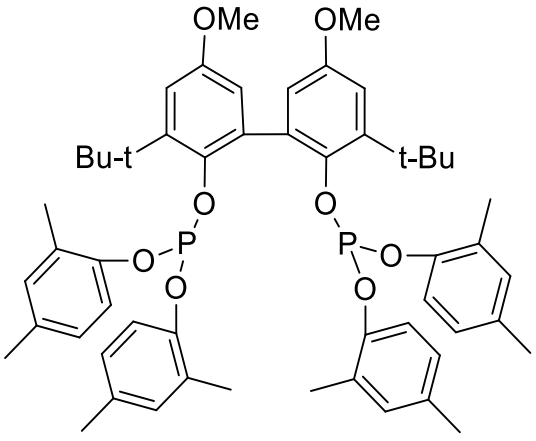
Claims

1. Method for preparing saturated C_n- and C_{2n}-alcohols where n = 4, 5 and 6 comprising the method steps of
   a) providing a mixture of isomeric C_n-aldehydes where n = 4, 5 and 6, wherein the proportion of unbranched aldehydes is at least 40% by weight, based on the C_n-aldehydes where n = 4, 5 and 6, and dividing the mixture into a first substream and a second substream via a split regulator
   b) carrying out an aldol condensation of the aldehydes present in the first substream to obtain a mixture of C_n- and α,β–unsaturated C_{2n}-aldehydes,
   c) mixing the mixture of C_n- and α,β–unsaturated C_{2n}-aldehydes obtained in b) with the second substream provided in a)
   d) hydrogenating the mixture of C_n- and α,β–unsaturated C_{2n}-aldehydes and isomeric C_n-aldehydes where n = 4, 5 and 6 obtained in c) with hydrogen to obtain a mixture of saturated C_n and C_{2n}-alcohols and
   e) separating the mixture of C_n and C_{2n}-alcohols by means of at least one two-column system or by means of at least one dividing wall column,

   wherein the isomer ratio of the C_n-alcohol obtained is adjusted by the ratio of the first and second substream produced in step a) and by the aldol condensation carried out in step b).

2. Method according to Claim 1, wherein the C_n-aldehydes where n = 4, 5 and 6 used in step a) were prepared by hydroformylation of isomeric olefins having 3 to 5 carbon atoms with synthesis gas in the presence of a hydroformylation catalyst to form the aldehydes specified.

3. Method according to Claim 2, wherein in the hydroformylation a catalyst system is used which comprises rhodium as central atom and is complexed with the ligand (1):



(1).

4. Method according to one or more of Claims 1 to 3, wherein the aldol condensation in step b) is carried out in the presence of aqueous sodium hydroxide solution.

5. Method according to one or more of Claims 1 to 4, wherein the aldol condensation of the C_n-aldehydes according to step b) is carried out in a tubular reactor which comprises at least one mixing module which disperses the reactant aldehyde into droplets having an average diameter (Sauter diameter) of 0.2 mm to 2 mm in the continuous catalyst phase (process liquor), which consists of aqueous sodium hydroxide solution and sodium salts of carboxylic acids and has a sodium content of 0.6 to 1.75% by mass and a pH in the range from 12.5 to 13.5.

6. Method according to one or more of Claims 1 to 5, wherein the aldol condensation of the C_n-aldehydes according to step b) is carried out in the temperature range from 100 to 150°C.

7. Method according to one or more of Claims 1 to 6, wherein the reaction pressure in the reactor during the aldol condensation of the C_n-aldehydes according to step b) is in the range from 0.2 to 1.0 MPa.

8. Method according to one or more of Claims 1 to 7, wherein the hydrogenation according to step d) is carried out in the temperature range from 170°C to 200°C at a pressure of $15*10^5$ Pa to $30*10^5$ Pa over a supported catalyst which contains at least nickel and copper as active components.

9. Method according to one or more of Claims 1 to 7, wherein the hydrogenation according to step d) is carried out with hydrogen in a pressure range from 5 to 100 bar and the hydrogenation temperatures are between 120 and 220°C.

10. Method according to one or more of Claims 1 to 9, wherein n = 5.