of Graphene”

Summary

Technical Problem

[0005]

However, the method of NPL 1 has extremely low production efficiency and is not suitable for efficiently and inexpensively producing large amounts of graphene.

[0006]

NPL 1 cites NPL 2, which describes the original production method, and discloses that progress was made in the production method. In NPL 2, graphene is obtained by adding 50 mg/ml (5 mass%) of graphite, mixing with a mixer for a long period of time, and centrifuging. However, only at most 1 to 10 μg/ml (0.0001 to 0.001%) of graphene can be obtained per 20 minutes even with optimization. The absolute amount obtained and the yield (about 0.01%) from graphite are insufficient. In addition, the step of performing centrifugation and collecting the supernatant is difficult to scale up. In fact, in NPL 3, 300-L scale production is attempted, but the amount produced per hour is 5 g = 0.0016 mass%.

[0007]

Thus, an object of the present disclosure is to provide an additive capable of efficiently improving the strength of a hydraulic composition.

Solution to Problem

[0008]

The present inventors conducted extensive research to achieve the above object, and found that the strength of a hydraulic composition can be efficiently improved by containing flaky carbon and an organic compound containing a hydrophilic group and a hydrophobic group with a high affinity for carbon. The inventors have accomplished the present disclosure as a result of further research based on this finding. Specifically, the

present disclosure includes the following features.

[0009]

Item 1.

An additive for a hydraulic composition, comprising flaky carbon and an organic compound containing a hydrophilic group and a hydrophobic group with a high affinity for carbon.

[0010]

Item 2.

The additive for a hydraulic composition according to Item 1, further comprising water.

[0011]

Item 3.

The additive for a hydraulic composition according to Item 1 or 2, wherein the hydrophilic group comprises at least one member selected from the group consisting of groups represented by formulas (1) to (6):

[0012]

The hydraulic composition according to Item 15 or 16, which is a cement hydration product.

[0028]

Item 18.

A method for producing the hydraulic composition of any one of Items 15 to 17, comprising mixing a hydraulic powder material and the additive for a hydraulic composition.

[0029]

Item 19.

The production method according to Item 18, wherein in the mixing step, a chemical admixture for concrete is further mixed.

[0029a]

In one aspect, there is provided an additive for a hydraulic composition, comprising flaky carbon and an organic compound containing a hydrophilic group and a hydrophobic group with a high affinity for carbon.

[0029b]

In another aspect, there is provided a method for producing the additive for a hydraulic composition as defined herein, comprising subjecting at least one carbonaceous material dispersion that contains a carbonaceous material having a layered structure, a water-soluble compound containing a hydrophobic group with a high affinity for carbon and a hydrophilic group, and a solvent to pressure treatment at 30 MPa or more,

wherein at least one treatment selected from the group consisting of the following (i) to (iii) is performed by the pressure treatment:

(i) two or more carbonaceous material dispersions that are the at least one carbonaceous material dispersion are collided with each other;

(ii) the carbonaceous material dispersion is collided with a metal or a ceramic material; and

(iii) the carbonaceous material dispersion is passed through a space with a cross-sectional area of 1 cm^2 or less,

the solvent comprises water, and

the content of the water is 70 mass% or more of the solvent.

[0029c]

In another aspect, there is provided a method for producing the additive for a hydraulic composition as defined herein, comprising:

placing a composition that contains a carbonaceous material having a layered structure, a water-soluble compound containing a hydrophobic group with a high affinity for carbon and a hydrophilic group, and a solvent between a rotary plate configured to rotate and a plate disposed substantially parallel to the rotary plate; and

applying shear to the carbonaceous material in the composition while adjusting the shortest distance between the rotary plate and the plate to 200 μm or less,

wherein the solvent comprises water, and

the content of the water is 70 mass% or more of the solvent.

[0029d]

In another aspect, there is provided a hydraulic composition comprising the additive for a hydraulic composition as defined herein and a hydraulic component.

[0029e]

In another aspect, there is provided a method for producing the hydraulic composition as defined herein, comprising mixing a hydraulic powder material and the additive for a hydraulic composition.

Advantageous Effects of Invention

[0030]

The present invention provides an additive capable of efficiently improving the strength of a hydraulic composition. In the present invention, the strength of a hydraulic composition can be improved by a method that has a production efficiency that is about 10000 times the production efficiency of NPL 1 (100% of the total amount used, compared with a yield of 0.01%) when the concentration of graphite added is 5 mass% and can be easily scaled up with no loss of graphite.

Brief Description of Drawings

[0031]

Fig. 1 is a diagram illustrating the configuration of an additive for a hydraulic composition of the present invention in which the content of an organic compound containing a hydrophilic group and a hydrophobic group with a high affinity for carbon is small (in which the surface of flaky carbon is covered with the organic compound containing a hydrophilic group and a hydrophobic group with a high affinity for carbon).

Fig. 2 is a diagram illustrating the configuration of an additive for a hydraulic composition of the present invention