Claims

Claim 1

A method for preparing polybutene, comprising the steps of:

supplying a C4 mixture to an isomerization reactor in which (i) 1-butene is isomerized into 2-butene by a hydrogen isomerization reaction using an isomerization catalyst in an isomerization zone of the isomerization reactor and (ii) iso-butene and 2-butene are separated by fractional distillation in a fractional distillation zone;

supplying a C4 mixture containing 2-butene which is separated in the isomerization reactor to a skeletal isomerization reactor, in which a part of normal-butene is skeletal isomerized into iso-butene by a skeletal isomerization reaction using a skeletal isomerization catalyst, and the obtained skeletal isomerization mixture is supplied and recycled to the isomerization reactor;

supplying (i) a raw material containing the iso-butene of high concentration and which is separated from the isomerization reactor and (ii) a polymerization catalyst to a polybutene polymerization reactor and thereby producing polybutene by a polymerization reaction; and

after the polymerization reaction, recycling whole or a part of the unreacted C4 of the polymerization reaction to the isomerization reactor.

Claim 2

The method of claim 1, wherein the polymerization catalyst comprises a main catalyst, a cocatalyst and an auxiliary cocatalyst, and the main catalyst is a Lewis acid selected from the group consisting of boron trifluoride, boron trichloride, aluminum trichloride and zinc chloride, and the cocatalyst is selected from the group consisting of water and an alcohol compound, and the auxiliary cocatalyst is an alkyl ether compound.

Claim 3

The method of claim 1, wherein, after the polybutene polymerization reaction, the iso-butene amount in the unreacted C4 is 2 to 20 weight%.

Claim 4

The method of claim 1, wherein the polybutene is polymerized with a catalyst mileage of 300 to 1200 g-polymer/g-catalyst.

Claim 5

The method of claim 1, wherein the polybutene is a conventional polybutene having 70 mol% or less of vinylidene in which a double bond is located at a terminal of the polybutene.

Claim 6

The method of claim 1, wherein the polybutene is a highly reactive polybutene having more than 70 mol% of vinylidene in which a double bond is located at a terminal of the polybutene, and whose molecular weight is from 300 to 5,000.

Claim 7

The method of claim 1, wherein the polymerization reaction is carried out at a temperature of -30 to 40℃. and at a pressure of 3 kg/cm_2 or more for a residence time of 5 to 100 minutes.

Claim 8

The method of claim 1, further comprising a step of removing an oxygen-containing organic substance and a halogen acid contained in the unreacted C4 of the polymerization reaction by using an impurity adsorption tower equipped with an adsorbent.

Claim 9

The method of claim 8, wherein the adsorbent is a compound selected from the group consisting of calcium hydroxide ($Ca(OH)_2$), calcium oxide (CaO), calcium carbonate ($CaCO_3$), calcium chloride ($CaCl_2$), potassium hydroxide (KOH), potassium carbonate (K_2CO_3), potassium bicarbonate ($KHCO_3$), potassium chloride (KCl), sodium hydroxide (NaOH), sodium carbonate (Na_2CO_3), sodium hydrogencarbonate ($NaHCO_3$), solid silica, solid alumina, zeolite, anion exchange resins in which

amine group is attached to resin, and cation exchange resins in which a sulfone group is attached to the resin.

Claim 10

The method of claim 8, wherein the adsorption tower is provided with an adsorption column for removing oxygen-containing organic substance contained in the unreacted C4 and an adsorption column for removing halogen acid contained in the unreacted C4.

Claim 11

An apparatus for preparing polybutene, comprising:

an isomerization reactor to which a C4 mixture is supplied and in which (i) 1-butene of the C4 mixture is isomerized into 2-butene by a hydrogen isomerization reaction and (ii) iso-butene and 2-butene of the C4 mixture are separated by fractional distillation;

a skeletal isomerization reactor to which a C4 mixture containing 2-butene separated in the isomerization reactor is supplied and in which a part of normal-butene is skeletal isomerized into iso-butene to obtain a skeletal isomerization mixture, and the obtained skeletal isomerization mixture is supplied and recycled to the isomerization reactor;

and a polybutene polymerization reactor to which (i) a raw material containing high concentration of iso-butene separated from the isomerization reactor and (ii) a polymerization catalyst are supplied and polymerized, thereby producing a reaction product;

wherein a whole or a part of unreacted C4 of the polymerization reaction is recycled in the isomerization reactor.

Claim 12

The apparatus of claim 11, further comprising:

a C4 distillation column for distilling the reaction product to separate unreacted C4 and residual organic compounds and for discharging the unreacted C4;

an adsorption tower provided with an adsorbent for removing organic substances and halogen acid which are contained in the unreacted C4, before returning the unreacted C4 which is discharged

from the C4 distillation column to the isomerization reactor and/or the polybutene polymerization reactor;

and a LP distillation column for discharging a light polymer among the residual organic compounds supplied from the C4 distillation column, thereby obtaining polybutene.