CLAIMS

1. A process for producing a Ziegler-Natta catalyst for the polymerization of olefins comprising the steps of:

a. combining a spherical spray-cooled $MgCl_2$-xROH support, wherein x is in the range of from 1.5 to 6.0 and ROH is an alcohol or a mixture of alcohols where R is a linear, cyclic, or branched hydrocarbon unit with 1-10 carbon atoms, with a transition metal compound in a reactor at a temperature of between -30°C and +40°C;

b. heating the mixture in the reactor to a temperature of between 30°C to 100°C;

c. concurrent with the heating in step (b), or following reaching the temperature of step (b), adding an internal electron donor consisting essentially of a diether compound to the mixture in the reactor;

d. heating the resulting mixture to at least 80°C, if necessary, and holding the resulting mixture at that temperature for 1 to 3 hours to produce a pre-catalyst;

e. filtering the mixture containing the pre-catalyst while still hot to obtain the solid pre-catalyst component;

f. extracting the pre-catalyst with a mixture of an organic solvent and a transition metal at a temperature of at least 100°C for 1-5 hours to form a catalyst; and

g. washing the catalyst with a hydrocarbon solvent and drying the catalyst under vacuum and/or elevated temperature of 30-100°C;

wherein the diether compound is selected such that the resulting solid catalyst component has an activity and hydrogen response suitable for the production of propylene polymers having a molecular weight distribution in the range from 5.75 to 9.

2. The process of claim 1, wherein the diether compound has the general structure (I):

$$R^1O-(C\,R^5R^6)_n-CR^3R^4-(C\,R^7R^8)_m-OR^2 \quad \textbf{(I)}$$

where

R^1 and R^2 are the same or different and are selected from the group consisting of a saturated or unsaturated aliphatic group of from 1 to 20 carbon atoms or an aryl group of from 6 to 20 carbon atoms,

$n + m = 2$ to 4,

R^3, R^4, R^5, R^6, R^7 and R^8 are identical or different and are each a hydrogen atom, a linear, cyclic or branched hydrocarbon group, for example an alkyl group of from 1 to 20 carbon atoms, an alkenyl group of from 2 to 20 carbon atoms, an aryl group of from 6 to 20 carbon atoms, an arylalkyl group of from 7 to 40 carbon atoms, an alkylaryl group of from 7 to 40 carbon atoms or an arylalkenyl group of from 8 to 40 carbon atoms and may contain one or more hetero atoms like Si, B, Al, O, S, N or P, and/or may contain halogen atoms like F, Cl or Br, and/or the two radicals R^3 and R^4 may form a hydrocarbon ring system, and R^3 and/or R^4 are different from hydrogen.

3. The process of claim 1, wherein the diether compound has the general structure (II):

$$R^1O-CH_2-CR^3R^4-CH_2-OR^2 \quad \textbf{(II)}$$

where

R^1 and R^2 are the same or different and are selected from the group consisting of a saturated or unsaturated aliphatic group of from 1 to 20 carbon atoms, more preferably an alkyl group of from 1 to 10 carbon atoms, even more preferably an alkyl group of from 1 to 4 carbon atoms, ideally a methyl or ethyl group, most ideally a methyl group,

R^3 and R^4 are identical or different and are each a linear, cyclic or branched hydrocarbon group, for example an alkyl group of from 1 to 20 carbon atoms, an alkenyl group of from 2 to 20 carbon atoms, an aryl group of from 6 to 20 carbon atoms, an arylalkyl group of from 7 to 40 carbon atoms, an alkylaryl group of from 7 to 40 carbon atoms or an arylalkenyl group of from 8 to 40 carbon atoms and may contain one or more hetero atoms like Si, B, Al, O, S, N or P, and/or may contain halogen atoms like F, Cl or Br, and/or the two radicals R^3 and R^4 may form a hydrocarbon ring system.

4. The process of claim 1, wherein the diether compound has the general structure (III):

$$R^1O - CH_2 - CR^3R^4 - CH_2 - OR^2 \quad \textbf{(III)}$$

where

R^1 and R^2 are identical and are selected from the group consisting of an alkyl group of from 1 to 10 carbon atoms, even more preferably an alkyl group of from 1 to 4 carbon atoms, ideally a methyl or ethyl group, most ideally a methyl group,

R^3 and R^4 are identical or different and are each a linear, cyclic or branched hydrocarbon group, for example an alkyl group of from 1 to 10 carbon atoms, an alkenyl group of from 2 to 10 carbon atoms, an aryl group of from 6 to 10 carbon atoms, an arylalkyl group of from 7 to 40 carbon atoms, an alkylaryl group of from 7 to 40 carbon atoms or an arylalkenyl group of from 8 to 40 carbon atoms, and/or the two radicals R^3 and R^4 may form a hydrocarbon ring system, which may contain one or more hetero atoms like Si, O, S, N or P.

5. The process of claim 1, wherein the diether compound comprises at least one of 2,2 di-cyclopentyl-1,3-dimethoxypropane; 2,2 di-(cyclopentylmethyl)-1,3-

2-yl)-2-cyclopentyl-1,3-dimethoxypropane; 2-ethyl-2-cyclohexyl-1,3-dimethoxypropane; 2-n-propyl-2-cyclohexyl-1,3-dimethoxypropane; 2-isopropyl-2-cyclohexyl-1,3-dimethoxypropane; 2-n-butyl-2-cyclohexyl-1,3-dimethoxypropane; 2-isobutyl-2-cyclohexyl-1,3-dimethoxypropane; 2-secbutyl-2-cyclohexyl-1,3-dimethoxypropane; 2-n-pentyl-2-cyclohexyl-1,3-dimethoxypropane; 2-(2-pentyl)-2-cyclohexyl-1,3-dimethoxypropane; 2-(3-pentyl)-2-cyclohexyl-1,3-dimethoxypropane; 2-methylbutyl-2-cyclohexyl-1,3-dimethoxypropane; 2-(3-methylbut-2-yl)-2-cyclohexyl-1,3-dimethoxypropane; and the corresponding 1,3-diethoxypropane analogues.

6. The process of claim 1, wherein the diether compound comprises at least one of 9,9-bis(methoxymethyl)fluorene; 9,9-bis(methoxymethyl)-2,3,6,7-tetramethylfluorene; 9,9-bis(methoxymethyl)-2,7-dimethylfluorene; 9,9-bis(methoxymethyl)-2,7-diisoproylfluorene; 9,9-bis(methoxymethyl)-2,7-ditertbutylfluorene; 9,9-bis(methoxymethyl)-2,8-dimethylfluorene; 9,9-bis(methoxymethyl)-3,6-dimethylfluorene; 9,9-bis(methoxymethyl)-3,6-ditertbutylfluorene; 9,9-bis(methoxymethyl)-3,6-diisopropylfluorene; 9,9-bis(methoxymethyl)-4,5-dimethylfluorene; 9,9-bis(methoxymethyl)-2-methylfluorene; 9,9-bis(methoxymethyl)-4-methylfluorene; 9,10-dihydro-9,9-dimethoxyanthracene; 9,10-dihydro-9,9-diethoxyanthracene; 9,9-Dimethoxyxanthene; 9,9-Diethoxyxanthene; and the corresponding 9,9-bis(ethoxymethyl)- ananalogues.

7. The process of claim 1, wherein the diether compound comprises at least one of 2,2-di-isobutyl-1,3-dimethoxypropane; 2,2-di-isopropyl-1,3-dimethoxypropane; 2,2-di-cyclopentyl-1,3-dimethoxypropane; 2-isopropyl-2-isopentyl-1,3-dimethoxypropane; 2-isopropyl-2-isobutyl-1,3-dimethoxypropane; 2-isopropyl-2-cyclopentyl-dimethoxypropane; 2-ethyl-2-tert-butyl-1,3-dimethoxypropane or the corresponding 1,3-diethoxypropane analogues or 9,9-bis(methoxymethyl)fluorene or 9,9-bis(ethoxymethyl)fluorene.

8. The process of claim 1, wherein the diether donor compound is used in an amount of from 0.01 to 2 mole for each mole of the magnesium halide compound.