Claims

1. Process for the combined preparation of at least butene and octene from ethene with the following steps:

a) providing an inert solvent whose boiling point or boiling range is below the boiling point of butene;

b) providing a first feed mixture comprising at least the inert solvent and ethene dissolved therein;

c) converting the first feed mixture in a first synthesis;

d) in the first synthesis oligomerizing at least a portion of the ethene present in the first feed mixture in the presence of a first heterogeneous catalyst and in the presence of the inert solvent to obtain a first reaction mixture comprising at least the inert solvent, butene, hexene and octene;

e) work-up of the first reaction mixture and/or a substance stream based thereon into a low boiler fraction comprising the inert solvent, at least one C_4-fraction comprising butenes, a C_6-fraction comprising hexenes, a C_8-fraction comprising octenes and into a C_{8+}-fraction comprising hydrocarbons having more than eight carbon atoms;

f) using at least a portion of the low boiler fraction for providing the first feed mixture;

g) providing a second feed mixture comprising at least hexene and ethene dissolved in the hexene using at least a portion of the C_6-fraction;

h) converting the second feed mixture in a second synthesis, wherein the second synthesis is spatially separated from the first synthesis;

i) in the second synthesis reacting at least a portion of the ethene present in the second feed mixture with at least a portion of the hexene present in the second feed mixture in the presence of a second heterogeneous catalyst to obtain a second reaction mixture comprising at least octene;

k) joint work-up of the second reaction mixture with the first reaction mixture or with the substance stream based thereon.

2. Process according to Claim 1, ~~characterized in that~~ wherein the low boiler fraction is separated at the top from the first reaction mixture or from the substance stream based on the first reaction mixture using a first distillation column to obtain an essentially solvent-free bottom product from which in turn the C_4-fraction, the C_6-fraction, the C_8-fraction and the C_{8+}-fraction are separated.

3. Process according to Claim 2, ~~characterized in that~~ wherein the low boiler fraction in the first synthesis and/or in the second synthesis comprises unreacted ethene in addition to the inert solvent.

4. Process according to Claim 1 or according to either of Claims 2 or 3, ~~characterized in that~~ wherein the inert solvent is propane or isobutane or a mixture of these two alkanes.

5. Process according to Claim 1 or according to any of Claims 2 to 4, ~~characterized in that~~ wherein the reaction conditions in the first synthesis are selected as follows:

Temperature:	20°C to 150°C
Pressure:	$1*10^5$ Pa to $50*10^5$ Pa
Weight hourly space velocity:	3 to 50 h^{-1}

and that the molar ratio of ethene to solvent in the first feed mixture is adjusted to a value between 0.1 and 0.5, where the proportion of ethene in the first feed mixture and the reaction conditions of the first synthesis are selected so that the solvent is present in a liquid phase.

6. Process according to Claim 5, wherein the proportion of ethene in the first feed mixture and the reaction conditions of the first synthesis are selected so that the ethene is completely dissolved in the liquid solvent.

7. Process according to Claim 5, wherein the proportion of ethene in the first feed mixture and the reaction conditions of the first synthesis are selected so that the ethene is partially dissolved in the liquid solvent and is present partially in the gas phase.

8. Process according to Claim 1 or according to any of Claims 2 to 7, ~~characterized in that~~ wherein the proportion of ethene in the second feed mixture is in the range from 0.1% by weight to 30% by weight and in that the second synthesis is carried out at a temperature in the range from 20°C to 150°C and at a pressure in the range from $1*10^5$ Pa to $50*10^5$ Pa, where the proportion of ethene in the second feed mixture and the reaction conditions of the second synthesis are selected so that the hexene is present in a liquid phase and the ethene is completely dissolved therein.

9. Process according to Claim 1 or any of Claims 2 to 8, ~~characterized in that~~ wherein the second reaction mixture is provided exclusively using at least a portion of the C_6-fraction and by adding ethene.

10. Process according to Claim 9, ~~characterized in that~~ wherein the second reaction mixture is provided exclusively using a first portion of the C_6-fraction and by adding ethene and that a second portion of the C_6-fraction is discharged.

11. Process according to Claim 9, ~~characterized in that~~ wherein the second reaction mixture is provided exclusively using the whole C_6-fraction and by adding ethene.

12. Process according to Claim 1 or any of Claims 2 to 11, ~~characterized in that~~ wherein a solid is used as heterogeneous catalyst which contains at least two components, where the first component comprises at least one element selected from among Ni, Cr, Fe, Ti, which is present in metallic and/or oxidic and/or hydridic form, and where the second component comprises at least one metal oxide selected from among Al_2O_3, SiO_2, TiO_2, ZrO_2.