Claims

1. A process for preparing a target alcohol, wherein the process comprises the following steps:

a) preparing an ester by carbonylating a C2 to C16 alkene or isoalkene with carbon monoxide and with an alcohol A, which is a mono- or polyalcohol (two or more OH groups) having 1 to 50 carbon atoms or is a mixture of two or more mono- and/or polyalcohols and which is used in a molar ratio to the C2 to C16 alkene or isoalkene (alcohol:C2 to C16 alkene or isoalkene) of 2 to 20, in the presence of a homogeneous catalyst system comprising at least one metal of groups 8 to 10 of the Periodic Table of the Elements or a compound thereof, a phosphorus-containing ligand and an acid, in a reaction zone to obtain a liquid product mixture, wherein the carbon monoxide is directly supplied or by a carbon monoxide-containing gas selected from the group consisting of synthesis gas, water gas, and generator gas;

b) performing a membrane separation to separate the homogeneous catalyst system from the liquid product mixture, which enriches the homogeneous catalyst system and additionally unconverted hydrocarbon and/or unconverted alcohol A in the retentate and enriches the ester formed in step a) in the permeate, wherein the membrane material used is an organic solvent nanofiltration membrane material which is acid-stable, stable in the presence of the acid of the catalyst system for at least 300 h, and which has at least one separation-active layer, and wherein the retentate is returned to the reaction zone in step a) and the permeate is routed to the subsequent step c);

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

d) hydrogenating the ester separated in step c) with hydrogen in the presence of the heterogeneous catalyst system in a hydrogenation zone to obtain an alcohol mixture comprising at least the target alcohol, the eliminated alcohol A and unconverted esters;

e) separating the target alcohol formed in step d) in at least one separation process step selected from thermal separation, distillation, extraction, crystallization and membrane separation.

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

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

4. The process according to Claim 1, wherein the alcohol A used in step a) is a mono- or polyalcohol (two or more OH groups) having from 1 to 15 carbon atoms, or a mixture of two or more mono- and/or polyalcohols.

5. The process according to Claim 4, wherein the alcohol A 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 and mixtures thereof.

6. The process according to Claim 1, wherein the C2 to C16 hydrocarbon comprises at least one olefinic double bond.

7. The process according to Claim 1, wherein the metal of groups 8 to 10 of the Periodic Table of the Elements or a compound thereof in the homogeneous catalyst system in step a) is palladium or a compound thereof.

8. The process according to Claim 1, wherein the phosphorus-containing ligand in the homogeneous catalyst system has a bidentate structure.

9. The process according to Claim 1, wherein the reaction in step a) is conducted at a pressure of 5 to 60 bar.

10. The process according to Claim 1, wherein the acid in the catalyst system in step a) is a Brønsted acid having a pKa ≤ 5, or a Lewis acid having a Lewis acid unit (LAU) value of more than 25.

11. The process according to Claim 1, wherein the acid in the catalyst system in step a) is a Brønsted acid or a Lewis acid, where the Brønsted acid is perchloric acid, sulfuric acid, phosphoric acid, methylphosphonic acid or a sulfonic acid, and where the Lewis acid is aluminium triflate, aluminium chloride, aluminium hydride, trimethylaluminium, tris(pentafluorophenyl)borane, boron trifluoride, boron trichloride or a mixture thereof.

12. The process according to Claim 1, wherein the carbon monoxide-containing gas is the synthesis gas and is separated to obtain separated carbon monoxide and separated

hydrogen upstream of the reaction zone and the carbon monoxide is routed to the reaction zone in step a) and the hydrogen separated to the hydrogenation zone in step d).

13. The process according to Claim 2, wherein the separation-active layer is composed of PEEK.

14. The process according to Claim 2, wherein the alcohol A used in step a) is a mono- or polyalcohol (two or more OH groups) having from 1 to 10 carbon atoms, or a mixture of two or more mono- and/or poly alcohols.

15. The process according to Claim 1, wherein the acid in the catalyst system in step a) is a Bronsted acid having a pKa ≤ 3, or a Lewis acid having an LAU value of more than 25.

16. The process according to Claim 2, wherein the C2 to C16 hydrocarbon having at least one olefinic double bond which is used in step a) is an n- or isoalkene having from 2 to 16 carbon atoms.