(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
22 January 2009 (22.01.2009)

PCT

(10) International Publication Number
WO 2009/011533 A2

(51) International Patent Classification:
C04B 14/12 (2006.01)

(21) International Application Number:
PCT/KR2008/004134

(22) International Filing Date: 14 July 2008 (14.07.2008)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2007-0071217 16 July 2007 (16.07.2007) KR

(71) Applicant *(for all designated States except US)*: **INGLATECH CORPORATION** [KR/KR]; 292-34, Songgok-ri, Moga-myeon, Icheon-si, Gyeonggi-do 467-872 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **KIM, Sang-Jin** [KR/KR]; A-614, Royal Palace Housevill, Sunae-dong, Bundang-gu, Seongnam-si, Gyeonggi-do 463-854 (KR). **HWANG, Eui-Jeong** [KR/KR]; 102-404, Cheong-Kwang Plus Apt., Namsan villiage, Annyeong-dong, Hwaseong-si, Gyeonggi-do 415-380 (KR).

(74) Agent: **PHIL & ONZI INT'L PATENT & LAW FIRM**; Jinsuk B/D 8F., 1536-7, Seocho-dong, Seocho-gu, Seoul 137-872 (KR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

WO 2009/011533 A2

(54) **Title:** ADIABATIC MATERIAL COMPRISING EXPANDED PERLITE AND POLYURETHANE AND METHOD OF PREPARING THE SAME AND CONSTRUCTION METERIALS COMPRISING THE ADIABATIC MATERIAL

(57) **Abstract:** The present invention relates to an adiabatic material comprising expanded perlite and polyurethane, a method of preparing the same, and construction materials comprising the adiabatic material. The adiabatic material of the present invention includes a plurality of expanded perlite first particles having a predetermined average particle dameter; a plurality of expanded perlite second particles having such an average particle diameter that they can locate in voids formed between the expanded perlite first particles; and a one-component water-blown polyurethane binder. The adiabatic material of the present invention has advantages of light weight, excellent adiabatic performance, fire resistance and flame retardance.

Description

ADIABATIC MATERIAL COMPRISING EXPANDED PERLITE AND POLYURETHANE AND METHOD OF PREPARING THE SAME AND CONSTRUCTION MATERIALS COMPRISING THE ADIABATIC MATERIAL

Technical Field

[1] The present invention relates to an adiabatic material comprising expanded perlite and polyurethane, a method of preparing the same, and construction materials comprising the adiabatic material. In particular, the present invention relates to an adiabatic material of light weight, excellent adiabatic performance, fire resistance and flame retardance, comprising expanded perlite and polyurethane, a method of preparing the same, and construction materials comprising the adiabatic material.

Background Art

[2] Generally, an adiabatic material is used in making buildings, and mainly comprises expanded polystyrene (hereinafter referred to as EPS) and expanded polyurethane (hereinafter referred to as EPU). The EPS and EPU are lightweight, for example 100 kg/m^3 or less, and low-priced, enable easy construction, and have excellent adiabatic performance, and thus they are used in large quantities as an adiabatic material of various buildings or a core material of a sandwich panel. However, they have disadvantages of easy burning, flame propagation and harmful gas generation, and thus they are very poor at heat resistance and flame retardance.

[3] To solve the problems of the conventional adiabatic material, various adiabatic materials with flame retardance have been developed, for example, typically a glass fiber, asbestos/rock wool materials, a polyester-based fiber material with treatment for flame resistance, or a polyolefin-based foam. However, the adiabatic materials do not satisfy the requirements of adiabatic performance and acoustic absorption or they are not lightweight and environmentally friendly, and thus they do not satisfy all of the requirements for construction materials, such as light weight, flame retardance, adiabatic performance and economical efficiency.

[4] And, conventionally an adhesive used to prepare an adiabatic material is an inorganic, water glass-based sodium silicate, a cement, a two-component polyurethane or a synthesized rubber-based adhesive. However, the inorganic adhesive is liable to break, and an organic adhesive has a high viscosity, and thus it has difficulty in

inducing to completely coat an uneven surface of a perlite foam. Therefore, it is difficult to design a molding process so that the adiabatic material has effective flame retardnace and adiabatic performance.

[5] Korean Patent Registration No. 10-0530015 discloses a lightweight fire resistant material prepared by mixing expandable perlite, diatomaceous earth, a loess powder and an activated carbon as an inorganic compound, sodium silicate and alumina sol as an inorganic binder, and a thermosetting phenol resin, and compression-molding the mixture at a high temperature. The ingredients have excellent flame retardance, but have a larger weight than EPS or EPU. And, the ingredients are molded into a molded product by a molding process of a high temperature of 250°C or more, and thus it is difficult to form a large area molded product, and manufacturing costs are increased due to the high temperature molding process.

Disclosure of Invention

Technical Problem

[6] An object of the present invention is to provide an adiabatic material having a simple preparing method, excellent flame retardance, adiabatic performance and fire resistance and light weight, a method of preparing the same and construction materials comprising the same.

Technical Solution

[7] To achieve the object, according to the present invention, an adiabatic material includes a plurality of expanded perlite first particles having a predetermined average particle diameter; a plurality of expanded perlite second particles having such an average particle diameter that they can locate in voids formed between the expanded perlite first particles; and a one-component water-blown polyurethane binder. The adiabatic material of the present invention includes the plurality of expanded perlite first particles and expanded perlite second particles, having excellent adiabatic performance, and polyurethan as a binder resin. And, the plurality of expanded perlite second particles are mainly located in voids between the plurality of expanded perlite first particles, and thus the adiabatic material is lightweight, and effectively retards the fire progression to exhibit excellent adiabatic performance, fire resistance and flame retardance.

[8] The adiabatic material of the present invention may include 50 to 600 parts by weight of the expanded perlite first particles and 50 to 300 parts by weight of the expanded perlite second particles based on 100 parts by weight of the polyurethane

binder, and alternatively the adiabatic material may further include at least one flame retardant selected from the group consisting of a phosphorus-based flame retardant, a melamine-based flame retardant and an inorganic flame retardant.

[9] And, according to another aspect of the present invention, a method of preparing an adiabatic material includes (S1) mixing uniformly a liquid type one-component water-blown polyurethane, the plurality of expanded perlite second particles, and water to prepare a paste; (S2) adding the plurality of expanded perlite first particles to the paste, and mixing them uniformly; (S3) providing water to the mixture of the step S2 to foam and cure the one-component water-blown polyurethane; and (S4) drying the cured material.

[10] In the method of preparing an adiabatic material according to the present invention, preferably the paste of the step S1 is a high fluidity paste having viscosity of 300 cps or less for uniform dispersion of the expanded perlite first particles and the expanded perlite second particles.

[11] The above-mentioned adiabatic material according to the present invention may be used to construction materials.

Mode for the Invention

[12] Hereinafter, the present invention is described in detail. The terms or languages used in the specification and claims should not be limitedly interpreted as general or dictionary definitions, but as meaning and concepts consistent with the technical spirit of the present invention based on the principle that the inventor can define properly the concepts of terms to explain his/her invention in the best manner.

[13] An adiabatic material according to the present invention includes a plurality of expanded perlite first particles having a predetermined average particle diameter; a plurality of expanded perlite second particles having such an average particle diameter that they can locate in voids formed between the expanded perlite first particles; and a one-component water-blown polyurethane binder.

[14] The expanded perlite according to the present invention can include an expanded perlite used in the art, the present invention is not limited to a specific kind of expanded perlite. And, the present invention is not limited to a specific particle diameter of the expanded perlite first particles, however the expanded perlite first particles having an average particle diameter of 2㎜ or more have the optimum effect. For example, the average particle diameter of the expanded perlite first particles may be between 2㎜ and 15㎜, however the present invention is not limited in this regard.

[15] Preferably, an average particle diameter of the expanded perlite second particles that

can be used in the present invention is such that the expanded perlite second particles can locate in voids formed between the expanded perlite first particles. For example, the average particle diameter of the expanded perlite second particles may be between 0.01㎜ and 2㎜, however the present invention is not limited in this regard.

[16] In the case that the adiabatic material according to the present invention includes 50 to 600 parts by weight of the expanded perlite first particles and 50 to 300 parts by weight of the expanded perlite second particles based on 100 parts by weight of the polyurethane binder, the adiabatic material may have the optimum effect designed by the present invention.

[17] The adiabatic material according to the present invention may further include additives used in the art according to necessity, which is obvious to persons having ordinary skills in the art. For example, the adiabatic material may further include at least one flame retardant selected from the group consisting of a phosphorus-based flame retardant, a melamine-based flame retardant and an inorganic flame retardant.

[18] Hereinafter, a method of preparing the adiabatic material according to the present invention is described in detail.

[19] First, a liquid type one-component water-blown polyurethane, the expanded perlite second particles and water are uniformly mixed to prepare a paste (S1).

[20] A predetermined amount of the expanded perlite second particles are added to the stock solution of one-component water-blown polyurethane as a binder of a molded product of the present invention, and the predetermined amount may be determined appropriately according to necessity of skilled persons, for example 50 to 300 parts by weight based on 100 parts by weight of the polyurethane.

[21] And, to uniformly mix the polyurethane with the expanded perlite first particles and the expanded perlite second particles, viscosity of the paste may be reduced for high fluidity. For example, the paste may be a high fluidity paste having viscosity of 300 cps or less, and for this purpose, 60 to 200 parts by weight of water may be used to prepare the paste based on 100 parts by weight of a mixture of the polyurethane and the expanded perlite second particles.

[22] In the case that a flame retardant is further included, preferably the flame retardant is added to the polyurethane before the expanded perlite second particles are added to the polyurethane, which may exhibit a flame retardant effect best. The flame retardant is included with a predetermined content, and the predetermined content is determined according to necessity of ordinary persons, for example 10 to 30 parts by weight based on 100 parts by weight of the polyurethane.

[23] Next, the expanded perlite first particles are added to the paste including the one-component water-blown polyurethane, the expanded perlite second particles and water, and they are mixed uniformly (S2).

[24] The present invention is not limited to a specific particle size of the expanded perlite first particles, for example an average particle diameter may be 2㎜ or more as mentioned above. And, the expanded perlite first particles may be added with a pre-determined content, and the predetermined content is determined appropriately according to necessity of ordinary persons. For example, 50 to 600 parts by weight of the expanded perlite first particles are added based on 100 parts by weight of the polyurethane, which is preferable for the optimum adiabatic performance and fire resistance and light weight of the adiabatic material of the present invention.

[25] After the expanded perlite first particles are added to the paste, water is provided to the mixture to foam and cure the one-component water-blown polyurethane (S3).

[26] In the case that the one-component water-blown polyurethane is foamed according to the present invention, the adiabatic material may be formed of a desired shape using an appropriate mold according to necessity.

[27] After the polyurethane is foamed, the cured material is dried to prepare the adiabatic material of the present invention (S4).

[28] In this case, the method may further include an additional foaming step before the drying step according to necessity.

[29] The adiabatic material prepared according to the present invention as mentioned above may be used in various fields, for example construction materials.

[30] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. The description proposed herein is just a preferable example for the purpose of illustrations only, not intended to limit the scope of the invention, so it should be understood that other equivalents and modifications could be made thereto without departing from the spirit and scope of the invention. The preferred embodiments of the present invention are provided to help persons having ordinary skills in the art understand the present invention more completely.

[31] Examples 1 to 4

[32] First, a one-component water-blown polyurethane, expanded perlite second particles (average particle diameter: 0.43㎜) and water were uniformly mixed with a mixing ratio based on parts by weight shown in the below Table 1 (unit: g) to prepare a paste, and then expanded perlite first particles (average particle diameter: 3.5㎜) were added

to and uniformly mixed with the paste, the mixture was injected into a mold of 220㎜ width, 220㎜ length and 50㎜ thickness, and the polyurethane dispersed uniformly in the mixture in the mold was induced to water-foaming and curing. The polyurethane was cured in the mold, separated from the mold, and dried in a constant temperature dryer of 80℃ for 24 hours to manufacture a molded product.

[33] Table 1

[Table 1]

[Table]

	Expanded perlite first particle	Expanded perlite second particle	One-component polyurethane	Water
Example 1	80	50	100	200
Example 2	80	80	100	200
Example 3	100	185	100	200
Example 4	100	290	100	200

[34] Example 1: compressive strength, flexural strength and density

[35] The compressive strength, flextural strength and density of molded products manufactured through the examples 1 to 4 were measured, and results are shown in the below Table 2.

[36] Table 2

[Table 2]

[Table]

	Compressive strength (kgf/㎠)	Flextural strength (kgf/㎠)	Density(kg/㎥)
Example 1	33	16	430
Example 2	29	15	360
Example 3	26	13.2	230
Example 4	22	8.	180

[37] As shown in Table 2, all of the molded products manufactured through the examples 1 to 4 exhibited excellent compressive strength of 20 kgf/㎠ or more and density of 500 kg/㎥ or less, and thus they satisfy the requirements of light weight.

[38] Example 2: thermal conductivity

[39] The thermal conductivity of each molded product manufactured through the examples 1 to 4 was measured according to the standard KS L 9016-05, and results are shown in the below Table 3.

[40] Table 3

[Table 3]

[Table]

	Example 1	Example 2	Example 3	Example 4
Thermal conductivity (W/mK)	0.068	0.057	0.048	0.026

[41] As shown in Table 3, all of the molded products manufactured through the examples 1 to 4 exhibited excellent thermal conductivity of 0.1 W/mK or less.

[42] Example 3: thermal radiation testing and gas harmfulness test

[43] The molded products manufactured through the examples 1 to 4 were tested for thermal radiation and gas harmfulness according to testing methods, No. 2006-476 (KS F ISO5660-1:2003) and No. 2006-476 (KS F 2271:2006) announced by Ministry of Korean Construction & Transportation, and results are shown in the below Table 4.

[44] Table 4

[Table 4]

[Table]

	Example 1	Example 2	Example 3	Example 4	Standard for determining quasi-incombustible materials
Total amount of radiated heat (MJ/㎡)	7.4	4.4	2.9	1.1	8 MJ/㎡ or less
Period of time when thermal radiation rate exceeds continuously 200㎾/㎡ (sec)	0	0	0	0	10 seconds or less
Harmful crack or hole to penetrate a sample during fire	None	None	None	None	Should be none
Time when a mouse stops its behavior (min:sec)	11:25	13:48	17:48	19:31	9 minutes or more

[45] As shown in Table 4, according to the tests for thermal radiation and gas harmfulness, the foam molded products according to the examples 1 to 4 of the present invention exceed a standard value used to determine quasi-incombustible materials. That is, it is found that the adiabatic material according to the present invention is a high performance adiabatic material corresponding to a quasi-incombustible material.

Industrial Applicability

[46] The adiabatic material of the present invention uses two kinds of expanded perlite particles having different average particle diameters, in which expanded perlite particles of a relatively smaller average particle diameter locate in voids between expanded perlite particles of a relatively larger average particle diameter. Thus, the adiabatic material is a quasi-incombustible material having light weight, excellent adiabatic performance, fire resistance and flame retardance and the reduced likelihood of harmful gas generation in the case of exposure to flame. And, the present invention uses a one-component water-blown polyurethane as a binder resin, and thus the polyurethane is induced to foaming and curing by water and has a low viscosity of fluidity, so that the expanded perlite particles and the polyurethane binder are easily mixed, consequently a method for preparing the adiabatic material is simple. And, the method does not use a solvent, and thus is environmentally friendly.

Claims

[1] An adiabatic material, comprising:
a plurality of expanded perlite first particles having a predetermined average particle diameter;
a plurality of expanded perlite second particles having such an average particle diameter that the expanded perlite second particles can locate in voids formed between the expanded perlite first particles; and
a one-component water-blown polyurethane binder.

[2] The adiabatic material according to claim 1,
wherein the average particle diameter of the expanded perlite first particle is between 2 ㎜ and 15 ㎜.

[3] The adiabatic material according to claim 1,
wherein the average particle diameter of the expanded perlite second particle is between 0.01 ㎜ and 2 ㎜.

[4] The adiabatic material according to claim 1,
wherein 50 to 600 parts by weight of the expanded perlite first particles and 50 to 300 parts by weight of the expanded perlite second particles are included based on 100 parts by weight of the polyurethane binder.

[5] The adiabatic material according to claim 1, further comprising:
at least one flame retardant selected from the group consisting of a phosphorus-based flame retardant, a melamine-based flame retardant and an inorganic flame retardant.

[6] A method of preparing an adiabatic material, comprising:
(S1) mixing uniformly a liquid type one-component water-blown polyurethane, a plurality of expanded perlite second particles, and water to prepare a paste;
(S2) adding a plurality of expanded perlite first particles to the paste, and mixing uniformly the expanded perlite first particles with the paste;
(S3) providing water to the mixture of the step S2 to foam and cure the one-component water-blown polyurethane; and
(S4) drying the cured material.

[7] The method of preparing an adiabatic material according to claim 6,
wherein the paste of the step S1 is a high fluidity paste having viscosity of 300 cps or less.

[8] The method of preparing an adiabatic material according to claim 6, further

comprising:

adding at least one flame retardant selected from the group consisting of a phosphorus-based flame retardant, a melamine-based flame retardant and an inorganic flame retardant in the step S1.

[9] The method of preparing an adiabatic material according to claim 6, wherein the step S4 further includes an additional foaming step before the drying step.

[10] Construction materials, comprising an adiabatic material defined in any one of claims 1 to 5.