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(54) Title: PLASTICIZER FOR VINYL CHLORIDE RESIN, VINYL CHLORIDE RESIN COMPOSITION, ELECTRIC WIRE, AND VEHICLE INTERIOR MATERIAL

(57) Abstract: The present invention provides a plasticizer for vinyl chloride resins which has good compatibility with vinyl chloride resins, and further which may be used to provide a vinyl chloride resin composition capable of being formed into an article having excellent cold resistance and heat resistance. The present invention relates to a plasticizer for vinyl chloride resins, including A1) an ester compound produced by reaction of a1) at least one compound selected from the group consisting of divalent to tetravalent aromatic carboxylic acids, and alkyl esters and anhydrides thereof, with a2) an alcohol mixture containing 2-propylheptanol, n-decanol, and n-dodecanol.

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PLASTICIZER FOR VINYL CHLORIDE RESIN, VINYL CHLORIDE RESIN COMPOSITION, ELECTRIC WIRE, AND VEHICLE INTERIOR MATERIAL

Technical Field

[0001] The present invention relates to a plasticizer for vinyl chloride resins which has good compatibility with vinyl chloride resins, and further which may be used to provide a vinyl chloride resin composition capable of being formed into an article having excellent cold resistance and heat resistance. The present invention also relates to a vinyl chloride resin composition containing the plasticizer for vinyl chloride resins, an electric wire formed from the vinyl chloride resin composition, and a vehicle interior material formed from the vinyl chloride resin composition.

Background Art

[0002] Vinyl chloride resins are often used as vinyl chloride resin compositions in which plasticizers are added in order to not only impart various properties such as flexibility but also to decrease working temperatures in various forming processes such as extrusion and calendering, thereby facilitating the forming processes.

[0003] It is desirable that the plasticizers used in such vinyl chloride resin compositions have advantageous properties such as having excellent compatibility with vinyl chloride resins, and allowing articles formed of vinyl chloride resin compositions to have excellent heat resistance and cold resistance (see, for example, WO 2017/030000).

[0004] Typical examples of the plasticizers used in the vinyl chloride resin compositions include alkyl esters of polybasic acids such as phthalic acid esters, adipic acid esters, and trimellitic acid esters, which may be used alone or in combinations of two or more. In the prior art, general purpose phthalic acid esters such as di-2-ethylhexyl phthalate (DOP) or diisononyl phthalate (DINP), which have an excellent balance between properties such as heat resistance and cold resistance, are often used in vinyl chloride resin compositions for use in electric wires (e.g. wire harnesses for vehicles), vehicle interior materials (e.g. vehicle interior leather), and similar applications. In recent years, however, the demand for cold resistance or heat resistance has become increasingly stronger, and such demand currently cannot be met with the above plasticizers.

[0005] It is generally known that C10 or higher alcohols with a carbon number greater than the above plasticizers, especially linear alcohols, may be used to improve cold resistance or heat resistance.

Summary of Invention

Technical Problem

[0006] However, the use of C10 or higher linear alcohols cannot provide desired properties such as cold resistance or heat resistance due to the reduction in compatibility with vinyl chloride resins. Thus, there is a current need to develop plasticizers for vinyl chloride resins which are excellent in flexibility, compatibility, heat resistance, and cold resistance.

[0007] An object of the present invention is to provide a plasticizer for vinyl chloride resins which has good compatibility with vinyl chloride resins, and further which may be used to provide a vinyl chloride resin composition capable of being formed into an article having excellent cold resistance and heat resistance. Another object of the present invention is to provide an electric wire (e.g. wire harness) and a vehicle interior material (e.g. vehicle interior leather) which include the vinyl chloride resin composition.

Solution to Problem

[0008] As a result of extensive studies, the inventors have found that: an ester compound produced from a specific alcohol mixture may be used as a plasticizer for vinyl chloride resins; a composition containing the ester compound and a vinyl chloride resin may be used to form an article which has heat resistance and cold resistance, i.e., can maintain plasticity, even when exposed to a high or low temperature environment; the ester compound has good compatibility with vinyl chloride resins and allows vinyl chloride resins to maintain their plasticity, even when exposed to a high or low temperature environment for a long period of time; and the composition may be preferably applied to forming materials for providing vehicle interior materials (e.g. vehicle interior leather) or coatings for electric wires (e.g. wire harnesses); etc. This finding has led to the completion of the present invention.

[0009] Specifically, the present invention relates to a plasticizer for vinyl chloride resins, including

A1) an ester compound produced by reaction of a1) at least one compound selected from the group consisting of divalent to tetravalent aromatic carboxylic acids, and alkyl esters and anhydrides thereof, with a2) an alcohol mixture containing 2-propylheptanol, n-decanol, and n-dodecanol.

[0010] The compound a1) is preferably at least one selected from the group consisting of phthalic acid, isophthalic acid, terephthalic acid, and alkyl esters thereof, and phthalic anhydride.

[0011] The alcohol mixture a2) preferably contains, based on 100 mol% of the mixture, 20 to 70 mol% of 2-propylheptanol, 10 to 60 mol% of n-decanol, and 20 to 70 mol% of n-dodecanol.

[0012] The alcohol mixture a2) preferably contains, based on 100 mol% of the mixture, 20 to 50 mol% of 2-propylheptanol, 10 to 60 mol% of n-decanol, and 20 to 50 mol% of n-dodecanol.

[0013] The alcohol mixture a2) preferably has an average carbon number of 10.4 to 11.4, more preferably 10.4 to 11.0.

[0014] The alcohol mixture a2) preferably has an average linearity of 50 to 95%, more preferably 60 to 85%.

[0015] The present invention also relates to a vinyl chloride resin composition, containing: X) the plasticizer for vinyl chloride resins; and Y) a vinyl chloride resin.

[0016] The plasticizer for vinyl chloride resins X) is preferably present in an amount of 10 to 100 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0017] The present invention also relates to an electric wire, including a conductive wire coated with the vinyl chloride resin composition.

[0018] The present invention also relates to a vehicle interior material, formed from the vinyl chloride resin composition.

Advantageous Effects of Invention

[0019] The plasticizer for vinyl chloride resins of the present invention has good compatibility with vinyl chloride resins and may be used to provide a vinyl chloride resin composition that can maintain plasticity, even when exposed to a high or low temperature environment. Moreover, the vinyl chloride resin composition of the present invention may be used in various applications, such as electric wire coating materials, automobile parts, leather, boots, gaskets, and hoses. The vinyl chloride resin composition of the present invention is particularly suitable for electric wire coating materials, especially for producing wire harnesses, and forming materials for producing vehicle interior materials such as vehicle interior leather.

Description of Embodiments

[0020] The plasticizer for vinyl chloride resins of the present invention includes A1) an ester compound produced by reaction of a1) at least one compound selected from the group consisting of divalent to tetravalent aromatic carboxylic acids, and alkyl esters and anhydrides thereof, with a2) an alcohol mixture containing 2-propylheptanol, n-decanol, and n-dodecanol.

The ester compound A1), which is produced from the alcohol mixture a2), is a mixture of ester compounds.

[0021] Examples of the divalent aromatic carboxylic acids (aromatic dicarboxylic acids), alkyl esters of aromatic dicarboxylic acids, and aromatic dicarboxylic anhydrides include phthalic acid, 4-methylphthalic acid, isophthalic acid, terephthalic acid, and alkyl esters thereof, and anhydrides of phthalic acid or 4-methylphthalic acid. Preferred among these are one or more compounds selected from the group consisting of phthalic acid, isophthalic acid, terephthalic acid, and alkyl esters thereof, and phthalic anhydride, with phthalic anhydride or alkyl esters of isophthalic acid being more preferred, because they contribute to providing excellent compatibility with vinyl chloride resins and to obtaining a vinyl chloride resin composition capable of being formed into an article having excellent heat resistance and cold resistance. The aromatic dicarboxylic acids, alkyl esters of aromatic dicarboxylic acids, and aromatic dicarboxylic anhydrides may be used alone or in combinations of two or more.

[0022] Examples of the trivalent aromatic carboxylic acids (aromatic tricarboxylic acids), alkyl esters of aromatic tricarboxylic acids, and aromatic tricarboxylic anhydrides include 1,3,5-benzenetricarboxylic acid, 1,2,4-benzenetricarboxylic acid, 1,2,3-benzenetricarboxylic acid, 3-methyl-1,2,4-benzenetricarboxylic acid, 3,5-dimethyl-1,2,4-benzenetricarboxylic acid, 3,5,6-trimethyl-1,2,4-benzenetricarboxylic acid, and alkyl esters and anhydrides thereof. Preferred among these are one or more compounds selected from the group consisting of 1,2,4-benzenetricarboxylic acid and alkyl esters and anhydride thereof because they contribute to providing excellent compatibility with vinyl chloride resins and to obtaining a vinyl chloride resin composition capable of being formed into an article having excellent heat resistance and cold resistance. The aromatic tricarboxylic acids, alkyl esters of aromatic tricarboxylic acids, and aromatic tricarboxylic anhydrides may be used alone or in combinations of two or more.

[0023] Examples of the tetravalent aromatic carboxylic acids (aromatic tetracarboxylic acids), alkyl esters of aromatic tetracarboxylic acids, and aromatic tetracarboxylic anhydrides include 1,2,4,5-benzenetetracarboxylic acid, 1,2,3,5-benzenetetracarboxylic acid, 1,2,3,4-benzenetetracarboxylic acid, 3-methyl-1,2,4,5-benzenetetracarboxylic acid, and 3,6-dimethyl-l,2,4,5-benzenetetracarboxylic acid. Preferred among these are one or more compounds selected from the group consisting of 1,2,4,5-benzenetetracarboxylic acid and alkyl esters and anhydride thereof because they contribute to providing excellent compatibility with vinyl chloride resins and to obtaining a vinyl chloride resin composition capable of being formed into an article having excellent heat resistance and cold resistance. The aromatic tetracarboxylic acids, alkyl esters of aromatic tetracarboxylic acids, and aromatic tetracarboxylic anhydrides may be used alone or in combinations of two or more.

[0024] The aforementioned compounds a1) may be used alone or in combinations of two or more. Preferred among the compounds a1) are divalent aromatic carboxylic acids (aromatic dicarboxylic acids), alkyl esters of aromatic dicarboxylic acids, and aromatic dicarboxylic anhydrides because they contribute to providing excellent compatibility with vinyl chloride resins and to obtaining a vinyl chloride resin composition capable of being formed into an article having excellent heat resistance and cold resistance.

[0025] The alcohol mixture a2) contains 2-propylheptanol, n-decanol, and n-dodecanol.

[0026] The amount of 2-propylheptanol based on 100 mol% of the alcohol mixture a2) is preferably 20 mol% or more, more preferably 30 mol% or more, still more preferably 40 mol% or more, but is preferably 70 mol% or less, more preferably 60 mol% or less, still more preferably 50 mol% or less. When it is within the range indicated above, more suitable effects can be obtained.

[0027] The amount of n-decanol based on 100 mol% of the alcohol mixture a2) is preferably 10 mol% or more, but is preferably 60 mol% or less, more preferably 40 mol% or less, still more preferably 20 mol% or less. When it is within the range indicated above, more suitable effects can be obtained.

[0028] The amount of n-dodecanol based on 100 mol% of the alcohol mixture a2) is preferably 20 mol% or more, more preferably 30 mol% or more, still more preferably 40 mol% or more, but is preferably 70 mol% or less, more preferably 60 mol% or less, still more preferably 50 mol% or less. When it is within the range indicated above, more suitable effects can be obtained.

[0029] The combined amount of 2-propylheptanol, n-decanol, and n-dodecanol, based on 100 mol% of the alcohol mixture a2) is preferably 80 mol% or more, more preferably 90 mol% or more, still more preferably 95 mol% or more, particularly preferably 98 mol% or more, most preferably 100 mol%. When it is within the range indicated above, more suitable effects can be obtained.

[0030] The average carbon number of the alcohol mixture a2) is preferably 10.4 or more, more preferably 10.6 or more, still more preferably 10.8 or more, but is preferably 11.4 or less, more preferably 11.2 or less, still more preferably 11.0 or less. When it is within the range indicated above, more suitable effects can be obtained.

The average carbon number of the alcohol mixture a2) as used herein is on the basis of mol.

[0031] The average linearity of the alcohol mixture a2) is preferably 50% or higher, more preferably 55% or higher, still more preferably 60% or higher, but is preferably 95% or lower, more preferably 90% or lower, still more preferably 85%

or lower, particularly preferably 80% or lower, most preferably 75% or lower, even most preferably 70% or lower, further most preferably 65% or lower. When it is within the range indicated above, more suitable effects can be obtained.

The average linearity of the alcohol mixture a2) as used herein is on the basis of mol.

[0032] The reaction of a1) at least one compound selected from the group consisting of divalent to tetravalent aromatic carboxylic acids, and alkyl esters and anhydrides thereof, with a2) an alcohol mixture containing 2-propylheptanol, n-decanol, and n-dodecanol may be carried out by any method.

[0033] Specifically, the ester compound A1) may be prepared by causing an esterification reaction of the components a1) and a2), optionally in the presence of an esterification catalyst, for example, at a temperature in a range of 100°C to 250°C for 2 to 25 hours. The conditions (e.g. temperature, time) of the esterification reaction are not particularly limited and may be appropriately selected.

[0034] Examples of the esterification catalyst include titanium-based catalysts such as tetraisopropyl titanate and tetrabutyl titanate, tin-based catalysts such as dibutyltin oxide, and organic sulfonic acid catalysts such as p-toluenesulfonic acid.

[0035] The amount of the esterification catalyst used may be appropriately selected, and is generally preferably in a range of 0.001 to 0.1 parts by mass per 100 parts by mass of the total amount of raw materials.

[0036] The amount of the component a2) used relative to the component a1) is preferably 1.00 to 1.30 mol, more preferably 1.03 to 1.10 mol, per mol of the carboxyl group of the component a1) in order to provide excellent compatibility with vinyl chloride resins and to obtain a vinyl chloride resin composition capable of being formed into an article having excellent heat resistance and cold resistance. More specifically, in the case where the component a1) is at least one compound selected from the group consisting of aromatic dicarboxylic acids, and alkyl esters and anhydrides thereof, the amount of the component a2) used relative to the component a1) is preferably 2.00 to 2.60 mol, more preferably 2.06 to 2.20 mol per mol of the component a1). In the case where the component a1) is at least one compound selected from the group consisting of aromatic tricarboxylic acids, and alkyl esters and anhydrides thereof, the amount of the component a2) used relative to the component a1) is preferably 3.00 to 3.90 mol, more preferably 3.09 to 3.30 mol per mol of the component a1). In the case where the component a1) is at least one compound selected from the group consisting of aromatic tetracarboxylic acids, and alkyl esters and anhydrides thereof, the amount of the component a2) used relative to the component a1) is preferably 4.00 to 5.20 mol, more preferably 4.12 to 4.40 mol per mol of the component a1).

[0037] As described above, the plasticizer for vinyl chloride resins of the present invention includes the ester compound A1). The amount of the ester compound A1) based on 100% by mass of the plasticizer for vinyl chloride resins of the present invention is preferably 10% by mass or more, more preferably 30% by mass or more, still more preferably 50% by mass or more, particularly preferably 70% by mass or more, most preferably 80% by mass or more, even most preferably 90% by mass or more, further most preferably 95% by mass or more, particularly most preferably 100% by mass, in order to permit easier production and to achieve the advantageous effects of the invention (providing good compatibility with vinyl chloride resins and obtaining a vinyl chloride resin composition capable of being formed into an article having excellent cold resistance and heat resistance).

[0038] The plasticizer for vinyl chloride resins of the present invention may include additional compounds as plasticizers for vinyl chloride resins in addition to the ester compound A1) as long as the advantageous effects of the present invention are not impaired. Examples of such additional compounds include benzoic acid esters such as diethylene glycol dibenzoate; phthalic acid esters such as dibutyl phthalate (DBP), di-2-ethylhexyl phthalate (DOP), diisononyl phthalate (DINP), diisodecyl phthalate (DIDP), diundecyl phthalate (DUP), and ditridecyl phthalate (DTDP); terephthalic acid esters such as bis(2-ethylhexyl) terephthalate (DOTP); isophthalic acid esters such as bis(2-ethylhexyl) isophthalate (DOIP); aliphatic dibasic acid esters such as di-2-ethylhexyl adipate (DOA), diisononyl adipate (DINA), diisodecyl adipate (DIDA), di-2-ethylhexyl sebacate (DOS), and diisononyl sebacate (DINS); trimellitic acid esters such as tri-2-ethylhexyl trimellitate (TOTM), triisononyl trimellitate (TINTM), and triisodecyl trimellitate

(TIDTM); pyromellitic acid esters such as tetra-2-ethylhexyl pyromellitate (TOPM); phosphoric acid esters such as tri-2-ethylhexyl phosphate (TOP) and tricresyl phosphate (TCP); alkyl esters of polyhydric alcohols such as pentaerythritol; polyesters having a molecular weight of 800 to 4,000 synthesized by polyesterification of dibasic acids such as adipic acid with glycols; epoxidized esters such as epoxidized soybean oil and epoxidized linseed oil; alicyclic dibasic acids such as diisononyl hexahydrophthalate; fatty acid glycol esters such as 1,4-butanediol dicaprate; tributyl acetylcitrate (ATBC); chlorinated paraffins obtained by chlorination of paraffin waxes or n-paraffins; chlorinated fatty acid esters such as chlorinated stearic acid esters; and higher fatty acid esters such as butyl oleate.

[0039] The vinyl chloride resin composition of the present invention contains: X) the plasticizer for vinyl chloride resins of the present invention; and Y) a vinyl chloride resin.

[0040] Examples of the vinyl chloride resin Y) include homopolymers of vinyl chloride, homopolymers of vinylidene chloride, copolymers derived essentially from vinyl chloride, and copolymers derived essentially from vinylidene chloride. The vinyl chloride resin Y) may be prepared by various known methods. Such preparation methods include, for example, suspension polymerization in the presence of an oil-soluble polymerization catalyst, or emulsion polymerization in the presence of a water-soluble polymerization catalyst in an aqueous medium. The degree of polymerization of the vinyl chloride resin Y) is usually 300 to 5,000, preferably 400 to 3,500. A degree of polymerization of 700 to 3,000 is preferred in order to obtain a vinyl chloride resin composition having excellent processability and capable of being formed into an article having high heat resistance.

[0041] Among the vinyl chloride resins Y) are copolymers such as: copolymers of vinyl chloride monomer with C2-30 α-olefins such as ethylene, propylene, 1-butene, 1-pentene, 1-hexene, 1-heptene, 1-octene, 1-nonene, 1-decene, 1-undecene, 1-dodecene, 1-tridecene, and 1-tetradecene, vinyl compounds such as acrylic acid and esters thereof, methacrylic acid and esters thereof, maleic acid and esters thereof, vinyl acetate, vinyl propionate, and alkyl vinyl ethers, polyfunctional monomers such as diallyl phthalate, or mixtures thereof; ethylene-acrylate copolymers such as ethylene-ethyl acrylate copolymers; ethylene-methacrylate copolymers; ethylene-vinyl acetate copolymers (EVA); and graft copolymers obtained by grafting vinyl chloride monomer onto butyl rubber, crosslinked acrylic rubber, polyurethane, butadiene-styrene-methyl methacrylate copolymers (MBS), butadiene-acrylonitrile-(α-methyl)styrene copolymers (ABS), styrene-butadiene copolymers, polyethylene, polymethyl methacrylate, or mixtures thereof.

[0042] The amount of the plasticizer for vinyl chloride resins X) in the vinyl chloride resin composition of the present invention is preferably 10 parts by mass or more, more preferably 40 parts by mass or more, but preferably 100 parts by mass or less, more preferably 80 parts by mass or less, per 100 parts by mass of the vinyl chloride resin Y) in order to provide excellent compatibility with vinyl chloride resins and to obtain a vinyl chloride resin composition capable of being formed into an article having excellent heat resistance and cold resistance.

[0043] The vinyl chloride resin composition of the present invention may contain various additives as long as the advantageous effects of the present invention are not impaired. Examples of such additives include flame retardants, stabilizers, stabilizing aids, colorants, processing aids, fillers, antioxidants (age resisters), ultraviolet absorbers, photostabilizers, lubricants, antistatic agents, and crosslinking activators.

[0044] The additional plasticizers other than the ester compound A1), and the additives may be used alone or in combinations of two or more.

[0045] Examples of the flame retardants include inorganic compounds such as aluminum hydroxide, antimony trioxide, magnesium hydroxide, and zinc borate; phosphorus compounds such as cresyl diphenyl phosphate, trischloroethyl phosphate, trischloropropyl phosphate, and trisdichloropropyl phosphate; and halogenated compounds such as chlorinated paraffins. When the vinyl chloride resin composition contains a flame retardant, the amount of the flame retardant is usually 0.1 to 20 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0046] Examples of the stabilizers include metal soap compounds such as lithium stearate, magnesium stearate, magnesium laurate, calcium ricinoleate, calcium stearate, barium laurate, barium ricinoleate, barium stearate, zinc octoate, zinc laurate, zinc ricinoleate, and zinc stearate; organotin compounds such as dimethyltin bis-2-ethylhexyl thioglycolate, dibutyltin maleate, dibutyltin bis butyl maleate, and dibutyltin dilaurate; and antimony mercaptide compounds. When the vinyl chloride resin composition contains a stabilizer, the amount of the stabilizer is usually 0.1 to 20 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0047] Examples of the stabilizing aids include phosphite compounds such as triphenyl phosphite, monooctyl diphenyl phosphite, and tridecyl phosphite; beta-diketone compounds such as acetylacetone and benzoylacetone; polyol compounds such as glycerin, sorbitol, pentaerythritol, and polyethylene glycol; perchlorate compounds such as barium perchlorate and sodium perchlorate; hydrotalcite compounds; and zeolite. When the vinyl chloride resin composition contains a stabilizing aid, the amount of the stabilizing aid is usually 0.1 to 20 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0048] Examples of the colorants include carbon black, lead sulfide, white carbon, titanium white, lithopone, colcothar, antimony sulfide, chromium yellow, chromium green, cobalt blue, and molybdenum orange. When the vinyl chloride resin composition contains a colorant, the amount of the colorant is usually 1 to 100 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0049] Examples of the processing aids include liquid paraffins, polyethylene waxes, stearic acid, stearic acid amide, ethylene bis stearic acid amide, butyl stearate, and calcium stearate. When the vinyl chloride resin composition contains a processing aid, the amount of the processing aid is usually 0.1 to 20 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0050] Examples of the fillers include metal oxides such as calcium carbonate, silica, alumina, clay, talc, diatomaceous earth, and ferrite; fibers and powders of glass, carbon, metals, or other materials; glass spheres, graphite, aluminum hydroxide, barium sulfate, magnesium oxide, magnesium carbonate, magnesium silicate, and calcium silicate. When the vinyl chloride resin composition contains a filler, the amount of the filler is usually 1 to 100 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0051] Examples of the antioxidants include phenolic compounds such as 2,6-di-tert-butylphenol, tetrakis[methylene-3-(3,5-tert-butyl-4-hydroxyphenol)-propionate]methane, and 2-hydroxy-4-methoxybenzophenone; sulfur compounds such as alkyl disulfides, thiodipropionate esters, and benzothiazole; phosphate compounds such as tris nonylphenyl phosphite, diphenyl isodecyl phosphite, triphenyl phosphite, and tris(2,4-di-tert-butylphenyl)phosphite; and organic metal compounds such as zinc dialkyl dithiophosphates and zinc diaryl dithiophosphates. When the vinyl chloride resin composition contains an antioxidant, the amount of the antioxidant is usually 0.2 to 20 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0052] Examples of the ultraviolet absorbers include salicylate compounds such as phenyl salicylate and p-tert-butylphenyl salicylate; benzophenone compounds such as 2-hydroxy-4-n-octoxybenzophenone and 2-hydroxy-4-n-methoxybenzophenone; benzotriazole compounds such as 5-methyl-1H-benzotriazole and 1-dioctylaminomethylbenzotriazole; and cyanoacrylate compounds. When the vinyl chloride resin composition contains an ultraviolet absorber, the amount of the ultraviolet absorber is usually 0.1 to 10 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0053] Examples of the photostabilizers include hindered amine photostabilizers, specific examples of which include bis(2,2,6,6-tetramethyl-4-piperidyl) sebacate, bis(1,2,2,6,6-pentamethyl-4-piperidyl) sebacate, and methyl 1,2,2,6,6-pentamethyl-4-piperidyl sebacate (mixture), bis(1,2,2,6,6-pentamethyl-4-piperidyl)[[3,5-bis(1,1-dimethylethyl)-4-hydroxyphenyl]methyl]butyl malonate, bis-(1-octyloxy-2,2,6,6-tetramethyl-4-piperidinyl) sebacate, a reaction product of 1,1-dimethyl ethyl hydroperoxide and octane, 4-benzoyloxy-2,2,6,6-tetramethylpiperidine, a mixture of esters of 2,2,6,6-tetramethyl-4-piperidinol with higher fatty acids, tetrakis(2,2,6,6-tetramethyl-4-piperidyl)-1,2,3,4-butanetetracarboxylate, tetrakis(1,2,2,6,6-pentamethyl-4-piperidyl)-1,2,3,4-butanetetracarboxylate, a polycondensate of dimethyl succinate and 4-hydroxy-2,2,6,6-tetramethyl-1-piperidineethanol, poly{(6-(1,1,3,3-tetramethylbutyl)amino-1,3,5-triazine-2,4-diyl){(2,2,6,6-tetramethyl-4-piperidyl)imino}hexamethylene{(2,2,6,6-tetramethyl-4-piperidyl)imino}}, a polycondensate of dibutylamine-1,3,5-triazine-N,N'-bis(2,2,6,6-tetramethyl-4-

piperidyl-1,6-hexamethylenediamine and N-(2,2,6,6-tetramethyl-4-piperidyl)butylamine, and N,N',N'',N'''-tetrakis-(4,6-bis-(butyl-(N-methyl-2,2,6, 6-tetramethylpiperidin-4-yl)amino)-triazin-2-yl)-4,7-diazadecane-1,10-diamine. When the vinyl chloride resin composition contains a photostabilizer, the amount of the photostabilizer is usually 0.1 to 10 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0054] Examples of the lubricants include silicone, liquid paraffins, paraffin waxes, fatty acid metal salts such as metal stearates and metal laurates, fatty acid amides, fatty acid waxes, and higher fatty acid waxes. When the vinyl chloride resin composition contains a lubricant, the amount of the lubricant is usually 0.1 to 10 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0055] Examples of the antistatic agents include alkyl sulfonate type, alkyl ether carboxylic acid type, and dialkyl sulfosuccinate type anionic antistatic agents; nonionic antistatic agents such as polyethylene glycol derivatives, sorbitan derivatives, and diethanolamine derivatives; cationic antistatic agents such as alkylamidoamine type, alkyldimethylbenzyl type, and other quaternary ammonium salts, alkylpyridinium type organic acid salts or hydrochlorides; and alkylbetaine type, alkylimidazoline type, and other amphoteric antistatic agents. When the vinyl chloride resin composition contains an antistatic agent, the amount of the antistatic agent is usually 0.1 to 10 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[0056] Examples of the crosslinking activators include polyfunctional monomers such as tetraethylene glycol dimethacrylate, divinylbenzene, diallyl phthalate, triallyl isocyanurate, trimethylol propane triacrylate, tetramethylolmethane tetramethacrylate, and trimethoxyethoxyvinylsilane, which may be used in a range of 0.5 to 30 parts by mass per 100 parts by mass of the vinyl chloride resin Y). In particular, an amount of 3 to 20 parts by mass is most effective.

[0057] The vinyl chloride resin composition of the present invention may be prepared as a blended powder by stirring and mixing a plasticizer for vinyl chloride resins X) including an ester compound A1) and a vinyl chloride resin Y), and optionally various additives using a stirrer such as a mortar mixer, Henschel mixer, Banbury mixer, or ribbon blender. Alternatively, the vinyl chloride resin composition may be prepared in the form of pellets by melt-forming of a plasticizer for vinyl chloride resins X) including an ester compound A1) and a vinyl chloride resin Y), and optionally various additives using a kneading machine such as a conical twin screw extruder, parallel twin screw extruder, single screw extruder, co-kneader type kneading machine, or roll kneader. Still alternatively, the vinyl chloride resin composition may be prepared in the form of a paste by mixing and kneading a plasticizer for vinyl chloride resins X) including an ester compound A1) and a vinyl chloride resin Y), especially in the form of a paste, and optionally various additives using a kneading machine such as a pony mixer, butterfly mixer, planetary mixer, ribbon blender, kneader, dissolver, biaxial mixer, high-speed mixer, or three-roll mill.

[0058] In the case where the vinyl chloride resin composition of the present invention is in the form of a blended powder or pellets, it may be melt-formed into an article having a desired shape by a method known in the art, such as vacuum forming, compression molding, extrusion, injection molding, calendering, press forming, blow molding, or powder molding.

[0059] Also, in the case where the vinyl chloride resin composition of the present invention is in the form of a paste, it may be formed into an article having a desired shape by a method known in the art, such as spreading, dipping, gravure processing, slush molding, or screening.

[0060] The shape of the formed article is not particularly limited and may be, for example, a rod, sheet, film, plate, cylindrical, circular, or elliptical shape, or a special shape (e.g. a star or polygonal shape) for toys, ornaments, or other applications.

[0061] The article formed as above is useful for pipes such as water pipes, joints for pipes, gutters such as rain gutters, window frame sidings, plates, corrugated plates, car underbody coatings, dashboards, instrument panels, consoles, door sheets, under carpet products, trunk seats, door trims, vehicle interior leather, and other vehicle interior materials, various leather products, decorative sheets, agricultural films, films for food packaging, coatings for conductive wires, various foamed products, hoses, medical tubes, tubes for food, gaskets for refrigerators, packings, wallpaper, flooring materials, boots, curtains, footwear soles, gloves, water stops, toys, panels, blood bags, infusion bags, tarpaulins, mats, impervious sheets, civil engineering sheets, roofing materials, waterproof sheets, insulation sheets, industrial tapes, glass films, erasers, and other applications.

[0062] The vinyl chloride resin composition of the present invention may be preferably used to produce a coating for conductive wires, among other articles. Further, the electric wire produced by coating a conductive wire with the vinyl chloride resin composition of the present invention is preferably a wire harness produced by coating a conductive wire with the vinyl chloride resin composition of the present invention.

[0063] The vinyl chloride resin composition of the present invention may also be preferably used to produce an automobile interior material, among other articles. The automobile interior material is preferably a vehicle interior leather formed from the vinyl chloride resin composition of the present invention.

Examples

[0064] The present invention will be described below in greater detail with reference to specific examples. In the examples, "parts" and "%" are by mass, unless otherwise noted. Moreover, acid values, hydroxyl values, and viscosities were measured by the following methods.

<Method for measuring acid value>

[0065] Acid values were measured in accordance with JIS K0070-1992.

<Method for measuring hydroxyl value>

[0066] Hydroxyl values were measured in accordance with JIS K0070-1992.

<Method for measuring viscosity>

[0067] Viscosities were measured in accordance with JIS K6901-1986.

Example 1 (Plasticizer for vinyl chloride resins)

[0068] In a reaction vessel, 148 g (1.0 mol) of phthalic anhydride, 76 g (0.48 mol) of 2-propylheptanol (manufactured by BASF), 179 g (1.13 mol) of n-decanol (manufactured by Kao Corporation; KALCOL 1098, linearity: 100 mol%), 90 g (0.48 mol) of n-dodecanol (manufactured by New Japan Chemical Co., Ltd.; CONOL 20P, linearity: 100 mol%), and 0.20 g of tetraisopropyl titanate as an esterification catalyst were put into a four-neck flask having an inner volume of 1 liter equipped with a thermometer, a stirrer, and a reflux condenser. The mixture was gradually heated to 230°C with stirring in a nitrogen stream, and heating was continued at 230°C while continuously removing generated water until the acid value reached 2 or lower. After the reaction, the unreacted 2-propylheptanol, n-decanol, and n-dodecanol were evaporated off under reduced pressure at 230 to 200°C to obtain 436 g of plasticizer A (acid value: 0.02, hydroxyl value: 0.03, viscosity at 25°C: 54 mPa·s).

The amounts of 2-propylheptanol, n-decanol, and n-dodecanol were 23 mol%, 54 mol%, and 23 mol%, respectively, based on 100 mol% of the alcohol mixture a2). Moreover, the alcohol mixture a2) had an average carbon number of 10.5 and an average linearity of 77%.

Example 2 (same as above)

[0069] In a reaction vessel, 148 g (1.0 mol) of phthalic anhydride, 100 g (0.63 mol) of 2-propylheptanol (manufactured by BASF), 116 g (0.74 mol) of n-decanol (manufactured by Kao Corporation; KALCOL 1098, linearity: 100 mol%), 137 g (0.74 mol) of n-dodecanol (manufactured by New Japan Chemical Co., Ltd.; CONOL 20P, linearity: 100 mol%), and 0.20 g of tetraisopropyl titanate as an esterification catalyst were put into a four-neck flask having an inner volume of 1 liter equipped with a thermometer, a stirrer, and a reflux condenser. The mixture was gradually heated to 230°C with stirring in a nitrogen stream, and heating was continued at 230°C while continuously removing generated water until the acid value reached 2 or lower. After the reaction, the unreacted 2-propylheptanol, n-decanol, and n-dodecanol were evaporated off under reduced pressure at 230 to 200°C to obtain 440 g of plasticizer B (acid value: 0.03, hydroxyl value: 0.04, viscosity at 25°C: 58 mPa·s).

The amounts of 2-propylheptanol, n-decanol, and n-dodecanol were 30 mol%, 35 mol%, and 35 mol%, respectively, based on 100 mol% of the alcohol mixture a2). Moreover, the alcohol mixture a2) had an average carbon number of 10.7 and an average linearity of 70%.

Example 3 (same as above)

[0070] In a reaction vessel, 148 g (1.0 mol) of phthalic anhydride, 133 g (0.84 mol) of 2-propylheptanol (manufactured by BASF), 46 g (0.29 mol) of n-decanol (manufactured by Kao Corporation; KALCOL 1098, linearity: 100 mol%), 180 g (0.97 mol) of n-dodecanol (manufactured by New Japan Chemical Co., Ltd.; CONOL 20P, linearity: 100 mol%), and 0.20 g of tetraisopropyl titanate as an esterification catalyst were put into a four-neck flask having an inner volume of 1 liter equipped with a thermometer, a stirrer, and a reflux condenser. The mixture was gradually heated to 230°C with stirring in a nitrogen stream, and heating was continued at 230°C while continuously removing generated water until the acid value reached 2 or lower. After the reaction, the unreacted 2-propylheptanol, n-decanol, and n-dodecanol were evaporated off under reduced pressure at 230 to 200°C to obtain 448 g of plasticizer C (acid value: 0.01, hydroxyl value: 0.04, viscosity at 25°C: 58 mPa·s).

The amounts of 2-propylheptanol, n-decanol, and n-dodecanol were 40 mol%, 14 mol%, and 46 mol%, respectively, based on 100 mol% of the alcohol mixture a2). Moreover, the alcohol mixture a2) had an average carbon number of 10.9 and an average linearity of 60%.

Example 4 (same as above)

[0071] In a reaction vessel, 194 g (1.0 mol) of dimethyl isophthalate, 76 g (0.48 mol) of 2-propylheptanol (manufactured by BASF), 179 g (1.13 mol) of n-decanol (manufactured by Kao Corporation; KALCOL 1098, linearity: 100 mol%), 90 g (0.48 mol) of n-dodecanol (manufactured by New Japan Chemical Co., Ltd.; CONOL 20P, linearity: 100 mol%), and 0.20 g of tetraisopropyl titanate as an esterification catalyst were put into a four-neck flask having an inner volume of 1 liter equipped with a thermometer, a stirrer, and a reflux condenser. The mixture was gradually heated to 230°C with stirring in a nitrogen stream, and heating was continued at 230°C for a certain period of time while continuously removing generated methanol. After the reaction, the unreacted 2-propylheptanol, n-decanol, and n-dodecanol were evaporated off under reduced pressure at 230 to 200°C to obtain 425 g of plasticizer D (acid value: 0.05, hydroxyl value: 0.08, viscosity at 25°C: 63 mPa·s).

The amounts of 2-propylheptanol, n-decanol, and n-dodecanol were 23 mol%, 54 mol%, and 23 mol%, respectively, based on 100 mol% of the alcohol mixture a2). Moreover, the alcohol mixture a2) had an average carbon number of 10.5 and an average linearity of 77%.

Comparative Example 1 [Synthesis of ester compound A') for comparison]

[0072] In a reaction vessel, 148 g (1.0 mol) of phthalic anhydride, 333 g (2.10 mol) of 2-propylheptanol (manufactured by BASF), and 0.20 g of tetraisopropyl titanate as an esterification catalyst were put into a four-neck flask having an inner volume of 1 liter equipped with a thermometer, a stirrer, and a reflux condenser. The mixture was gradually heated to 230°C with stirring in a nitrogen stream, and heating was continued at 230°C while continuously removing generated water until the acid value reached 2 or lower. After the reaction, the unreacted 2-propylheptanol was evaporated off under reduced pressure at 230 to 200°C to obtain 424 g of plasticizer E (acid value: 0.04, hydroxyl value: 0.05, viscosity at 25°C: 102 mPa·s).

Comparative Example 2 (same as above)

[0073] In a reaction vessel, 148 g (1.0 mol) of phthalic anhydride, 179 g (1.13 mol) of 2-propylheptanol (manufactured by BASF), 181 g (0.97 mol) of n-dodecanol (manufactured by New Japan Chemical Co., Ltd.; CONOL 20P, linearity: 100 mol%), and 0.20 g of tetraisopropyl titanate as an esterification catalyst were put into a four-neck flask having an inner volume of 1 liter equipped with a thermometer, a stirrer, and a reflux condenser. The mixture was gradually heated to 230°C with stirring in a nitrogen stream, and heating was continued at 230°C while continuously removing generated water until the acid value reached 2 or lower. After the reaction, the unreacted 2-propylheptanol and n-dodecanol were evaporated off under reduced pressure at 230 to 200°C to obtain 427 g of plasticizer F (acid value: 0.02, hydroxyl value: 0.03, viscosity at 25°C: 68 mPa·s).

Comparative Example 3 (same as above)

[0074] In a reaction vessel, 148 g (1.0 mol) of phthalic anhydride, 447 g (2.4 mol) of n-dodecanol (manufactured by New Japan Chemical Co., Ltd.; CONOL 20P, linearity: 100 mol%), and 0.20 g of tetraisopropyl titanate as an esterification catalyst were put into a four-neck flask having an inner volume of 1 liter equipped with a thermometer, a stirrer, and a reflux condenser. The mixture was gradually heated to 230°C with stirring in a nitrogen stream, and heating was continued at 230°C while continuously removing generated water until the acid value reached 2 or lower. After the reaction, the unreacted dodecanol was evaporated off under reduced pressure at 230 to 200°C to obtain 456 g of plasticizer G (acid value: 0.06, hydroxyl value: 0.08, viscosity at 25°C: 58 mPa·s).

Example 5 (vinyl chloride resin composition)

[0075] 50 parts of the plasticizer for vinyl chloride resins (plasticizer A prepared in Example 1), 100 parts of a vinyl chloride resin [ZEST 1000Z manufactured by Shin Dai-Ichi Vinyl Corporation, degree of polymerization: 1,000], and 4 parts of a filler (a calcium/zinc composite stabilizer (product name: GLECK MP-677D) manufactured by NISSIN TRADING Co., Ltd.) were mixed to prepare a vinyl chloride resin composition 1) of the present invention. The vinyl chloride resin composition 1) was used to form articles, which were then evaluated for the plasticizing effect of the plasticizer for vinyl chloride resins on the vinyl chloride resin, heat resistance, and cold resistance. In addition, they were evaluated for compatibility between the plasticizer for vinyl chloride resins and the vinyl chloride resin. The methods for preparation of the articles used in the evaluations and the methods for evaluation thereof are shown below. The evaluation results are also shown in Table 1.

· Evaluation of plasticizing effect of plasticizer for vinyl chloride resins on vinyl chloride resin

<Conditions for forming article>

[0076] The vinyl chloride resin composition 1) was kneaded for 10 minutes in a two-roll mill heated to 170°C, and the kneaded vinyl chloride resin composition 1) was formed into a sheet having a thickness of 0.5 mm using a die (0.5 mm-thick die) capable of forming an article having a thickness of 0.5 mm in a press heated to 170°C.

<Evaluation Method>

[0077] The plasticizing effect was evaluated by measuring 100% modulus (tensile stress at 100% elongation) and tensile elongation in accordance with JIS K6251.

Specifically, the 0.5 mm-thick sheet was subjected to tensile testing under the conditions below to measure 100% modulus and tensile elongation. The tensile elongation (in percentage) was determined by subtracting the initial distance between chucks (20 mm) from the distance between chucks at which tensile fracture of the 0.5 mm-thick sheet occurred, and dividing the difference by the distance between chucks (20 mm).

Measurement device: "TENSILON Universal Material Testing Instrument" manufactured by ORIENTEC CORPORATION

Sample shape: No. 3 Dumbbell

Distance between chucks: 20 mm

Tensile rate: 200 mm/min

Measurement atmosphere: temperature of 23°C, humidity of 50%

[0078] A lower 100% modulus corresponds to a higher effect in plasticizing the vinyl chloride resin. Also, a higher tensile elongation corresponds to a higher effect in plasticizing the vinyl chloride resin.

· Evaluation of heat resistance of article formed of vinyl chloride resin composition

<Conditions for forming article>

[0079] The vinyl chloride resin composition 1) was kneaded for 10 minutes in a two-roll mill heated to 170°C, and the kneaded vinyl chloride resin composition 1) was formed into a sheet having a thickness of 0.5 mm using a die (0.5 mm-thick die) capable of forming an article having a thickness of 0.5 mm in a press heated to 170°C. No. 3 dumbbells (dumbbell specimens) were prepared from the 0.5 mm-thick sheet in accordance with JIS K6251.

<Evaluation Method>

[0080] A heat aging test was performed in accordance with JIS K6257. The test conditions included 120°C for 168 hours. The mass of each dumbbell specimen before and after the heat aging test was measured to calculate the difference (decrease) in mass before and after the heat aging test (as a percentage on the basis of the mass before the heat aging test). A smaller value indicates that the plasticizer for vinyl chloride resins had a greater tendency to remain in the article even after the heat aging test, and thus the heat resistance effect of the plasticizer for vinyl chloride resins could be expected.

[0081] In addition, a tensile test was performed under the conditions of JIS K6251 before and after the heat aging test to determine the elongation of the dumbbell specimens before and after the heat aging test. Then, the elongation (retention of elongation) after the heat aging test relative to the elongation before the heat aging test (=100%) of the dumbbell specimens was calculated. A greater retention of elongation indicates that the plasticizing effect had a greater tendency to be maintained even after the heat aging test, and the vinyl chloride resin composition was considered to have higher heat resistance.

· Evaluation of cold resistance of article formed of vinyl chloride resin composition

<Conditions for forming article>

[0082] The vinyl chloride resin composition 1) was kneaded for 10 minutes in a two-roll mill heated to 170°C, and the kneaded vinyl chloride resin composition 1) was formed into a sheet having a thickness of 1.0 mm using a die (1.0 mm-thick die) capable of forming an article having a thickness of 1.0 mm in a press heated to 170°C. Specimens were prepared from the 1.0 mm-thick sheet in accordance with JIS K6745.

<Evaluation Method>

[0083] Cold resistance was evaluated using a Clash-Berg torsion flexibility tester in accordance with JIS K6745. A lower temperature indicates a higher cold resistance.

· Evaluation of Compatibility

<Conditions for forming article>

[0084] The vinyl chloride resin composition 1) was kneaded for 10 minutes in a two-roll mill heated to 170°C, and the kneaded vinyl chloride resin composition 1) was formed into a sheet having a thickness of 1.0 mm using a die (1.0 mm-thick die) capable of forming an article having a thickness of 1.0 mm in a press heated to 170°C. Two 1.0 mm-thick sheets having a size of 5 cm × 5 cm were cut out from the sheet.

<Evaluation Method>

[0085] The two sheets were overlapped on each other and left at 70°C and 95% r. h. for 30 days. After that, the outer surfaces of the sheets and the overlapping surfaces of the sheets were evaluated based on the following criteria.

Good: When the outer surfaces of the sheets and the overlapping surfaces of the sheets were visually observed, there were no powdery, viscous, or other foreign bodies (bleeding), and no bleeding was observed even when the outer surfaces of the sheets and the overlapping surfaces of the sheets were touched by fingers.

Poor: Bleeding was observed when the outer surfaces of the sheets and the overlapping surfaces of the sheets were visually observed or when the outer surfaces of the sheets and the overlapping surfaces of the sheets were touched by fingers.

Example 6 (same as above)

[0086] A vinyl chloride resin composition 2) was prepared in the same manner as in Example 5, except that 50 parts of plasticizer B prepared in Example 2 was used instead of 50 parts of plasticizer A prepared in Example 1. The composition was evaluated in the same manner as in Example 5, and the results are shown in Table 1.

Example 7 (same as above)

[0087] A vinyl chloride resin composition 3) was prepared in the same manner as in Example 5, except that 50 parts of plasticizer C prepared in Example 3 was used instead of 50 parts of plasticizer A prepared in Example 1. The composition was evaluated in the same manner as in Example 5, and the results are shown in Table 1.

Example 8 (same as above)

[0088] A vinyl chloride resin composition 4) was prepared in the same manner as in Example 5, except that 50 parts of plasticizer D prepared in Example 4 was used instead of 50 parts of plasticizer A prepared in Example 1. The composition was evaluated in the same manner as in Example 5, and the results are shown in Table 1.

Comparative Example 4 (vinyl chloride resin composition for comparison)

[0089] A vinyl chloride resin composition 5) was prepared in the same manner as in Example 5, except that 50 parts of plasticizer E prepared in Comparative Example 1 was used instead of 50 parts of plasticizer A prepared in Example 1. The composition was evaluated in the same manner as in Example 5, and the results are shown in Table 2.

Comparative Example 5 (same as above)

[0090] A vinyl chloride resin composition 6) was prepared in the same manner as in Example 5, except that 50 parts of plasticizer F prepared in Comparative Example 2 was used instead of 50 parts of plasticizer A prepared in Example 1. The composition was evaluated in the same manner as in Example 5, and the results are shown in Table 2.

Comparative Example 6 (same as above)

[0091] A vinyl chloride resin composition 7) was prepared in the same manner as in Example 5, except that 50 parts of plasticizer G prepared in Comparative Example 3 was used instead of 50 parts of plasticizer A prepared in Example 1. The composition was evaluated in the same manner as in Example 5, and the results are shown in Table 2.

[0092] [Table 1]

Evaluation item	Example 5	Example 6	Example 7	Example 8
Type of plasticizer	Plasticizer A (Example 1)	Plasticizer B (Example 2)	Plasticizer C (Example 3)	Plasticizer D (Example 4)
Plasticizing effect〔100% Modulus (MPa)〕	12.5	12.5	12.2	13.4
Plasticizing effect〔Elongation (%)〕	332	343	363	340
Heat resistance〔Decrease (%) after heat aging〕	6.7	5.7	5.8	4.7
Heat Resistance〔Retention of elongation (%)〕	88	91	92	95
C/B Cold flex temperature (°C)	−34	−34	−35	−37
Compatibility (Presence or absence of bleeding)	Good	Good	Good	Good
Raw materials (Availability, cost)	Good	Good	Good	Good

[0093] [Table 2]

Evaluation item	Comparative Example 4	Comparative Example 5	Comparative Example 6
Type of plasticizer	Plasticizer E (Comparative Example 1)	Plasticizer F (Comparative Example 2)	Plasticizer G (Comparative Example 3)
Plasticizing effect [100% Modulus (MPa)]	12.0	12.7	14.3
Plasticizing effect [Elongation (%)]	325	348	270
Heat resistance [Decrease (%) after heat aging]	10.2	6.8	0.6
Heat Resistance [Retention of elongation (%)]	1	7	108
C/B Cold flex temperature (°C)	-28	-32	-38
Compatibility (Presence or absence of bleeding)	Good	Good	Poor

[0094] As can be seen from the results shown in Tables 1 and 2, plasticizers for vinyl chloride resins according to the present invention had excellent compatibility with a vinyl chloride resin and were used to provide vinyl chloride resin compositions capable of being formed into articles having excellent heat resistance and cold resistance. Thus, it was demonstrated that the plasticizer for vinyl chloride resins of the present invention has good compatibility with vinyl chloride resins and may be used to provide a vinyl chloride resin composition that can maintain plasticity, even when exposed to a high or low temperature environment. Further, the plasticizer for vinyl chloride resins of the present invention, which is made from inexpensive and easily available alcohols, solves the problem of cost of raw materials.

Claims

[Claim 1] A plasticizer for vinyl chloride resins, comprising

A1) an ester compound produced by reaction of a1) at least one compound selected from the group consisting of divalent to tetravalent aromatic carboxylic acids, and alkyl esters and anhydrides thereof, with a2) an alcohol mixture containing 2-propylheptanol, n-decanol, and n-dodecanol.

[Claim 2] The plasticizer for vinyl chloride resins according to claim 1, wherein the compound a1) is at least one selected from the group consisting of phthalic acid, isophthalic acid, terephthalic acid, and alkyl esters thereof, and phthalic anhydride.

[Claim 3] The plasticizer for vinyl chloride resins according to claim 1 or 2, wherein the alcohol mixture a2) contains, based on 100 mol% of the mixture, 20 to 70 mol% of 2-propylheptanol, 10 to 60 mol% of n-decanol, and 20 to 70 mol% of n-dodecanol.

[Claim 4] The plasticizer for vinyl chloride resins according to claim 1 or 2, wherein the alcohol mixture a2) contains, based on 100 mol% of the mixture, 20 to 50 mol% of 2-propylheptanol, 10 to 60 mol% of n-decanol, and 20 to 50 mol% of n-dodecanol.

[Claim 5] The plasticizer for vinyl chloride resins according to any one of claims 1 to 4, wherein the alcohol mixture a2) has an average carbon number of 10.4 to 11.4.

[Claim 6] The plasticizer for vinyl chloride resins according to any one of claims 1 to 4, wherein the alcohol mixture a2) has an average carbon number of 10.4 to 11.0.

[Claim 7] The plasticizer for vinyl chloride resins according to any one of claims 1 to 6, wherein the alcohol mixture a2) has an average linearity of 50 to 95%.

[Claim 8] The plasticizer for vinyl chloride resins according to any one of claims 1 to 6, wherein the alcohol mixture a2) has an average linearity of 60 to 85%.

[Claim 9] A vinyl chloride resin composition, comprising: X) the plasticizer for vinyl chloride resins according to any one of claims 1 to 8; and Y) a vinyl chloride resin.

[Claim 10] The vinyl chloride resin composition according to claim 9, wherein the plasticizer for vinyl chloride resins X) is present in an amount of 10 to 100 parts by mass per 100 parts by mass of the vinyl chloride resin Y).

[Claim 11] An electric wire, comprising a conductive wire coated with the vinyl chloride resin composition according to claim 9 or 10.

[Claim 12] A vehicle interior material, formed from the vinyl chloride resin composition according to claim 9 or 10.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/057909

A. CLASSIFICATION OF SUBJECT MATTER
INV. C08K5/12 B60K37/00 B62D25/04 C07C67/00 C07C69/76
ADD.

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)
C08K B62D C07C B60K

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)

EPO-Internal, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 3 339 368 A1 (DAINIPPON INK & CHEMICALS [JP]) 27 June 2018 (2018-06-27) claim 11 examples 8, 9 -----	1-12
Y	WO 2016/115257 A2 (LAWTER INC [US]) 21 July 2016 (2016-07-21) claims 13, 18 -----	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Gerber, Myriam

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2018/057909

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3339368 A1	27-06-2018	CN 107922700 A	17-04-2018
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