DESCRIPTION

TITLE

HYDROTALCITE AND RESIN COMPOSITION COMPRISING SAME

FIELD

[0001]

The present invention relates to hydrotalcite and to a resin composition comprising it.

BACKGROUND

[0002]

Hydrotalcite is a general name for inorganic compounds that include natural mineral hydrotalcite ($Mg_6Al_2(OH)_{16}CO_3 \cdot 4H_2O$), and synthetic hydrotalcite compounds having a similar laminar crystal structure. Hydrotalcite is known to be useful as an additive for resins, serving as a heat stabilizer or deoxidizer.

[0003]

PTL 1, for example, discloses a perchlorate ion-type hydrotalcite compound obtained from the following step (a) and step (b). Step (a) is a step in which a Group IIa metal salt of perchloric acid is added to an aqueous slurry containing 1 mol of a hydrotalcite compound of the formula $M^{2+}_{1-x}Al(OH)_2 \cdot (CO_3)_{x/2} \cdot mH_2O$ [where M^{2+} represents at least one divalent metal ion selected from the group consisting of Mg, Ca, Ni, Cu and Zn, and x and m satisfy the inequalities $0 < x < 0.5$ and $0 \leq m \leq 2$], in a proportion of 0.2 to 1.0 mol. Step (b) is a step of drying the mixed product obtained in the previous step.

[0004]

With the perchlorate ion-type hydrotalcite compound of PTL 1 it is possible to solve the drawbacks of hydrotalcite compounds used as halogen-containing resin stabilizers, to prevent impairment of color tone during molding and use, and to easily accomplish high-temperature molding, while also improving releasability from metal surfaces.

[CITATION LIST]

[PATENT LITERATURE]

[0005]

[PTL 1] Japanese Unexamined Patent Publication HEI No. 6-219732

SUMMARY

[TECHNICAL PROBLEM]

[0006]

The perchlorate ion-type hydrotalcite disclosed in PTL 1 is produced by a method in which a metal salt of perchloric acid is added to an aqueous slurry containing carbonate ion-type hydrotalcite, for ion-exchange between the carbonate ion and perchlorate ion. A method using such an aqueous slurry will hereunder be referred to as "wet method". The hydrotalcite obtained by this method is a mixture of perchlorate ion-type hydrotalcite as the reaction product and carbonate ion-type hydrotalcite as the production starting material.

[0007]

When perchlorate ion-type hydrotalcite is produced by a conventional wet method, some of the carbonate ions of the carbonate ion-type hydrotalcite may not be properly ion-exchanged with perchlorate ion. This may result in residue of the perchlorate ion-type hydrotalcite or the carbonate ion-type hydrotalcite whose crystal structure has disintegrated, or of the magnesium perchlorate by-product, in the obtained hydrotalcite (that is, the mixture).

[0008]

If the perchlorate ion-type hydrotalcite or carbonate ion-type hydrotalcite whose crystal structure has disintegrated remains in the hydrotalcite, and the hydrotalcite is added to a resin, the thermal stability of the resin product formed by the resin may be lowered. Specifically, the resin product may undergo discoloration (blackening) when the resin product has been subjected to heat at or above a certain level.

[0009]

If magnesium perchlorate by-product remains in the hydrotalcite, on the other hand, and the hydrotalcite is added to a resin, the outer appearance of the resin product formed by the resin may be impaired. Specifically, one or more black spots due to magnesium perchlorate are often generated in the resin product when the resin product is subjected to heat at or above a certain level.

[0010]

The present invention has been accomplished in light of these circumstances, and its object is to provide novel hydrotalcite that can yield resin products with excellent thermal stability and outer appearance when applied to resin products.

[SOLUTION TO PROBLEM]

[0011]

The present disclosure encompasses the following aspects.

[0012]

(First disclosure)

The first disclosure is hydrotalcite. The hydrotalcite of the first disclosure has a first peak

and a second peak in a powder X-ray diffraction pattern. The first peak is a peak at a diffraction angle 2θ located in the range of 9.0° to 10.0°. The second peak is a peak at a diffraction angle 2θ located in the range of 11.0° to 12.0°. The half-width of the first peak is 0.30° to 0.70°. The half-width of the second peak is 0.10° to 0.40°. The hydrotalcite of the first disclosure also lacks a peak corresponding to magnesium perchlorate.

[0013]

(Second disclosure)

The second disclosure is the hydrotalcite of the first disclosure wherein the ratio I_1/I_2 between the intensity I_1 of the first peak and the intensity I_2 of the second peak is in the range of 0.10 to 1.50.

[0014]

(Third disclosure)

The third disclosure is the hydrotalcite of the first disclosure or second disclosure wherein the second peak is a peak corresponding to carbonate ion-type hydrotalcite represented by the following formula (1).

$$M^{2+}_{1-x}Al(OH)_2\cdot(CO_3)_{x/2}\cdot mH_2O \quad (1)$$

In formula (1), x is a number satisfying the inequality $0 < x < 0.5$. Also, m is a number satisfying the inequality $0 \leq m \leq 2$. M^{2+} is any metal ion selected from a group consisting of Mg^{2+}, Ca^{2+}, Ni^{2+}, Cu^{2+} and Zn^{2+}.

[0015]

(Fourth disclosure)

The fourth disclosure is the hydrotalcite of any one of the first disclosure to third disclosure wherein the BET specific surface area is in the range of 3.0 m^2/g to 12.5 m^2/g.

[0016]

(Fifth disclosure)

The fifth disclosure is a resin composition. The resin composition of the fifth disclosure comprises hydrotalcite according to any one of the first disclosure to fourth disclosure, and a resin.

[0017]

(Sixth disclosure)

The sixth disclosure is the resin composition of the fifth disclosure wherein the resin is a vinyl chloride-based resin or polyolefin-based resin.

[ADVANTAGEOUS EFFECTS OF INVENTION]

[0018]

According to the invention it is possible to provide novel hydrotalcite that can yield resin

products with excellent thermal stability and outer appearance when applied to resin products.

BRIEF DESCRIPTION OF DRAWINGS

[0019]

Fig. 1 is a graph showing powder X-ray diffraction patterns for each of the hydrotalcites of Examples 1, 3 and 4 and Comparative Examples 1 and 2.

Fig. 2 shows the results of evaluating the resins of each of the hydrotalcites of Examples 1, 3 and 4 and Comparative Examples 1 and 2.

DESCRIPTION OF EMBODIMENTS

[0020]

The hydrotalcite of the invention can impart a very high level of thermal stability when added to a chlorine-containing resin, and especially a vinyl chloride-based resin. In particular, the hydrotalcite of the invention comprises perchlorate ion-type and carbonate ion-type hydrotalcite having a highly supported crystal structure, in a crystalline state suitable for inhibiting thermal decomposition in the resin. This allows hydrochloric acid generated in high-temperature environments to be efficiently trapped, while adequately inhibiting chain thermal degradation of the resin.

As a result, a notable effect is exhibited of preventing blackened discoloration of the resin and maintaining excellent insulating performance and aesthetic quality for prolonged periods, during the thermal history of processing, and when used as a wire or cable sheathing material which is exposed to electrification or environmental heat during long periods of practical use.

[0021]

Preferred embodiments of the hydrotalcite of the invention and a resin composition comprising it will now be explained in detail. Unless otherwise specified, the numerical ranges used herein are ranges that include the upper and lower limits.

[0022]

The present inventors have avidly conducted research with the object of achieving the object described above. As a result, a novel method was found for synthesizing perchlorate ion-type hydrotalcite, which uses a dry method without an aqueous slurry, and in which ion-exchange reaction is carried out under specific conditions. This method is less likely to result in residue of the perchlorate ion-type hydrotalcite or carbonate ion-type hydrotalcite whose crystal structure has disintegrated, or of the magnesium perchlorate by-product, in the obtained hydrotalcite. This helps prevent reduction in the thermal stability and outer appearance of a resin product formed from a resin, when the hydrotalcite has been added to the resin. That is, the resin product is resistant to discoloration (blackening), and generation of one or more black spots from

magnesium perchlorate is also less likely, even when a certain degree of heat has been applied to the resin product.

[0023]

Thus, hydrotalcite obtained by the new method described above can yield resin products with excellent thermal stability and outer appearance when it is applied in resin products.

[0024]

The present invention has been completed on the basis of this knowledge. The present invention encompasses the aspects of the embodiments as laid out below. Preferred embodiments of the hydrotalcite of the invention will be explained first.

[0025]

<Hydrotalcite>

Hydrotalcite according to one embodiment of the invention has a first peak and a second peak in the powder X-ray diffraction (XRD) pattern. The first peak is a peak at a diffraction angle 2θ located in the range of 9.0° to 10.0°. The second peak is a peak at a diffraction angle 2θ located in the range of 11.0° to 12.0°.

[0026]

In the hydrotalcite of this embodiment, the half-widths of the first peak and second peak are within specified ranges. Specifically, the half-width of the first peak is 0.30° to 0.70°. The half-width of the second peak is 0.10° to 0.40°.

[0027]

The hydrotalcite of this embodiment also lacks a peak corresponding to magnesium perchlorate in the XRD pattern.

[0028]

These features of the hydrotalcite of this embodiment will now be explained in detail.

[0029]

First, the hydrotalcite of this embodiment can be obtained by a novel production method in which ion-exchange reaction is carried out by a dry method under the specific conditions described below. A dry method is a method that does not employ an aqueous slurry. Specifically, it is a method in which carbonate ion-type hydrotalcite powder or paste is mixed with an aqueous acid solution, without using an aqueous slurry, and ion-exchange reaction is carried out. A dry method does not include addition of water to the mixture to form an aqueous slurry, even after the reaction.

In this novel production method as well, ion-exchange of some of the carbonate ions of the carbonate ion-type hydrotalcite with perchlorate ions results in production of perchlorate ion-type hydrotalcite, similar to the prior art. The hydrotalcite of this embodiment is therefore also in a state where the perchlorate ion-type hydrotalcite (the reaction product) and the carbonate ion-

type hydrotalcite (production starting material) are mixed, i.e. a mixture of the two types.

[0030]

(First peak)

The first peak wherein the diffraction angle 2θ is located in the range of 9.0° to 10.0° is a peak corresponding to the perchlorate ion-type hydrotalcite in the hydrotalcite of this embodiment.

[0031]

(Half-width of first peak)

For this embodiment, the half-width of the first peak is 0.30° to 0.70°. That the half-width of the first peak is in the range of 0.30° to 0.70° means that the perchlorate ion-type hydrotalcite without disintegration of the crystal structure, i.e. lacking defects in the crystal structure, exists in a crystalline state which suitably imparts thermal stability to the resin.

[0032]

The half-width of the first peak may be 0.31° or greater, 0.32° or greater, 0.33° or greater or 0.35° or greater. The half-width of the first peak may also be 0.68° or smaller, 0.65° or smaller, 0.63° or smaller or 0.60° or smaller.

[0033]

(Second peak)

The second peak where the diffraction angle 2θ is located in the range of 11.0° to 12.0° is a peak corresponding to the carbonate ion-type hydrotalcite in the hydrotalcite of this embodiment.

[0034]

(Half-width of second peak)

For this embodiment, the half-width of the second peak is 0.10° to 0.40°. That the half-width of the second peak is in the range of 0.10° to 0.40° means that the carbonate ion-type hydrotalcite without disintegration of the crystal structure, i.e. lacking defects in the crystal structure, exists in a crystalline state which suitably imparts thermal stability to the resin.

[0035]

The half-width of the second peak may be 0.12° or greater, 0.14° or greater, 0.16° or greater, 0.18° or greater or 0.20° or greater. The half-width of the second peak may also be 0.38° or smaller, 0.36° or smaller, 0.34° or smaller, 0.32° or smaller or 0.30° or smaller.

[0036]

As mentioned above, the perchlorate ion-type hydrotalcite and carbonate ion-type hydrotalcite which have no disintegration of the crystal structure in the hydrotalcite of this embodiment each exist in a crystalline state suitable for imparting thermal stability to the resin. When the hydrotalcite of this embodiment is applied to a resin product, therefore, the resin product is resistant to blackening and can exhibit excellent thermal stability.

[0037]

(Peak corresponding to magnesium perchlorate)

The hydrotalcite of this embodiment also lacks a peak corresponding to magnesium perchlorate in the XRD pattern. A peak corresponding to magnesium perchlorate is a peak at a diffraction angle 2θ of 22.5° to 23.0°.

[0038]

Throughout the present specification, the phrase "lacking a peak corresponding to magnesium perchlorate" means that essentially no peak corresponding to magnesium perchlorate is detected when the powder X-ray diffraction pattern has been measured under the conditions described below. Consequently, a convex pattern that has been produced due to noise at a position corresponding to magnesium perchlorate in the XRD pattern is not included as a peak corresponding to magnesium perchlorate.

[0039]

That the XRD pattern lacks a peak corresponding to magnesium perchlorate means that the hydrotalcite of this embodiment is in a state where magnesium perchlorate by-product has been sufficiently reduced or is absent.

[0040]

Since the hydrotalcite of this embodiment therefore lacks a peak corresponding to magnesium perchlorate in the XRD pattern, magnesium perchlorate by-product is either sufficiently reduced or is absent. Therefore when the hydrotalcite of this embodiment is applied to a resin product, it is less likely to have black spots generated in the resin product due to magnesium perchlorate, and an excellent outer appearance can be obtained.

[0041]

The powder X-ray diffraction pattern of the hydrotalcite can be obtained by the following method.

[0042]

[Powder X-ray diffraction]

First, the sample powder to be measured is placed in an X-ray measuring cell. The surface of the sample powder is flattened by a metal weight to obtain a measuring sample. An "EMPYREAN" X-ray diffractometer (product of PANalytical) is then used for X-ray measurement under the following measuring conditions, to obtain a powder X-ray diffraction (XRD) pattern.

[0043]

(X-ray measuring conditions)

X-ray source: Cu-Kα rays (λ = 1.542angstrom)

Voltage: 45 kV

Current: 40 mA

Goniometer: Sample horizontal goniometer (reflection mode)

Step size: 0.026°

Step time: 10.2 sec

Scan speed: 0.656°/sec

Diffraction angle 2θ: 5.0° to 65.0°

[0044]

The XRD pattern obtained in this manner is processed using the X-ray diffraction software "High Score Plus" (product of PANalytical). Specifically, after baseline compensation with an XRD pattern diffraction angle 2θ in the range of 8.5° to 10.5°, a peak corresponding to perchlorate-type hydrotalcite is designated as the first peak and an asymmetric function is used for profile fitting, with split width and shape, to determine the peak intensity (net intensity) and half-width (average of FWHM Left and FWHM Right) of the first peak.

[0045]

Similarly, after baseline compensation with an XRD pattern diffraction angle 2θ in the range of 10.6° to 12.6°, a peak corresponding to carbonate ion-type hydrotalcite is designated as the second peak and an asymmetric function is used for profile fitting, with split width and shape, to determine the peak intensity (net intensity) and half-width (average of FWHM Left and FWHM Right) of the second peak.

[0046]

(Function and effect)

As mentioned above, the perchlorate ion-type hydrotalcite and carbonate ion-type hydrotalcite which have no disintegration of the crystal structure in the hydrotalcite of this embodiment each exist in a crystalline state suitable for imparting thermal stability to the resin. Therefore when the hydrotalcite of this embodiment is applied to a resin product, the resin product is resistant to blackening and can exhibit excellent thermal stability. In addition, the hydrotalcite of this embodiment either has the magnesium perchlorate by-product sufficiently reduced or absent. Therefore when the hydrotalcite of this embodiment is applied to a resin product, it is less likely to have black spots generated in the resin product due to magnesium perchlorate, and a resin product with an excellent outer appearance can be obtained.

[0047]

The hydrotalcite of this embodiment can yield resin products with excellent thermal stability and outer appearance, and is therefore advantageous for contributing to achieving SDGs (Sustainable Development Goals) adopted by the United Nations summit.

[0048]

The preferred physical properties and features of the hydrotalcite of this embodiment will

now be explained.

[0049]

In the hydrotalcite of this embodiment, the ratio I_1/I_2 between the intensity I_1 of the first peak and the intensity I_2 of the second peak in the XRD pattern is preferably in the range of 0.10 to 1.50. If the ratio I_1/I_2 is within this range, the perchlorate ion-type hydrotalcite and carbonate ion-type hydrotalcite will be mixed in the hydrotalcite in a specified relative ratio, and excellent thermal stability can be more reliably exhibited when the hydrotalcite is applied to the aforementioned resin product.

[0050]

The ratio I_1/I_2 may be 0.15 or higher, 0.20 or higher, 0.25 or higher or 0.30 or higher. The ratio I_1/I_2 may also be 1.40 or lower, 1.30 or lower, 1.20 or lower or 1.10 or lower.

[0051]

The ratio I_1/I_2 is calculated from the intensities of the first peak and second peak determined by powder X-ray diffraction as described above.

[0052]

(Carbonate ion-type hydrotalcite)

For this embodiment, the carbonate ion-type hydrotalcite used as the production starting material in the hydrotalcite may be a carbonate ion-type hydrotalcite that is known in the relevant field, so long as it can impart thermal stability when applied to resin products. Examples of such carbonate ion-type hydrotalcites include hydrotalcite represented by the following formula (1').

$$M^{2+}_{1-x}M^{3+}_{x}(OH)_2(CO_3)_{x/2}\cdot mH_2O \quad (1')$$

In formula (1'), M^{2+} represents a divalent metal ion. M^{3+} represents a trivalent metal ion. The letter x represents a number satisfying the inequality $0 < x < 0.5$. The letter m represents a number satisfying the inequality $0 \leq m \leq 5$.

[0053]

In formula (1'), M^{2+} is preferably at least one ion from among Mg^{2+}, Ca^{2+}, Ni^{2+}, Cu^{2+} and Zn^{2+}. M^{3+} is preferably Al^{3+}.

[0054]

For this embodiment, the carbonate ion-type hydrotalcite is most preferably carbonate ion-type hydrotalcite represented by the following formula (1). In other words, in the hydrotalcite of this embodiment, the second peak of the XRD pattern is preferably a peak corresponding to carbonate ion-type hydrotalcite represented by the following formula (1).

$$M^{2+}_{1-x}Al(OH)_2\cdot(CO_3)_{x/2}\cdot mH_2O \quad (1)$$

In formula (1), x is a number satisfying the inequality $0 < x < 0.5$. Also, m is a number satisfying the inequality $0 \leq m \leq 2$. M^{2+} is any metal ion from among Mg^{2+}, Ca^{2+}, Ni^{2+}, Cu^{2+}

or Zn^{2+}.

[0055]

If the carbonate ion-type hydrotalcite in the hydrotalcite of this embodiment is carbonate ion-type hydrotalcite represented by formula (1), it will be possible to more reliably exhibit excellent thermal stability when it is applied in a resin product.

[0056]

The carbonate ion-type hydrotalcite in the production starting material is in powdered form or paste form. The water content of the powdered or paste-like carbonate ion-type hydrotalcite is 0 to 60 mass%.

[0057]

The carbonate ion-type hydrotalcite in the production starting material may also be surface treated. Surface treatment agents include higher fatty acids, higher fatty acid alkali metal salts, anionic surfactants, cationic surfactants, silane coupling agents, titanate coupling agents, aluminum coupling agents, silicone-based treatment agents, water glass, silicic acid, phosphoric acid esters, esters of polyhydric alcohols and fatty acids, and higher alcohol sulfuric acid esters. These surface treatment agents may be used alone or in combinations of two or more. Higher fatty acids are preferably used among these. As higher fatty acids there are preferred one or more higher fatty acids selected from the group consisting of lauric acid, oleic acid and stearic acid.

[0058]

(Aqueous acid solution)

The acid of the guest substance to be reacted with the carbonate ion-type hydrotalcite of the production starting material is used in the form of an aqueous acid solution obtained by dissolution in water. The pH of the aqueous acid solution is 6 or lower. The acid used in the aqueous acid solution is an inorganic perchloric acid. When a metal salt of perchloric acid is used as the acid, a washing step is necessary to remove the by-product after the reaction, making it necessary to provide equipment for the washing step, and to carry out waste water disposal.

[0059]

The method for producing the hydrotalcite of this embodiment will be described later.

[0060]

The hydrotalcite of this embodiment preferably has a BET specific surface area in the range of 3.0 m^2/g to 12.5 m^2/g. If the BET specific surface area of the hydrotalcite is within this range, it will be possible to more reliably exhibit excellent thermal stability when applied in the resin product described above.

[0061]

The BET specific surface area may be 3.5 m^2/g or greater, 4.0 m^2/g or greater or 4.2 m^2/g or greater. The BET specific surface area may also be 12.4 m^2/g or lower, 12.2 m^2/g or lower or

12.0 m^2/g or lower.

[0062]

The BET specific surface area of the hydrotalcite is the specific surface area (m^2/g) obtained by the BET method, and it is measured by the following method.

[0063]

[BET specific surface area measurement method]

Using a "BELsorp-max" high-precision specific surface area/pore distribution measuring device (product of MicrotracBell), the sample to be measured is pretreated at 110°C for 15 minutes, and measurement is performed by a flow-type one point method while flowing nitrogen gas.

[0064]

As mentioned above, the hydrotalcite of this embodiment can be obtained by a novel production method in which ion-exchange reaction is carried out by a dry method under specific conditions.

A preferred embodiment of the method for producing the hydrotalcite of the invention will be explained below.

[0065]

<Production method>

The method for producing hydrotalcite for this embodiment comprises a mixing step, a drying step, and a pulverizing and classification step.

The steps will now be explained in detail.

[0066]

(Mixing step)

The mixing step is a step in which the powdered or paste-like carbonate ion-type hydrotalcite is mixed with an aqueous acid solution for ion-exchange reaction. In the mixing step, first the powdered or paste-like hydrotalcite and the aqueous acid solution are supplied to a reactor equipped with stirring means. The contents of the reactor are then stirred and mixed for ion-exchange reaction.

[0067]

The water content of the mixture when the powdered or paste-like hydrotalcite is mixed with the aqueous acid solution is 10 to 60 mass%. If the water content of the mixture is less than 10 mass%, the ion-exchange reaction will proceed less easily, lengthening the time until completion of the reaction and resulting in poor production efficiency. If the water content of the mixture is greater than 60 mass%, the longer drying time in the drying step will tend to produce magnesium perchlorate as a by-product. Generation of perchlorates such as magnesium perchlorate can lead to formation of black spots after addition to a resin composition.

[0068]

In the mixing step, some of the carbonate ions of the carbonate ion-type hydrotalcite are ion-exchanged with perchlorate ion, producing perchlorate ion-type hydrotalcite. The hydrotalcite obtained after the reaction is therefore also in a state where the perchlorate ion-type hydrotalcite (the reaction product) and the carbonate ion-type hydrotalcite (production starting material) are mixed, i.e. a mixture of these.

[0069]

The powdered or paste-like carbonate ion-type hydrotalcite used as the production starting material, and the aqueous acid solution, are the same ones as mentioned above.

[0070]

The reactor equipped with a stirrer used in the mixing step may be a batch kneader, planetary mixer or crusher, for example. It is preferred to use a batch kneader.

[0071]

The order of supply of the production starting materials to the reactor may be either supply of the powdered or paste-like carbonate ion-type hydrotalcite first, or supply of the aqueous acid solution first. However it is preferred to supply the powdered or paste-like carbonate ion-type hydrotalcite first to the reactor, and then to supply the aqueous acid solution, while stirring. Supplying the powdered or paste-like carbonate ion-type hydrotalcite first helps to facilitate uniform mixing.

[0072]

The mixing temperature in the mixing step is preferably 20°C or higher. If the mixing temperature is 20°C or higher it will be possible to increase the efficiency of the ion-exchange reaction. The mixing temperature is also preferably 80°C or lower. Limiting the mixing temperature to 80°C or lower can reduce the risk of ignition or explosion of the perchloric acid.

[0073]

In regarding to the mixing time, the appropriate end point for the ion-exchange reaction will differ depending on the stress by the stirrer of the reactor used, for example. The mixing time in the mixing step may therefore be set in the following manner. First, 10 g of the mixture in the reactor is sampled. A 10 g portion of the sampled mixture is suspended in 100 mL of ion-exchanged water. The pH of the obtained suspension is measured. The procedure from sampling to pH measurement is carried out at specified time points. The point at which the change in pH measured in this manner falls below pH 0.5/hr is defined as the end point of the ion-exchange reaction. Specifically, this is the end point for mixing.

[0074]

When using a reactor equipped with a common stirrer, the mixing time will generally be in the range of about 1 to 800 minutes.

[0075]

The mixture obtained after the mixing step is then supplied to the subsequent drying step.

[0076]

(Drying step)

The drying step is a step in which the mixture is dried after the mixing step. In the drying step, the mixture obtained after the mixing step, i.e. upon completion of the reaction, is dried using any desired dryer.

[0077]

The dryer used in the drying step may be a paddle dryer, or a batch kneader, band dryer, vacuum dryer or spray dryer equipped with a heating apparatus. Magnesium perchlorate may be generated if uniform drying cannot be achieved. The dryer is therefore preferably one that can accomplish uniform drying. Preferred dryers are a paddle dryer provided with stirring means, or a batch kneader equipped with a heating apparatus. Using these will allow the mixture to be uniformly dried in a short period of time after completion of the reaction, so that production of magnesium perchlorate can be more easily reduced. It is particularly preferred to use a batch kneader equipped with a heating apparatus. By using a batch kneader equipped with a heating apparatus it is possible to carry out the mixing step and drying step in the same apparatus. This can result in improved productivity.

[0078]

An apparatus for removal of moisture may also be installed in the dryer. Providing such an apparatus makes it possible to shorten the drying time. An example of a device that removes moisture is a gas supply/exhaust port.

[0079]

The drying temperature in the drying step is preferably 100°C or higher. If the drying temperature is 100°C or higher it will be possible to shorten the drying time. This can also result in improved productivity. The drying temperature is also preferably 200°C or lower. If the drying temperature is 200°C or lower it will be possible to inhibit degeneration of the surface treatment agent when surface-treated hydrotalcite has been used.

[0080]

The end point for drying in the drying step is the end point for drying at which the amount of drying loss of the mixture is less than 5%. The drying loss of the mixture is the rate of change in weight before and after heating for 1 hour at 105°C. The drying time in the drying step is generally 1 hour to 1100 hours. A drying time of 1100 hours or less will help to inhibit generation of magnesium perchlorate by-product. The drying time in the drying step is preferably 20 hours or less and even more preferably 16 hours or less. Such a drying time can more reliably inhibit generation of magnesium perchlorate by-product.

[0081]

The mixture obtained after the drying step is supplied to the subsequent pulverizing and classification step.

[0082]

(Pulverizing and classification step)

The pulverizing and classification step is a step in which the mixture obtained from the drying step is pulverized and classified into specified particle sizes. In the pulverizing and classification step, the dried mixture is pulverized using any desired pulverizer. The pulverized mixture is then classified into specified particle sizes using any desired classifier.

[0083]

The pulverizer used in the pulverizing and classification step may be a hammer mill, pin mill, jet mill or ball mill.

[0084]

The classifier used in the pulverizing and classification step may be an vibrating sieve or wind classifier. When a vibrating sieve is used as the classifier, it is preferred to use a fine net of 100 mesh or greater. Using a coarse net of less than 100 mesh will result in failure to disaggregate the coarse grain components, creating white spots, when the mixture is used as a resin additive.

[0085]

Carrying out a pulverizing and classification step after the aforementioned mixing step can yield hydrotalcite according to this embodiment. The obtained hydrotalcite may also be supplied to an optional post-treatment step. Such a post-treatment step may be, for example, a surface treatment step, or a mixing step with other added components.

[0086]

<Resin composition>

The hydrotalcite of this embodiment may also be used as an additive to improve the thermal stability of a resin. Specifically, another embodiment of the invention is a resin composition comprising hydrotalcite according to the embodiment described above, and a resin.

[0087]

Since the resin composition of the embodiment comprises hydrotalcite according to the embodiment described above, it is possible to obtain a resin product with excellent thermal stability and outer appearance when it is applied to a resin product.

[0088]

(Resin)

The resin used in the resin composition of the embodiment may be any desired resin suited for a given purpose. Such resins include thermoplastic resins and thermosetting resins. These

resins may be used alone or in combinations of two or more.

[0089]

Examples of thermoplastic resins to be used in the resin composition of this embodiment include chlorine-containing resins, olefin-based resins, polystyrene, copolymers of ethylene with vinyl acetate, copolymers of ethylene with acrylic acid ethers, copolymers of ethylene with methyl acrylate, polypropylene, copolymers of propylene with other α-olefins, polybutene-1, poly 4-methylpentene-1, polystyrene, copolymers of styrene with acrylonitrile, copolymers of ethylene with propylene diene rubber and copolymers of ethylene with butadiene, as well as polyvinyl acetate, polylactic acid, polyvinyl alcohol, polyacrylates, polymethacrylates, polyurethanes, polyesters, polyethers, polyamides, ABS, polycarbonates, polyphenylene sulfide and synthetic rubber.

[0090]

Among these thermoplastic resins, chlorine-containing resins include vinyl chloride-based resins and chlorine-based rubber.

[0091]

Vinyl chloride-based resins include polyvinyl chloride, chlorinated polyvinyl chloride, polyvinylidene chloride, chlorinated polyethylene, vinyl chloride-vinyl acetate copolymer, vinyl chloride-ethylene copolymer, vinyl chloride-propylene copolymer, vinyl chloride-styrene copolymer, vinyl chloride-isobutylene copolymer, vinyl chloride-vinylidene chloride copolymer, vinyl chloride-styrene-maleic anhydride terpolymer, vinyl chloride-styrene-acrylonitrile copolymer, vinyl chloride-butadiene copolymer, vinyl chloride-isoprene copolymer, vinyl chloride-chlorinated propylene copolymer, vinyl chloride-vinylidene chloride-vinyl acetate terpolymer, vinyl chloride-maleic acid ester copolymer, vinyl chloride-methacryl acid ester copolymer, vinyl chloride-acrylonitrile copolymer and copolymers of vinyl chloride with different vinyl ethers.

[0092]

Chlorine-based rubbers include chloroprene rubber, chlorinated butyl rubber, chlorosulfonated polyethylene rubber, chlorinated polyethylene rubber and epichlorohydrin rubber.

[0093]

Of the thermoplastic resins to be used in the resin composition of the embodiment, olefin-based resins include olefin-based resins such as polyethylene, copolymers of ethylene with other α-olefins, polypropylene, copolymers of propylene with other α-olefins, polybutene-1, and poly 4-methylpentene-1. Synthetic rubbers include ethylenepropylene diene rubber (EPDM), styrene-butadiene rubber (SBR), acrylonitrile-butadiene rubber (NBR), butyl rubber, isoprene rubber, silicon rubber, fluorine rubber, brominated butyl rubber and epichlorohydrin rubber.

[0094]

The thermosetting resin to be used in the resin composition of the embodiment may be a phenol resin, melamine resin, epoxy resin, unsaturated polyester resin or alkyd resin.

[0095]

These resins may be used alone or in combinations of two or more.

[0096]

The resin in the resin composition of the embodiment is preferably a vinyl chloride-based resin or polyolefin-based resin. Such resins tend to have reduced thermal stability, and especially tend to produce blackening. Even when comprising such resins, however, the resin composition of the embodiment can exhibit excellent thermal stability due to the hydrotalcite of the invention.

[0097]

The hydrotalcite content of the resin composition is not particularly restricted so long as the effect of the invention is not inhibited. An example for the hydrotalcite content in the resin composition is a content of 0.1 part by mass to 250 parts by mass with respect to 100 parts by mass of the resin. The hydrotalcite content is preferably 1 part by mass to 200 parts by mass.

[0098]

(Other additives)

The resin composition may also comprise other additives in addition to the hydrotalcite, in ranges that do not interfere with the effect of the invention.

[0099]

Such other additives include antioxidants, reinforcing agents, ultraviolet absorbers, lubricants, delustering agents, pigments, flame retardants, flame-retardant aids and fillers. Talc may also be mentioned as a reinforcing material. Microparticulate silica may be mentioned as a delustering agent. Pigments include carbon black. Flame retardants include bromine-based flame retardants and phosphoric acid ester-based flame retardants. Flame-retardant aids include zinc stannate, alkali metal stannates and carbon powders. Calcium carbonate is an example of a filler. Any of these additives may be used alone or in combinations of two or more.

[0100]

The content of such additives may be in amounts suited for the purpose of addition of each additive. Examples for the contents include contents of 0.01 parts by mass to 50 parts by mass with respect to 100 parts by mass of the resin.

[0101]

The resin composition can be obtained by mixing or kneading at least the resin and the hydrotalcite of the embodiment using any desired mixing means or kneading means. The mixing means or kneading means may be a single-screw or twin-screw extruder, roll or Banbury mixer.

[0102]

The resin composition can be used to produce a desired molded article, i.e. a resin product, using any desired molding means. The molding means used for production of the resin product may be any desired molding means suited for the type of resin or resin product and the required product properties. Such molding means include injection molding, extrusion molding, blow molding, press molding, rotational molding, calender molding, sheet forming molding, transfer molding, laminated molding, vacuum molding and powder slush molding.

[0103]

The resin product to which the hydrotalcite of the invention is applied may be a sheet, film, structural member, part or covering material, for which excellent thermal stability and outer appearance are required.

[0104]

The invention is not restricted to the embodiments described above or the Examples described below, and can incorporate appropriate combinations, alternatives and modifications within ranges that do not fall outside of the object and gist of the invention. Incidentally, the ordinal terms “first” and “second” as used throughout the present specification serve merely to distinguish between numbered elements and are not used to indicate any relative ordering, precedence or importance.

EXAMPLES

[0105]

The present invention will now be explained in greater detail using Examples and Comparative Examples. However, it is to be understood that the invention is not limited to these Examples.

[0106]

(Example 1)

A 560 kg portion of carbonate ion-type hydrotalcite powder was supplied to a batch kneader having two stirring blades rotating at an average rotational speed of 6.5 rpm. Next, 360 kg of a 40 mass% aqueous perchloric acid solution was loaded into the batch kneader. The water content of the mixture was 26 mass%. Mixing was continued for 210 minutes, and the carbonate ion-type hydrotalcite and perchloric acid were reacted. The batch kneader was then heated and the reacted mixture was dried. The drying time was 16 hours or less. The dried mixture was then pulverized with a pulverizer. The pulverized mixture was sifted with a vibrating sieve to obtain hydrotalcite for Example 1.

[0107]

(Example 2)

The mixing time was changed to 270 minutes. The procedure was otherwise carried out in

the same manner as Example 1 to obtain hydrotalcite for Example 2.

[0108]

(Example 3)

The mixing time was changed to 280 minutes. The procedure was otherwise carried out in the same manner as Example 1 to obtain hydrotalcite for Example 3.

[0109]

(Example 4)

The carbonate ion-type hydrotalcite supply rate was changed to 380 kg. The loading amount of the 40 mass% aqueous perchloric acid solution was changed to 244 kg. The water content of the mixture was 26 mass%. The average rotational speed of the two stirring blades was changed to 18.5 rpm. The mixing time was changed to 460 minutes. Except for these changes, the procedure was carried out in the same manner as Example 1 to obtain hydrotalcite for Example 4.

[0110]

(Example 5)

The mixing time was changed to 440 minutes. The procedure was otherwise carried out in the same manner as Example 4 to obtain hydrotalcite for Example 5.

[0111]

(Example 6)

The mixing time was changed to 510 minutes. The procedure was otherwise carried out in the same manner as Example 4 to obtain hydrotalcite for Example 6.

[0112]

(Example 7)

The mixing time was changed to 570 minutes. The procedure was otherwise carried out in the same manner as Example 4 to obtain hydrotalcite for Example 7.

[0113]

(Example 8)

The mixing time was changed to 360 minutes. The procedure was otherwise carried out in the same manner as Example 4 to obtain hydrotalcite for Example 8.

[0114]

(Example 9)

The mixing time was changed to 470 minutes. The procedure was otherwise carried out in the same manner as Example 4 to obtain hydrotalcite for Example 9.

[0115]

(Example 10)

The average rotational speed of the two stirring blades was changed to 20 rpm. The mixing time was changed to 380 minutes. Except for these changes, the procedure was carried out in the

same manner as Example 4 to obtain hydrotalcite for Example 10.

[0116]

(Example 11)

The average rotational speed of the two stirring blades was changed to 15 rpm. The mixing time was changed to 380 minutes. Except for these changes, the procedure was carried out in the same manner as Example 4 to obtain hydrotalcite for Example 11.

[0117]

(Example 12)

The carbonate ion-type hydrotalcite supply rate was changed to 200 kg. The loading amount of the 40 mass% aqueous perchloric acid solution was changed to 128 kg. The average rotational speed of the two stirring blades was changed to 14 rpm. The mixing time was changed to 330 minutes. Except for these changes, the procedure was carried out in the same manner as Example 1 to obtain hydrotalcite for Example 12.

[0118]

(Comparative Example 1)

A 1.5 kg portion of carbonate ion-type hydrotalcite powder was supplied to a batch kneader having two stirring blades rotating at an average rotational speed of 41.5 rpm. Next, a 40 mass% aqueous perchloric acid solution was loaded into the batch kneader to a 0.66 weight ratio with the carbonate ion-type hydrotalcite (that is, as the 40 mass% aqueous perchloric acid/carbonate-type hydrotalcite weight ratio). Mixing was continued for 90 minutes, and the carbonate ion-type hydrotalcite and perchloric acid were reacted. Water was then added to and mixed with the reacted mixture, until the proportion of the reacted mixture was 300 g/L. The water content of the mixture was 228 mass%. The obtained aqueous slurry was dried for 24 hours in an oven. The dried mixture was then sifted with a 100 mesh sieving net to obtain hydrotalcite for Comparative Example 1.

[0119]

(Comparative Example 2)

The aqueous slurry of the carbonate ion-type hydrotalcite was supplied into a stirring blade-equipped reactor. A 40 mass% aqueous perchloric acid solution was loaded into the reactor to a molar ratio of 1.2 with respect to the carbonate ion-type hydrotalcite, and the carbonate ion-type hydrotalcite and perchloric acid were reacted in a continuous manner. The reacted mixture was then subjected to dry granulation by spray drying. It was then sifted with a vibrating sieve to obtain hydrotalcite for Comparative Example 2.

[0120]

(Comparative Example 3)

The aqueous slurry of the carbonate ion-type hydrotalcite was supplied into a reactor. A 40

mass% aqueous perchloric acid solution was loaded into the reactor to a molar ratio of 1.2 with respect to the carbonate ion-type hydrotalcite, and the carbonate ion-type hydrotalcite and perchloric acid were reacted in a continuous manner. The reacted mixture was then subjected to dry granulation by spray drying. It was then sifted with a vibrating sieve to obtain hydrotalcite for Comparative Example 3.

[0121]

(Measurements and evaluation)

Each of the hydrotalcites of Examples 1 to 12 and Comparative Examples 1 to 3 obtained as described above were used for measurement of the respective half-widths of the first peak and second peak, the intensity ratio of the first peak and second peak, and the BET specific surface area, by the measuring methods described above. The hydrotalcite particle size distribution and the drying loss were also measured by the measuring methods described below.

[0122]

The measurement results are shown in Tables 1 and 2. Fig. 1 shows powder X-ray diffraction patterns for each of the hydrotalcites of Examples 1, 3 and 4 and Comparative Examples 1 and 2.

[0123]

[Method of measuring particle size distribution]

The hydrotalcite particle size distribution is measured by wet laser diffraction/scattering using an "MT3300EX II" particle size distribution analyzer (product of MicrotracBel). The solvent used is ethanol. The specific procedure is as follows. First, 0.1 to 0.3 g of the hydrotalcite powder sample to be measured is loaded into a measuring cell. After elapse of 1 minute, the volume-based cumulative 10% particle size (D10), 50% particle size (D50) and 90% particle size (D90) are measured.

[0124]

[Method of measuring drying loss]

First, a hydrotalcite powder sample to be measured is placed in a glass bottle with a diameter of 40 mm and a height of 30 mm, to a depth of 3 to 5 mm. The weight of the glass bottle containing the powder sample is then measured. The weight of the glass bottle measured beforehand is subtracted from the weight of the glass bottle containing the powder sample, to determine the weight M_0 (g) of the powder sample. The glass bottle containing the powder sample is placed in an oven at 105°C and dried for 1 hour. The powder sample-containing glass bottle is then removed out. The removed glass bottle is placed in a desiccator containing dry silica gel and cooled for 30 to 60 minutes. The weight of the glass bottle containing the cooled powder sample is then measured. The weight of the glass bottle is subtracted from the weight of the glass bottle containing the cooled powder sample, to determine the weight M_1 (g) of the

cooled powder sample. The drying loss is calculated by the following formula.

Drying loss (%) = $(M_0 - M_1)/M_0 \times 100$

[0125]

The hydrotalcites of Examples 1 to 12 and Comparative Examples 1 and 2 were also used in evaluation of resins by the following heat resistance test. For Example 6 and Comparative Example 3, a Congo red test was conducted as described below, for evaluation of the trapping property for hydrochloric acid generated in a high-temperature environment.

[0126]

[210°C heat resistance test of resin]

To 90 parts of polyvinyl chloride (PVC) (K value = 72), 10 parts of PVC paste (K value = 67), 70 parts of a plasticizer, 0.4 parts of a stabilizer and 7.2 parts of a stabilizing aid there are added 1.7 parts of the hydrotalcite sample to be evaluated, and the mixture is kneaded with a mixer. The kneaded resin composition is placed in a molding frame and heated for a specified time period in an oven at 210°C to form a test piece with a thickness of 5 mm. Several heating times are set every 4 minutes in an oven at 210°C (specifically, at 4 minutes, 8 minutes, 12 minutes, 16 minutes, 20 minutes, 24 minutes, 28 minutes, 32 minutes and 36 minutes), to fabricate test pieces for each heating time.

[0127]

The fabricated test piece is visually observed and the presence or absence of black spots is confirmed.

The color of the fabricated test piece is also visually confirmed, and the heating time for the blackened test piece is recorded as the “time until blackening”. A longer “time until blackening” is evaluated as more excellent thermal stability. A “time until blackening” of 32 minutes or less, on the other hand, is evaluated as poor thermal stability.

[0128]

[Congo red test]

The hydrotalcite sample to be evaluated (1.0 parts) is added to 100 parts of polyvinyl chloride (PVC) (K value = 72), 50 parts of a plasticizer, 0.6 parts of a stabilizer and 2.6 parts of a stabilizing aid. Roll kneading is carried out at 170°C to produce a sheet with a thickness of 0.7 mm.

The fabricated sheet is cut to a size of 5 mm square. A 2 g portion of the cut sheet section is set in a glass test tube with an outer diameter of 15 mm and a length of 150 mm.

Congo red test paper with a width of 7 mm is wetted with glycerin. The top end of the Congo red test paper is held in a slitted cork stopper, inserted vertically at the center of the test tube, and fixed in place. The Congo red test paper is adjusted so that the lower end is at a location 40 mm from the top of the test tube.

The test tube is immersed in an oil bath at 200°C so that the bottom of the test tube is 70 mm below the liquid level. The time (min) from the start of immersion until the color of the tip of the Congo red test paper changes to blue is measured.

[0129]

The resin evaluation results are shown in Table 1 below. Fig. 2 shows the results of evaluating the resins of each of the hydrotalcites of Examples 1, 3 and 4 and Comparative Examples 1 and 2. The Congo red test results are shown in Table 2 below.

[0130]

[Table 1]

Table 1

		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Example 9	Example 10	Example 11	Example 12	Comp. Ex. 1	Comp. Ex. 2
Physical properties of hydrotalcite	Half-width of first peak	0.33	0.32	0.33	0.45	0.32	0.36	0.35	0.36	0.37	0.54	0.56	0.52	0.26	0.26
	Half-width of second peak	0.30	0.28	0.29	0.27	0.28	0.31	0.27	0.27	0.27	0.22	0.22	0.23	0.28	0.00
	Intensity ratio of first peak and second peak (I_1/I_2)	0.86	0.89	1.01	0.51	0.96	0.93	0.82	0.67	0.74	0.36	0.31	0.42	0.35	-
	Presence or absence of peak for Mg perchlorate	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
	BET specific surface area (m^2/g)	12.0	11.4	11.4	10.2	10.1	8.8	7.3	9.2	9.8	4.2	6.4	6.8	17.2	12.9
	D50 (μm)	19.0	19.2	15.6	9.4	26.8	26.9	45.4	16.2	25.2	19.9	21.4	14.2	46.4	31.4
	D10 (μm)	3.8	3.8	3.5	3.1	4.2	5.7	7.2	4.1	5.3	5.4	5.2	7.6	5.7	7.1
	D90 (μm)	69.6	73.4	65.3	36.4	93.8	68.2	117.8	43.2	83.6	62.7	70.7	57.6	133.9	58.7
	Drying loss (%)	3.2	3.2	2.9	4.2	3.6	3.5	4.1	2.9	3.1	4.1	4.9	4.4	3.2	2.2
Resin evaluation	Presence or absence of black spots	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Absent
	Time until blackening (min)	36	36	36	36	36	36	36	36	36	36	36	36	32	32

[0131]

[Table 2]

Table 2

	Example 6	Comparative Example 3
Half-width of first peak	0.36	0.26
Half-width of second peak	0.31	0.00
Intensity ratio of first peak and second peak (I_1/I_2)	0.93	-
Presence or absence of peak for Mg perchlorate	Absent	Absent
BET specific surface area (m^2/g)	8.8	12.9
D50 (μm)	26.9	31.4
D10 (μm)	5.7	7.1
D90 (μm)	68.2	58.7
Drying loss (%)	3.5	12.9
Congo red test result (min)	58.0	51.7

[0132]

As shown in Table 1, Fig. 1 and Fig. 2, the hydrotalcites of Examples 1 to 12 all exhibited no observable black spots in the resin evaluation. Moreover, the hydrotalcites of Examples 1 to 12 all had time until blackening of 36 minutes or longer in the resin evaluation, indicating excellent thermal stability. It was thus demonstrated that the hydrotalcites of Examples 1 to 12, when applied in resin products, yielded resin products with excellent thermal stability and outer appearance.

[0133]

On the other hand, the hydrotalcite of Comparative Example 1 had a first peak half-width outside of the range of the invention. The hydrotalcite of Comparative Example 1 therefore had a shorter time until blackening in the resin evaluation. Also, as indicated by the arrow in Fig. 1, the hydrotalcite of Comparative Example 1 had a peak corresponding to magnesium perchlorate with an intensity of 162 at the position where the diffraction angle 2θ was 22.7°. The hydrotalcite of Comparative Example 1 was therefore confirmed to have a considerably large number of black spots in the resin evaluation.

This suggested that the hydrotalcite of Comparative Example 1, when applied to a resin product, will produce a resin product with inferior thermal stability and outer appearance.

[0134]

The hydrotalcite of Comparative Example 2 had half-widths for the first peak and second peak that were outside of the range of the invention. The hydrotalcite of Comparative Example 2 therefore had a short time until blackening in the resin evaluation.

This suggested that the hydrotalcite of Comparative Example 2, when applied to a resin

product, will produce a resin product with inferior thermal stability.

[0135]

As shown in Table 2, Example 6 which used hydrotalcite according to the invention exhibited significant results, with extension of the thermal stability time by about 12% (6.3 min) compared to Comparative Example 3. This supports the hypothesis that maintenance of a specific crystalline state by the hydrotalcite of the invention increases the effectiveness of hydrochloric acid trapping sites at high temperature, while helping to retard progressive deterioration of the resin. For purposes that require high reliability and long-term durability, such as wire sheathing materials, the difference in thermal stability time can not only prevent molding defects (blackening) in products, but can also inhibit time-dependent deterioration after installation. The hydrotalcite of the invention is therefore highly suitable as a stabilizer for high-quality wire sheathing resin compositions.

CLAIMS

[Claim 1]

Hydrotalcite having, in a powder X-ray diffraction pattern:

a first peak at a diffraction angle 2θ located in a range of 9.0° to 10.0° and

a second peak at a diffraction angle 2θ located in a range of 11.0° to 12.0°, wherein

a half-width of the first peak is 0.30° to 0.70° and

a half-width of the second peak is 0.10° to 0.40°, and

lacking a peak corresponding to magnesium perchlorate.

[Claim 2]

Hydrotalcite according to claim 1, wherein a ratio I_1/I_2 between an intensity I_1 of the first peak and an intensity I_2 of the second peak is in a range of 0.10 to 1.50.

[Claim 3]

Hydrotalcite according to claim 1, wherein the second peak is a peak corresponding to carbonate ion-type hydrotalcite represented by a following formula (1).

$$M^{2+}_{1-x}Al(OH)_2\cdot(CO_3)_{x/2}\cdot mH_2O \quad (1)$$

In formula (1), x is a number satisfying an inequality $0 < x < 0.5$, m is a number satisfying an inequality $0 \leq m \leq 2$, and M^{2+} is any metal ion selected from a group consisting of Mg^{2+}, Ca^{2+}, Ni^{2+}, Cu^{2+} and Zn^{2+}.

[Claim 4]

Hydrotalcite according to claim 1, wherein a BET specific surface area is in a range of 3.0 m^2/g to 12.5 m^2/g.

[Claim 5]

A resin composition comprising hydrotalcite according to claim 1, and a resin.

[Claim 6]

The resin composition according to claim 5, wherein the resin is a vinyl chloride-based resin or polyolefin-based resin.