An insect pest controlling resin composition comprising a thermoplastic resin, a pyrethroid compound, piperonyl butoxide, and a phosphorus-based antioxidant. This is used as a raw material of an insect pest controlling net.
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DESCRIPTION

Title of the Invention

INSECT PEST CONTROLLING RESIN COMPOSITION

Technical Field

The present invention relates to a resin composition, a resin molded body and a net for controlling insect pests.

Background Art

An insect repellent fiber containing an antioxidant is described in patent document 1. Phosphites as an antioxidant are described in patent document 2. Nets containing an insect pest controlling component are described in patent documents 3 and 4. Further, an insect repellent fiber containing a pyrethroid compound and a synergist such as piperonyl butoxide and the like is described in patent document 5.

As prior technical literatures, following documents are listed.

Disclosure of Invention

(Problem to be solved by the Invention)

The present invention has an object of providing a resin composition and the like for controlling insect pests having a stronger effect.

(Means for solving the Problem)

A first aspect of the present invention is an insect pest controlling resin composition comprising a thermoplastic resin, a pyrethroid compound, piperonyl butoxide and a phosphorus-based antioxidant.

A second aspect of the present invention is an insect pest controlling resin molded body formed by melt-molding of the above-described insect pest controlling resin composition of the first aspect.

A third aspect of the present invention is an insect pest controlling net obtained by knitting or weaving the above-described insect pest controlling resin molded body of the second aspect in the form of thread so as to form a lot of meshes.

In the present invention, the pyrethroid compound is preferably permethrin. The phosphorus-based antioxidant is preferably a compound represented by the general formula (I), and particularly, a compound represented by the general formula (II), that is,

6- [3- (3-t-butyl-4-hydroxy-5-methyl) propoxy]- 2,4,8,10-tetra-
t-butyldibenz \([d, f]\) [1,3,2]-dioxaphosphepin is preferable.

(Effect of the Invention)

According to the above-described insect pest controlling resin composition of the first aspect, a stronger insect pest controlling effect can be manifested in comparison with conventional compositions.

According to the above-described insect pest controlling resin molded body of the second aspect, handling properties such as storage, transportation and the like of the above-described insect pest controlling resin
composition of the first aspect can be improved.

According to the above-described insect pest controlling net of the third aspect, an insect pest can be controlled more effectively.

Brief Description of Drawings

Fig. 1 is a partial view of an insect pest controlling net of the present invention having a knitted structure.

Fig. 2 is a partial view of an insect pest controlling net of the present invention having a woven structure.

Best Mode for Carrying Out the Invention

The insect pest controlling resin composition of the present invention comprises a thermoplastic resin, a pyrethroid compound, piperonyl butoxide and a phosphorus-based antioxidant. The insect pest controlling resin composition of the present invention can be obtained by mixing these components, or melt-kneading these components, or molding these components, or other methods.

Regarding the blending amounts of components in the insect pest controlling resin composition of the present invention, it is preferable to contain 30 to 99.9799 parts by weight of a thermoplastic resin, 0.01 to 50 parts by weight of a pyrethroid compound, 0.01 to 50 parts by weight of piperonyl butoxide, and 0.0001 to 20 parts by weight of
a phosphorus-based antioxidant, and it is more preferable to contain 50 to 99.799 parts by weight of a thermoplastic resin, 0.1 to 25 parts by weight of a pyrethroid compound, 0.1 to 25 parts by weight of piperonyl butoxide, and 0.001 to 10 parts by weight of a phosphorus-based antioxidant.

[Thermoplastic resin]

The thermoplastic resin is used as a carrier for supporting a pyrethroid compound, piperonyl butoxide, and a phosphorus-based antioxidant. Polyolefin resins, polyvinyl alcohol, polyvinyl acetate, polycarbonates, polyesters, polyamides, polystyrene, polymethyl methacrylate, acrylonitrile-butadiene-styrene copolymer, polyvinyl chloride and the like can be used as the thermoplastic resin.

As the thermoplastic resin, polyolefin resins are preferable. As the polyolefin resin, the following compounds are preferable.

(i) a-olefin homopolymers: for example, polyethylene, polypropylene and the like.

(ii) ethylene-a-olef in copolymers: for example, an ethylene-propylene copolymer, an ethylene-butene-1 copolymer, an ethylene-4-methyl-1-pentene copolymer, an ethylene-hexene copolymer and the like.

(iii) copolymers of ethylene with an organic carboxylic acid derivative having an ethylenic unsaturated bond: for
example, an ethylene-methyl methacrylate copolymer, an ethylene-vinyl acetate copolymer, an ethylene-acrylic acid copolymer, an ethylene-vinyl acetate-methyl methacrylate copolymer and the like.

[Pyrethroid compound]

Examples of the pyrethroid compound include permethrin, cyphenothrin, d-phenothrin, resmethrin, fenvalerate, esfenvalerate, fenpropathrin, ethofenprox, tralomethrin, deltamethrin, cypermethrin, silafluofen, bifenthrin and the like.

These pyrethroid compounds can be used singly or in combination of two or more. The above-described compounds include those having optical isomers, steric isomers, geometric isomers and the like, and the pyrethroid compound of the present invention includes isomers and mixtures thereof.

[Piperonyl butoxide]

Piperonyl butoxide is a synergist, and its chemical name is as described below.

5-[[2-(2-butoxyethoxy)ethoxy]methyl]-6-propyl-1,3-benzodioxole

[Phosphorus-based antioxidant]

As the phosphorus-based antioxidant, compounds represented by the general formula (I) are preferably used.
In the general formula (I), substituents $R^1$, $R^2$, $R^4$, and $R^5$ represent each independently a hydrogen atom, an alkyl group having 1 to 8 carbon atoms, a cycloalkyl group having 5 to 8 carbon atoms, an alkylcycloalkyl group having 6 to 12 carbon atoms, an aralkyl group having 7 to 12 carbon atoms, or a phenyl group.

Particularly, $R^1$, $R^2$, and $R^4$ represent preferably an alkyl group having 1 to 8 carbon atoms, a cycloalkyl group having 5 to 8 carbon atoms, or an alkylcycloalkyl group having 6 to 12 carbon atoms, $R^5$ represents preferably a hydrogen atom, an alkyl group having 1 to 8 carbon atoms, or a cycloalkyl group having 5 to 8 carbon atoms. Here, typical examples of the alkyl group having 1 to 8 carbon atoms include methyl, ethyl, $n$-propyl, $i$-propyl, $n$-butyl, $i$-butyl, sec-butyl, $t$-butyl, $t$-pentyl, $i$-octyl, $t$-octyl, 2-ethylhexyl and the like. Typical examples of the cycloalkyl group having 5 to 8 carbon atoms include cyclopentyl, cyclohexyl, cycloheptyl, cyclooctyl and the
like. Typical examples of the alkylcycloalkyl group having 6 to 12 carbon atoms include 1-methylcyclopentyl, 1-methylcyclohexyl, 1-methyl-4-i-propylcyclohexyl and the like. Further, typical examples of the aralkyl group having 7 to 12 carbon atoms include benzyl, a-methylbenzyl, a,a-dimethylbenzyl and the like. 

Especially, \( R^1 \) and \( R^4 \) represent preferably a t-alkyl group such as t-butyl, t-pentyl, t-octyl and the like; cyclohexyl, 1-methylcyclohexyl or the like. \( R^2 \) represents preferably an alkyl group having 1 to 5 carbon atoms such as methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, sec-butyl, t-butyl, t-pentyl and the like, particularly preferably methyl, t-butyl or t-pentyl. \( R^5 \) represents preferably a hydrogen atom, or an alkyl group having 1 to 5 carbon atoms such as methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, sec-butyl, t-butyl, t-pentyl and the like.

The substituent \( R^3 \) represents a hydrogen atom or an alkyl group having 1 to 8 carbon atoms. Examples of the alkyl group having 1 to 8 carbon atoms include the same alkyl groups as described above. \( R^3 \) represents preferably a hydrogen atom or an alkyl group having 1 to 5 carbon atoms, particularly preferably a hydrogen atom or a methyl group.

The substituent \( X \) represents a simple bond, a sulfur atom, or a \(-\text{CHR}^6-\) group (\( R^6 \) represents a hydrogen atom, an
alkyl group having 1 to 8 carbon atoms, or a cycloalkyl group having 5 to 8 carbon atoms). The alkyl group or the cycloalkyl group represented by $R^6$ includes the same alkyl groups or cycloalkyl groups as described above, respectively. $X$ represents preferably a simple bond; a methylene group; or a methylene group substituted by methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, t-butyl or the like.

The substituent $A$ represents an alkylene group having 2 to 8 carbon atoms or a $-COR^7 -$ group ($R^7$ represents a simple bond or an alkylene group having 1 to 8 carbon atoms, and * means bonding to the oxygen side). Typical examples of the alkylene group represented by $R^7$ include ethylene, propylene, butylene, pentamethylene, hexamethylene, octamethylene, 2,2-dimethyl-1,3-propylene and the like, preferably, propylene. * means that a carbonyl is linked to oxygen of a phosphite.

Either the substituent $Y$ or $Z$ represents a hydroxyl group, an alkoxy group having 1 to 8 carbon atoms, or an aralkyloxy group having 7 to 12 carbon atoms, and another one represents a hydrogen atom or an alkyl group having 1 to 8 carbon atoms. Examples of the alkyl group having 1 to 8 carbon atoms include the same alkyl groups as described above. Examples of the alkoxy group having 1 to 8 carbon atoms include alkoxy groups in which the alkyl portion is
the same alkyl having 1 to 8 carbon atoms as described above. Examples of the aralkyloxy group having 7 to 12
carbon atoms include aralkyloxy groups in which the aralkyl portion is the same aralkyl having 7 to 12 carbon atoms as

described above.

As the phosphorus-based antioxidant, specifically, one or more compounds optionally selected from the following compound group can be used.

- phenyl diisodecyl phosphite,
- diphenyl isoctyl phosphite,
- diphenyl isodecyl phosphite,
- triphenyl phosphite,
- trisnonyl phenyl phosphite,
- tris-(nonyl phenyl) phosphite or tris-(dinonyl phenyl) phosphite or a mixture of them,
- distearyl-pentaerythritol diphosphite
- bis (nonyl phenyl)pentaerythritol diphosphite
- 4,4'-isopropylidenediphenol C12-C15 alkyl phosphite
- 4,4'-butylidenebis (3-methyl-6-t-butylphenyl-di-
tridecyl phosphite)
- 1,1,3-tris (2-methyl-4-di-tridecyl phosphite
5-t-butylphenyl )butane
- 3,4,5,6-dibenzo-1,2-oxaphosphane-2-oxide
- trilauryl trithiophosphite
- trisisodecyl phosphite
tris (tridecyl) phosphite
phenyl di (tridecyl) phosphite
diphenyl tridecyl phosphite
phenyl-bisphenol A pentaerythritol diphosphite
3,5-di-t-butyl-4-hydroxybenzylphosphonic acid diethyl ester
2- [3- (3-t-butyl-4-hydroxy-5-methylphenyl ) propionyloxy] ethyl 2,2'- (3,3',5,5'-tetra-t-butylbiphenyl ) phosphite
2- [3- (3, 5-di-t-butyl-4 -hydroxyphenyl ) propionyloxy] ethyl 2,2'- (3,3',5,5'-tetra-t-butylbiphenyl ) phosphite
2- [3- (3, 5-di-t-butyl-4 -hydroxyphenyl ) propionyloxy] ethyl 2,2'- (3,3',5,5'-tetra-t-butylbiphenyl ) phosphite
3- (3, 5-di-t-butyl-4-hydroxyphenyl ) propyl 2,2'- (3,3',5,5'-tetra-t-butylbiphenyl ) phosphite
3- (3,5-di-t-butyl-4-hydroxyphenyl ) propyl 2,2'-methylenebis (6-t-butyl-4-methylphenyl ) phosphite
3- (3-t-butyl-4-hydroxy-5-methylphenyl ) propyl 2,2'-methylenebis (6-t-butyl-4-methylphenyl ) phosphite
tris-(2,4-di-t-butylphenyl) phosphite
*bis (2,4-di-t-butylphenyl) pentaerythritol diphosphite
*bis (2,6-di-t-butyl-4-methylphenyl) pentaerythritol diphosphite
*bis (2,4-di-cumylphenyl) pentaerythritol diphosphite
*tetrakis (2,4-di-t-butylphenyl) -4,4'-biphenylene diphosphonite
*3- (3-t-butyl-4-hydroxy-5-methylphenyl) propyl 2,2'-(3,3',5,5'-tetra-t-butylbiphenyl) phosphite
*bis-[2,4-di-t-butyl (6-methyl)phenyl]ethyl phosphite

As the phosphorus-based antioxidant, particularly, a compound represented by the general formula (II), that is, 6-[3-(3-t-butyl-4-hydroxy-5-methyl propoxy]-2,4,8,10-tetra-t-butyl dibenz [d,f][1,3,2]-dioxaphosphepin is preferably used. This compound is commercially marketed under the trade name of "Sumilizer GP" (manufactured by Sumitomo Chemical Co., Ltd.). "Sumilizer" is a registered trademark of Sumitomo Chemical Co., Ltd.

The insect pest controlling resin composition of the
The present invention may contain blending ingredients such as insecticides such as carbamate compounds, organophosphorus compounds and the like; antifungal agents, antibacterial agents, pigments, aromatic substances, deodorant agents, spreading agents, ultraviolet absorbers, light stabilizers, lubricants, anti-blocking agents, anti-static agents, surfactants, fillers, flame retardants, plasticizers, anti-rust agents and the like, in a range not deteriorating the effect of the present invention.

The insect pest controlling resin composition of the present invention is capable of manifesting a stronger insect pest controlling effect in comparison with conventional compositions.

[Production method]

The insect pest controlling resin composition of the present invention can be produced, for example, as described in the following method (i), (ii) or (iii)

(i) A thermoplastic resin, three constituent components (pyrethroid compound, piperonyl butoxide and phosphorus-based antioxidant), and optional blending ingredients are mixed with stirring, and the resultant mixture is melt-kneaded.

(ii) A thermoplastic resin, at least one constituent component selected from three constituent components (pyrethroid compound, piperonyl butoxide, and phosphorus-
based antioxidant), and optional blending ingredients are mixed with stirring, and the resultant mixture is melt-kneaded to obtain a resin molded body. Then, constituent components not selected are coated on the surface of the resin molded body.

(iii) A thermoplastic resin and optional blending ingredients are mixed with stirring, and the resultant mixture is melt-kneaded to obtain a resin molded body. Then, three constituent components (pyrethroid compound, piperonyl butoxide, and phosphorus-based antioxidant) are coated on the surface of the resin molded body.

The resin composition of the present invention can also be produced by supporting one or more components selected from a pyrethroid compound, piperonyl butoxide, and a phosphorus-based antioxidant on a carrier, then, melt-kneading the components with a thermoplastic resin. Examples of the carrier include silica type compounds, zeolites, clay minerals, metal oxides, micas, hydrotalcites, organic carriers and the like. The silica type compound includes amorphous silicas and crystalline silicas, and examples thereof include powder silicic acid, fine powdery silicic acid, acid earth, diatomaceous earth, quartz, white carbon and the like. Examples of the zeolites include type A zeolite, mordenite and the like; examples of the clay mineral include montmorillonite, saponite, beidelite,
bentonite, kaolinite, halloysite, nacrite, dickite, anorthite, illite, sericite and the like; examples of the metal oxides include zinc oxide, magnesium oxide, aluminum oxide, iron oxide, copper oxide, titanium oxide and the like; examples of the micas include mica, vermiculite and the like; examples of the hydrotalcites include hydrotalcite, smectite and the like; examples of the organic carrier include charcoals (wood charcoal, peat, grass peat and the like), polymer beads (fine crystalline cellulose, polystyrene beads, acrylate beads, methacrylate beads, polyvinyl alcohol beads and the like), and polymer beads obtained by cross-linking them, and the like. Additionally, pearlite, gypsum, ceramic, volcanic rock and the like are listed. As the carrier, amorphous inorganic carriers are preferable, and amorphous silica is further preferable.

The insect pest controlling resin molded body of the present invention can also be formed, for example, by melt-molding the insect pest controlling resin composition of the present invention. As the production method, methods usually used in molding processing of resins can be used, and examples thereof include extrusion molding, injection molding, blow molding, compression molding, powder molding, press molding and the like. A part of raw materials can be coated on the molded body by, for example, an immersion
method, spray method and the like.

The insect pest controlling resin molded body may also be produced by producing a master batch by using the insect pest controlling resin composition of the present invention, and performing the above-described method by using this master batch and a thermoplastic resin.

Pellets having a core-sheath structure may also be produced by using the insect pest controlling resin composition of the present invention. Specifically, there are pellets in which the core layer is composed of the insect pest controlling resin composition of the present invention and the sheath layer is composed of any thermoplastic resin. Such pellets are suitable as a master batch.

Examples of the insect pest controlling resin molded body of the present invention include films, sheets, wall papers, curtains, floor materials, packaging materials, hoses, tapes, tubes, pipes, bags, tents, turfs, store curtains, blinds, electric wires, cables, sheaths, threads, synthetic fiber threads, ropes, filters, guts, toothbrush bristles, shoes, bags, clothes, electronic devices, electric devices, household electrical appliances, sports goods, office equipments, vehicle equipments, transport machines, distribution materials such as containers, cases and the like; those used in housing supplies and housing
parts; pet supplies such as dog houses, mats, sheets, collars, tags and the like; etc., and these are used as insect repellent articles for human; pets such as dog, cat, bird and the like; domestic animals such as cow, pig, sheep, bird and the like; etc. Films and sheets can be further processed into a molded body having a desired shape by vacuum molding and the like.

The insect pest controlling net of the present invention is formed by knitting or weaving a thread obtained by spinning the insect pest controlling resin composition of the present invention so as to form a lot of meshes. The insect pest controlling net of the present invention has a knitted structure when formed by knitting, and has a woven structure when formed by weaving. Fig. 1 shows one example of a net having a knitted structure formed by knitting threads 1 so as to form a lot of meshes 3, and Fig. 2 shows one example of a net having a woven structure formed by weaving threads 1 so as to form a lot of meshes 3. It is preferable that the insect pest controlling net of the present invention has a knitted structure.

The size of the mesh 3 is appropriately set depending on the length of an insect pest to be controlled, and it is preferable that the mesh has a size with which when the insect pest tries to pass through a net, the insect pest
gets into touch with the net. In general, the size of the mesh 3 (hole size) is in the range of 2 to 5 mm, preferably 2 to 4 mm.

It is preferable that the thread 1 is a monofilament having given breadth. By this, a knitting work or a weaving work becomes easy. In this case, "given breadth" means a breadth with which the strength as an insect pest controlling net can be maintained. In general, when the thread 1 is a monofilament, it is preferable to use a monofilament having a denier in the range of 100 to 350.

In the insect pest controlling net of the present invention, when a coming insect pest tries to pass through the mesh 3, it gets into touch with the thread 1. Thus, the insect pest is controlled without fail.

According to the insect pest controlling net of the present invention, various noxious insects can be controlled. Particularly, flying insect pests as described below can be controlled. For example: Culex such as Culex pipiens, Culex tritaeniorhynchus and the like; Aedes such as Aedes aegypti, Aedes (Stegomyia) albopictus and the like; Anopheles such as Anopheles sinensis and the like; Chironomidae; Muscidae such as Musca domestica, Muscina stabulans, Fannia canicularis Linnaeus and the like; Calliphoridae; Sarcophagidae; Drosophilidae; Albipunctatus; Phoridae; Tabanidae; Simuliidae; Stomoxys; Ceratopogonidae.
EXAMPLES

Examples of the insect pest controlling net of the present invention will be explained below. The present invention is not limited to these examples.

[Example 1]

10.0 parts by weight of amorphous silica, 10.0 parts by weight of permethrin, 7.0 parts by weight of zinc stearate, 1.0 part by weight of "Sumilizer GP", and 0.4 parts by weight of BHT were mixed with stirring by a Super Mixer, to obtain a powder A. To polyethylene melted at 150°C in a single screw extruder, the powder A was added so that its amount was 28.4 parts by weight with respect to 62 parts by weight of the polyethylene and the mixture was kneaded, and further, piperonyl butoxide was added by using a fluid infusion pump so that its amount was 5.0 parts by weight and the mixture was kneaded, and the kneaded melt was extruded through a dice into a strand which was cooled with water, and cut by a pelletizer, to obtain master batch pellets in the form of a circular cylinder.

Next, 20.0 parts by weight of the resultant master batch pellets and 80.0 parts by weight of polyethylene were mixed with stirring. Then, from the resultant mixture, monofilaments were spun at a processing temperature of 240°C. The resultant resin threads were knitted so as to
form a lot of meshes, producing a net A. Thus, an insect pest controlling net of the present invention was obtained. The size of the mesh was set so that the number of holes per 6.45 cm² was 100.

[Example 2]

10.0 parts by weight of amorphous silica, 10.0 parts by weight of permethrin, 7.0 parts by weight of zinc stearate, 5.5 parts by weight of "Sumilizer GP", and 0.4 parts by weight of BHT were mixed with stirring by a Super Mixer, to obtain a powder B. To polyethylene melted at 150°C in a single screw extruder, the powder B was added so that its amount was 32.9 parts by weight with respect to 62 parts by weight of the polyethylene and the mixture was kneaded, and further, piperonyl butoxide was added by using a fluid infusion pump so that its amount was 5.0 parts by weight and the mixture was kneaded, and the kneaded melt was extruded through a dice into a strand which was cooled with water, and cut by a pelletizer, to obtain master batch pellets in the form of a circular cylinder.

Next, 20.0 parts by weight of the resultant master batch pellets and 80.0 parts by weight of polyethylene were mixed with stirring. Then, from the resultant mixture, monofilaments were spun at a processing temperature of 240°C. The resultant resin threads were knitted so as to form a lot of meshes, producing a net B. Thus, an insect
pest controlling net of the present invention was obtained. The size of the mesh was set so that the number of holes per 6.45 cm² was 100.

[Example 3]

10.0 parts by weight of amorphous silica, 7.0 parts by weight of zinc stearate, 5.5 parts by weight of "Sumilizer GP", and 0.4 parts by weight of BHT are mixed with stirring by a Super Mixer, to obtain a powder C. To polyethylene melted at 150°C in a single screw extruder, the powder C is added so that its amount is 22.9 parts by weight with respect to 62 parts by weight of the polyethylene and the mixture is kneaded, and further, piperonyl butoxide is added by using a fluid infusion pump so that its amount is 5.0 parts by weight and the mixture is kneaded, and the kneaded melt is extruded through a dice into a strand which is cooled with water, and cut by a pelletizer, to obtain master batch pellets in the form of a circular cylinder.

Next, 20.0 parts by weight of the resultant master batch pellets and 80.0 parts by weight of polyethylene are mixed with stirring. Then, from the resultant mixture, monofilaments are spun at a processing temperature of 240°C. The resultant resin threads are knitted so as to form a lot of meshes, producing a net C. The size of the mesh is set so that the number of holes per 6.45 cm² is 100.

Separately, 10.0 parts by weight of permethrin and 3.0
parts by weight of propylene glycol are dissolved in 87.0 parts by weight of an alcohol, to obtain a spray liquid SI.

The spray liquid SI is sprayed onto the net C and the net C is dried under air for 24 hours. Thus, an insect pest controlling net of the present invention is obtained.

[Example 4]

10.0 parts by weight of amorphous silica, 7.0 parts by weight of zinc stearate, 5.5 parts by weight of "Sumilizer GP", and 0.4 parts by weight of BHT are mixed with stirring by a Super Mixer, to obtain a powder C. To polyethylene melted at 150°C in a single screw extruder, the powder C is added so that its amount is 22.9 parts by weight with respect to 62 parts by weight of the polyethylene and the mixture is kneaded, and the kneaded melt is extruded through a dice into a strand which is cooled with water, and cut by a pelletizer, to obtain master batch pellets in the form of a circular cylinder.

Next, 20.0 parts by weight of the resultant master batch pellets and 80.0 parts by weight of polyethylene are mixed with stirring. Then, from the resultant mixture, monofilaments are spun at a processing temperature of 240°C. The resultant resin threads are knitted so as to form a lot of meshes, producing a net D. The size of the mesh is set so that the number of holes per 6.45 cm² is 100.

Separately, 10.0 parts by weight of permethrin, 5.0
parts by weight of piperonyl butoxide and 3.0 parts by weight of propylene glycol are dissolved in 82.0 parts by weight of an alcohol, to obtain a spray liquid \( S_2 \).

The spray liquid \( S_2 \) is sprayed onto the net \( D \) and the net \( D \) is dried under air for 24 hours. Thus, an insect pest controlling net of the present invention is obtained.

[Example 5]

10.0 parts by weight of amorphous silica, 7.0 parts by weight of zinc stearate, 5.5 parts by weight of "Sumilizer GP", and 0.4 parts by weight of BHT are mixed with stirring by a Super Mixer, to obtain a powder \( C \). To polyethylene melted at 150°C in a single screw extruder, the powder \( C \) is added so that its amount is 22.9 parts by weight with respect to 62 parts by weight of the polyethylene and the mixture is kneaded, further, piperonyl butoxide is added by using a fluid infusion pump so that its amount is 5.0 parts by weight and the mixture is kneaded, and the kneaded melt is extruded through a dice into a strand which is cooled with water, and cut by a pelletizer, to obtain master batch pellets in the form of a circular cylinder.

Next, 20.0 parts by weight of the resultant master batch pellets and 80.0 parts by weight of polyethylene are mixed with stirring. Then, from the resultant mixture, monofilaments are spun at a processing temperature of 240°C. The resultant resin threads are knitted so as to form a lot
of meshes, producing a net C. The size of the mesh is set so that the number of holes per 6.45 cm² is 100.

The net C is immersed in 10.0% w/v of an alcohol solution of permethrin, then, taken out and dried under air for 24 hours. Thus, an insect pest controlling net of the present invention is obtained.

[Example 6]

10.0 parts by weight of amorphous silica, 7.0 parts by weight of zinc stearate, 5.5 parts by weight of "Sumilizer GP", and 0.4 parts by weight of BHT are mixed with stirring by a Super Mixer, to obtain a powder C. To polyethylene melted at 150°C in a single screw extruder, the powder C is added so that its amount is 22.9 parts by weight with respect to 62 parts by weight of the polyethylene and the mixture is kneaded, and the kneaded melt is extruded through a dice into a strand which is cooled with water, and cut by a pelletizer, to obtain master batch pellets in the form of a circular cylinder.

Next, 20.0 parts by weight of the resultant master batch pellets and 80.0 parts by weight of polyethylene are mixed with stirring. Then, from the resultant mixture, monofilaments are spun at a processing temperature of 240°C. The resultant resin threads are knitted so as to form a lot of meshes, producing a net D. The size of the mesh is set so that the number of holes per 6.45 cm² is 100.
The net D is immersed in 10.0% w/v of an alcohol solution of permethrin and 5.0% w/v of piperonyl butoxide, then, taken out and dried in air for 24 hours. Thus, an insect pest controlling net of the present invention is obtained.

[Comparative Example 1]

10.0 parts by weight of amorphous silica, 10.0 parts by weight of permethrin, 7.0 parts by weight of zinc stearate, and 0.4 parts by weight of BHT were mixed with stirring by a Super Mixer, to obtain a powder C. To polyethylene melted at 150°C in a single screw extruder, the powder C was added so that its amount was 27.4 parts by weight with respect to 62 parts by weight of the polyethylene and the mixture was kneaded, further, piperonyl butoxide was added by using a fluid infusion pump so that its amount was 5.0 parts by weight and the mixture was kneaded, and the kneaded melt was extruded through a dice into a strand which was cooled with water, and cut by a pelletizer, to obtain master batch pellets in the form of a circular cylinder.

Next, 20.0 parts by weight of the resultant master batch pellets and 80.0 parts by weight of polyethylene were mixed with stirring. Then, from the resultant mixture, monofilaments were spun at a processing temperature of 240°C. The resultant resin threads were knitted so as to
form a lot of meshes, producing a net. The size of the mesh was set so that the number of holes per 6.45 cm² was 100.

[Test Example]

(Test Method)

From the obtained net, piece of 10 × 10 cm was cut as sample. The sample was washed with 200 ml of acetone, and stored in a constant temperature chamber at 70°C for 2 hours, then, subjected to a test.

The test was carried out as described below. That is, the sample was fixed on a plane surface, and a perti dish having a diameter of about 4 cm was covered on the sample. Next, 10 female adult insects of Culex quinquefasciatus were released in the perti dish and this condition was maintained for 3 minutes, then, the insects were released in another cage. After a certain time, the number of knocked down Culex quinquefasciatus female adult insects was counted.

(Result)

The knocked down ratio after 20 minutes was 50% in Example 1 and 46% in Example 2, while 18% in Comparative Example 1.

As described above, the insect pest controlling net of the present invention is capable of controlling insect pests more effectively as compared with conventional nets.
Industrial Applicability

The insect pest controlling resin composition of the present invention can be a raw material of an insect pest controlling net which is capable of controlling insect pests more effectively, thus, its industrial use value is large.
CLAIMS

1. An insect pest controlling resin composition comprising:
   a thermoplastic resin, a pyrethroid compound, piperonyl butoxide, and a phosphorus-based antioxidant.

2. The insect pest controlling resin composition according to Claim 1, wherein the thermoplastic resin is a polyolefin.

3. The insect pest controlling resin composition according to Claim 2, wherein the thermoplastic resin is polyethylene.

4. The insect pest controlling resin composition according to Claim 1, wherein the thermoplastic resin is a polyester.

5. The insect pest controlling resin composition according to Claim 1, wherein the pyrethroid compound is permethrin.

6. The insect pest controlling resin composition according to Claim 1, wherein the phosphorus-based antioxidant is a compound represented by the general formula (I):
(wherein, $R^1$, $R^2$, $R^4$, and $R^5$ represent each independently a hydrogen atom, an alkyl group having 1 to 8 carbon atoms, a cycloalkyl group having 5 to 8 carbon atoms, an alkylcycloalkyl group having 6 to 12 carbon atoms, an aralkyl group having 7 to 12 carbon atoms, or a phenyl group. $R^3$ represents a hydrogen atom or an alkyl group having 1 to 8 carbon atoms. $X$ represents a simple bond, a sulfur atom, or a $-\text{CHR}^6-$ group ($R^6$ represents a hydrogen atom, an alkyl group having 1 to 8 carbon atoms, or a cycloalkyl group having 5 to 8 carbon atoms). $A$ represents an alkylene group having 2 to 8 carbon atoms or a $*-\text{COR}^7-$ group ($R^7$ represents a simple bond or an alkylene group having 1 to 8 carbon atoms, and * means bonding to the oxygen side). Either $Y$ or $Z$ represents a hydroxyl group, an alkoxy group having 1 to 8 carbon atoms, or an aralkyloxy group having 7 to 12 carbon atoms, and another one represents a hydrogen atom or an alkyl group having 1 to 8 carbon atoms.)
7. The insect pest controlling resin composition according to Claim 1, wherein the phosphorus-based antioxidant includes one or more compounds optionally selected from:

- tris-(2,4-di-t-butylphenyl) phosphite,
- bis (2,4-di-t-butylphenyl )pentaerythritol diphosphate,
- bis (2,6-di-t-butyl-4-methylphenyl )pentaerythritol diphosphate,
- bis (2,4-di-cumylphenyl )pentaerythritol diphosphate,
- tetrakis(2, 4-di-t-butylphenyl )-4,4'-biphenylene diphosphonite,
- 6-[3- (3-t-butyl-4-hydroxy-5-methyl) propoxy]-2,4,8,10-tetra-t-butyl dibenz [d,f] [1,3,2]-dioxaphosphepin, and
- bis-[2, 4-di-t-butyl 6-methyl phenyl]ethyl phosphite.

8. The insect pest controlling resin composition according to Claim 1, wherein the phosphorus-based antioxidant is 6-[3- (3-t-butyl-4-hydroxy-5-methyl )propoxy]-2,4,8,10-tetra-t-butyl dibenz [d,f] [1,3,2] -dioxaphosphepin.

9. The insect pest controlling resin composition according to Claim 1, wherein the surface of the thermoplastic resin is coated by one or more compounds selected from a pyrethroid compound, piperonyl butoxide, and a phosphorus-based antioxidant.

10. An insect pest controlling resin molded body formed by melt-molding the insect pest controlling resin
composition according to Claim 1.

11. The insect pest controlling resin molded body according to Claim 10, wherein the molded body is a thread.

12. An insect pest controlling net formed by knitting or weaving the thread according to Claim 11 so as to form a lot of meshes.
INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2010/073487

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. A01N 2/5 (2006.01), A01N 2/34 (2006.01), A01N 3/08 (2006.01),
A01N 7/36 (2006.01), A01P7/04 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. A01N 2/10, A01N 2/34, A01N 3/08, A01N 7/36, A01P7/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>JP 59-163475 A (KANEBO, LTD., KANEBO GOSEN, KK.) 1984.09.14, Claims, Examples (No Family)</td>
<td>1-12</td>
</tr>
<tr>
<td>Y</td>
<td>JP 6-128114 A (EARTH CHEMICAL CO.) 1994.05.10, [0002] (No Family)</td>
<td>1-12</td>
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</tbody>
</table>

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Date of the actual completion of the international search 17.02.2011

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