CLAIMS

1. A $MgCl_2$-based catalyst system comprising a support, titanium, and a diether internal electron donor as the only internal electron donor and having an activity and hydrogen response suitable for the production of propylene polymers having a molecular weight distribution (PI(GPC)) in the range from 5.75 to 9; wherein the support consists of a $MgCl_2$-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.

2. The catalyst system 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, and optionally contain one or more hetero atoms and/or halogen 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 catalyst system of claim 1, wherein the diether compound has the general structure (II):

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

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,

R^3 and R^4 are identical or different and are each a linear, cyclic or branched hydrocarbon group, and optionally contain one or more hetero atoms and/or may contain halogen atoms, and/or the two radicals R^3 and R^4 may form a hydrocarbon ring system.

4. The catalyst system 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,

R^3 and R^4 are identical or different and are each a linear, cyclic or branched hydrocarbon group, and/or the two radicals R^3 and R^4 may form a hydrocarbon ring system optionally containing one or more hetero atoms.

5. The catalyst system 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-dimethoxypropane;

2,2-di-cylohexyl-1,3-dimethoxypropane;

2,2-di-(cylohexylmethyl)-1,3-dimethoxypropane;

2,2-di-norbornyl-1,3-dimethoxypropane;

2,2-di-phenyl-1,3-dimethoxypropane;

2,2-di-phenylmethyl-1,3-dimethoxypropane;

2,2-di-n-propyl-1,3-dimethoxypropane;

2,2-di-isopropyl-1,3-dimethoxypropane;

2,2-di-n-butyl-1,3-dimethoxypropane;

2,2-di-secbutyl-1,3-dimethoxypropane;

2,2-di-isobutyl-1,3-dimethoxypropane;

2,2-di-n-pentyl-1,3-dimethoxypropane;

2,2-di-(2-pentyl)-1,3-dimethoxypropane;

2,2-di-(3-pentyl)-1,3-dimethoxypropane;

2,2-di-(methylbutyl)-1,3-dimethoxypropane;

2,2-di-(3-methylbut-2-yl)-1,3-dimethoxypropane;

2,2-di-isopentyl-1,3-dimethoxypropane;

2,2-di-n-hexyl-1,3-dimethoxypropane;

2,2-di-2-hexyl-1,3-dimethoxypropane;

2,2-di-3-hexyl-1,3-dimethoxypropane;

2,2-di-(2-methylpentyl)-1,3-dimethoxypropane;

2,2-di-(3-methylpentyl)-1,3-dimethoxypropane;

2,2-di-(4-methylpentyl)-1,3-dimethoxypropane;

2-tertbutyl-1,3-dimethoxypropane;

2-ethyl-2-tertbutyl-1,3-dimethoxypropane;

2-n-propyl-2-tertbutyl-1,3-dimethoxypropane;

2-n-butyl-2-tertbutyl-1,3-dimethoxypropane;

2-isobutyl-2-tertbutyl-1,3-dimethoxypropane;

2-n-pentyl-2-tertbutyl-1,3-dimethoxypropane;

2-isopentyl-2-tertbutyl-1,3-dimethoxypropane;

2-n-hexyl-2-tertbutyl-1,3-dimethoxypropane;

2-ethyl-2-isopropyl-1,3-dimethoxypropane;

2-n-propyl-2-isopropyl-1,3-dimethoxypropane;

2-n-butyl-2-isopropyl-1,3-dimethoxypropane;

2-secbutyl-2-isopropyl-1,3-dimethoxypropane;

2-isobutyl-2-isopropyl-1,3-dimethoxypropane;

2-n-pentyl-2-isopropyl-1,3-dimethoxypropane;

2-(2-pentyl)-2-isopropyl-1,3-dimethoxypropane;

2-(3-pentyl)-2-isopropyl-1,3-dimethoxypropane;

2-methylbutyl-2-isopropyl-1,3-dimethoxypropane;

2-(3-methylbut-2-yl)-2-isopropyl-1,3-dimethoxypropane;

2-isopentyl-2-isopropyl-1,3-dimethoxypropane;

2-n-hexyl-2-isopropyl-1,3-dimethoxypropane;

2-(2-hexyl)-2-isopropyl-1,3-dimethoxypropane;

2-(3-hexyl)-2-isopropyl-1,3-dimethoxypropane;

2-(2-methylpentyl)-2-isopropyl-1,3-dimethoxypropane;

2-(3-methylpentyl)-2-isopropyl-1,3-dimethoxypropane;

2-(4-methylpentyl)-2-isopropyl-1,3-dimethoxypropane;

2-ethyl-2-cyclopentyl-1,3-dimethoxypropane;

2-n-propyl-2-cyclopentyl-1,3-dimethoxypropane;

2-isopropyl-2-cyclopentyl-1,3-dimethoxypropane;

2-n-butyl-2-cyclopentyl-1,3-dimethoxypropane;

2-isobutyl-2-cyclopentyl-1,3-dimethoxypropane;

2-secbutyl-2-cyclopentyl-1,3-dimethoxypropane;

2-n-pentyl-2-cyclopentyl-1,3-dimethoxypropane;

2-(2-pentyl)-2-cyclopentyl-1,3-dimethoxypropane;

2-(3-pentyl)-2-cyclopentyl-1,3-dimethoxypropane;

2-methylbutyl-2-cyclopentyl-1,3-dimethoxypropane;

2-(3-methylbut-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 catalyst system 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)-analogues.

7. The catalyst system 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 catalyst system 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.

9. A process for the polymerization of olefins, comprising contacting olefins of formula $CH2=CHR^1$, in which R^1 is hydrogen or a hydrocarbon radical having 1-12 carbon atoms, with a catalyst according to claim 1 under polymerization conditions.

10. An $MgCl_2$-based catalyst system comprising a support, titanium, and a mixture of diether compounds as the only internal electron donors and having an activity and hydrogen response suitable for the production of propylene polymers having a molecular weight distribution (PI(GPC)) in the range from 5.75 to 9, wherein the support consists of a $MgCl_2$-xROH support, wherein x is in the range 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 with 1-10 carbon atoms.

11. The catalyst system of claim 10, wherein the diether compounds have 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 ~~about~~ 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 optionally containing one or more hetero atoms and/or halogen atoms, 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.

12. The catalyst system of claim 10, wherein the diether compounds have 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 ~~about~~ 20 carbon atoms,

R^3 and R^4 are identical or different and are each a linear, cyclic or branched hydrocarbon group optionally containing one or more hetero atoms and/or halogen atoms, and/or the two radicals R^3 and R^4 may form a hydrocarbon ring system.

13. The catalyst system of claim 10, wherein the diether compounds have 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,

R^3 and R^4 are identical or different and are each a linear, cyclic or branched hydrocarbon group, and/or the two radicals R^3 and R^4 may form a hydrocarbon ring system optionally containing one or more hetero atoms.

14. The catalyst system of claim 10, wherein the mixture of diether compounds comprises at least one of

2,2 di-cyclopentyl-1,3-dimethoxypropane;

2,2 di-(cyclopentylmethyl)-1,3-dimethoxypropane;

2,2-di-cylohexyl-1,3-dimethoxypropane;

2,2-di-(cylohexylmethyl)-1,3-dimethoxypropane;

2,2-di-norbornyl-1,3-dimethoxypropane;

2,2-di-phenyl-1,3-dimethoxypropane;

2,2-di-phenylmethyl-1,3-dimethoxypropane;

2,2-di-n-propyl-1,3-dimethoxypropane;

2,2-di-isopropyl-1,3-dimethoxypropane;

2,2-di-n-butyl-1,3-dimethoxypropane;

2,2-di-secbutyl-1,3-dimethoxypropane;

2,2-di-isobutyl-1,3-dimethoxypropane;

2,2-di-n-pentyl-1,3-dimethoxypropane;

2,2-di-(2-pentyl)-1,3-dimethoxypropane;

2,2-di-(3-pentyl)-1,3-dimethoxypropane;

2,2-di-(methylbutyl)-1,3-dimethoxypropane;

2,2-di-(3-methylbut-2-yl)-1,3-dimethoxypropane;

2,2-di-isopentyl-1,3-dimethoxypropane;

2,2-di-n-hexyl-1,3-dimethoxypropane;

2,2-di-2-hexyl-1,3-dimethoxypropane;

2,2-di-3-hexyl-1,3-dimethoxypropane;

2,2-di-(2-methylpentyl)-1,3-dimethoxypropane;

2,2-di-(3-methylpentyl)-1,3-dimethoxypropane;

2,2-di-(4-methylpentyl)-1,3-dimethoxypropane;

2-tertbutyl-1,3-dimethoxypropane;

2-ethyl-2-tertbutyl-1,3-dimethoxypropane;

2-n-propyl-2-tertbutyl-1,3-dimethoxypropane;

2-n-butyl-2-tertbutyl-1,3-dimethoxypropane;

2-isobutyl-2-tertbutyl-1,3-dimethoxypropane;

2-n-pentyl-2-tertbutyl-1,3-dimethoxypropane;

2-isopentyl-2-tertbutyl-1,3-dimethoxypropane;

2-n-hexyl-2-tertbutyl-1,3-dimethoxypropane;

2-ethyl-2-isopropyl-1,3-dimethoxypropane;

2-n-propyl-2-isopropyl-1,3-dimethoxypropane;

2-n-butyl-2-isopropyl-1,3-dimethoxypropane;

2-secbutyl-2-isopropyl-1,3-dimethoxypropane;

2-isobutyl-2-isopropyl-1,3-dimethoxypropane;

2-n-pentyl-2-isopropyl-1,3-dimethoxypropane;

2-(2-pentyl)-2-isopropyl-1,3-dimethoxypropane;

2-(3-pentyl)-2-isopropyl-1,3-dimethoxypropane;

2-methylbutyl-2-isopropyl-1,3-dimethoxypropane;

2-(3-methylbut-2-yl)-2-isopropyl-1,3-dimethoxypropane;

2-isopentyl-2-isopropyl-1,3-dimethoxypropane;

2-n-hexyl-2-isopropyl-1,3-dimethoxypropane;

2-(2-hexyl)-2-isopropyl-1,3-dimethoxypropane;

2-(3-hexyl)-2-isopropyl-1,3-dimethoxypropane;

2-(2-methylpentyl)-2-isopropyl-1,3-dimethoxypropane;

2-(3-methylpentyl)-2-isopropyl-1,3-dimethoxypropane;

2-(4-methylpentyl)-2-isopropyl-1,3-dimethoxypropane;

2-ethyl-2-cyclopentyl-1,3-dimethoxypropane;

2-n-propyl-2-cyclopentyl-1,3-dimethoxypropane;

2-isopropyl-2-cyclopentyl-1,3-dimethoxypropane;

2-n-butyl-2-cyclopentyl-1,3-dimethoxypropane;

2-isobutyl-2-cyclopentyl-1,3-dimethoxypropane;

2-secbutyl-2-cyclopentyl-1,3-dimethoxypropane;

2-n-pentyl-2-cyclopentyl-1,3-dimethoxypropane;

2-(2-pentyl)-2-cyclopentyl-1,3-dimethoxypropane;

2-(3-pentyl)-2-cyclopentyl-1,3-dimethoxypropane;

2-methylbutyl-2-cyclopentyl-1,3-dimethoxypropane;

2-(3-methylbut-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.

15. The catalyst system of claim 10, wherein the mixture of diether compounds 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)-analogues.

16. The catalyst system of claim 10, 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.

17. The catalyst system of claim 10, wherein the mixture of diether compounds is used in an amount of from 0.01 to 2 mole for each mole of the magnesium.

18. A process for the polymerization of olefins, comprising contacting olefins of formula $CH2=CHR^1$, in which R^1 is hydrogen or a hydrocarbon radical having 1-12 carbon atoms, with a catalyst according to claim 10 polymerization conditions.

19. The catalyst system of claim 1, wherein the support is a spherical spray-cooled $MgCl_2$-xROH support.

20. The catalyst system of claim 10, wherein the support is a spherical spray-cooled $MgCl_2$-xROH support.

21. The catalyst system of claim 1, wherein the support has a particle size in the range from 20 microns to 200 microns.

22. The catalyst system of claim 10, wherein the support has a particle size in the range from 20 microns to 200 microns.