing agent.

7. The method according to claim 1, wherein purification of the organic phase in step (vii) is by washing with water, removing the aqueous phase and/or distilling any residual water from the organic phase.

8. The method according to claim 1, wherein the organic phase obtained in step (vii) is recycled into the hydrocarbon stream containing the amine before step (i).

9. The method according to claim 1, wherein the aqueous phase obtained in step (vi) is transferred to a catalyst removal and deactivation section of a plant for oligomerization of ethylene.

10. The method according to claim 1, wherein the pH in step (v) is basic.

11. The method according to claim 1, wherein the volumetric ratio of hydrocarbon stream:aqueous inorganic acid is 1.5:1 to 4:1.

12. The method according to claim 11, wherein the volumetric ratio of hydrocarbon stream:aqueous inorganic acid is 3:1 to 5:1.

13. The method according to claim 12, wherein phase separation time in step (ii) is about four times lower than the time required for a 1:1 volumetric ratio.

14. A method for removal and recovery of an organic amine from a hydrocarbon stream containing the amine, comprising the steps of:

i) mixing the hydrocarbon stream containing the amine with an aqueous inorganic acid in a volumetric ratio of hydrocarbon stream:aqueous inorganic acid of greater than 1:1 to 5:1,

ii) phase separating of hydrocarbon and aqueous phase;

iii) emoving the hydrocarbon phase and optionally further purifying thereof,

iv) optionally recycling at least a part of the hydrocarbon phase obtained in step (iii) into mixing step (i),

v) mixing the aqueous phase obtained in step (iii) with an aqueous alkaline solution,

vi) phase separating of an aqueous phase and an organic phase formed, wherein volumetric ratio of organic phase to aqueous phase is greater than 1:1 to 5:1,

vii) removing the organic phase obtained in step (vi) and optionally further purifying thereof.

15. The method according to claim 14, wherein the volumetric ratio of organic phase to aqueous phase in step (vi) is 1.5:1 to 4:1.

16. The method according to claim 14, wherein the volumetric ratio of organic phase to aqueous phase in step (vi) is 3:1 to 5:1.

17. A method for removal and recovery of an organic amine from a hydrocarbon stream containing the amine, comprising the steps of:

i) mixing the hydrocarbon stream containing the amine with an aqueous inorganic acid in a volumetric ratio of hydrocarbon stream:aqueous inorganic acid of greater than 1:1 to 5:1,

ii) phase separating of hydrocarbon and aqueous phase;

iii) removing the hydrocarbon phase and optionally further purifying thereof,

iv) recycling at least a part of the hydrocarbon phase obtained in step (iii) into mixing step (i),

v) mixing the aqueous phase obtained in step (iii) with an aqueous alkaline solution,

vi) phase separating of an aqueous phase and an organic phase formed,

vii) removing the organic phase obtained in step (vi) and optionally further purifying thereof.

18. The method according to claim 17, wherein the volumetric ratio of hydrocarbon stream:aqueous inorganic acid in step (i) is 1.5:1 to 5:1.

19. The method according to claim 17, wherein the volumetric ratio of hydrocarbon stream:aqueous inorganic acid in step (i) is 3:1 to 5:1.