Claims

1. Process for oligomerizing ethene over a heterogeneous catalyst and for regenerating said catalyst, having the following features:
   a) the oligomerization is effected in an oligomerization operation in which ethene at least partly dissolved in a liquid solvent is contacted with the heterogeneous catalyst;
   b) the regeneration is effected in a regeneration operation in which the catalyst in the absence of ethene, hydrogen and oxygen is purged with a liquid purge medium;
   c) oligomerization operation and regeneration operation alternate over time, such that a time-limited oligomerization operation is followed by a time-limited regeneration operation, and the latter in turn by a time-limited oligomerization operation;
   d) the heterogeneous catalyst is always at the same location~~, which is the reason why both oligomerization operation and regeneration operation take place at this location~~;
   e) the location of the catalyst is supplied with thermal energy in order to impose a set temperature thereon~~, it being entirely possible for the actual temperature at the catalyst to deviate from the set temperature in a time- and space-limited manner~~;
   f) the set temperature in regeneration operation is higher than the set temperature in oligomerization operation~~.~~;

2. ~~Process according to Claim 1, characterized in that~~wherein both the solvent and the purge medium are selected from the alkenes having three to twelve carbon atoms or from the ~~alkenes~~ alkanes having three to ten carbon atoms per molecule or from mixtures thereof, this enumeration including the cycloalkenes and the cycloalkanes.

3~~2~~. Process according to Claim ~~2~~1, ~~characterized in that~~wherein the solvent and the purge medium are identical.

4~~3~~. Process according to Claim ~~3~~2, ~~characterized in that~~wherein the solvent and the purge medium are one of the following substances or a mixture of two or more of these substances: propane, isobutane, pentane, cyclopentane, hexane, cyclohexane, heptane, cycloheptane.

5~~4~~. Process according to Claim 1 or according to any of Claims 2 to 4~~3~~, ~~characterized in that~~wherein the set temperature in oligomerization operation is between 20°C and 130°C, and ~~in that~~wherein the set temperature in regeneration operation is between 80°C and 150°C; additionally with the proviso that the set temperature chosen in regeneration operation is higher than the set temperature in oligomerization operation.

6~~5~~. Process according to Claim ~~5~~4, ~~characterized in that~~wherein the oligomerization operation is effected under the following conditions:

Pressure:	$1*10^5$ Pa to $50*10^5$ Pa
WHSV:	2 h^{-1} to 50 h^{-1}

Ethene content in overall solution: 1% by weight to 50% by weight

and in thatwherein the regeneration operation is effected under the following conditions:

Pressure: $1*10^5$ Pa to $50*10^5$ Pa

WHSV: 2 h^{-1} to 50 h^{-1}

Ethene content in overall solution: 0% by weight to 1% by weight

~~7~~6. Process according to Claim 1 or according to any of Claims 2 to ~~6~~5, characterized in thatwherein the duration of a regeneration operation is shorter than the duration of the preceding oligomerization operation, especially in thatwherein the duration of the regeneration operation is less than 20%, preferably less than 10% and most preferably less than 5% of the duration of the preceding oligomerization operation.

~~8~~7. Process according to Claim 1 or according to any of Claims 2 to ~~7~~6, characterized in thatwherein the location of the catalyst where the regeneration operation and the oligomerization operation are effected is a reactor through which a temperature control medium flows for the purpose of supplying thermal energy, and in thatwherein the set temperature is set by the feed temperature of the temperature control medium.

~~9~~8. Process according to Claim 1 or according to any of Claims 2 to ~~8~~7, characterized in thatwherein the purge medium is circulated in regeneration operation, and in thatwherein the purge medium circulated, away from the location of the catalyst, is purified with the aid of a separation apparatus to free it of at least some components dissolved in the purge medium.

~~10~~9. Process according to Claim ~~9~~8, characterized in thatwherein the separation apparatus is a filter or a membrane or a cold trap, or a combination of two or more of these separation apparatuses.

~~11~~10. Process according to Claim ~~2~~1 or according to any of Claims ~~3~~2 to ~~8~~7, wherein the purge medium is an alkene having three to twelve carbon atoms or a mixture of two or more such alkenes or a mixture of one or more such alkenes with at least one alkane having three to seven carbon atoms, characterized in thatwherein the purge medium in regeneration operation is drawn off from the location of the catalyst and – optionally after purification – conducted to a second heterogeneous catalyst remote from the catalyst to be regenerated, and in thatwherein at least one alkene present in the purge medium is subjected to a chemical reaction over the second catalyst, especially a second oligomerization, an isomerization or an etherification or an oxidative dehydrogenation.

~~12~~11. Process according to Claim ~~2~~1 or according to any of Claims ~~3~~2 to ~~8~~7, wherein the purge medium is an alkane having three to seven carbon atoms or a mixture of two or more such alkanes, characterized in thatwherein the purge medium in regeneration operation is drawn off from the location of the catalyst and conducted to a second heterogeneous catalyst remote

from the catalyst to be regenerated, and ~~in that~~wherein at least one alkane present in the purge medium is subjected to a chemical reaction over the second catalyst, especially a dehydrogenation to give alcohols and/or acid derivatives.

~~13~~12. Process according to Claim 1 or any of Claims 2 to ~~12~~11, ~~characterized in that~~wherein the heterogeneous catalyst used is a solid containing at least two components, the first component containing at least one element selected from Ni, Cr, Fe, Ti and being in metallic and/or oxidic and/or hydridic form, and the second component comprising at least one metal oxide selected from Al_2O_3, SiO_2, TiO_2, ZrO_2.

~~14~~13. Process according to Claim 1 or any of Claims 2 to ~~13~~12, ~~characterized in that~~wherein less than 5% by weight of the ethene converted in oligomerization operation is converted to oligomers or polymers of ethene having sixteen or more than sixteen carbon atoms.

~~15~~14. Process according to Claim 1 or any of Claims 2 to ~~14~~13, ~~characterized in that~~wherein the conversion of ethene is determined continuously in oligomerization operation, and ~~in~~ thatwherein there is then a changeover from oligomerization operation to regeneration operation when the conversion of ethene has dropped to a value between 95% and 100%.