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(54) **Title:** GYPSUM BASED COMPOSITION AND COMPOSITES PREPARED THEREFROM

(57) **Abstract:** The present disclosure relates to a gypsum based composition containing gypsum in an amount ranging from 50 to 99.9 % of the total weight of the composition and at least one polyester based reinforcing material having length ranging from 3 to 6 mm and linear mass density ranging from 1.5 to 12 Denier, in an amount ranging from 0.01 to 20% of the total weight of the composition. The present disclosure further relates to a gypsum based composite, prepared from the afore-stated gypsum based composition, having flexural strength ranging from 92 to 98.5 Kg/ cm². The composite of the present disclosure is at least one selected from the group consisting of boards, walls, plinths, slabs, columns, sheets, casts and shafts.



GYPSUM BASED COMPOSITION AND COMPOSITES PREPARED THEREFROM.

FIELD

The present disclosure relates to a gypsum based composition and composites prepared therefrom.

BACKGROUND

Gypsum is calcium sulfate dehydrate that occurs in nature in the form of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. In the construction industry, gypsum is extensively used as a binder and lightweight mortar for concrete compositions. In addition to this, gypsum is also used to protect steel structures from fire, to delay the effect of fire on flammable building materials and even as a cast to aid in the healing of bone fractures.

Boards or walls prepared from gypsum are nowadays used as an alternative to the conventional plasters in the construction industry, mainly due to the ease of installation and faster and cost effective construction process. It is significant to note that the gypsum boards or walls can also be directly applied over wood or metal framing, masonry and concrete surfaces. Furthermore, construction blocks prepared from lightweight gypsum boards or walls may reduce economic losses arising during unforeseen catastrophes such as earthquakes, floods and fire.

In spite of the advantages, gypsum is accompanied by the drawbacks of having poor strength and being brittle. It is observed that nearly 3 to 5% of gypsum board or wall raw material is wasted during manufacturing whereas 10 to 12% of the same is wasted during installation.

Various studies have been carried out in an attempt to overcome the afore-stated drawback. Use of different substituents and/ or excipients has been explored to evaluate the effect on strength and brittleness. However, most efforts have failed to produce gypsum boards or walls of the desired flexural strength.

Therefore, there is a need for developing a gypsum composition and composites such as gypsum boards or walls prepared therefrom having the desired strength and aesthetic finish.

OBJECTS

Some of the objects of the present disclosure, of which at least one embodiment is adapted to provide, are described herein below:

It is an object of the present disclosure to provide a gypsum based composition.

It is another object of the present disclosure to provide a gypsum based composition which is safe and economical.

It is yet another object of the present disclosure to provide a gypsum based composition which is ecofriendly.

It is still another object of the present disclosure to provide a gypsum based composition for preparing gypsum based composites having enhanced strength and processability.

It is yet another object of the present disclosure to provide a gypsum based composition for preparing gypsum based composites having desirable bending resistance and sagging tendency.

It is still another object of the present disclosure to ameliorate one or more problems of the prior art or to at least provide a useful alternative.

Other objects and advantages of the present disclosure will be more apparent from the following description which is not intended to limit the scope of the present disclosure.

SUMMARY

The present disclosure provides a gypsum based composition comprising gypsum in an amount ranging from 50 to 99.9 % of the total weight of the composition and at

least one polyester based reinforcing material having length ranging from 3 to 6 mm and linear mass density ranging from 1.5 to 12 Denier, in an amount ranging from 0.01 to 20% of the total weight of the composition. The present disclosure further provides a gypsum based composite, prepared from the afore-stated gypsum based composition, having flexural strength ranging from 92 to 98.5 Kg/ cm². The composite of the present disclosure is at least one selected from the group consisting of boards, walls, plinths, slabs, columns, sheets, casts and shafts.

DETAILED DESCRIPTION

In accordance with one aspect, the present disclosure provides a gypsum based composition containing gypsum and at least one polyester based reinforcing material to improve the inherent strength and durability associated with gypsum. Typically, gypsum is present in an amount ranging from 50 to 99.9 % of the total weight of the composition.

The polyester based reinforcing material is at least one selected from the group consisting of polyethylene terephthalate (PET), polyglycolic acid (PGA), polylactic acid (PLA), polycaprolactone (PCL), polyhydroxyalkanoate (PHA), polyhydroxybutyrate (PHB), polybutylene terephthalate (PBT), polytrimethylene terephthalate (PTT), polytrimethylene naphthalate (PTN), polybutylene naphthalate (PBN), polyethylene naphthalate (PEN) and vectran. The inventors of the present disclosure have found that when the reinforcing material fibers have length ranging from 3 to 6 mm and linear mass density ranging from 1.5 to 12 Denier, they offer the desirable strength to the gypsum composite. Furthermore, as a result of the reduced brittleness, the composite has desirable processability, dimensional stability and aesthetic appeal. The composites are easy to handle during transportation, construction and installation activities and there is a reduction in the wastage of raw material. Even further, the composites have the ability of withstanding various types of environmental conditions.

Typically, the polyester based reinforcing material is present in an amount ranging from 0.01 to 20% of the total weight of the composition.

The composition of the present disclosure may further include at least one additive selected from the group consisting of vehicles, binding agents, viscosity modifiers, fillers, rheology modifiers, preservatives, wetting and dispersing agents. The composition may also further include at least one ingredient selected from the group consisting of vegetable fibers, vegetable fibers in asphalt, silica fume, fly ash, rice husk ash, slate, sand, steel, microconcrete, clay, metals, galvanized metals, coated metals, carbon fibers, carbon nanotubes and glass fibers.

The process for preparation of the gypsum based composition can be any process known to a person skilled in the art.

In accordance with another aspect, the present disclosure provides gypsum based composites prepared from the afore-stated gypsum based composition. Typically, the composite is at least one selected from the group consisting of boards, walls, plinths, slabs, columns, sheets, casts and shafts. Furthermore, the flexural strength of the composites ranges from 92 to 98.5 Kg/ cm², as a virtue of the afore-mentioned specifications of the polyester based reinforcing material.

The process for preparation of the gypsum based composite of the present disclosure varies according to the type of composite to be prepared and is typically a process known to a person skilled in the art. In accordance with one exemplary embodiment, the process for preparation of a gypsum board or wall is presented herein below.

In the first step, gypsum, additives and the polyester fibers in the afore-mentioned specifications are mixed in water to obtain a gypsum composition. The composition so obtained is in the form of paste. In the second step, the composition is poured in a mold to obtain a gypsum sheet having length of 30 cm, width of 5 cm and thickness of 1.2 cm. In the third step, at least one side of the gypsum sheet is covered with paper. It is ensured that the paper sticks to the surface of the gypsum sheet firmly. Accordingly, several such sheets are prepared and allowed to cure and dry at a predetermined temperature for a predetermined time period to obtain gypsum boards.

The present disclosure will now be discussed in the light of the following non-limiting embodiments:

Example 1: Flexural strength of the gypsum based composites of the present disclosure

The inventors of the present disclosure carried out a series of trials where the flexural strength of gypsum based composites of the present disclosure was measured and compared with those having different reinforcing agents or the same reinforcing agent with different specifications. The results are displayed herein below in the form of Table 1.

Table 1. Results of flexural strength analysis

Sr. No.	Sample details	Flexural Strength (Kg/ cm ²)	% Improvement
1	Gypsum only	82.7	NA
2	Gypsum with glass fiber*	92.1	11.4
3	Gypsum with PET (1.5 Denier and 6 mm)	95.5	15.4
4	Gypsum with PET (12 Denier and 3 mm)	98.1	18.6
5	Gypsum with PET (12 Denier and 6 mm)	92.5	11.8
6	Gypsum with PET (12 Denier and 8 mm)	88.1	6.5
7	Gypsum with PET (12 Denier and 10 mm)	84.3	1.9
8	Gypsum with PET (12 Denier and 15 mm)	78.6	-5

*The specifications of the glass fiber were same as those of PET fibers

Table 1 indicates:

- PET is a better reinforcing material than glass fiber in the present context;

- PET fibers, as a reinforcing material, show the most desirable results when their length ranges from 3 to 6 mm and linear mass density ranges from 1.5 to 12 Denier.

Example 2: Sagging properties of the gypsum based composites of the present disclosure

The gypsum based composites of the present disclosure were subjected to accelerated sagging tests and the results obtained are presented herein below in Table 2.

Table 2. Results of accelerated sagging tests

Sr. No.	Sample details	Sagging after 48 hours
1	Gypsum with glass fiber	5.40%
2	Gypsum with PET (1.5 Denier and 6 mm)	2.17%
3	Gypsum with PET (12 Denier and 6 mm)	1.06%
4	Gypsum with PET (0.6 Denier and 6 mm)	3.26%

Table 2 indicates that sagging is minimum in case of 12D fibers with 6 mm cut length as 12D fibers with short cut length have higher bending rigidity.

The embodiments herein and the various features and advantageous details thereof are explained with reference to the non-limiting embodiments in the description.

Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments

without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

TECHNICAL ADVANTAGES AND ECONOMIC SIGNIFICANCE

- The gypsum based composites of the present disclosure have desirable processability, dimensional stability and aesthetic appeal.
- The composites are easy to handle during transportation, construction and installation activities
- There is a reduction in the wastage of raw material.
- The composites have the ability of withstanding various types of environmental conditions.
- The gypsum based composites of the present disclosure show lesser sagging as compared to the composites prepared by using glass fiber.

Throughout this specification the word “comprise”, or variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The use of the expression “at least” or “at least one” suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the invention to achieve one or more of the desired objects or results.

The numerical values given for various physical parameters, dimensions and quantities are only approximate values and it is envisaged that the values higher than

the numerical value assigned to the physical parameters, dimensions and quantities fall within the scope of the invention and the claims unless there is a statement in the specification to the contrary.

While certain embodiments of the inventions have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Variations or modifications in the process or compound or formulation or combination of this invention, within the scope of the invention, may occur to those skilled in the art upon reviewing the disclosure herein. Such variations or modifications are well within the spirit of this invention. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the invention.

Claims:

1. A gypsum based composition comprising:
 - i. gypsum in an amount ranging from 50 to 99.9 % of the total weight of the composition; and
 - ii. at least one polyester based reinforcing material having length ranging from 3 to 6 mm and linear mass density ranging from 1.5 to 12 Denier, in an amount ranging from 0.01 to 20% of the total weight of the composition.
2. The composition as claimed in claim 1, wherein said polyester based reinforcing material is at least one selected from the group consisting of polyethylene terephthalate (PET), polyglycolic acid (PGA), polylactic acid (PLA), polycaprolactone (PCL), polyhydroxyalkanoate (PHA), polyhydroxybutyrate (PHB), polybutylene terephthalate (PBT), polytrimethylene terephthalate (PTT), polytrimethylene naphthalate (PTN), polybutylene naphthalate (PBN), polyethylene naphthalate (PEN) and vectran.
3. The composition as claimed in claim 1, further includes at least one additive selected from the group consisting of vehicles, binding agents, viscosity modifiers, fillers, rheology modifiers, preservatives, wetting and dispersing agents.
4. The composition as claimed in claim 1, further includes at least one ingredient selected from the group consisting of vegetable fibers, vegetable fibers in

asphalt, silica fume, fly ash, rice husk ash, slate, sand, steel, microconcrete, clay, metals, galvanized metals, coated metals, carbon fibers, carbon nanotubes and glass fibers.

5. A gypsum based composite prepared from the gypsum based composition as claimed in claim 1, having flexural strength ranging from 92 to 98.5 Kg/ cm².
6. The composite as claimed in claim 5, being at least one selected from the group consisting of boards, walls, plinths, slabs, columns, sheets, casts and shafts.