Claims

1. Method for preparing linear alpha-olefins (LAO) by oligomerization of ethylene in the presence of solvent and homogenous catalyst, comprising the steps of:

   (i) feeding ethylene, solvent and catalyst into an oligomerization reactor,

   (ii) oligomerizing the ethylene in the reactor,

   (iii) removing a reactor outlet stream comprising solvent, linear alpha-olefins, ethylene, and catalyst from the reactor via a reactor outlet piping system,

   (iv) transferring the reactor outlet stream to a catalyst deactivation and removal step, and

   (v) deactivating and removing the catalyst from the reactor outlet stream,

   characterized in that at least one organic amine is added into the oligomerization reactor and/or into the reactor outlet piping system wherein the organic amine is removed from the reactor outlet stream by distillation, extraction or adsorption and the removed organic amine is recycled into the reactor and/or the reactor outlet piping system.

2. Method according to claim 1, characterized in that the amine is mixed with catalyst components prior to feeding the catalyst components into the oligomerization reactor.

3. Method according to claim 1 or 2, characterized in that the amine is added continuously.

4. Method according to any of the preceding claims, characterized in that the organic amine is a primary, secondary, tertiary or cyclic amine.

5. Method according to any of the preceding claims, wherein the organic amine is soluble in an organic phase containing linear alpha-olefins.

6. Method according to any of the preceding claims, wherein the organic amine is insoluble or has a low solubility in water or a mixture of water and caustic.

7. Method according to any of the preceding claims wherein the removed organic amine is recycled into the reactor and/or the reactor outlet piping system together with the solvent.

8. Method according to any of the preceding claims, wherein the added amine is dissolved in a solvent, preferably toluene or a linear alpha olefin fraction or a linear alpha olefin product.

9. Method according to any of the preceding claims, wherein the amine is mixed in the reactor outlet piping system with the reactor outlet stream by means of a mixing device, preferably a static mixer, a dynamic mixer, an ultrasonic mixer or a ventury mixing nozzle.

10. Method according to any of the preceding claims, wherein the catalyst is deactivated by caustic.

11. Method according to any of the preceding claims, wherein the amine has a boiling point differing from the boiling point of the solvent utilized of not more than 20°C, preferably not more than 10°C, preferably not more than 5°C.

12. Method according to any of the preceding claims, wherein the catalyst comprises a zirconium salt of organic acids and at least one organo aluminum compound.

13. Method according to claim 12, wherein the zirconium salt has the formula $ZrCl_{4-m}X_m$, wherein X = OCOR or OSO_3R' with R and R´ being independently alkyl, alkene or phenyl, and wherein $0 < m < 4$.

14. Method according to claim 13, characterized in that the organic amine is added in an amount of 0.1 to 2.0 mol equivalent to chloride, preferably 0.5 to 1.0 mol equivalent to chloride.

15. Method according to any of claims 12 to 14, wherein the at least one aluminum compound has the general formula $R^1_nAl_{3-n}$ or $Al_2Y_3R^1_3$, wherein R^1 represents an alkyl group having from 1 to 20 carbon atoms, Y represents Cl, Br or I, n is any number within the range $1 < n < 2$.

Claims

1. Method for preparing linear alpha-olefins (LAO) by oligomerization of ethylene in the presence of solvent and homogenous catalyst, comprising the steps of:

   (i) feeding ethylene, solvent and catalyst into an oligomerization reactor,

   (ii) oligomerizing the ethylene in the reactor,

   (iii) removing a reactor outlet stream comprising solvent, linear alpha-olefins, ethylene, and catalyst from the reactor via a reactor outlet piping system,

   (iv) transferring the reactor outlet stream to a catalyst deactivation and removal step, and

   (v) deactivating and removing the catalyst from the reactor outlet stream,

   characterized in that at least one organic amine is added into the reactor outlet piping system wherein the organic amine is removed from the reactor outlet stream by distillation, extraction or adsorption and the removed organic amine is recycled into the reactor outlet piping system, the organic amine is soluble in an organic phase containing linear alpha-olefins and the organic amine is insoluble or has a low solubility in water or a mixture of water and caustic, and wherein the catalyst is deactivated by caustic.

2. Method according to claim 1 , characterized in that the amine is added continuously.

3. Method according to any of the preceding claims, characterized in that the organic amine is a primary, secondary, tertiary or cyclic amine.

4. Method according to any of the preceding claims, wherein the removed organic amine is recycled into the reactor outlet piping system together with the solvent.

5. Method according to any of the preceding claims, wherein the added amine is dissolved in a solvent, preferably toluene or a linear alpha olefin fraction or a linear alpha olefin product.

6. Method according to any of the preceding claims, wherein the amine is mixed in the reactor outlet piping system with the reactor outlet stream by means of a mixing device, preferably a static mixer, a dynamic mixer, an ultrasonic mixer or a ventury mixing nozzle.

7. Method according to any of the preceding claims, wherein the amine has a boiling point differing from the boiling point of the solvent utilized of not more than 20°C, preferably not more than 10°C, preferably not more than 5°C.

8. Method according to any of the preceding claims, wherein the catalyst comprises a zirconium salt of organic acids and at least one organo aluminum compound.

9. Method according to claim 8, wherein the zirconium salt has the formula $ZrCl_{4-m}X_m$, wherein X = OCOR or OSO_3R' with R and R' being independently alkyl, alkene or phenyl, and wherein $0 < m < 4$.

10. Method according to claim 8, characterized in that the organic amine is added in an amount of 0.1 to 2.0 mol equivalent to chloride, preferably 0.5 to 1.0 mol equivalent to chloride.

11. Method according to any of claims 9 to 10, wherein the at least one aluminum compound has the general formula $R^1_nAl_{3-n}$ or $Al_2Y_3R^1_3$, wherein R^1 represents an alkyl group having from 1 to 20 carbon atoms, Y represents Cl, Br or I, n is any number within the range $1 < n < 2$.