

DESCRIPTION

RESIN COMPOSITION, FIBER AND TEXTILE

5 Technical Field

This application claims priority under the Paris Convention on Japanese Patent Application No. 2007-318005 filed on December 10, 2007, the entire disclosure of which is herein incorporated by reference.

10 The present invention relates to a resin composition which can retain an insecticide at a high concentration without containing a filler.

Background Art

15 As means for sustained release of insect pest control agents such as insecticides, insect growth controlling agents and insect repellants there has hitherto been known, for example, a process of forming a resin composition, which has been prepared by kneading a thermoplastic resin
20 and an insect pest control agent or impregnating a thermoplastic resin with an insect pest control agent, into a molding such as film or sheet and releasing the insect pest control agent from the molding. Solubility of the insect pest control agent in the thermoplastic resin
25 slightly varies depending on selection of the resin and

insect pest control agent, but is usually low at about 0.1 to 5% by weight. Therefore, in the film or sheet formed by the above method, sustained release of the insect pest control agent for a long period could not be sometimes expected. Therefore, a technique of compounding a large amount of an insect pest control agent was required so as to enable sustained release of the insect pest control agent for a long period. For example, Patent Document 1 describes that a molding obtained from a thermoplastic resin and a filler is drawn and microvoids generated by the drawing are impregnated with a large amount of a chemical such as an insect pest control agent, thus enabling sustained release of the insect pest control agent for a long period.

[Patent Document 1] Japanese Unexamined Patent Publication (Kokai) No. 7-10708

Disclosure of the Invention

In the technique described in Patent Document 1, however, since the filler must be used so as to generate microvoids, the following problems were sometimes caused by the addition of the filler. That is, it may become difficult, depending on the amount of the filler added, to obtain a molding having excellent transparency and the external appearance of the molding may be damaged by

deposition of resinous deposits during long term processing.

Under such situations, a problem to be solved, that is to say, an object of the present invention is to provide a resin composition which can retain an insect pest control agent at a high concentration without containing a filler.

Thus, the present invention relates to a resin composition comprising a component (A), a component (B) and a component (C), wherein the content of the component (A) is from 1 to 99% by weight, the content of the component (B) is from 99 to 1% by weight, provided that the total amount of the component (A) and the component (B) is let be 100% by weight, and the content of the component (C) is from 1.5 to 50 parts by weight, provided that the total amount of the component (A) and the component (B) is let be 100 parts by weight, and the components (A), (B) and (C) are as follows:

component (A): non-crystalline or low crystalline olefin-based polymer as a polymer contains monomer units derived from olefin with which neither a crystal fusion peak having a heat of crystal fusion of 30 J/g or more, nor a crystallization peak having a heat of crystallization of 30 J/g or more are observed at a range of -50 to 200°C by differential scanning calorimetry according to JIS K 7122, compound (B): a crystalline propylene-based polymer, and component (C): an insect pest control agent.

According to the present invention, there is provided a resin composition which can retain an insect pest control agent at a high concentration without containing a filler.

5 Best Mode for Carrying out the Invention

The non-crystalline or low crystalline olefin-based polymer as the component (A) of the present invention is a polymer containing monomer units derived from olefin with which neither a crystal fusion peak having a heat of
10 crystal fusion of 30 J/g or more, nor a crystallization peak having a heat of crystallization of 30 J/g or more is observed at a range of -50 to 200°C by differential scanning calorimetry according to JIS K 7122. When the resin composition does not contain such a non-crystalline
15 or low crystalline olefin-based polymer, or the amount of the non-crystalline or low crystalline olefin-based polymer is less than the lower limit defined in the present invention, even if the resin composition contains it, the insect pest control agent cannot be sometimes retained at a
20 high concentration. Hereinafter, the component (A) may also be referred to as a non-crystalline or low crystalline olefin-based polymer (A).

The olefin composing the non-crystalline or low crystalline olefin-based polymer (A) of the present
25 invention includes, for example, ethylene, propylene and α -

olefin having 4 to 20 carbon atoms, and the α -olefin having 4 to 20 carbon atoms includes, for example, a straight-chain α -olefin such as 1-butene, 1-pentene, 1-hexene, 1-heptene, 1-octene, 1-nonene, 1-decene, 1-undecene, 1-dodecene, 1-tridecene, 1-tetradecene, 1-pentadecene, 1-hexadecene, 1-heptadecene, 1-octadecene, 1-nanodecene, and 1-eicosene; and a branched α -olefin such as 3-methyl-1-butene, 3-methyl-1-pentene, 4-methyl-1-pentene, 2-ethyl-1-hexene, and 2,2,4-trimethyl-1-pentene.

The non-crystalline or low crystalline olefin-based polymer (A) of the present invention include, for example, ethylene homopolymer, ethylene-propylene copolymer, ethylene-1-butene copolymer, ethylene-1-hexene copolymer, ethylene-1-octene copolymer, ethylene-1-heptene copolymer, ethylene-1-nonene copolymer, ethylene-1-decene copolymer, ethylene-1-undecene copolymer, ethylene-1-dodecene copolymer, ethylene-1-tridecene copolymer, ethylene-1-tetradecene copolymer, ethylene-1-pentadecene copolymer, ethylene-1-hexadecene copolymer, ethylene-1-heptadecene copolymer, ethylene-1-octadecene copolymer, ethylene-1-nanodecene copolymer, ethylene-1-eicosene copolymer, propylene homopolymer, propylene-1-butene copolymer, propylene-1-hexene copolymer, propylene-1-octene copolymer, propylene-1-heptene copolymer, propylene-1-nonene copolymer, propylene-1-decene copolymer, propylene-1-undecene

copolymer, propylene-1-dodecene copolymer, propylene-1-tridecene copolymer, propylene-1-tetradecene copolymer, propylene-1-pentadecene copolymer, propylene-1-hexadecene copolymer, propylene-1-heptadecene copolymer, propylene-1-octadecene copolymer, propylene-1-nanodecene copolymer, propylene-1-eicosene copolymer, ethylene-propylene-1-butene copolymer, ethylene-propylene-1-hexene copolymer, ethylene-propylene-1-octene copolymer, ethylene-1-butene-1-hexene copolymer, and these may be used alone, or two or more kinds of them may be used in combination. The component (A) is preferably propylene-1-butene copolymer, propylene-1-hexene copolymer, propylene-1-octene copolymer, ethylene-propylene-1-butene copolymer, ethylene-propylene-1-hexene copolymer, ethylene-propylene-1-octene copolymer, more preferably propylene-1-butene copolymer, ethylene-propylene-1-butene copolymer, and still more preferably propylene-1-butene copolymer.

The non-crystalline or low crystalline olefin-based polymer (A) of the present invention may contain monomer units derived from monomers other than olefin, and the monomers other than olefin includes, for example, a vinyl aromatic compound. The content of the monomer units derived from the monomers other than olefin is preferably 20 mol% or less based on 100 mol% of the entire non-crystalline or low crystalline olefin-based copolymer.

The vinyl aromatic compound as monomers other than the olefin includes, for example, styrene, α -methylstyrene, p-methylstyrene, vinylxylene, monochlorostyrene, dichlorostyrene, monobromostyrene, dibromostyrene, fluorostyrene, p-tert-butylstyrene, ethylstyrene, vinyl naphthalene.

From the viewpoint of retaining the insect pest control agent at a high concentration, the non-crystalline or low crystalline olefin-based polymer (A) of the present invention is preferably a polymer which satisfies the following relation (1):

$$0 \leq [x/(x + y)] < 0.6 \quad (1)$$

in the above formula (1), x denotes the content (mol%) of monomer units derived from ethylene of a component (A), and y denotes the content (mol%) of monomer units derived from α -olefin having 4 to 20 carbon atoms in a component (A), provided that the content of the entire component (A) is 100 mol%.

From the viewpoint of retaining the insect pest control agent at a high concentration, in the non-crystalline or low crystalline olefin-based polymer (A) of the present invention, it is preferred that neither a crystal fusion peak having a heat of crystal fusion of 30 J/g or more, nor a crystallization peak having a heat of crystallization of 30 J/g or more is observed at a range of

-50 to 200°C by differential scanning calorimetry according to JIS K 7122.

From the viewpoint of reducing stickiness of the resulting resin composition, a molecular weight distribution of the non-crystalline or low crystalline olefin-based polymer (A) of the present invention is preferably from 1 to 4, and more preferably from 1.5 to 3. The molecular weight distribution is a ratio (M_w/M_n) of a weight average molecular weight (M_w) to a number average molecular weight (M_n) and can be measured by gel permeation chromatography (GPC) using standard polystyrenes as molecular weight standard substances.

From the viewpoint of reducing stickiness of the resulting resin composition, the intrinsic viscosity $[\eta]$ of the non-crystalline or low crystalline olefin-based polymer (A) of the present invention measured in a tetralin solvent at 135°C is preferably 0.1 dl/g or more. From the viewpoint of reducing damage to a processing machine due to an excessive torque produced in processing, the intrinsic viscosity is preferably 10 dl/g or less, and more preferably from 0.5 to 5 dl/g.

As the method of the polymerization for producing the non-crystalline or low crystalline olefin-based polymer (A) of the present invention, there can be employed a slurry polymerization method, a solution polymerization method, a

bulk polymerization method and a gas phase polymerization method, and the non-crystalline or low crystalline olefin-based polymer can be produced by polymerizing a predetermined monomer using a metallocene catalyst. The metallocene catalyst includes, for example, metallocene-based catalysts described in Japanese Unexamined Patent Publication (Kokai) Nos. 58-19309, 60-35005, 60-35006, 60-35007, 60-35008, 61-130314, 3-163088, 4-268307, 9-12790, 9-87313, 11-80233 and Published Japanese Translation No. 10-508055 of the PCT Application. The method of producing a non-crystalline or low crystalline olefin-based polymer using a metallocene catalyst is particularly preferably the method described in the specification of EP-A-1 211 287.

The crystalline propylene-based polymer (B) of the present invention is a polymer containing monomer units derived from propylene in which a crystal fusion peak having a heat of crystal fusion of 30 J/g or more and/or a crystallization peak having a heat of crystallization of 30 J/g or more are observed at a range of -50 to 200°C by differential scanning calorimetry according to JIS K 7122. From the viewpoint of reducing stickiness of the resulting resin composition, the crystalline propylene-based polymer (B) is preferably a polymer in which a crystal fusion peak having a heat of crystal fusion of 50 J/g or more, or a crystallization peak having a heat of crystallization of 50

J/g or more is observed at a range of -50 to 200°C. From the viewpoint of reducing stickiness of the resulting resin composition, the temperature at which a crystallization peak is observed is preferably within a range from 50 to 180°C, and more preferably from 70 to 160°C. When a plurality of crystallization peaks are observed within a range from -50 to 200°C, the temperature at which a crystal fusion peak having a maximum peak temperature among crystal fusion peaks is preferably from 50 to 180°C, and more preferably from 70 to 160°C, from the viewpoint of reducing stickiness of the resulting resin composition.

The crystalline propylene-based polymer (B) of the present invention is usually a polymer in which the content of the monomers unit derived from propylene is 50% by weight or more relative to the total weight of the crystalline propylene-based polymer (B) (100% by weight), and examples thereof include propylene homopolymer, ethylene-propylene random copolymer, ethylene-propylene block copolymer, and random or block copolymer of propylene and α -olefin having 4 to 20 carbon atoms. The α -olefin includes, for example, straight-chain α -olefins such as 1-butene, 1-pentene, 1-hexene, 1-heptene, 1-octene, 1-nonene, 1-decene, 1-undecene, 1-dodecene, 1-tridecene, 1-tetradecene, 1-pentadecene, 1-hexadecene, 1-heptadecene, 1-octadecene, 1-nanodecene, and 1-eicosene; and branched α -

olefins such as 3-methyl-1-butene, 3-methyl-1-pentene, 4-methyl-1-pentene, 2-ethyl-1-hexene, and 2,2,4-trimethyl-1-pentene. The crystalline propylene-based polymer (B) is preferably propylene homopolymer, ethylene-propylene random copolymer, ethylene-propylene block copolymer, propylene-1-butene random copolymer, or propylene-ethylene-1-butene random copolymer, and more preferably propylene homopolymer, ethylene-propylene random copolymer, or propylene-ethylene-1-butene random copolymer. These polymers may be used either alone or in combination.

The method of producing the crystalline propylene-based polymer (B) of the present invention includes known polymerization methods using known polymerization catalysts. Examples of known polymerization catalysts include a Ziegler-Natta catalyst and a complex-based catalyst using a metallocene or non-metallocene complex. Examples of known polymerization methods include a slurry polymerization method, a solution polymerization method, a bulk polymerization method and a gas phase polymerization method. As the crystalline propylene-based polymer (B), commercially available products may be used.

Examples of the insect pest control agent (C) in the present invention include compounds having insect pest control activity, such as insecticides, insect growth controlling agents and insect repellants.

Examples of insecticides include pyrethroid-based

compounds, organophosphorus-based compounds, carbamate-based compounds, and phenylpyrazole-based compounds.

Examples of the pyrethroid-based compounds include

permethrin, allethrin, d-allethrin, dd-allethrin, d-

5 tetramethrin, prallethrin, d-phenothrin, d-resmethrin, empenthrin, fenvalerate, esfenvalerate, fenpropathrin, cyhalothrin, etofenprox, tralomethrin, esbiothrin, benfulthrin, terallethrin, deltamethrin, phenothrin, tefluthrin, bifenthrin, cyfluthrin, cyphenothrin,

10 cypermethrin and α -cypermethrin. Examples of the organophosphorus-based compounds include phenitrothion, dichlorobos, dichlorvos, naled, fenthion, cyanophos, chloropyrifos, diazinon, calchlophos and salithion.

Examples of the carbamate-based compounds include

15 methoxydiazon, propoxur, carbaryl and fenobucarb.

Examples of the insect growth controlling agents

include pyriproxyfen, methoprene, hydroprene, diflubenzuron, cyromazine, phenoxy carb and lufenuron. These insect growth controlling agents may be used either alone or in

20 combination.

Examples of the insect repellants include

diethyltolamide and dibutyl phthalate.

A single agent or, alternatively, two or more agents in combination may be used as the insect pest control agent

25 (C) of the present invention. Also, a compound having the

effect of enhancing insect pest control activity may be used in combination with the insect pest control agent (c). Examples of the compound include piperonyl butoxide, MGK264 and octachlorodipropyl ether.

5 As the insect pest control agent (C) of the present invention, insecticides are preferable. Pyrethroid compounds are more preferable, and pyrethroid compounds having a vapor pressure of less than 1×10^{-6} mmHg at 25°C are further preferable. Examples of the pyrethroid
10 compounds having a vapor pressure of less than 1×10^{-6} mmHg at 25°C include pyriproxyfen, resmethrin and permethrin. A resin composition capable of retaining the insect pest control effect for a long period can be obtained by using an insecticide having a low vapor
15 pressure.

 The resin composition of the present invention comprises a non-crystalline or low crystalline olefin-based polymer (A) in which neither a crystal fusion peak having a heat of crystal fusion of 30 J/g or more, nor a
20 crystallization peak having a heat of crystallization of 30 J/g or more is observed at a range of -50 to 200°C by differential scanning calorimetry according to JIS K 7122, a crystalline propylene-based polymer (B) and an insect pest control agent (C), wherein the content of the
25 component (A) is from 1 to 99% by weight and the content of

the component (B) is from 99 to 1% by weight relative to the total amount of the component (A) and the component (B) (100% by weight), and the content of the component (C) is from 1.5 to 50 parts by weight where the total amount of the component (A) and the component (B) is let be 100 parts by weight. When the total amount of the component (A) and the component (B) is 100% by weight, it is preferable that the content of the component (A) and the content of the component (B) be from 1 to 70% by weight and from 99 to 30% by weight, respectively, and it is more preferable that the content of the component (A) and the content of the component (B) be from 1 to 50% by weight and from 99 to 50% by weight, respectively. If the content of the component (B) in the resin composition is less than 1% by weight, the resin composition obtained in the present invention may be inferior in handling. In contrast, if the content of the component (B) is more than 99% by weight, the insect pest control agent may not be retained at a high concentration.

If the total amount of the component (A) and the component (B) is 100 parts by weight, the content of the component (C) is preferably from 1.5 to 20 parts by weight, and more preferably from 1.5 to 10 parts by weight. If the content of the component (C) in the resin composition is less than 1.5 parts by weight, the effect of the insect pest control agent may be hardly obtained. In contrast, if

the content is more than 50 parts by weight, the amount exceeds solubility of the insect pest control agent in the component (A) and the component (B) and thus the resin composition obtained in the present invention may be inferior in handling.

The melt flow rate as measured at a testing temperature of 230°C under a testing load of 21.2 N of the resin composition obtained in the present invention is preferably 0.1 g/10 minutes or more and less than 100 g/10 minutes, and more preferably 0.5 g/10 minutes or more and 70 g/10 minutes or less. The resin composition having a melt flow rate within the above range is excellent in processability.

Unless the characteristics of the resin composition of the present invention are significantly impaired, the resin composition may be optionally used in combination with other resins such as modified polyolefin-based resin, rosin-based resin, polyterpene-based resin, synthetic petroleum resin, cumarone-based resin, phenol-based resin, xylene-based resin, styrene-based resin and isoprene-based resin.

The modified polyolefin-based resin includes, for example, polyolefin-based resins modified with modification compounds such as maleic anhydride, dimethyl maleate, diethyl maleate, acrylic acid, methacrylic acid,

tetrahydrophthalic acid, glycidyl methacrylate and hydroxyethyl methacrylate. The polyolefin-based resins to be used herein may be known polyolefins and examples thereof include ethylene-based resin, isotactic
5 polypropylene, syndiotactic polypropylene, random type polypropylene containing a comonomer, block type polypropylene produced by multi-step polymerization, poly(4-methyl-1-pentene), poly(1-butene) and non-crystalline α -olefin-based copolymer like that mentioned
10 previously.

Examples of the rosin-based resin include natural rosin, polymerized rosin, partially hydrogenated rosin, completely hydrogenated rosin, esters of these rosins (for example, glycerin ester, pentaerythritol ester, ethylene
15 glycol ester, methyl ester, etc.) and rosin derivatives (for example, disproportionated rosin, and fumaric acid-modified rosin).

Examples of the polyterpene-based resin include homopolymers of cyclic terpenes such as α -pinene, β -pinene,
20 dipentene; copolymers of cyclic terpenes; copolymers of cyclic terpenes and phenol-based compounds such as phenol and bisphenol (for example, terpene-phenol-based resin such as α -pinene-phenol resin, dipentene-phenol resin, terpene-bisphenol resin, etc.), and aromatic modified terpene
25 resins as copolymers of cyclic terpenes and aromatic

monomers.

Examples of the synthetic petroleum resin include homopolymer and copolymer of C₅ fraction and C₆-C₁₁ fraction of naphtha cracked oil, and other olefin-based fractions, and hydrogenated products of these homopolymers and copolymers, such as aliphatic petroleum resin, aromatic petroleum resin, alicyclic petroleum resin and aliphatic-alicyclic copolymer. The synthetic petroleum resin further includes copolymerized petroleum resin such as copolymers of naphtha cracked oil and terpene, and hydrogenated products of such copolymers.

Preferred C₅ fractions of naphtha cracked oil include, for example, methylbutenes such as isoprene, cyclopentadiene, 1,3-pentadiene, 2-methyl-1-butene and 2-methyl-2-butene; pentenes such as 1-pentene and 2-pentene; and dicyclopentadiene. Preferred C₆-C₁₁ fractions include, for example, methylstyrenes such as indene, styrene, o-vinyltoluene, m-vinyltoluene, p-vinyltoluene, α -methylstyrene and β -methylstyrene; methylindene, ethylindene, vinylxylene, and propenylbenzene. Preferred olefin-based fractions include, for example, butene, hexene, heptene, octene, butadiene, and octadiene.

The chroman-based resin includes, for example, homopolymer of chroman or copolymer of chroman and indene.

The phenol-based resin includes, for example,

alkylphenol resin, alkylphenol-acetylene resin obtained by condensation of alkylphenol and acetylene, and modified products of these resins. The phenol-based resin may be either a novolak type resin obtained by methylation of phenol using an acid catalyst, or a resole type resin obtained by methylation using an alkaline catalyst.

The xylene-based resin includes, for example, a xylene-formaldehyde resin produced from m-xylene and formaldehyde, and a modified resin obtained by adding a third component to such a xylene-formaldehyde resin and then causing the resulting mixture to react.

The styrene-based resin includes, for example, low molecular weight polymer of styrene, copolymer of α -methylstyrene and vinyltoluene, copolymer of styrene, acrylonitrile and indene, copolymer of styrene and butadiene, and copolymer of styrene and ethylenebutylene.

The isoprene-based resin includes, for example, a resin obtained by copolymerizing a C_{10} alicyclic compound, a dimer of isoprene, with a C_{10} chain compound.

Unless the characteristics of the present invention are significantly impaired, the composition of the present invention may contain one or more kinds of additives.

Examples of such additives include antioxidants, antiblocking agents, lubricants, antistatic agents,

weathering agents, pigments, processing improving agents

and metal soaps.

In the production of the resin composition of the present invention, the method of mixing a component (A) and a component (B) as resin components with a component (C) as an insect pest control agent is not particularly limited. When the insect pest control agent is thermally stable, the insect pest control agent can be mixed with the components (A) and (B) as resin components using a kneader such as roll-type kneader or Banbury type kneader, or a single or twin screw extruder. The resin composition can also be obtained by immersing the components (A) and (B) as resin components in the component (C) as the insect pest control agent.

Since the resin composition of the present invention can contain an insect pest control agent at a high concentration, various moldings obtained by using the resin composition can release the insect pest control agent for a long period.

The resin composition obtained by the present invention can be used after being molded into various moldings and can be preferably used in the form of fiber. As used herein, the fiber means a monofilament or multifilament.

The monofilament is a continuous yarn composed of a single yarn. Usually, the monofilament is produced by

taking up, after cooling and drawing, each of filaments melt-extruded through several tens to several hundreds of spinning nozzles of one die. Monofilaments are used as fishing lines, brushes, strings for tennis rackets and fishing nets.

The monofilament is not specifically limited in cross-sectional shape and it may have any cross-sectional shape such as circular, hollow, flat, square, half moon, triangle, pentagon or polygon shape. Furthermore, the monofilament may be a core-sheath or sea-island type composite monofilament. When the fiber of the present invention is the monofilament, the fineness thereof preferably is, and may be appropriately selected according to applications, from 50 to 1,000 deniers.

The multifilament is a single yarn obtained by twisting several to several tens of filaments and is used in the form of ropes, nets, pile materials of carpets, and raw yarns of nonwoven fabrics.

The method of producing a multifilament includes the following method. First, a number of molten filaments extruded through spinning nozzles are cooled by passing through a cooling zone. Cooling may be performed so that each of single yarn filaments will not be fused with each other and, after cooling, an oil solution is applied by an oiling roller. The undrawn yarn is taken up after being

wound up or further twisted (or drafted) in a drawing step.

When the fiber of the present invention is a multifilament, the fineness of its each single yarn is from 1 to 100 deniers and is preferably from 50 to 500 deniers and may be appropriately selected according to intended applications.

The temperature at which the resin composition is melt-extruded in fiber production is preferably as high as possible so far as it holds that the resin composition does not degrade, that the resin composition can be formed into a fiber, and that the insect pest control agent as the component (C) in the resin composition does not decompose. The temperature is usually from 200 to 300°C, and is preferably from 220 to 280°C. The nozzles to be used are preferably arranged so that a number of molten filaments extruded can be uniformly cooled.

The fiber obtained from the resin composition of the present invention can be employed in the form of textiles having an insect-repellent function, such as clothings, household appliances, miscellaneous goods, outdoor goods, goods for agriculture, forestry and fisheries, and sanitary goods.

Examples of household appliances and miscellaneous goods include mosquito nets, insect-repellent nets, bedding covers, bedding bags, curtains, cushions, sofa covers,

kitchen mats, bath mats, washstand mats, toilet mats,
toilet sheet covers, clothing covers and carpets.

Examples of goods for agriculture, forestry and
fisheries include insect-repellent nets, insect pest
5 control sheets and fishing nets; examples of outdoor goods
include tents, hammocks, ropes and sleeping bags; and
examples of sanitary goods include masks, adhesive plasters
and bandages.

When used as a mosquito net, the insecticidal effect
10 is exerted by bringing mosquito mediating infectious
diseases such as malaria into contact with the insecticide
on the surface of the fiber. Such an insecticidal method
is an environmentally friendly control method.

The resin composition obtained by the present
15 invention is molded by a publicly known molding method such
as extrusion forming, injection molding, blown film
extrusion or mold stamping molding, and also can be used in
wide applications, for example, miscellaneous goods such as
sheets, films, transfusion bottles, pipes, hoses, electric
20 wire coatings, toys and writing materials; automotive
materials; and household appliance materials.

Examples

The present invention will be described in more
25 detail by Examples.

Physical properties were evaluated by the following methods.

(1) Melt Flow Rate (unit: g/10 minutes)

In accordance with JIS K 7210, a melt flow rate was measured at a testing temperature of 230°C under a testing load of 21.18 N.

(2) Content (unit: mol%) of Monomer Unit Derived from Each Monomer Contained in Non-Crystalline α -Olefin-Based Copolymer

The content of each monomer unit in a propylene-1-butene polymer was calculated from the measuring results of ^{13}C -NMR spectrum using a nuclear magnetic resonance apparatus (available from Bruker Co. under the trade name of AC-250). Specifically, a composition ratio of monomer units derived from propylene to monomer units derived from 1-butene was calculated from the ratio of the spectral intensity of a signal due to the methyl carbons of the monomer units derived from propylene and the spectral intensity of a signal due to the methyl carbons derived from the monomer units derived from 1-butene.

(3) Crystal Fusion Peak

In accordance with JIS K 7121, the measurement was performed by the use of a differential scanning calorimeter (DSC220C available from Seiko Electronic Co., Ltd.: input compensation DSC). Specifically, a sample polymer was

heated from room temperature to 200°C at a rate of 30°C/minutes and maintained at 200°C for 5 minutes. After being cooled to -100°C at a rate of 10°C/ minutes, the sample was maintained at -100°C for 5 minutes. Then, the sample was heated from -100°C to 200°C at a rate of 10°C/minutes, whereby a crystal fusion peak was measured.

(4) Molecular Weight Distribution (Mw/Mn)

The molecular weight distribution was measured by gel permeation chromatography (GPC). Using a 150C/GPC available from Waters Co. as a measuring device, o-dichlorobenzene as a measuring solvent, Sdex Packed Column A-80M (2 columns) available from Showa Denko K.K. as a column and standard polystyrenes (available from TOSOH Corporation, molecular weight: 68 to 8,400,000) as molecular weight standard substances, 400 µl of a solution prepared by dissolving about 5 mg of a sample polymer in 5 ml of o-dichlorobenzene was poured under the conditions of an eluting temperature of 140°C and an eluting solvent flow rate of 1.0 ml/minutes. A polystyrene equivalent weight average molecular weight (Mw) and a polystyrene equivalent number average molecular weight (Mn) were measured by a differential refraction detector, and then the molecular weight distribution (Mw/Mn) as a ratio of both molecular weights was determined.

(5) Intrinsic Viscosity ([η], unit: dl/g)

Using an Ubbelohde's viscometer, the intrinsic viscosity was measured in a tetralin solvent at 135°C. A tetralin solution having a concentration of a non-crystalline α -olefin-based copolymer (c) of 0.6, 1.0 or 1.5 mg/ml was prepared and the time required for the liquid level of the solution to pass between two marked lines was measured three times. At each concentration was repeated the measurement three times. An average of the three measurements was taken as a specific viscosity (η_{sp}) at each concentration and a value obtained by zero extrapolation of c of η_{sp}/c was determined as an intrinsic viscosity ($[\eta]$).

(6) Amount of Insect pest Control Agent contained in Resin Composition

A component (A) and a component (B) are kneaded to form a press sheet of 0.5 mm in thickness. After sampling of about 0.5 g of the press sheet, the accurate weight thereof, which is expressed as W_1 , is measured. Fifty milliliter of permethrin as a component (C) is added into a sample bottle, and about 0.5 g of the sampled press sheet is immersed. Every day, the press sheet immersed in the insecticide is taken out, washed with alcohol, accurately weighed, and then re-immersed into the insecticide. At the time when no weight change occurs, it is confirmed that the component (C) in the resin composition has reached a

saturation concentration, and the weight (W_2) is recorded. Using the following formula (2), the content (S) of the component (C) in the resin composition is determined. The larger this value, the more the content of the component (C). Namely, the component is retained at a higher concentration.

$$S = (W_2 - W_1) / W_1 \times 100 \quad (2)$$

Example 1

[Production of Non-Crystalline or Low Crystalline Olefin-Based Polymer as Component (A)]

In a 100 L SUS reactor equipped with a stirrer, propylene and 1-butene were continuously polymerized by the following method using hydrogen as a molecular weight regulator to obtain a propylene-1-butene copolymer corresponding to a non-crystalline α -olefin-based copolymer.

From the lower portion of the reactor, hexane as a polymerization solvent was continuously fed at a feed rate of 100 L/hour, propylene was continuously fed at a feed rate of 24.00 kg/hour, and 1-butene was continuously fed at a feed rate of 1.81 kg/hour, respectively.

Similarly, dimethylsilylene (tetramethylcyclopentadienyl) (3-tert-butyl-5-methyl-2-phenoxy)titanium dichloride as a polymerization catalyst was continuously fed at a feed rate of 0.005 g/hour, triphenylmethyltetrakis(pentafluorophenyl) borate was

continuously fed at a feed rate of 0.298 g/hour and triisobutyl aluminum was continuously fed at a feed rate of 2.315 g/hour.

5 The reaction solution was continuously extracted from the upper portion of the reactor so that the volume of the reaction solution in the reactor could be always maintained at 100 L.

The polymerization reaction was performed at 45°C by circulating cooling water through a jacket attached to the outside of the reactor.

A small amount of ethanol was added to the reaction solution extracted continuously from the upper portion of the reactor to terminate the polymerization reaction, and then the unreacted monomer was removed. The reaction solution was washed with water so as to remove the residual polymerization catalyst contained in the reaction solution, and the polymerization solvent was finally removed by steam in a large amount of water to obtain a propylene-1-butene copolymer (hereinafter referred to as a polymer (A1)), which was dried under reduced pressure at 80°C for 24 hours. The content of the monomer units derived from propylene of the polymer (A1) was 94.5 mol%, the content of the monomer units derived from 1-butene was 5.5 mol%, and the content of the monomer units derived from ethylene was 0.0 mol%. The $[\eta]$ of the polymer (A1) was 2.3 dl/g, the molecular

weight distribution (Mw/Mn) was 2.2 (Mw = 420,000, Mn = 191,000), and neither a crystal fusion peak nor a crystallization peak was observed.

[Production of Mixture of Component (A) and Component (B)]

5 Thirty percent by weight of the polymer (A1) as the component (A) and 70% by weight of an ethylene-propylene random copolymer (available from Sumitomo Chemical Co., Ltd. NOBLEN S131) as the component (B) were compounded and then kneaded at temperature of 220°C and a screw speed of 100
10 rpm for 5 minutes using a twin screw batch type kneader "Brabender Plasticoder" (available from Brabender Co.). The resulting melt was subjected to hot press molding at 230°C to obtain a 0.5 mm thick specimen and then sampling (weight of about 0.5 g) was performed.

15 [Preparation of Resin Composition]

As described in (6), the resulting press molding of the component (A) and the component (B) was immersed in permethrin (available from Sumitomo Chemical Co., Ltd. under the trade name of EXMIN, vapor pressure at 25°C: 5.5×10^{-7} mmHg) as the component (C). After a lapse of time,
20 the content (S) of the component (C) in the resin composition was determined using the equation (2). The resulting value is shown in Table 1.

Example 2

25 The same operation as in Example 1 was performed,

except that 50% by weight of the polymer (A1) as the component (A) and 50% by weight of an ethylene-propylene random copolymer (available from Sumitomo Chemical Co., Ltd., NOBLEN S131) as the component (B) were compounded.

5 The resulting physical properties are shown in Table 1.

Example 3

The same operation as in Example 1 was performed, except that 70% by weight of the polymer (A1) as the component (A) and 30% by weight of an ethylene-propylene random copolymer (available from Sumitomo Chemical Co., Ltd., NOBLEN S131) as the component (B) were compounded. The resulting physical properties are shown in Table 1.

Comparative Example 1

The same operation as in Example 1 was performed, except that only 100% by weight of a propylene-based resin (available from Sumitomo Chemical Co., Ltd., NOBLEN FS2011DG3) was used as the component (B). The resulting physical properties are shown in Table 1.

Table 1

		Ex. 1	Ex. 2	Ex. 3	C.Ex.1
Content of component (A) Polymer (A1)		30	50	70	0
Content of component (B)	Ethylene-propylene random copolymer	70	50	30	
	Propylene-based resin				100
Melt flow rate of resin composition (g/10 minutes)		1.9	1.3	1.0	2.5
Content of permethrin as component (C)		5.7	8.4	11	1.1

Component (B)

An ethylene-propylene random copolymer (available from Sumitomo Chemical Co., Ltd., NOBLEN S131): a crystal fusion peak having a heat of fusion of 60 J/G was observed at 130°C.

5 A propylene-based resin (available from Sumitomo Chemical Co., Ltd., NOBLEN FS2011DG3): a crystal fusion peak having a heat of fusion of 110 J/G was observed at 158°C.

10 The resin compositions satisfying the constituent elements of the present invention of Examples 1 to 3 can retain a high concentration of the insecticide without containing a filler.

Example 4

15 Using the resin composition of the present invention, a multifilament was produced and bleeding properties of the insect pest control agent was evaluated.

[Production of Resin Pellets]

20 Using a twin screw extruder (diameter 43 mm, L/D = 30), insect pest control agent-containing resin pellets were obtained.

25 A mixture obtained by mixing 7% by weight of the polymer (A1), 91% by weight of a propylene-based resin (MFR 13 g/10 min.) and 2% by weight of permethrin was introduced through a hopper of an extruder, and then strands were extruded through five die openings each having a diameter

of 4 mm under the conditions of a melt-kneading zone temperature of 200°C, a die temperature of 200°C and a discharge amount of 20 kg/hour, cooled in a cooling water bath and then cut into pellets using a pelletizer.

5 [Production of Multifilament]

The above pellets were placed in a single screw extruder, melted at 220°C, and then 24 yarns were extruded through 24 circular die openings each having a diameter of 0.5 mm arranged concentrically and taken up at a rate of 10 300 m/min while oiling to obtain raw yarns having a fineness of 270 deniers (single yarn: 11.2 deniers). Each raw yarn paid out at a rate of 40 m/min was twisted by drawing at a draw ratio of 3 times at a rate of 120 m/min while being heated on a hot plate at 110°C to obtain a 15 drawn yarn having a fineness of 90 deniers (single yarn: 3.7 deniers). Thus, a multifilament containing 2% by weight of an insect pest control agent was obtained. The resulting multifilament was not sticky as a result of oozing of the insect pest control agent and was a yarn 20 suited for a fabric.

[Evaluation of Bleeding Properties of Insect pest Control Agent]

A bundle of yarns obtained by cutting the resulting multifilament into yarns each having a length of 50 m (0.5 25 g) was placed in a glass container and 10 cc of ethanol was

added, followed by shaking for one minute to previously wash the surface of yarns. The step of warming in an oven at 40°C for one day and washing the surface of yarns by shaking with 10 cc of ethanol for one minute was repeated
5 for 2 days. The absorbance at 272 nm of an ethanol wash collected 1 day and 2 days after the step was measured and the concentration of permethrin was measured using a calibration curve. As a result, the content of permethrin bled on the surface of yarns after 1 day was 4,300 µg/g and
10 the content of permethrin bled on the surface of yarns after 1 day was 4,000 µg/g, and bleed recovery after washing was satisfactory.

CLAIMS

1. A resin composition comprising a component (A), a component (B) and a component (C), wherein the content of the component (A) is from 1 to 99% by weight, the content of the component (B) is from 99 to 1% by weight, provided that the total amount of the component (A) and the component (B) is let be 100% by weight, and the content of the component (C) is from 1.5 to 50 parts by weight, provided that the total amount of the component (A) and the component (B) is let be 100 parts by weight, and the components (A), (B) and (C) are as follows:
component (A): non-crystalline or low crystalline olefin-based polymer as a polymer having a monomer unit derived from olefin with which neither a crystal fusion peak having a heat of crystal fusion of 30 J/g or more, nor a crystallization peak having a heat of crystallization of 30 J/g or more are observed at a range of -50 to 200°C by differential scanning calorimetry according to JIS K 7122, compound (B): a crystalline propylene-based polymer, and component (C): an insect pest control agent.

2. The resin composition according to claim 1, wherein the component (A) is a polymer satisfying the following relation (1):

$$0 \leq [x/(x + y)] < 0.6 \quad (1)$$

in the above formula (1), x represents the content (mol%) of a monomer unit derived from ethylene of the component (A), and y represents the content (mol%) of the monomer unit derived from α -olefin having 4 to 20 carbon atoms of the component (A), and the content of the entire component (A) is 100 mol%.

3. The resin composition according to claim 1 or 2,
10 wherein the component (A) is a non-crystalline olefin-based polymer in which neither a crystal fusion peak having a heat of crystal fusion of 1 J/g or more, nor a crystallization peak having a heat of crystallization of 1 J/g or more are observed at a range of -50 to 200°C by
15 differential scanning calorimetry according to JIS K 7122.

4. A fiber comprising the resin composition according to any one of claims 1 to 3.

20 5. A textile comprising the fiber according to claim 4.

6. The textile according to claim 5, which is a mosquito net.