



SPECIFICATION

Title of the Invention

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TITANIUM CATALYST COMPONENT FOR OLEFIN POLYMERIZATION,

5 AND PROCESS FOR POLYMERIZATION OF OLEFIN
USING THE CATALYST COMPONENT

Claims

1. A titanium catalyst component for olefin polymerization prepared by contacting:

10 [A] a solid magnesium aluminum complex obtainable by contacting (a-1) a magnesium solution comprising a halogen-containing magnesium compound, an alcohol having at least 6 carbon atoms and a hydrocarbon solvent with (a-2) an organoaluminum compound, and containing magnesium, halogen,
15 aluminum and an alkoxy group having at least 6 carbon atoms; with

[B] a tetravalent titanium compound.

2. A titanium catalyst component for olefin polymerization according to claim 1, which is obtainable by
20 contacting [A] the solid magnesium aluminum complex with [B] the tetravalent titanium compound in a hydrocarbon solvent.

3. A titanium catalyst component for olefin polymerization according to claim 1, which is obtainable by contacting [A] the solid magnesium aluminum complex with [B] the
25 tetravalent titanium compound at temperatures of 50 to 120 °C in a hydrocarbon solvent.

4. A process for an olefin polymerization characterized by polymerizing or copolymerizing an olefin having 2 to 20 carbon atoms in the presence of a catalyst for the olefin
30 polymerization comprising [I] the titanium catalyst component

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for the olefin polymerization as claimed in claim 1 and [II] an
organoaluminum compound catalyst component.

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for the olefin polymerization as claimed in claim 1 and [II] an organoaluminum compound catalyst component.

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Detailed Description of the Invention

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FIELD OF THE INVENTION

The present invention relates to a titanium catalyst component for an olefin polymerization capable of preparing olefin polymer particles having a narrow particle distribution with high polymerization activity, and to a process for
10 polymerization of an olefin by the use of the titanium catalyst component for an olefin polymerization.

BACKGROUND OF THE INVENTION

Olefin polymers such as linear low density polyethylene
15 (LLDPE) are excellent in transparency and mechanical strength, and widely in use as films and the like.

For preparing the olefin polymers such as LLDPE, usually known is a process of copolymerizing ethylene with α -olefins in the presence of Ziegler-type catalysts. In the process, a high-
20 temperature solution polymerization that is conducted in a hydrocarbon solvent at a temperature higher than the melting point of the resulting polymer is broadly utilized. However, if polymers having a high molecular weight is intended to be obtained, a polymer concentration in the polymer solution must
25 be lowered because the viscosity of the polymer solution becomes high with increase of the molecular weight. As a result, a problem of low productivity of polymers takes place.

On the other hand, in the case of conducting the polymerization by a slurry polymerization process, there are
30 caused such problems that the polymer dissolves or swells easily

in a polymerization solvent, the viscosity of the polymer solution increases or the polymer adheres to the wall of the polymerizer, in result, the slurry concentration is hardly enhanced and it becomes difficult to a long run continuous
5 polymerization.

With the view of solving the above-mentioned problems, the present applicant prosecuted extensive researches and proposed the titanium catalyst component for olefin polymerization excellent in slurry processability, capable of running
10 polymerization in a high slurry concentration and preparing olefin polymers excellent in (copolymerization) compositional distribution with high polymerization activity, for example, Japanese Patent Laid-Open Publ. No.195108/1985.

The catalyst component for olefin polymerization disclosed
15 in Japanese Patent L-O-P No.195108/1985 can be polymerized olefins with high polymerization activity, and produce an olefin copolymer having a narrow compositional distribution.

Moreover, the advent of a titanium catalyst component capable of preparing olefin polymers having a narrow particle
20 size distribution with high polymerization activity has been desired.

OBJECT OF THE INVENTION

The present invention is intended to solve such problems associated with the prior arts as mentioned above, and an object
25 of the present invention is to provide a titanium catalyst component for olefin polymerization capable of preparing olefin polymers having a narrow particle size distribution and an excellent copolymerization compositional distribution with high polymerization activity, and to provide a process for



polymerizing olefins using the titanium catalyst component for olefin polymerization.

SUMMARY OF THE INVENTION

5 The titanium catalyst component for olefin polymerization according to the present invention is prepared by contacting:

 [A] a solid magnesium aluminum complex obtainable by contacting (a-1) a magnesium solution comprising a halogen-containing magnesium compound, an alcohol having at least 6
10 carbon atoms and a hydrocarbon solvent with (a-2) an organoaluminum compound, and containing magnesium, halogen, aluminum and an alkoxy group having at least 6 carbon atoms; with

 [B] a tetravalent titanium compound,
15 and essentially contains magnesium, halogen, aluminum, an alkoxy group having at least 6 carbon atoms and titanium.

 The process for an olefin polymerization according to the invention is characterized by polymerizing or copolymerizing olefins in the presence of a catalyst for the olefin
20 polymerization comprising [I] the titanium catalyst component for the olefin polymerization as described above and [II] the organoaluminum compound catalyst component.

DETAILED DESCRIPTION OF THE INVENTION

25 The titanium catalyst component for olefin polymerization according to the present invention, a process for preparing the catalyst component and a process for polymerizing olefins using the titanium catalyst component for olefin polymerization will be described in detail hereinafter.

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The term "polymerization" used herein may include "homopolymerization" and sometimes also may include "copolymerization". Also, the term "polymer" used herein may include "homopolymer" and sometimes also "copolymer".

5 Fig. 1 is an exemplary process for preparing the titanium catalyst component for olefin polymerization according to the present invention.

The titanium catalyst component for olefin polymerization according to the present invention is prepared by contacting:

10 [A] a solid magnesium aluminum complex obtainable by contacting (a-1) a magnesium solution comprising a halogen-containing magnesium compound, an alcohol having at least 6 carbon atoms and a hydrocarbon solvent with (a-2) an organoaluminum compound, and containing magnesium, halogen,
15 aluminum and an alkoxy group having at least 6 carbon atoms; with

[B] a halogen-containing tetravalent titanium compound.

First, the solid magnesium aluminum complex containing magnesium, halogen, aluminum and an alkoxy group having at least
20 6 carbon atoms [A] will be described.

The solid magnesium aluminum complex [A] is obtained by contacting:

(a-1) a magnesium solution formed from a halogen-containing magnesium compound, an alcohol having at least 6 carbon atoms
25 and a hydrocarbon solvent, with

(a-2) an organoaluminum compound.

In the solid magnesium aluminum complex [A], the atomic ratio Al/Mg is in the range of usually 0.05 to 1, preferably 0.08 to 0.7, more preferably 0.12 to 0.6. The alkoxy group
30 having at least 6 carbon atoms is contained, based on 1 part by



weight of magnesium, in an amount of usually 0.5 to 15 parts by weight, preferably 2 to 13 parts by weight, more preferably 5 to 10 parts by weight. The atomic ratio $X^1(\text{halogen})/\text{Mg}$ is in the range of usually 1 to 3, preferably 1.5 to 2.5.

- 5 The solid magnesium aluminum complex [A] may be optionally bonded with electron donors described below. The solid magnesium aluminum complex [A] is desired to be granular, and has the particle diameter in the range of 1 to 200 μm , more preferably 2 to 100 μm and the standard deviation of the particle size distribution in the range of 1.0 to 2.0.

Examples of the halogen-containing magnesium compound employed in the preparation of the magnesium solution (a-1) in the invention may include:

- magnesium halides, such as magnesium chloride, magnesium
15 bromide, magnesium iodide and magnesium fluoride;
alkoxymagnesium halides, such as methoxymagnesium chloride, ethoxymagnesium chloride, isopropoxymagnesium chloride, butoxymagnesium chloride and octoxymagnesium chloride;
aryloxymagnesium halides, such as phenoxymagnesium chloride
20 and methylphenoxymagnesium chloride;
alkoxymagnesiums, such as diethoxymagnesium, diisopropoxymagnesium, dibutoxymagnesium, and dioctoxymagnesium;
aryloxymagnesiums, such as diphenoxymagnesium and dimethylphenoxymagnesium; and
25 magnesium carboxylates, such as magnesium laurate and magnesium stearate.

The halogen-containing magnesium compound may be a complex or composite compound of these compounds with other metals, or a mixture of these compounds with other metallic compound.

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Of these, preferred are magnesium halides and alkoxymagnesium halides; more preferred are magnesium chloride and alkoxy magnesium chloride; and most preferred is magnesium chloride.

5 These compounds may be used alone or in combination.

The liquid magnesium compound solution (a-1) employed in the invention is composed of the halogen-containing magnesium compound, an alcohol having at least 6 carbon atoms and a hydrocarbon solvent.

10 Examples of the alcohol having at least 6 carbon atoms used in the invention include:

aliphatic alcohols, such as 2-methylpentanol, 2-ethylbutanol, n-heptanol, n-octanol, 2-ethylhexanol, decanol, dodecanol, tetradecyl alcohol, undecenol, oleyl alcohol and

15 stearyl alcohol;

alicyclic alcohols, such as cyclohexanol and methylcyclohexanol;

aromatic alcohols, such as benzyl alcohol, methylbenzyl alcohol, isopropylbenzyl alcohol, α -methylbenzyl alcohol and

20 α,α -dimethylbenzyl alcohol; and

alkoxy group-containing aliphatic alcohols, such as n-butyl cellosolve and 1-butoxy-2-propanol.

Of these, 2-ethylhexanol is particularly preferred.

These alcohols may be used alone or in combination.

25 Contacting the halogen-containing magnesium compound with the alcohol having at least 6 carbon atoms and a hydrocarbon solvent, the halogen-containing magnesium compound is dissolved in the hydrocarbon solvent to give a magnesium solution.

Examples of the hydrocarbon solvent may include:



aliphatic hydrocarbons, such as propane, butane, n-pentane, isopentane, n-hexane, isohexane, n-heptane, n-octane, isooctane, n-decane, n-dodecane and kerosine;

alicyclic hydrocarbons, such as cyclopentane,
5 methylcyclopentane, cyclohexane and methylcyclohexane;

aromatic hydrocarbons, such as benzene, toluene and xylene;
and

halogenated hydrocarbons, such as methylene chloride, ethyl chloride, ethylene chloride and chlorobenzene.

10 Of these, aliphatic hydrocarbons, particularly those of 3 to 10 carbon atoms, are preferably employed.

These hydrocarbon solvents may be used alone or in combination.

The contact of the halogen-containing magnesium compound
15 with the alcohol having at least 6 carbon atoms and the hydrocarbon solvent is carried out at a temperature of usually not lower than room temperature, preferably not lower than 65 °C, more preferably about 80 to 300 °C, most preferably about 100 to about 200 °C, for 15 minutes to 5 hours, preferably 30
20 minutes to 3 hours, though these conditions vary depending upon the compound and the alcohol used, etc.

The alcohol is used in an amount of generally not less than 1 mol, preferably about 1 to about 20 mol, more preferably about 1.5 to about 12 mole, per 1 mol of the halogen-containing
25 magnesium compound, though this amount varies depending upon the magnesium compound and the solvent used, etc.

In contacting the halogen-containing magnesium compound with the alcohol having at least 6 carbon atoms and the hydrocarbon solvent, an electron donor may coexist if necessary.



Examples of the electron donor may include phenol, aldehyde, carboxylic acid, organic halide, organic or inorganic ester, ether, diether, diester, acid amide, acid anhydride, ammonia, amine, nitrile, pyridine and isocyanate.

- 5 Contacting the magnesium solution (a-1) and the organoaluminum compound (a-2), the solid magnesium aluminum complex [A] is obtained.

Preferably used as the organoaluminum compound (a-2) in the invention is, for example, an organoaluminum compound
10 represented by the following formula (iv):



wherein R^a is a hydrocarbon group of 1 to 12 carbon atoms, X is halogen or hydrogen, and n is 1 to 3.

The hydrocarbon group of 1 to 12 carbon atoms may include
15 an alkyl group, a cycloalkyl group and an aryl group. Examples of the groups include methyl, ethyl, n-propyl, isopropyl, isobutyl, pentyl, hexyl, octyl, cyclopentyl, cyclohexyl, phenyl and tolyl.

Exemplary organoaluminum compound (a-2) may include:
20 trialkylaluminums, such as trimethylaluminum, triethylaluminum, triisopropylaluminum, triisobutylaluminum, trioctylaluminum and tri-2-ethylhexylaluminum;
alkenylaluminums, such as isoprenylaluminum;
dialkylaluminum halides such as dimethylaluminum chloride,
25 diethylaluminum chloride, diisopropylaluminum chloride, diisobutylaluminum chloride and dimethylaluminum bromide;
alkylaluminum sesquihalides, such as methylaluminum sesquichloride, ethylaluminum sesquichloride, isopropylaluminum sesquichloride, butylaluminum sesquichloride and ethylaluminum
30 sesquibromide;



alkylaluminum dihalides, such as methylaluminum dichloride, ethylaluminum dichloride, isopropylaluminum dichloride and ethylaluminum dibromide; and

alkylaluminum hydrides, such as diethylaluminum hydride and
5 diisobutylaluminum hydride.

Also employable as the organoaluminum compound is a compound represented by the following formula (v):



wherein R^a is the same as R^a in the formula (iv); n is 1 or 2;
10 and Y is $-OR^b$, $-OSiR^c_3$, $-OAlR^d_2$, $-NR^e_2$, $-SiR^f_3$ or $-N(R^g)AlR^h_2$, wherein R^b , R^c , R^d and R^h are each methyl, ethyl, isopropyl, isobutyl, cyclohexyl or phenyl; R^e is hydrogen, methyl, ethyl, isopropyl, phenyl or trimethylsilyl; and R^f and R^g are each methyl or ethyl.

15 Examples of such organoaluminum compounds include:

(1) $R^a_n Al(OR^b)_{3-n}$, such as dimethylaluminum methoxide, diethylaluminum ethoxide and diisobutylaluminum methoxide;

(2) $R^a_n Al(OSiR^c_3)_{3-n}$, such as $Et_2Al(OSiMe_3)$, (iso-Bu) $_2Al(OSiMe_3)$ and (iso-Bu) $_2Al(OSiEt_3)$;

20 (3) $R^a_n Al(OAlR^d_2)_{3-n}$, such as $Et_2AlOAlEt_2$ and (iso-Bu) $_2AlOAl(iso-Bu)_2$;

(4) $R^a_n Al(NR^e_2)_{3-n}$, such as Me_2AlNEt_2 , $Et_2AlNHMe$, $Me_2AlNHEt$, $Et_2AlN(Me_3Si)_2$ and (iso-Bu) $_2AlN(Me_3Si)_2$;

(5) $R^a_n Al(SiR^f_3)_{3-n}$, such as (iso-Bu) $_2AlSiMe_3$; and

25 (6) $R^a_n Al[N(R^g)AlR^h_2]_{3-n}$, such as $Et_2AlN(Me)AlEt_2$ and (iso-Bu) $_2AlN(Et)Al(iso-Bu)_2$.

In addition, also employable as the the organoaluminum compound (a-2) is a complex alkylate which is composed of a metal of Group I and aluminum, and represented by the following
30 formula:





wherein M^i is Li, Na or K, and R^j is a hydrocarbon group of 1 to 15 carbon atoms.

Examples of the complex alkylate may include $LiAl(C_2H_5)_4$
5 and $LiAl(C_7H_{15})_4$.

Of the organoaluminum compounds as exemplified above,
preferably used are trialkylaluminum, dialkylaluminum halide,
dialkylaluminum hydride and dialkylaluminum alkoxide. Of these,
trialkylaluminum, particularly, is preferred because a catalyst
10 with a favorable shape can be obtained using it.

These organoaluminum compounds may be used alone or in
combination.

In preparing the solid magnesium aluminum complex [A], the
organoaluminum compound (a-2) is desirably used in such an
15 amount that the molar ratio (ROH/Al) of the alcohol (ROH) having
at least 6 carbon atoms used for the preparation of the
magnesium solution (a-1) to the aluminum atom (Al) contained in
the organoaluminum compound (a-2) is in the range of about 0.5
to 5, preferably 1 to 3.

20 The contact of the magnesium solution (a-1) with the
organoaluminum compound (a-2) can be carried out by adding
dropwise the organoaluminum compound (a-2) slowly to the
magnesium solution (a-1) having a magnesium concentration of
preferably 0.005 to 2 mol/l, more preferably 0.05 to 1 mol/l,
25 with stirring for 0.2-2 hours. In this manner, a solid
magnesium aluminum complex [A] having excellent particle
properties can be obtained.

The temperature of contacting the magnesium solution (a-1)
with the organoaluminum compound (a-2) is in the range of
30 usually -50 to 150 °C, preferably -30 to 100 °C.



The titanium catalyst component for olefin polymerization [I] according to the present invention is obtained by contacting the above-described solid magnesium aluminum complex [A] with a tetravalent titanium compound [B].

5 The tetravalent titanium compound [B] is preferably represented by the following formula (ii):



wherein R is a hydrocarbon group, X is halogen, and $0 \leq g \leq 3$.

Examples of such tetravalent titanium compound [B] include:
 10 titanium tetrahalides such as TiCl_4 , TiBr_4 and TiI_4 ;
 alkoxytitanium trihalides, such as $\text{Ti}(\text{OCH}_3)\text{Cl}_3$,
 $\text{Ti}(\text{OC}_2\text{H}_5)\text{Cl}_3$, $\text{Ti}(\text{On-C}_4\text{H}_9)\text{Cl}_3$, $\text{Ti}(\text{OC}_2\text{H}_5)\text{Br}_3$, and $\text{Ti}(\text{O-iso-C}_4\text{H}_9)\text{Br}_3$;
 dialkoxytitanium dihalides, such as $\text{Ti}(\text{OCH}_3)_2\text{Cl}_2$,
 $\text{Ti}(\text{OC}_2\text{H}_5)_2\text{Cl}_2$, $\text{Ti}(\text{On-C}_4\text{H}_9)_2\text{Cl}_2$, and $\text{Ti}(\text{OC}_2\text{H}_5)_2\text{Br}_2$; and
 15 trialkoxytitanium monohalides, such as $\text{Ti}(\text{OCH}_3)_3\text{Cl}$,
 $\text{Ti}(\text{OC}_2\text{H}_5)_3\text{Cl}$, $\text{Ti}(\text{On-C}_4\text{H}_9)_3\text{Cl}$, and $\text{Ti}(\text{OC}_2\text{H}_5)_3\text{Br}$.

These compounds may be used alone or in combination.

The tetravalent titanium compound [B] is used in such an amount that the atomic ratio $\text{Ti}/(\text{Mg}+\text{Al})$ is in the range of 0.05
 20 to 18, preferably 0.1 to 15 per the solid magnesium aluminum complex [A].

The contact of the solid magnesium aluminum complex [A] with the tetravalent titanium compound [B] is carried out preferably in a hydrocarbon solvent. As the hydrocarbon
 25 solvent, those similar to the aforesaid hydrocarbons can be employed.

In the invention, the contact is carried out at a temperature of usually 0 to 150 °C, preferably 50 to 130 °C, more preferably 60 to 120 °C.

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The titanium catalyst component for olefin polymerization according to the invention can be obtained in the manner as described above, and contains, as essential components, magnesium, halogen, aluminum, an alkoxy group having at least 6 carbon atoms and titanium. The atomic ratio Ti/Mg is in the range of usually 0.01 to 0.5, preferably 0.05 to 0.4.

The atomic ratio Al/Mg is in the range of usually 0.01 to 1.5, preferably 0.02 to 1.2.

The alkoxy group having at least 6 carbon atoms is used in an amount of usually 0.1 to 15 parts by weight, preferably 0.3 to 10 parts by weight, more preferably 0.5 to 6 parts by weight, based on 1 part by weight of magnesium.

The atomic ratio X(halogen)/Mg is in the range of usually 1 to 3, preferably 1.5 to 2.5

In accordance with the process for olefin polymerization according to the present invention, olefins are polymerized or copolymerized in the presence of a catalyst for olefin polymerization comprising [I] the above-described titanium catalyst for olefin polymerization and optionally [II] the organoaluminum compound.

Examples of the olefins polymerized in the invention may include α -olefins having 2 to 27 carbon atoms, for example, ethylene, propylene, 2-methylpropylene, 1-butene, 1-hexene, 1-pentene, 4-methyl-1-pentene, 3-methyl-1-pentene, 1-octene, 1-nonene, 1-decene, 1-undecene and 1-dodecene. The α -olefins may be copolymerized with polyenes. Examples of such polyenes include butadiene, isoprene, 1,4-hexadiene, dicyclopentadiene and 5-ethylidene-2-norbornene.

Of these, in particular, ethylene is preferably homopolymerized or copolymerized with other olefins

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The copolymer of ethylene with the other olefins thus obtained contains constituent units derived from ethylene preferably in an amount of at least 90 % by mol.

As the organoaluminum compound [II] employed in the polymerization, the aforesaid organoaluminum compound (a-2) used in the preparation of the titanium catalyst component for olefin polymerization [I] can be used.

In the polymerization, the titanium catalyst component for olefin polymerization [I] is used in an amount of generally about 0.00001 to about 1 mmol, preferably about 0.0001 to about 0.1 mmol, in terms of Ti atom, per 1 liter of the polymerization reaction volume.

The organoaluminum compound [II] is optionally used in an amount of 1 to 1,000 mol, preferably 2 to 500 mol, per 1 g-atom of the titanium contained in the titanium catalyst component for olefin polymerization [I].

The titanium catalyst component for olefin polymerization may contain an electron donor.

As the electron donors, those used in preparing the titanium catalyst component for olefin polymerization [I] described above can be used, moreover an organosilicon compound represented by the following formula:



wherein R and R' are hydrocarbon groups and $0 < n < 4$.

Examples of the organosilicon compound include trimethylmethoxysilane, trimethylethoxysilane, dimethyl-dimethoxysilane, dimethyldiethoxysilane, diisopropyl-dimethoxysilane, t-butylmethyldimethoxysilane,



- t-butylmethyldiethoxysilane, t-amylmethyldiethoxysilane,
diphenyldimethoxysilane, phenylmethyldimethoxysilane,
diphenyldiethoxysilane, bis-o-tolyldimethoxysilane,
bis-m-tolyldimethoxysilane, bis-p-tolyldimethoxysilane,
5 bis-p-tolyldiethoxysilane, bisethylphenyldimethoxysilane,
dicyclohexyldimethoxysilane, cyclohexylmethyldimethoxysilane,
cyclohexylmethyldiethoxysilane, ethyltrimethoxysilane,
ethyltriethoxysilane, vinyltrimethoxysilane, methyltrimethoxy-
silane, n-propyltriethoxysilane, decyltrimethoxysilane,
10 decyltriethoxysilane, phenyltrimethoxysilane, γ -chloropropyl-
trimethoxysilane, methyltriethoxysilane, ethyltriethoxysilane,
vinyltriethoxysilane, t-butyltriethoxysilane, n-butyltriethoxy-
silane, iso-butyltriethoxysilane, phenyltriethoxysilane, γ -
aminopropyltriethoxysilane, chlorotriethoxysilane, ethyltri-
15 isopropoxysilane, vinyltributoxysilane, cyclohexyltrimethoxy-
silane, cyclohexyltriethoxysilane, 2-norbornanetrimethoxysilane,
2-norbornanetriethoxysilane, 2-norbornanemethyldimethoxysilane,
ethyl silicate, butyl silicate, trimethylphenoxysilane,
methyltriallyloxysilane, vinyltris(β -methoxyethoxysilane),
20 vinyltriacetoxysilane, dimethyltetraethoxydisiloxane,
cyclopentyltrimethoxysilane, 2-methylcyclopentyltrimethoxysilane,
2,3-dimethylcyclopentyltrimethoxysilane, cyclopentyltriethoxy-
silane, dicyclopentyldimethoxysilane, bis(2-methylcyclopentyl)
dimethoxysilane, bis(2,3-dimethylcyclopentyl) dimethoxysilane,
25 dicyclopentyldiethoxysilane, tricyclopentylmethoxysilane,
tricyclopentylethoxysilane, dicyclopentylmethylethoxysilane,
dicyclopentylethylmethoxysilane, hexenyltrimethoxysilane,
dicyclopentylmethylethoxysilane, cyclopentyldimethylmethoxy-
silane, cyclopentyldiethylmethoxysilane, cyclopentyldimethyl-
30 ethoxysilane, etc.

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These compounds may be used alone or in combination.

Of these, preferably used are ethyltriethoxysilane,
n-propyltriethoxysilane, t-butyltriethoxysilane, vinyl-
triethoxysilane, phenyltriethoxysilane, vinyltributoxysilane,
5 diphenyldimethoxysilane, phenylmethyldimethoxysilane, bis-p-
tolylldimethoxysilane, p-tolylmethyldimethoxysilane,
dicyclohexyldimethoxysilane, cyclohexylmethyldimethoxysilane,
2-norbornanetriethoxysilane, 2-norbornanemethyldimethoxysilane,
phenyltriethoxysilane, dicyclopentyldimethoxysilane, hexe-
10 nitrilemethoxysilane, cyclopentyltriethoxysilane, tricyclo-
pentyldimethoxysilane, cyclopentyltriethoxysilane, tricyclopentyl-
methoxysilane, cyclopentyldimethylmethoxysilane, etc.

Furthermore, usable examples of the electron donors may
include nitrogen-containing compounds, other oxygen-containing
15 compounds and phosphorus-containing compounds.

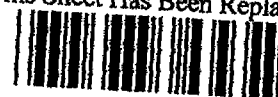
Examples of the nitrogen-containing compounds may include
substituted methylenediamine such as
2,6-substituted piperidine, 2,5-substituted piperidine,
N,N,N',N'-tetramethylmethylenediamine, N,N,N',N'-
20 tetraethylmethylenediamine;

substituted methylenediamine such as 1,3-
dibenzylimidazolidine, 1,3-dibenzyl-2-phenylimidazolidine.

Examples of the phosphorus-containing compounds may include
phosphorous ester such as triethylphosphite, tri-n-propyl-
25 phosphite, triisopropylphosphite, tri-n-butylphosphite,
triisobutylphosphite, diethyl-n-butylphosphite,
diethylphenylphosphite.

Examples of the oxygen-containing compounds may include
2,6-substituted tetrahydropyran, 2,5-substituted
30 tetrahydropyran.

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These electron donors are used, based on 1 mole of aluminum atom in the titanium catalyst component [I], in an amount of usually not more than 10 moles, preferably not more than 2 moles, especially 0.05-1 mole.

5 The titanium catalyst component for olefin polymerization may be supported on a carrier. Examples of such a carrier include Al_2O_3 , SiO_2 , B_2O_3 , MgO , CaO , TiO_2 , ZnO , Zn_2O , SnO_2 , BaO , ThO and resins such as a styrene/divinylbenzene copolymer.

10 Further, the catalyst for olefin polymerization as described above may be prepolymerized with olefins.

Hydrogen may be used in the polymerization, whereby a molecular weight of a polymer obtained can be regulated.

In the present invention, the polymerization of olefin may be carried out by either a liquid phase polymerization, such as
15 a solution polymerization and a suspension polymerization, or a gas phase polymerization. Further, the polymerization may be carried out either batchwise, semi-continuously or continuously.

When a slurry polymerization is carried out, any of an inert solvent and olefin which is liquid at a polymerization
20 temperature may be used as a reaction solvent.

Examples of such inert solvents include aliphatic hydrocarbons, such as propane, butane, n-pentane, isopentane, n-hexane, isohexane, n-heptane, n-octane, isooctane, n-decane, n-dodecane and kerosine; alicyclic hydrocarbons, such as
25 cyclopentane, methylcyclopentane, cyclohexane and methylcyclohexane; and aromatic hydrocarbons, such as benzene, toluene, xylene and ethylbenzene. These inert solvents may be used singly or in combination.

The polymerization temperature is in the range of usually
30 20 to 150 °C, preferably 50 to 120 °C, more preferably 70 to 110



°C; and the polymerization pressure is in the range of usually 1 to 1,000 kg/cm², preferably 2 to 40 kg/cm².

The copolymerization may be carried out in plural steps.

The olefin polymer obtained as above may be either a
5 homopolymer of olefin, an olefin random copolymer or a block copolymer, but preferred are a homopolymer of ethylene and a random copolymer of ethylene with an α -olefin.

Particularly preferably, an ethylene homopolymer or an ethylene/ α -olefin copolymer, having a density of 0.900 to 0.970
10 g/cm³, preferably 0.910 to 0.970 g/cm³, is prepared in the present invention. The density used herein is that determined in accordance with ASTM D1505.

According to the present invention as described above, olefins can be (co)polymerized with high polymerization
15 activity, and moreover, olefin copolymers having excellent compositional distribution can be obtained.

In the invention, the olefin polymers are obtained in the form of particles, and the particle diameter is in the range of generally 10 to 1,500 μ m, preferably 45 to 1,000 μ m.

20 The standard deviation of the particles is in the range of 1.0 to 2.0, preferably 1.0 to 1.6.

The olefin polymers obtained as above according to the present invention have a narrow particle size distribution, for example and have a small amount of fine particles having a
25 diameter of not more than 100 μ m. The fine particles exist in an amount of usually not more than 10 % by weight, preferably not more than 5 % by weight in the all polymer particles.

The olefin polymers obtained in the invention may contain various additives, such as heat stabilizers, weathering
30 stabilizers, antistatic agents, anti-blocking agents,

lubricants, nucleating agents, pigments, dyes, inorganic fillers and organic fillers.

EFFECT OF THE INVENTION

5 The titanium catalyst component for olefin polymerization according to the present invention comprises the halogen-containing titanium compound supported on the solid magnesium aluminum complex, and is allowed to polymerize olefins with high polymerization activity. Moreover, when the component is
10 allowed to copolymerize olefins, an olefin copolymer having an excellent compositional distribution can be prepared.

Specifically, the titanium catalyst component is capable of preparing olefin polymer particles having a narrow particle size distribution, and extremely fine particles are produced in only
15 a small amount.

The process for olefin polymerization according to the present invention is carried out using the titanium catalyst component for olefin polymerization, to provide an olefin polymer having a narrow particle size distribution with high
20 polymerization activity. When the polymerization is carried out in the slurry, slurry-handling properties are also excellent.

EXAMPLE

The present invention will be described below in more detail with reference to non-limiting examples.

25 Example 1

[Preparation of a catalyst component]

4.8 g of a commercially available magnesium chloride anhydride, 19.5 g of 2-ethylhexanol and 200 ml of decane were heated at 140 °C for 3 hours to give a homogeneous solution
30 containing the magnesium chloride. A mixture solution composed

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of 60 mmol of triethylaluminum and 52 ml of decane was added dropwise at 20 °C over 30 minutes with constant stirring to the solution. Then, the mixture was heated to 80 °C over 2 hours and kept at 80°C for 2 hours. Terminating the reaction with heating, solids were separated by filtration and washed once with 200 ml of decane, to produce a solid magnesium aluminum complex.

The solid magnesium aluminum complex was suspended again in 200 ml of decane, followed by the addition of 400 mmol of titanium tetrachloride, The reaction was carried out at 80 °C for 2 hours. Then, the reaction product was well washed with hexane to produce a hexane suspension of a solid catalyst. The composition of the solid catalyst is shown in Table 2.

A portion (corresponding to 5 g of the solid catalyst) of the hexane suspension of the solid catalyst was withdrawn and was added to a 300 ml reactor equipped with a teflon agitator. Further, 0.5 g of liquid paraffin was added to the reactor, and the content of the reactor was stirred. Then, the reactor was placed in a bath of 40 °C while causing nitrogen to pass through the reactor at a rate of 80 Nl/Hr, to evaporate hexane. By the dry, a powdery Ti catalyst component containing about 10 % of liquid paraffin was obtained.

[Polymerization]

A 2-liter autoclave was charged with 1 liter of purified hexane in a nitrogen atmosphere, followed by the addition of 0.1 mmol (in terms of Ti atom) of the suspension composed of 1.0 mmol of triethylaluminum and the powdery Ti catalyst component which were suspended in hexane. The reaction mixture was heated to 80 °C, and was fed with 4.0 kg/cm²G of hydrogen and was then further fed with ethylene continuously over 2 hours so that the



total pressure was kept at 8.0 kg/cm²G. The temperature of the polymerization was adjusted at 80 °C.

Terminating the polymerization, an ethylene polymer produced was separated from the hexane solvent and dried.

5 The results are shown in Table 2.

The yield of the powdery polymer was 227 g, and the polymer had MFR of 2.7 g/10 min and an apparent bulk specific gravity of 0.33 g/cc.

10 The particle size distribution of the powdery polymer is shown in Table 1.

Table 1

> 850 μm	850 μm ~ 500 μm	500 μm ~ 250 μm	250 μm ~ 180 μm	180 μm ~ 100 μm	100 μm ~ 45 μm	< 45 μm
0	0.4 wt. %	93.1 wt. %	4.1 wt. %	1.8 wt. %	0.6 wt. %	0

Example 2

15 The procedure of Example 1 was followed with the exception of changing the amount of 2-ethylhexanol from 19.5 g to 16.3 g and the amount of triethylaluminum from 60 mmol to 46 mmol.

The results are shown in Table 2.

Example 3

20 The procedure of Example 2 was followed with the exception of varying the temperature condition after the addition of 400 mmol of titanium tetrachloride from 80 °C to 100 °C.

The results are shown in Table 2.

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Example 4

The procedure of Example 1 was followed with the exception of changing the amount of 2-ethylhexanol from 19.5 g to 16.3 g and the amount of triethylaluminum from 60 mmol to 43 mmol.

5 The results are shown in Table 3.

Example 5

The procedure of Example 1 was followed with the exception of changing the amount of 2-ethylhexanol from 19.5 g to 15.3 g and the amount of triethylaluminum from 60 mmol to 41 mmol.

10 The results are shown in Table 2.

Comparative Example 1

4.8 g of a commercially available magnesium chloride anhydride, 19.5 g of 2-ethylhexanol and 200 ml of decane were heated at 140 °C for 3 hours to give a homogeneous solution containing magnesium chloride. A mixture solution composed of 52 mmol of triethylaluminum and 45 ml of decane was added dropwise at 20 °C over 30 minutes with stirring to the solution. Then, the solution was heated to 80 °C over 2.5 hours and maintained at 80 °C for 1 hour. After completion of the reaction with heating, the reaction slurry was allowed to stand, then the supernatant was removed. Then, 200 ml of decane and 50 mmol of diethylaluminum chloride were added to the remaining slurry containing a solid portion produced in the above reaction and the reaction was carried out again at 80 °C for 1 hour. Subsequently, the solid portion was separated by filtration and washed once with 100 ml of decane, to prepare a solid component containing an organic group having reducing power.

The solid component thus obtained was suspended again in 200 ml of decane, and then 25 mmol of titanium tetrachloride was added to the resulting suspension. The suspension was reacted at

80 °C for 2 hours, to separate a solid produced by filtration.

The solid was washed 5 times with hexane, to produce a titanium catalyst component.

Using the titanium catalyst component thus obtained,
5 ethylene was polymerized in a manner similar to that of Example 1.

The results are shown in Table 2.

Table 2

10

<u>Results of Polymerization</u>						
	Amount of Ti supported (wt%)	Activity g-PE/g- Catalyst	MFR g/10 min.	Bulk Specific Gravity g/cc	Particle Size Distribution (wt%)	
					>850μm	<100μm
Ex. 1	7.3	34,600	2.7	0.33	0	0.6
2	7.0	36,900	4.4	0.32	0	1.0
3	7.0	33,000	4.9	0.31	0.1	1.5
4	6.7	31,200	5.7	0.30	0	0.7
5	6.7	33,900	4.5	0.30	0.1	1.6
Com.						
Ex. 1	5.7	10,600	2.8	0.30	2.1	1.6

25

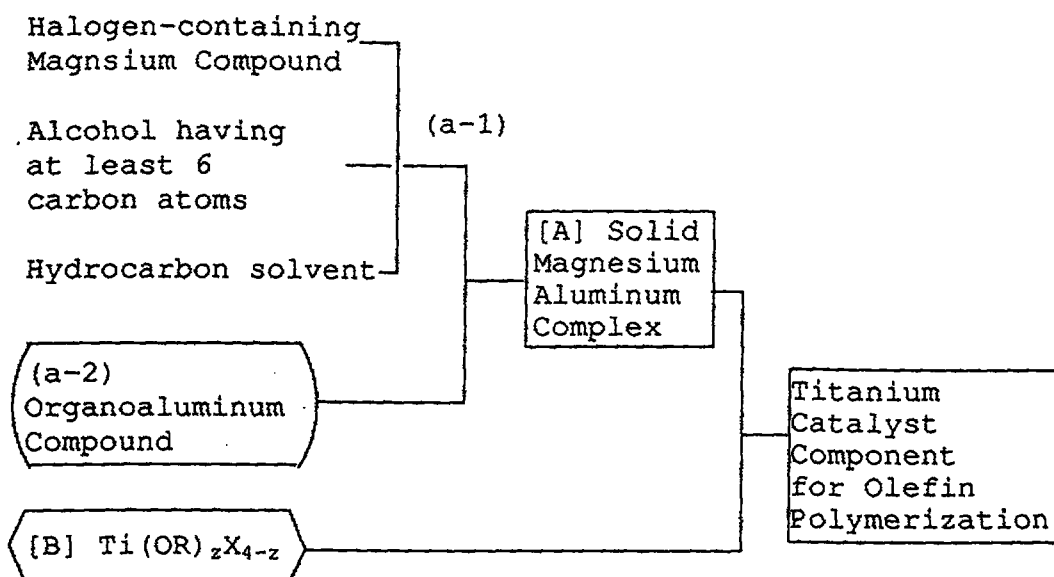
BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 shows a process for preparing the titanium catalyst
component for olefin polymerization according to the present
30 invention.

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Fig.1



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