

SPECIFICATION

HYDROTALCITE-TYPE COMPOUND PARTICLES, AND STABILIZER
FOR CHLORINE-CONTAINING RESINS AND CHLORINE-CONTAINING
RESIN COMPOSITION USING THE PARTICLES

TECHNICAL FIELD

[0001]

The present invention relates to hydrotalcite-type compound particles capable of providing a chlorine-containing resin composition which is free from deterioration in electrical insulating property thereof owing to inclusion of the hydrotalcite-type compound particles, and capable of allowing a chlorine-containing resin in the composition to exhibit an excellent thermal stability and preventing the resin from suffering from undesirable coloration.

BACKGROUND ART

[0002]

In recent years, Pb and Sn conventionally used as a stabilizer for chlorine-containing resins have now been replaced with harmless combination of a metal soap and a hydrotalcite-type compound. The materials using the chlorine-containing resins have been used in various applications such as electric wire sheathing, films, building materials and pipes.

[0003]

Hydrotalcites are generally in the form of a layered compound represented by the formula: $\text{Mg}_6\text{Al}_2(\text{OH})_{16}\text{CO}_3 \cdot 4\text{H}_2\text{O}$ in which CO_3 , H_2O and OH^- are inserted between the layers comprising Mg-Al. A part or whole of Mg^{2+} in the structure may be substituted with a divalent cation such as Ni^{2+} , Zn^{2+} , Sr^{2+} and Ca^{2+} , and a part or whole of Al^{3+} in the structure may also be substituted with a trivalent cation such as Fe^{3+} and Cr^{3+} . Further, CO_3^{2-} may be substituted with an anion such as SO_4^{2-} and Cl^- . In addition, in general, the hydrotalcites can maintain their structure even when the molar ratios of the divalent and trivalent cations are varied, and can retain the layered structure when the molar ratios lie within the range of 2 to 4. The layered compounds in which the composition of these constitutional elements or the ratios of the divalent and trivalent cations are varied, are generally called hydrotalcite-type compounds.

[0004]

In particular, the conventional stabilizers used in the applications of electric wire sheathing have been rapidly replaced with those comprising the hydrotalcite-type compounds. However, when using the hydrotalcite-type compounds in the stabilizers used in the electric wire sheathing applications, the resulting electric wires tend to deteriorated in electric resistance thereof. Although

low-voltage electric wires using the hydrotalcite-type compounds are still kept in an acceptable level for practical use, high-voltage electric wires using the hydrotalcite-type compounds tend to suffer from significant leak, thereby rendering the electric wires practically unusable. For this reason, in the high-voltage electric wires, Pb-based stabilizers having a high electrical insulating property have been still used.

[0005]

However, in view of environmental suitability, it is required to use Pb-free stabilizers even in the high-voltage electric wires. Therefore, there is an increasing demand for hydrotalcite-type compounds which can maintain a high electrical insulating property.

[0006]

In general, aqueous solutions, etc., in which a larger amount of ions are dissolved can exhibit a higher electric conductivity. Also, resins comprising a larger amount of conductive ions can exhibit a higher electric conductivity. In other words, as the amount of the conductive ions in the resins increases, the electrical insulating property of the resins is lowered.

[0007]

The hydrotalcite-type compound particles comprise a trace amount of impurity ions such as a sulfate ion and a sodium ion in their structure or near the surface thereof.

It is considered that these impurity ions cause deterioration in electrical insulating property. Also, these impurity ions tend to cause undesirable coloration or deterioration in thermal stability of resins.

[0008]

Hitherto, it is known that the hydrotalcite-type compounds are employed as a stabilizer for chlorine-containing resins (Patent Documents 1 to 3). It is also known that when the content of sodium in the hydrotalcite-type compounds is small, an electric resistance thereof tends to be increased (Patent Documents 2 and 3).

[0009]

Patent Document 1: Japanese Patent Application Laid-open (KOKAI) No. 2000-290451

Patent Document 2: Japanese Patent Application Laid-open (KOKAI) No. 2007-106620

Patent Document 3: PCT Pamphlet WO 2006/043352

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0010]

The hydrotalcite-type compound particles described in Patent Documents 1 to 3 not only tend to be still insufficient in electrical insulating property, but also tend to hardly exhibit an excellent function as a stabilizer for chlorine-containing resin compositions.

[0011]

In view of the above conventional problems, an object or technical task of the present invention is to provide hydrotalcite-type compound particles which comprise a less amount of conductive ions eluted out therefrom, and a resin composition comprising the hydrotalcite-type compound particles which can exhibit a high electrical insulating property.

MEANS FOR SOLVING PROBLEMS

[0012]

The above object or technical task of the present invention can be achieved by the following inventions.

[0013]

That is, according to the present invention, there are provided Mg-Al-based or Mg-Zn-Al-based hydrotalcite-type compound particles comprising soluble anions in a total amount of not more than 70 ppm (Invention 1).

[0014]

Also, according to the present invention, there are provided the Mg-Al-based or Mg-Zn-Al-based hydrotalcite-type compound particles as described in the above Invention 1, wherein a content of sodium in the particles is not more than 700 ppm (Invention 2).

[0015]

Further, according to the present invention, there is

provided a stabilizer for chlorine-containing resins comprising the hydrotalcite-type compound particles as described in the above Invention 1 or 2, for stabilizing a chlorine-containing resin composition (Invention 3).

[0016]

Furthermore, according to the present invention, there is provided a chlorine-containing resin composition comprising a chlorine-containing resin and the hydrotalcite-type compound particles as described in the above Invention 1 or 2 which are incorporated in the chlorine-containing resin (Invention 4).

[0017]

Furthermore, according to the present invention, there is provided a chlorine-containing resin composition comprising a chlorine-containing resin and the hydrotalcite-type compound particles as described in the above Invention 1 or 2 which are incorporated in the chlorine-containing resin (Invention 5).

[0018]

In addition, according to the present invention, there is provided a process for producing the hydrotalcite-type compound particles as described in the above Invention 1 or 2, comprising the steps of adjusting a pH value of a slurry obtained after producing and aging the hydrotalcite-type compound particles to 9.5 to 12; and then subjecting the hydrotalcite-type compound particles

to washing and drying (Invention 6).

[0019]

Also, according to the present invention, there is provided the process as described in the above Invention 5, wherein the washing step comprising washing the hydrotalcite-type compound particles with a dilute alkali aqueous solution and then with water (Invention 7).

[0020]

Also, according to the present invention, there is provided the process as described in the above Invention 6, wherein the dilute alkali aqueous solution and/or water used in the washing step has a temperature of 30 to 90°C (Invention 8).

EFFECT OF THE INVENTION

[0021]

By using the hydrotalcite-type compound particles according to the present invention which have a less amount of conductive ions eluted out therefrom, it is possible to impart a high electrical insulating property to resins, and improve a thermal stability and coloration thereof.

PREFERRED EMBODIMENTS FOR CARRYING OUT THE INVENTION

[0022]

First, the hydrotalcite-type compound particles

according to the present invention are described.

[0023]

In the hydrotalcite-type compound particles according to the present invention which have a less amount of conductive ions eluted out therefrom, the hydrotalcite-type compound used therein is constituted from Mg, Al, Zn, etc., and generally referred to as an Mg-Al-based hydrotalcite compound or an Mg-Zn-Al-based hydrotalcite compound.

[0024]

The composition of the hydrotalcite-type compound particles according to the present invention is not particularly limited. For example, as generally known in the art, a molar ratio of Mg to Al (Mg/Al) in the particles is preferably 1.0 to 3.5. Also, in the Mg-Al-Zn-based particles, a molar ratio of zinc to a sum of Mg and Al is preferably 0.0010 to 0.30, and a molar ratio of Zn to Al (Zn/Al) is preferably about 0.005 to about 0.5.

[0025]

The total amount of soluble anions (including soluble sulfate ions, soluble nitrate ions and soluble chloride ions) which are present in the hydrotalcite-type compound particles according to the present invention is not more than 70 ppm. When the content of the soluble anions in the particles is too large, the hydrotalcite-type compound particles may fail to exhibit a high electrical insulating

property. In particular, the divalent sulfate ions tend to have a larger adverse influence on the electrical insulating property as compared to monovalent ions. The content of the soluble anions in the hydrotalcite-type compound particles is preferably not more than 60 ppm and more preferably not more than 50 ppm. Meanwhile, the lower limit of the content of the soluble anions in the hydrotalcite-type compound particles is usually about 5 ppm.

[0026]

The content of sodium in the hydrotalcite-type compound particles according to the present invention is preferably not more than 700 ppm. When the sodium content is small, the amount of sodium dissolved out from the particles also tends to be reduced. Although the sodium ions have a less influence on electrical insulating property than the soluble anions, the less sodium content may lead to a higher electrical insulating property. The content of sodium in the hydrotalcite-type compound particles is preferably not more than 600 ppm and more preferably not more than 550 ppm. Meanwhile, the lower limit of the sodium content in the hydrotalcite-type compound particles is usually about 20 ppm.

[0027]

The hydrotalcite-type compound particles according to the present invention have a specific surface area of 5 to

150 m²/g. The hydrotalcite-type compound particles having a specific surface area of less than 5 m²/g tend to be difficult to produce industrially. The hydrotalcite-type compound particles having a specific surface area of more than 150 m²/g also tend to be difficult to produce industrially. The specific surface area of the hydrotalcite-type compound particles is preferably 7 to 100 m²/g and more preferably 8 to 50 m²/g.

[0028]

The hydrotalcite-type compound particles according to the present invention may comprise calcium in an amount of about 0.01 to about 5% by weight.

[0029]

The hydrotalcite-type compound particles according to the present invention may also comprise zinc oxide in an amount of about 0.01 to about 8% by weight.

[0030]

The hydrotalcite-type compound particles according to the present invention have an average plate surface diameter of 0.05 to 0.8 μ m.

[0031]

Next, the process for producing the hydrotalcite-type compound particles according to the present invention is described.

[0032]

As the hydrotalcite-type compound particles according

to the present invention, there are desirably used those particles obtained by subjecting the core particles to growth reaction under normal pressures (refer to Japanese Patent Application Laid-open (KOKAI) No. 2002-293535) or those particles produced in an autoclave at a temperature of 105 to 350°C, more specifically, for example, Mg-Al-based hydrotalcite-type compound particles obtained by such a method in which an anion-containing alkaline aqueous solution, a magnesium salt aqueous solution and an aluminum salt aqueous solution are mixed with each other to prepare a mixed solution having a pH value in the range of 10 to 14; the resulting mixed solution is aged in a temperature range of 80 to 105°C to produce core particles of Mg-Al-based hydrotalcite-type particles; next, an aqueous suspension comprising the core particles is mixed with a magnesium salt aqueous solution and an aluminum salt aqueous solution comprising magnesium and aluminum such that a total molar amount of magnesium and aluminum is not more than 0.35 time a total molar amount of the above magnesium and aluminum added upon production of the core particles; and then the resulting slurry is aged in a temperature range of 60 to 105°C while maintaining a pH value of 10 to 14 to obtain the Mg-Al-based hydrotalcite-type compound particles. These hydrotalcite-type compound particles may be produced, for example, from raw materials such as metal sulfates, metal nitrates, metal chlorides

and metal oxides comprising Mg, Al and Zn, an alkali such as sodium hydroxide and potassium hydroxide, and an anion source raw material such as sodium carbonate, basic magnesium carbonate and potassium carbonate.

[0033]

In order to produce the hydrotalcite-type compound particles which have a less content of soluble anions (including soluble sulfate ions, soluble nitrate ions and soluble chloride ions), a pH value of a slurry obtained after producing and aging the aimed hydrotalcite-type compound particles, or a pH value of a slurry obtained after subjecting the particles to various treatments such as hydrophobic surface treatment, is preferably adjusted to the range of 9.5 to 12, and more preferably 9.8 to 11.5. When the pH value of the slurry is adjusted to the above-specified range, the content of the anions such as sulfate ions tends to be readily reduced by washing (water-washing). Although sodium is relatively easily removed by washing with water, it may be difficult to reduce the contents of soluble sulfate ions, soluble nitrate ions and soluble chloride ions only by washing with water. For this reason, upon washing, the hydrotalcite-type compound particles are first washed with a dilute alkali aqueous solution to reduce the content of the anions such as sulfate ions, and then washed with water, whereby the content of the anions such as sulfate ions tends to be

readily reduced. As the dilute alkali aqueous solution used for adjusting a pH value of the slurry comprising the hydrotalcite-type compound particles or for washing the particles before the water-washing, there may be used aqueous solutions of alkalis such as sodium hydroxide and sodium carbonate.

[0034]

Further, the dilute alkali aqueous solution and/or water used upon the water-washing preferably have a temperature of 30 to 90°C. When using the dilute alkali aqueous solution and/or water whose temperature lies within the above-specified range, the velocity of diffusion of the ions can be enhanced, and further the viscosity of water can be reduced, thereby attaining a high water-washing effect. The temperature of the dilute alkali aqueous solution and/or water is more preferably 40 to 70°C.

[0035]

The thus obtained hydrotalcite-type compound particles are preferably dried at a temperature of basically 105 to 150°C. When the drying temperature is less than 105°C, the resulting resin composition tends to suffer from foaming inside of the resin owing to a large content of water in the hydrotalcite-type compound particles, and further a prolonged drying time tends to be required for drying the resin composition, resulting in

uneconomical procedure. When the drying temperature is more than 150°C, the effect of suppressing deterioration of resins when used as a stabilizer for soft to semi-hard chlorine-containing resin compositions tends to be lowered. When using the hydrotalcite-type compound particles as the stabilizer for soft to semi-hard chlorine-containing resin compositions, the drying temperature of the hydrotalcite-type compound particles is preferably 105 to 130°C. The drying may be performed for a necessary period of time according to an amount of the particles to be dried or a drying method, and the drying time is preferably 3 to 24 hr.

[0036]

Next, the stabilizer for chlorine-containing resins and the chlorine-containing resin composition according to the present invention are described.

[0037]

The hydrotalcite-type compound particles as described in the above Invention 1 or 2 can be used as a stabilizer for chlorine-containing resins by incorporating the particles into a chlorine-containing resin composition.

[0038]

The chlorine-containing resin composition of the present invention preferably comprises 100 parts by weight of a resin and 0.1 to 10 parts by weight of the hydrotalcite-type compound particles which are

incorporated in the resin. When the content of the hydrotalcite-type compound particles in the resin composition is less than 0.1 part by weight, the effect of the particles as the stabilizer tends to be lowered. When the content of the hydrotalcite-type compound particles in the resin composition is more than 10 part by weight, the above effect as the stabilizer tends to be already saturated, and therefore the addition of more than necessary amount of the particles tends to become meaningless. Further, if the hydrotalcite-type particles are added in such a more than necessary amount, the obtained resin composition tends to suffer from foaming, resulting in adverse influences such as poor appearance and undesirable early coloration thereof.

[0039]

In addition, a plasticizer, and other stabilizers and additives may be added to the resin, if required.

[0040]

Examples of the suitable plasticizer include trimellitic acid ester-based plasticizers such as trioctyl trimellitate (TOTM) and tri-n-octyl-n-decyl trimellitate, phthalic acid ester-based plasticizers such as diisodecyl phthalate (DIDP), diisononyl phthalate (DINP) and di-2-ethylhexyl phthalate (DOP), and polyester-based plasticizers such as polypropylene adipate and polypropylene sebacate.

[0041]

Examples of the suitable other stabilizers include zinc compounds such as zinc stearate, zinc laurate and zinc ricinoleate; β -diketones such as dibenzoyl methane, stearyl benzoyl methane and dehydroacetic acid; phosphites such as alkyl allyl phosphates and trialkyl phosphates; polyhydric alcohol-based compounds such as dipentaerythritol, pentaerythritol, glycerol, diglycerol and trimethylol propane; higher fatty acids such as stearic acid, lauric acid and oleic acid; and epoxy-based compounds such as epoxidized linseed oil and epoxidized soybean oil.

[0042]

Examples of the other additives include antioxidants such as phenol-based compounds, amine-based compounds and phosphoric acid-based compounds; gelling promoters such as those compounds obtained by replacing a terminal end of polyesters with a OH group, acrylonitrile-styrene copolymers and methyl methacrylate-styrene copolymers; fillers such as calcium carbonate, silica, glass beads, mica and glass fibers; flame retardants such as inorganic flame retardants, e.g., antimony trioxide, aluminum hydroxide and zinc borate, bromine-containing organic flame retardants and halogen-containing phosphoric acid ester-based flame retardants; lubricants such as stearic acid, polyethylene wax, calcium stearate, magnesium

stearate and barium stearate; and mildew-proof agents such as Triclosan, Orthocide, Sanaisole 100 and Sanaisole 300.

[0043]

When the hydrotalcite-type compound particles are used in the chlorine-containing resin composition, the surface of the respective hydrotalcite-type compound particles is preferably treated with at least one compound selected from the group consisting of higher fatty acids, anionic surfactants, phosphoric acid esters of higher fatty acids, coupling agents and polyhydric alcohol esters. With the surface treatment, the chlorine-containing resin composition can be further improved in stability.

[0044]

Examples of the higher fatty acids include lauric acid, stearic acid, palmitic acid, oleic acid and linolic acid. Examples of the phosphoric acid esters of higher fatty acids include stearyl ether phosphate, oleyl ether phosphate and lauryl ether phosphate. Examples of the polyhydric alcohol esters include sorbitan monooleate, sorbitan monolaurate and stearic acid monoglyceride.

[0045]

Examples of the anionic surfactants include salts such as sodium laurylsulfate, sodium dodecylbenzenesulfonate, sodium stearate, potassium oleate and potassium castor oil.

[0046]

Examples of the coupling agents include silane-based coupling agents, aluminum-based coupling agents, titanium-based coupling agents and zirconium-based coupling agents.

[0047]

The method for treating the hydrotalcite-type compound particles with the above surface-treating agents is not particularly limited. The hydrotalcite-type compound particles may be subjected to wet reaction with the surface-treating agents. Alternatively, the hydrotalcite-type compound particles may be subjected to dry surface treatment with the surface-treating agents using a Henschel mixer, etc., or the hydrotalcite-type compound particles may be simply mixed with the surface-treating agents.

[0048]

In the case where the chlorine-containing resin composition of the present invention is in the form of a hard or semi-hard material comprising no plasticizer or a very small amount of the plasticizer, when the hydrotalcite-type compound particles according to the present invention are used in the chlorine-containing resin composition comprising the following components, the time required until reaching Level 3 as shown in the below-mentioned coloration level is not shorter than 65 min and the time required until reaching Level 5 as shown in the below-mentioned coloration level is not shorter

than 100 min under such a condition that the composition comprises 0.8 part by weight of zinc stearate.

[0049]

Chlorine-containing resin (polymerization degree: 1000):

"Taiyo PVC TH1000" produced by Taiyo Vinyl Chloride Co., Ltd. 100 parts by weight

Di-2-ethylhexyl phthalate ("DOP" produced by Dai-Hachi Kagaku Co., Ltd.) 0 to 25 parts by weight

Hydrotalcite-type compound particles

3.5 parts by weight

Zinc stearate (general reagent)

0.6 to 0.9 part by weight

[0050]

Also, in the case where the chlorine-containing resin composition is in the form of a soft material comprising a large amount of the plasticizer, when the hydrotalcite-type compound particles according to the present invention are used in the chlorine-containing resin composition comprising the following components, the time required until reaching Level 3 as shown in the below-mentioned coloration level is not shorter than 65 min and the time required until reaching Level 5 as shown in the below-mentioned coloration level is not shorter than 100 min.

[0051]

Chlorine-containing resin (polymerization degree: 1000):

"Taiyo PVC TH1000" produced by Taiyo Vinyl Chloride

Co., Ltd.	100 parts by weight
Di-2-ethylhexyl phthalate ("DOP" produced by Dai-Hachi Kagaku Co., Ltd.)	40 to 80 parts by weight
Hydrotalcite-type compound particles of the present invention	3.0 parts by weight
Zinc stearate (general reagent)	0.6 part by weight

[0052]

The volume resistivity of the chlorine-containing resin composition according to the present invention may vary depending upon the aimed applications thereof, and is preferably not less than $2.0 \times 10^{14} \Omega \cdot \text{cm}$.

[0053]

Next, the process for producing the chlorine-containing resin composition according to the present invention is described.

[0054]

The chlorine-containing resin composition according to the present invention may be produced by an ordinary method. For example, in the case where the composition is formed into a kneaded sheet, the resin, the hydrotalcite-type compound particles, and various stabilizers and additives described above, are mixed with each other at predetermined ratios, and the resulting mixture is kneaded by heated rolls to obtain a kneaded sheet. Then, the obtained sheet is subjected to pressing treatment using a hot press, thereby obtaining the aimed kneaded sheet. The

kneading temperature of the heated rolls may vary depending upon the resin or resin composition to be kneaded thereby, and is preferably 140 to 300°C. The pressing temperature of the hot press is preferably 145 to 320°C.

[0055]

<Function>

When using the hydrotalcite-type compound particles according to the present invention, it is possible to suppress deterioration in electrical insulating property of resins, and further to enhance a thermal stability of the resins and suppress undesirable coloration of the resins.

[0056]

That is, in the case where the hydrotalcite-type compound particles according to the present invention which have a less content of soluble anions having an electrical conductivity such as soluble sulfate ions, soluble nitrate ions and soluble chloride ions are used as a stabilizer for resins, it is possible to produce a resin composition having a high electrical insulating property. In addition, burning of the resins owing to the salts can be suppressed, so that it becomes possible to obtain a resin composition having a high thermal stability which is free from occurrence of undesirable coloration. In addition, when the hydrotalcite-type compound particles

have a less sodium content, still higher effects can be attained.

EXAMPLES

[0057]

Typical Examples of the present invention are as follows.

[0058]

The contents of the respective elements such as sodium, magnesium, aluminum, zinc and calcium were determined by dissolving a sample with an acid and analyzing the resulting solution with yttrium as an internal standard using a plasma emission spectroscopic analyzer "iCAP6500" manufactured by Thermo-Electron Co., Ltd.

[0059]

The method for measuring contents of soluble anions is described below. That is, 5 g of a sample was intimately dispersed in 40 mL of ethanol, and 100 mL of ultrapure water were further added to the resulting dispersion, followed by shaking the dispersion in a closed container for 1 min. The obtained mixture was allowed to stand as such at 22°C for 20 hr, and then the resulting slurry was filtered to separate a filtrate therefrom. The thus separated filtrate was boiled for 60 min while replenishing ultrapure water, to evaporate ethanol

therefrom, and then cooled, and further ultrapure water was added to the obtained reaction solution to adjust a liquid volume thereof to 100 mL. The thus obtained reaction solution was analyzed using an ion chromatographic analyzer "ICA-2000" produced by Toa D.K.K. Co., Ltd., to measure respective contents of sulfate ions, nitrate ions and chloride ions therein.

[0060]

The specific surface area of the particles was measured by a B.E.T. method using nitrogen.

[0061]

The roll-kneading of the resin was performed as follows. That is, the resin was kneaded using a 6-inch twin roll-type kneader. The kneading temperature was controlled to a temperature range of 140 to 190°C according to the resin composition to be kneaded, and the kneading time was adjusted to 5 min.

[0062]

The sheet thus obtained by the above roll-kneading was subjected to compression-molding to form a compression-molded product having a size of 200 mm x 200 mm x 1 to 1.5 mm. The apparatus used for production of the compression-molded product was provided therein with a 70-t automatic press (ram area: 210 cm²) as a heating press and a 30-t manual press (ram area: 180 cm²) as a cooling press. The compression-molding was conducted under such a

condition that the sheet was successively subjected to pre-heating (under no pressure) for 3 min and pressing (under 6.3 MPa) for 2 min at a temperature of 140 to 190°C, and then to cooling (under 3.1 MPa) for 3 min.

[0063]

The obtained sheet was subjected to measurement of electric resistance (electrical insulating property) thereof. Specifically, the resin-pressed sheet having a thickness of 1.0 mm was prepared, and then stored in a desiccator maintained at a temperature of 30°C and a humidity of 60% for one day. Thereafter, a volume resistivity value ($\Omega \cdot \text{cm}$) of the thus treated sheet was measured according to JIS K 6723.

[0064]

The thermal stability test was performed by using a Geer oven aging tester "102-SHF-77S" manufactured by Yasuda Seiki Seisakusho Co., Ltd. The pressed sheet was cut into a test piece having a size of 30 mm x 30 mm. The obtained test piece was placed on a glass plate and subjected to the aging test at 190°C for 200 min. During the aging test, the two test pieces per one sample were taken out from the tester every 10 min and attached onto a recording paper.

[0065]

The coloration level of each of the pressed sheet and the test pieces for thermal stability test was defined by

the following Levels 1 to 7.

[0066]

Level 1: Substantially no coloration was recognized

Level 2: Light brown coloration was recognized

Level 3: Brown coloration was recognized

Level 4: Partially carbonized or blackened

Level 5: Entirely carbonized or blackened

[0067]

Next, the present invention is described by the following Examples and Comparative Examples.

[0068]

Example 1:

(Production of hydrotalcite-type compound particles)

A slurry prepared by dispersing 26.9 g of magnesium oxide in pure water and an aqueous solution comprising 81.0 g of aluminum sulfate octahydrate were mixed with each other while stirring. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 58.3 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared slurry comprising a mixture of the magnesium oxide and aluminum sulfate octahydrate, and the resulting mixed solution was heated to 80°C, followed by stirring the mixed solution at 80°C for 5 hr. The total

volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 175°C for 4 hr while stirring.

[0069]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 67°C while stirring, and the pH value of the slurry was controlled to 10.3. Then, a solution prepared by dissolving 2.3 g of sodium palmitate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.7 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 40°C dilute sodium hydroxide aqueous solution having a pH value of 11.5, and then with 15 L of pure water at 40°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 11.0 m²/g.

[0070]

(Production and evaluation of chlorine-containing resin composition)

The hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0071]

Chlorine-containing resin composition	100 phr
DOP	55 phr

Zinc stearate	0.6 phr
The above sample	3.0 phr

[0072]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 80 min, and the time required until reaching Level 5 was 120 min.

[0073]

Example 2:

(Production of hydrotalcite-type compound particles)

Magnesium sulfate heptahydrate crystals, zinc sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals weighed in amounts of 141.0 g, 41.5 g and 69.4 g, respectively, were dissolved in pure water. Separately, 30.6 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 152.4 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared slurry comprising a mixture of the magnesium sulfate heptahydrate crystals, zinc sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals, and the resulting mixed solution was heated to

85°C, followed by stirring the mixed solution at 85°C for 6 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 185°C for 6 hr while stirring.

[0074]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 65°C while stirring, and the pH value of the slurry was controlled to 10.1. Then, a solution prepared by dissolving 2.5 g of sodium stearate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.6 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 50°C dilute sodium hydroxide aqueous solution having a pH value of 11 and then with 15 L of pure water at 50°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 10.0 m²/g.

[0075]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0076]

Chlorine-containing resin composition 100 phr

DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0077]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 75 min, and the time required until reaching Level 5 was 115 min.

[0078]

Example 3:

(Production of hydrotalcite-type compound particles)

Magnesium sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals weighed in amounts of 176.3 g and 69.4 g, respectively, were dissolved in pure water. Separately, 30.6 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 152.4 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals, and the resulting mixed solution was

heated to 90°C, followed by stirring the mixed solution at 90°C for 10 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 145°C for 6 hr while stirring.

[0079]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 65°C while stirring, and the pH value of the slurry was controlled to 11.2. Then, a solution prepared by dissolving 1.9 g of sodium laurate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.8 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 45°C dilute sodium hydroxide aqueous solution having a pH value of 12.5 and then with 15 L of pure water at 45°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 9.0 m²/g.

[0080]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (semi-hard composition).

[0081]

Chlorine-containing resin composition 100 phr

DOP	20 phr
Zinc stearate	0.8 phr
The above sample	3.5 phr

[0082]

The above resin composition was kneaded using rolls at 178°C for 5 min, and then subjected to compression-molding/pressing treatment at 178°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 75 min, and the time required until reaching Level 5 was 115 min.

[0083]

Example 4:

(Production of hydrotalcite-type compound particles)

Magnesium chloride hexahydrate crystals, zinc chloride monohydrate crystals and aluminum chloride hexahydrate crystals weighed in amounts of 101.9 g, 26.0 g and 80.5 g, respectively, were dissolved in pure water. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 136.1 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium chloride hexahydrate crystals, zinc chloride monohydrate

crystals and aluminum chloride hexahydrate crystals, and the resulting mixed solution was heated to 95°C, followed by stirring the mixed solution at 95°C for 8 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 165°C for 7 hr while stirring.

[0084]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 70°C while stirring, and the pH value of the slurry was controlled to 9.9. Then, a solution prepared by dissolving 2.5 g of sodium palmitate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.7 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 45°C dilute sodium hydroxide aqueous solution having a pH value of 11 and then with 16 L of pure water at 45°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 10.2 m²/g.

[0085]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0086]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0087]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 75 min, and the time required until reaching Level 5 was 120 min.

[0088]

Example 5:

(Production of hydrotalcite-type compound particles)

Magnesium chloride hexahydrate crystals and aluminum chloride hexahydrate crystals weighed in amounts of 141.0 g and 74.3 g, respectively, were dissolved in pure water. Separately, 32.9 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 163.5 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium

chloride hexahydrate crystals and aluminum chloride hexahydrate crystals, and the resulting mixed solution was heated to 75°C, followed by stirring the mixed solution at 75°C for 15 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 170°C for 9 hr while stirring.

[0089]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 70°C while stirring, and the pH value of the slurry was controlled to 10.9. Then, a solution prepared by dissolving 2.0 g of sodium laurate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.9 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 40°C dilute sodium hydroxide aqueous solution having a pH value of 12 and then with 15 L of pure water at 40°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 10.4 m²/g.

[0090]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0091]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0092]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 90 min, and the time required until reaching Level 5 was 110 min.

[0093]

Example 6:

(Production of hydrotalcite-type compound particles)

Magnesium nitrate hexahydrate crystals, zinc nitrate hexahydrate crystals and aluminum nitrate nonahydrate crystals weighed in amounts of 149.8 g, 25.0 g and 125.0 g, respectively, were dissolved in pure water. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 126.4 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a

mixture of the magnesium nitrate hexahydrate crystals, zinc nitrate hexahydrate crystals and aluminum nitrate nonahydrate crystals, and the resulting mixed solution was heated to 90°C, followed by stirring the mixed solution at 90°C for 10 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 175°C for 8 hr while stirring.

[0094]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 62°C while stirring, and the pH value of the slurry was controlled to 10.0. Then, a solution prepared by dissolving 2.5 g of sodium stearate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.6 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 45°C dilute sodium hydroxide aqueous solution having a pH value of 11.5 and then with 15 L of pure water at 45°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 9.8 m²/g.

[0095]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin

composition (soft composition).

[0096]

Chlorine-containing resin composition	100 phr
TOTM	60 phr
Zinc stearate	0.7 phr
The above sample	3.3 phr

[0097]

The above resin composition was kneaded using rolls at 162°C for 5 min, and then subjected to compression-molding/pressing treatment at 162°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 80 min, and the time required until reaching Level 5 was 110 min.

[0098]

Example 7:

(Production of hydrotalcite-type compound particles)

Magnesium nitrate hexahydrate crystals and aluminum nitrate nonahydrate crystals weighed in amounts of 171.2 g and 125.0 g, respectively, were dissolved in pure water. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 126.4 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared

aqueous solution comprising a mixture of the magnesium nitrate hexahydrate crystals and aluminum nitrate nonahydrate crystals, and the resulting mixed solution was heated to 90°C, followed by stirring the mixed solution at 90°C for 10 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 130°C for 5 hr while stirring.

[0099]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 62°C while stirring, and the pH value of the slurry was controlled to 10.0. Then, a solution prepared by dissolving 2.5 g of sodium stearate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.6 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 3 L of a 60°C dilute sodium hydroxide aqueous solution having a pH value of 11 and then with 25 L of pure water at 60°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 19.2 m²/g.

[0100]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin

composition (soft composition).

[0101]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0102]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 80 min, and the time required until reaching Level 5 was 115 min.

[0103]

Example 8:

(Production of hydrotalcite-type compound particles)

Magnesium sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals weighed in amounts of 176.3 g and 69.4 g, respectively, were dissolved in pure water. Separately, 30.6 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 152.4 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared

aqueous solution comprising a mixture of the magnesium sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals, and the resulting mixed solution was heated to 90°C, followed by stirring the mixed solution at 90°C for 10 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 145°C for 6 hr while stirring.

[0104]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 65°C while stirring, and the pH value of the slurry was controlled to 11.9. Then, a solution prepared by dissolving 1.9 g of sodium laurate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.8 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 40°C dilute sodium hydroxide aqueous solution having a pH value of 13 and then with 15 L of pure water at 45°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 9.3 m²/g.

[0105]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin

composition (semi-hard composition).

[0106]

Chlorine-containing resin composition	100 phr
DOP	20 phr
Zinc stearate	0.8 phr
The above sample	3.5 phr

[0107]

The above resin composition was kneaded using rolls at 178°C for 5 min, and then subjected to compression-molding/pressing treatment at 178°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 75 min, and the time required until reaching Level 5 was 110 min.

[0108]

Example 9:

(Production of hydrotalcite-type compound particles)

Magnesium chloride hexahydrate crystals, zinc chloride monohydrate crystals and aluminum chloride hexahydrate crystals weighed in amounts of 101.9 g, 26.0 g and 80.5 g, respectively, were dissolved in pure water. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 136.1 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali

aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium chloride hexahydrate crystals, zinc chloride monohydrate crystals and aluminum chloride hexahydrate crystals, and the resulting mixed solution was heated to 95°C, followed by stirring the mixed solution at 95°C for 8 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 165°C for 7 hr while stirring.

[0109]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 70°C while stirring, and the pH value of the slurry was controlled to 11.7. Then, a solution prepared by dissolving 2.5 g of sodium palmitate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.7 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 55°C dilute sodium hydroxide aqueous solution having a pH value of 13 and then with 16 L of pure water at 45°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 10.1 m²/g.

[0110]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0111]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0112]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 75 min, and the time required until reaching Level 5 was 110 min.

[0113]

Example 10:

(Production of hydrotalcite-type compound particles)

Magnesium chloride hexahydrate crystals and aluminum chloride hexahydrate crystals weighed in amounts of 141.0 g and 74.3 g, respectively, were dissolved in pure water. Separately, 32.9 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 203.5 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an

alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium chloride hexahydrate crystals and aluminum chloride hexahydrate crystals, and then an aqueous solution in which 4.50 g of calcium chloride dihydrate crystals were dissolved was added thereto. The resulting mixed solution was heated to 75°C, followed by stirring the mixed solution at 75°C for 15 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 170°C for 9 hr while stirring.

[0114]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 70°C while stirring, and the pH value of the slurry was controlled to 10.9. Then, a solution prepared by dissolving 2.0 g of sodium laurate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.9 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 40°C dilute sodium hydroxide aqueous solution having a pH value of 12 and then with 15 L of pure water at 40°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 10.0 m²/g, and the

molar ratio of Mg/Ca/Al therein was 2.40/0.10/1.00.

[0115]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0116]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0117]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 90 min, and the time required until reaching Level 5 was 110 min.

[0118]

Example 11:

(Production of hydrotalcite-type compound particles)

Magnesium chloride hexahydrate crystals, zinc chloride monohydrate crystals and aluminum chloride hexahydrate crystals weighed in amounts of 101.9 g, 23.4 g

and 80.5 g, respectively, were dissolved in pure water. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 136.1 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium chloride hexahydrate crystals, zinc chloride monohydrate crystals and aluminum chloride hexahydrate crystals, and the resulting mixed solution was heated to 95°C, followed by stirring the mixed solution at 95°C for 8 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 165°C for 7 hr while stirring. Thereafter, 1.4 g of zinc oxide were added to and mixed with the thus aged solution.

[0119]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 70°C while stirring, and the pH value of the slurry was controlled to 11.7. Then, a solution prepared by dissolving 2.5 g of sodium palmitate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.7 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 2 L of a 45°C dilute sodium hydroxide

aqueous solution having a pH value of 12.5 and then with 16 L of pure water at 45°C, and further dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 10.7 m²/g.

[0120]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0121]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0122]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 80 min, and the time required until reaching Level 5 was 110 min.

[0123]

Comparative Example 1:

(Production of hydrotalcite-type compound particles)

A slurry prepared by dispersing 26.9 g of magnesium oxide in pure water, and an aqueous solution comprising 81.0 g of aluminum sulfate octahydrate crystals, were mixed with each other while stirring. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 58.3 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the slurry previously prepared by mixing the magnesium oxide and aluminum sulfate octahydrate with each other, and the resulting mixed solution was heated to 80°C, followed by stirring the mixed solution at 80°C for 5 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 175°C for 4 hr while stirring.

[0124]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 72°C while stirring, and the pH value of the slurry was controlled to 8.9. Then, a solution prepared by dissolving 2.3 g of sodium palmitate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.7 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 15 L of pure water at 40°C, and then

dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 11.3 m²/g.

[0125]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0126]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0127]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 50 min, and the time required until reaching Level 5 was 90 min.

[0128]

Comparative Example 2:

(Production of hydrotalcite-type compound particles)

Magnesium sulfate heptahydrate crystals and aluminum

sulfate octahydrate crystals weighed in amounts of 176.3 g and 69.4 g, respectively, were dissolved in pure water. Separately, 30.6 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 152.4 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals. The resulting mixed solution was heated to 90°C, followed by stirring the mixed solution at 90°C for 10 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 145°C for 6 hr while stirring.

[0129]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 65°C while stirring, and the pH value of the slurry was controlled to 9.0. Then, a solution prepared by dissolving 1.9 g of sodium laurate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.8 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 15 L of pure water at 45°C, and then dried at 125°C for 8 hr. As a result, it was confirmed

that the resulting sample had a specific surface area of 9.5 m²/g.

[0130]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (semi-hard composition).

[0131]

Chlorine-containing resin composition	100 phr
DOP	20 phr
Zinc stearate	0.8 phr
The above sample	3.5 phr

[0132]

The above resin composition was kneaded using rolls at 178°C for 5 min, and then subjected to compression-molding/pressing treatment at 178°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 55 min, and the time required until reaching Level 5 was 95 min.

[0133]

Comparative Example 3:

(Production of hydrotalcite-type compound particles)

Magnesium chloride hexahydrate crystals, zinc chloride monohydrate crystals and aluminum chloride

hexahydrate crystals weighed in amounts of 101.9 g, 26.0 g and 80.5 g, respectively, were dissolved in pure water. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 136.1 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium chloride hexahydrate crystals, zinc chloride monohydrate crystals and aluminum chloride hexahydrate crystals, and the resulting mixed solution was heated to 95°C, followed by stirring the mixed solution at 95°C for 8 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 165°C for 7 hr while stirring.

[0134]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 70°C while stirring, and the pH value of the slurry was controlled to 9.1. Then, a solution prepared by dissolving 2.5 g of sodium palmitate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.7 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 16 L of pure water at 45°C, and then

dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of 9.5 m²/g.

[0135]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0136]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0137]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 60 min, and the time required until reaching Level 5 was 95 min.

[0138]

Comparative Example 4:

(Production of hydrotalcite-type compound particles)

Magnesium nitrate hexahydrate crystals and aluminum

nitrate nonahydrate crystals weighed in amounts of 171.2 g and 125.0 g, respectively, were dissolved in pure water. Separately, 35.7 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 126.4 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium nitrate hexahydrate crystals and aluminum nitrate nonahydrate crystals, and the resulting mixed solution was heated to 90°C, followed by stirring the mixed solution at 90°C for 10 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 130°C for 5 hr while stirring.

[0139]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 62°C while stirring, and the pH value of the slurry was controlled to 8.6. Then, a solution prepared by dissolving 2.5 g of sodium stearate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.6 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 25 L of pure water at 60°C, and then dried at 125°C for 8 hr. As a result, it was confirmed

that the resulting sample had a specific surface area of 18.9 m²/g.

[0140]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (soft composition).

[0141]

Chlorine-containing resin composition	100 phr
DOP	55 phr
Zinc stearate	0.6 phr
The above sample	3.0 phr

[0142]

The above resin composition was kneaded using rolls at 158°C for 5 min, and then subjected to compression-molding/pressing treatment at 158°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 60 min, and the time required until reaching Level 5 was 85 min.

[0143]

Comparative Example 5:

(Production of hydrotalcite-type compound particles)

Magnesium sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals weighed in amounts of 176.3 g

and 69.4 g, respectively, were dissolved in pure water. Separately, 30.6 g of sodium carbonate crystals were dissolved in pure water, and further the resulting solution was mixed with 122.4 mL of a sodium hydroxide aqueous solution (12 N) and pure water to prepared an alkali aqueous solution. Then, the thus obtained alkali aqueous solution was charged into the previously prepared aqueous solution comprising a mixture of the magnesium sulfate heptahydrate crystals and aluminum sulfate octahydrate crystals, and the resulting mixed solution was heated to 90°C, followed by stirring the mixed solution at 90°C for 10 hr. The total volume of the resulting reaction solution was adjusted to 1 L, and then the reaction solution was transferred into an autoclave in which the reaction solution was aged at 145°C for 6 hr while stirring. [0144]

Successively, the temperature of the thus obtained reaction slurry was adjusted to 65°C while stirring, and the pH value of the slurry was controlled to 7.4. Then, a solution prepared by dissolving 1.9 g of sodium laurate in hot water (80°C) was charged into the resulting slurry. The obtained reaction mixture was aged for 0.8 hr. The reaction mixture was filtered, and the obtained filter cake was washed with 15 L of pure water at 45°C, and then dried at 125°C for 8 hr. As a result, it was confirmed that the resulting sample had a specific surface area of

9.7 m²/g.

[0145]

(Production and evaluation of chlorine-containing resin composition)

The above hydrotalcite-type compound particles were used to produce the following chlorine-containing resin composition (semi-hard composition).

[0146]

Chlorine-containing resin composition	100 phr
DOP	20 phr
Zinc stearate	0.8 phr
The above sample	3.5 phr

[0147]

The above resin composition was kneaded using rolls at 178°C for 5 min, and then subjected to compression-molding/pressing treatment at 178°C, thereby obtaining a pressed sheet. It was confirmed that the obtained sheet exhibited such a coloration level that the time required until reaching Level 3 was 60 min, and the time required until reaching Level 5 was 95 min.

[0148]

Table 1

Examples and Comp. Examples	Mg/Zn/Al (molar ratio)	Specific surface area (m ² /g)	Soluble salts		
			SO ₄ ²⁻ (ppm)	NO ₃ ⁻ (ppm)	Cl ⁻ (ppm)
Example 1	2.0/-/1.0	11	28	3	5
Example 2	2.0/0.5/1.0	10	35	4	3
Example 3	2.5/-/1.0	9	20	2	8
Example 4	1.5/0.5/1.0	10.2	5	3	34
Example 5	2.25/-/1.0	10.4	3	1	29
Example 6	1.75/0.25/1.0	9.8	4	29	3
Example 7	2.0/-/1.0	19.2	6	34	7
Example 8	2.5/-/1.0	9.3	18	2	6
Example 9	1.5/0.5/1.0	10.1	4	3	27
Example 10	2.4/-/1.0	10.0	4	2	33
Example 11	1.5/0.5/1.0	10.7	3	5	30
Comp. Example 1	2.0/-/1.0	11.3	69	5	12
Comp. Example 2	2.5/-/1.0	9.5	101	9	16
Comp. Example 3	1.5/0.5/1.0	9.5	12	5	81
Comp. Example 4	2.0/-/1.0	18.9	8	79	9
Comp. Example 5	2.5/-/1.0	9.7	112	7	15

Table 1 (continued)

Examples and Comp. Examples	Soluble salts	Na (ppm)	Electric resistance ($\Omega \cdot \text{cm}$)	Time of thermal stability test	
	Total amount of SO_4^{2-} , NO_3^- and Cl^- (ppm)			Level 3 (min)	Level 5 (min)
Example 1	36	156	5.0×10^{14}	80	120
Example 2	42	216	4.6×10^{14}	75	115
Example 3	30	264	5.3×10^{14}	75	115
Example 4	42	204	4.9×10^{14}	75	120
Example 5	33	306	5.7×10^{14}	90	110
Example 6	36	276	8.1×10^{14}	80	110
Example 7	47	222	4.7×10^{14}	80	115
Example 8	26	540	4.5×10^{14}	75	110
Example 9	34	486	4.3×10^{14}	75	110
Example 10	39	324	5.8×10^{14}	90	110
Example 11	38	421	4.1×10^{14}	80	110
Comp. Example 1	86	809	1.1×10^{14}	50	90
Comp. Example 2	126	776	0.8×10^{14}	55	95
Comp. Example 3	98	906	1.4×10^{14}	60	95
Comp. Example 4	96	783	1.5×10^{14}	60	85
Comp. Example 5	134	32	1.9×10^{14}	60	95

INDUSTRIAL APPLICABILITY

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By using the hydrotalcite particles according to the present invention, it is possible to provide a chlorine-containing resin composition which is improved in electrical insulating property, coloration and thermal stability. Therefore, the chlorine-containing resin composition can be used in more extensive applications.

CLAIMS

1. Mg-Al-based or Mg-Zn-Al-based hydrotalcite-type compound particles comprising soluble anions in a total amount of not more than 70 ppm.
2. Mg-Al-based or Mg-Zn-Al-based hydrotalcite-type compound particles according to claim 1, wherein a content of sodium in the particles is not more than 700 ppm.
3. A stabilizer for chlorine-containing resins comprising the hydrotalcite-type compound particles as defined in claim 1 or 2, for stabilizing a chlorine-containing resin composition.
4. A chlorine-containing resin composition comprising a chlorine-containing resin and the hydrotalcite-type compound particles as defined in claim 1 or 2 which are incorporated in the chlorine-containing resin.
5. A process for producing the hydrotalcite-type compound particles as defined in claim 1 or 2, comprising the steps of adjusting a pH value of a slurry obtained after producing and aging the hydrotalcite-type compound particles to 9.5 to 12; and then subjecting the hydrotalcite-type compound particles to washing and drying.

6. A process according to claim 5, wherein the washing step comprising washing the hydrotalcite-type compound particles with a dilute alkali aqueous solution and then with water.

7. A process according to claim 6, wherein the dilute alkali aqueous solution and/or water used in the washing step has a temperature of 30 to 90°C.