Claims

1. Process for preparing a carboxylic acid or salt thereof, with the process comprising the following steps:

a) preparing an ester by reacting (carbonylating) a C2 to C20 hydrocarbon having at least one multiple bond, preferably having at least one olefinic double bond, with carbon monoxide and with an alcohol A in the presence of a homogeneous catalyst system in a reaction zone to obtain a product mixture;

b) carrying out a membrane separation to separate the homogeneous catalyst system from the product mixture, whereby the homogeneous catalyst system and unreacted hydrocarbon and/or unreacted alcohol A, preferably unreacted alcohol A, are enriched in the retentate and the ester formed in step a) is enriched in the permeate, wherein the membrane material used is a membrane material capable of OSN (organic solvent nanofiltration) that includes at least one separation-active layer;

c) separating the ester formed in step a) from the permeate in at least one separation step selected from thermal separation, for example distillation, extraction, crystallization and membrane separation;

d) hydrolysing or saponifying the ester prepared in step a) in the presence of an acidic catalyst or a saponifying agent to obtain a reaction mixture that comprises at least the carboxylic acid or salt thereof, the eliminated alcohol A, water and unreacted ester;

e) separating the carboxylic acid or salt thereof formed in step d) in at least one separation process step selected from thermal separation, for example distillation, extraction, crystallization and membrane separation.

2. Process according to Claim 1, wherein the separation-active layer is composed of a PAEK (polyaryl ether ketone) polymer.

3. Process according to Claim 2, wherein the separation-active layer is composed of PEEK (polyether ether ketone), preferably having a degree of sulfonation of less than 20%, preferably less than 10%.

4. Process according to any of the preceding claims, wherein the alcohol A is a mono- or polyol (two or more OH groups) having 1 to 50 carbon atoms, preferably 1 to 15 carbon atoms, more preferably 1 to 10 carbon atoms, or a mixture of two or more mono- and/or polyols.

5. Process according to Claim 4, wherein the alcohol used in step a) is selected from the group consisting of methanol, ethanol, 1-propanol, 1-butanol, 1-pentanol, 1-hexanol, 2-propanol, tert-butanol, 3-pentanol, 2-propylheptanol, cyclohexanol, phenol or mixtures thereof.

6. Process according to any of the preceding claims, wherein the homogeneous catalyst system used in the carbonylation in step a) comprises at least one metal from groups 8 to 10 of the periodic table of the elements or a compound thereof, a ~~preferably~~ phosphorus-containing ligand and an acid.

7. Process according to any of the preceding claims, wherein the carbon monoxide used in the reaction in step a) is provided by first separating a carbon monoxide-containing gas and passing the carbon monoxide into the reaction zone.

8. Process according to any of the preceding claims, wherein the membrane material is a membrane material capable of OSN (organic solvent nanofiltration) that is stable for at least 300 h in the presence of the acid in the catalyst system.

9. Process according to any of the preceding claims, wherein the acid in the catalyst system in step a) is a Brønsted acid having a pKa ≤ 5, preferably having a pKa ≤ 3, or a Lewis acid having an Lewis Acid Unit (LAU) value of more than 25, preferably having an LAU value of 29.

10. Process according to any of the preceding claims, wherein the acid in the catalyst system in step a) is a Brønsted acid or a Lewis acid, the Brønsted acid being perchloric acid, sulfuric acid, phosphoric acid, methylphosphonic acid or a sulfonic acid and the Lewis acid being aluminium triflate, aluminium chloride, aluminium hydride, trimethylaluminium, tris(pentafluorophenyl)borane, boron trifluoride, boron trichloride or a mixture thereof.

11. Process according to any of the preceding claims, wherein the retentate obtained in the membrane separation in step b) is recycled into the reaction zone in step a) and the permeate obtained is supplied to the subsequent step c).

12. Process according to any of the preceding claims, wherein the process after the separation in step c) includes the following further steps:

c1) transesterifying the ester formed in step a) with a second alcohol, wherein this second alcohol differs from the alcohol A used in step a), in a second reaction zone to obtain a second product mixture;

c2) separating the ester formed in step c1) and separating the rest of the second product mixture through thermal separation and/or by means of membrane separation, and recycling the eliminated ~~first~~ alcohol A into the first reaction zone and also recycling the unreacted second alcohol into the second reaction zone;

wherein the ester formed in step c1) is used in the hydrolysis or saponification in step d).

13. Process according to Claim 12, wherein the second alcohol in step ~~e~~c1) is added in excess.

14. Process according to Claim 12 or 13, wherein the second alcohol used in step ~~e~~c1) is a more high-boiling alcohol than the ~~first~~ alcohol A.

15. Process according to any of Claims 12 to 14, wherein a proportion of the eliminated ~~first~~ alcohol A is already withdrawn from the second reaction zone and recycled into the first reaction zone.