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MOD-WALL CONCRETE

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ABSTRACT OF THE DISCLOSURE

A concrete composition developed to provide a material of construction which can be utilized to build essentially all types of structures, including houses, office buildings, and the like, which is capable of being wet mixed and subsequently molded into convenient and useful shapes. The composition has great strength, excellent shrink resistance properties, is shock resistant, and provides good insulation for structures, and is adapted for use with suitable molds to form the entire wall, slab and roof structure of a house or other building in a single pouring.

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a new composition for use in building structures, and more particularly, to a new composition which may be poured as a liquid and combines the features of strength, shock resistance, insulation, and waterproofing qualities in a single material.

DESCRIPTION OF THE PRIOR ART

Conventional building techniques may be typified by the construction of a conventional home or office building in which the following sequence is followed: The lot or ground area upon which the structure is to be constructed must first be graded and the slab poured after footings are dug and forms set. Skilled labor needed in setting the slab are carpenters for setting the forms, roofers to handle waterproofing of the slab, iron workers to tie in reinforcing steel and lay wire mesh, plumbers, whose function is to install necessary piping and fixtures, and cement finishers to place and finish the concrete. After pouring the slab, carpenters must again be utilized to strip the forms and laborers must be directed to move the necessary material and clean excess debris from the lot. More carpenters are then necessary to frame the house, electricians must be used to wire it, and a crew of insulators utilized to apply sheeting and to insulate the interior walls. Roofers must then be directed to apply the roofing, and yet another crew to apply the sheet rock. Painters must then tape, float and paint the structure interior, tile men must be available to install the floors, and carpenters directed to place the cabinets and Formica. Next the bricklayers must brick the exterior of the house and the operating engineer must return to grade the lot to final sepecifications.

From a consideration of the above simplified illustration, it is obvious that current construction techniques involve the use of many skilled crafts, which, in combination with high material costs, effects a high cost of construction which must be passed on to the owner of the home or other structure being built. Furthermore, studies show that the cost of construction has increased each year from year to year, and is likely to continue doing so for the foreseeable future.

Alternative methods of construction designed to reduce costs may be exemplified by use of concrete blocks in erecting structures, but these techniques are subject to severe limitations, chief among which are poor appearance, lack of sufficient insulating properties, and the expense of providing necessary strength. Nor does the addition of brick to provide the necessary structural strength and a pleasing appearance solve the problem, since a brick wall having comparable strength must be built to a minimum thickness of 8 inches, and requires the services of a bricklayer to construct, thereby again increasing construction costs.

While it has long been known that conventional structural and structural lightweight concretes may be utilized as construction materials, these materials have been found to be unsatisfactory as a poured-in-place, all inclusive material of construction for walls and roof structure, since the cost of this material is so great and it is subject to severe limitations regarding insulation and shock resistant properties. Furthermore, the cost of precast panels built of these materials is generally prohibitive because of high transportation and erection costs.

SUMMARY OF THE INVENTION

Accordingly, it is the purpose of this invention to provide a composition of matter which may be used to form the walls, slab and roof structure, as well as other component parts of a structure, which composition has the necessary density, durability, and strength for functional use. The composition may be readily poured into any suitable mold, may be easily nailed, sawed and drilled, and is readily formed to provide a simulated brick or other outer structure having a pleasing appearance, and simulated sheetrock or other desired interior structure. The composition is also fireproof, waterproof, vermin resistant, rot proof, wind resistant, erosion proof and storm proof, and is characterized by shock resistance and good insulating properties. In a typical embodiment of the invention, the mod-wall concrete composition may function as a single wall composition having the above-noted characteristics with the exterior walls having the same appearance as ordinary brick, and the interior walls simulating textured gypsum board. The forms utilized to cast this material have been especially designed for fast, efficient erection and are equipped with wall ties for bracing which effect an absolutely straight and true surface with desired ornamentation on both the exterior and interior walls, and require no additional bracing.

It has been found that the following basic ingredients may be combined to provide a composition having the characteristics heretofore noted: Water, gypsum, vermiculite, cement, wood fibers, and sisal. Additional preferred ingredients which may be added to aid shrink resistance and minimize porosity are calcium chloride and fly ash.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It will be recognized that the materials heretofore set forth can be prepared in varying proportions to provide compositions suitable for various environmental conditions. For example, the gypsum material is introduced with cement, and preferably portland cement, which is a high quality cement composition, to provide the necessary structural strength, both ingredients being preferably mixed in the composition in the range of from about 15% to about 40% by volume. Vermiculite is preferably added in the proportion of from about 9% to about 29% by volume in order to provide the composition with necessary insulation properties. As an additional insulating feature, wood fibers are preferably added to the composition in a volume percentage range of from about 8% to about 28%. The wood fibers, which may be added in the form of sawdust or chips not exceeding about seven-eighths of an inch in diameter, also serve to provide shock resistance in the composition for use in earthquake prone areas such as California, for example, where such resistance is particularly necessary. Calcium chloride may also be

added to the mixture as desired, preferably in the volume percentage range of from about 0.25% to about 1%, in order to limit shrinkage and thereby increase the strength of the composition as it sets. It should be pointed out that under circumstances where calcium chloride is used, it is generally preferred not to use a greater than 1% by volume concentration, because such an excess tends to cause rapid setting of the composition mixture and frequently inhibits proper forming of the mixture as it is poured. However, under certain conditions where it is desired to effect a fast setting of the building material composition, larger percentages of calcium chloride may be used. Fly ash may also be selectively utilized in the composition to enhance waterproofing characteristics, and this ingredient is preferably added in a volume percentage of from about 0.25% to about 1%. It has been found that particulate fly ash or, in the alternative, limestone dust, will furnish the proper filling agent to fill the porous structure of the composition to provide the necessary waterproofing qualities. Sisal is also preferably utilized as a reinforcing agent to complement the gypsum and cement, and is preferably added in a volume percentage range of from about 1% to about 2%. Water is then added to the mixture in the proportion of about 3.5 gallons per cubic foot of mixture to provide the necessary fluidity. It will be appreciated that the concentration of water in the composition is not critical, it being necessary only to provide the necessary fluidity to effectuate pumping or otherwise facilitating entry of the composition mixture into the forms.

In a most preferred embodiment of the invention, the construction composition of this invention is composed of the following ingredients in the following volumetric proportions to effect optimum setting and curing conditions:

Gypsum—20%	Calcium chloride—1%
Vermiculite—29%	Fly ash—1%
Portland cement—20%	Sisal—1%
Wood fibers—28%	

Water—3.5 gallons/cubic foot of mixture.

It will be recognized that different types and grades of the material noted above such as gypsum or plasterboard, for example, may be utilized in the composition. Preferred among the mineral $CaSO_4\ 2H_2O$ which may be used are those gypsum compositions having the trade names "Hydrostone" and "Densacal Plaster," both trade names of which relate to high density $CaSO_4\ 2H_2O$, or gypsum. Ordinary gypsum may be utilized in the invention, but the above compositions are preferred due to greater strength. It will be appreciated that the vermiculite ingredient may be selected from the group of micaceous minerals or hydrous silicates or mixtures of these, and particularly those derived from alteration of mica, the granules of which expand at high temperature to yield a lightweight, highly water absorbent material. Furthermore, the fly ash may be substantially any combustible ash which is a byproduct of combustible fuel, and the sisal ingredient is preferably small diameter cordage of short nap length, which will easily blend into the composition mixture.

The invention will be better understood by a consideration of the following examples:

EXAMPLE I

Twenty-eight pounds of gypsum, twent-eight pounds of portland cement, four pounds of calcium chloride, eight pounds of limestone dust, three and one-half pounds of vermiculite, twelve ounces of sisal, and seven pounds of shredded wood fibers were placed in a mixing container, and into this mixture was added three and one-half gallons of water. The composition was stirred to provide a uniform mixing, and was noted to be viscous. The mixture was then poured into a form for testing and allowed to stand for twenty-eight days to cure. After the curing period the specimen, which was observed to be a greyish brown in color, was broken under test conditions and was found to withstand one thousand pounds per square inch of pressure before failing. The density of the mix was found to be ninety-one pounds per cubic foot on a wet basis, and sixty-eight pounds per cubic foot on a dry basis. The compressive strength of similar samples computed on a time-of-curing basis was found to be as follows:

2 hours—250 p.s.i. 28 days—1,000 p.s.i.
7 days—650 p.s.i.

EXAMPLE II

A sample of the product illustrated in Example I was immersed in water for 48 hours, wiped dry, weighed, and placed in an oven and heated at 230° F. for 48 hours. The sample was then cooled in a sealed chamber, weighed, and the drying and cooling cycle repeated for an additional 48 hour period. The gravimetric results were as follows:

Initial wt. (lbs.)	5.27
Wt. after 48 hrs. sat (lbs.)	5.87
Wt. after initial drying (lbs.)	4.05
Linear shrinkage (percent)	0.0381

EXAMPLE III

A sample of the product set forth in Example I was subjected to a test for flexural strength in accordance with ASTM standards, which strength was found to be as follows:

Total load (lbs.)	850
Flexural strength (p.s.i.)	330.6

EXAMPLE IV

A sample of the product illustrated in Example I was subjected to successive water immersion, freezing and thawing conditions as follows: The sample was first weighed, then immersed in water for 8 hours, and removed and again weighed. It was then placed in a −35° F. chamber and frozen for 8 hours, removed and placed in an oven and heated at 350° F. for 8 hours, after which it was removed and again weighed. The results were as follows:

Initial wt. (lbs.)	5.25
Wt. after 8 hrs. sat (lbs.)	5.80
Dry wt. after 8 hrs. (lbs.)	4.0
No. of freezing and thawing cycles	90
Adverse effects	None

While it will be recognized that the composition of this invention may be introduced into the forms by a variety of techniques, it is preferred to pump the mixture into the forms. This procedure ensures that the forms are uniformly filled, and effects a continuous and uninterrupted flow to avoid "cold" joints in the composition as it hardens; after a firm set has been achieved, the forms are removed.

A preferred technique for introducing the mod-wall concrete composition into the forms is by pumping from a minimum of two discharge points on the pump, and curing is effected by allowing the mixture to set for a specified period of time. Under ordinary circumstances, the setting time in the forms should not exceed 2 hours, after which the forms are removed. As heretofore noted, depending upon the particular design of the forms utilized, the outside of the structure may simulate a brick or concrete surface and the inside can be designed to resemble a textured gypsum, which may be easily painted or otherwise decorated for finishing purposes. Other materials may be simulated as desired, depending upon the form design. The material may be mill mixed to exact specifications with strict quality control, requiring only the addition of water at the job site with no special plant or equipment needed, to effect the desired composition. Furthermore, the capability for producing a particular wall having particular specifications is limited only by the availability of the proper forms, mixer and equipment to pump the mix to the forms.

It is significant that under circumstances where additional insulating properties are required, either the wall thickness of the structure may be increased, the density of the mix reduced, or particular ingredients, such as wood fibers and vermiculite, may be added in increased quantities. Furthermore, the durability and permanency of the composition structure is essentially that of conventional concrete, and maintenance of the interior wall is limited to that which would normally be required in conventional structures, such as painting, paneling, wallpapering and/or texturing. Since the wall is solid, the necessity of replacing torn and broken sheetrock as in conventional housing is removed, and the wall is capable of being nailed for installation of paneling, if desired. Furthermore, trim, molding, and accessories may be installed and adhesives applied for hanging wallpaper, as in conventional structures.

In addition to the superior qualities characteristic of the composition enumerated above, it is further significant that pouring of this product and the product itself is unaffected by wide temperature variation, since the composition will not freeze when poured in subzero temperatures due to the heat of hydration generated in the setting material. So long as the water can be added before it freezes, the mixture will not be adversely affected by either low or high temperature, and it can be poured when outside temperatures are as low as −20° Fahrenheit. Furthermore, the pouring technique itself, as well as the composition mixture, is unaffected by hot and cold weather, freezing and thawing conditions, as well as varying humidity and other adverse weather conditions.

It is also significant that the composition of this invention may be readily adapted for use in any part of the United States as a material of construction due to its versatility. For example, it may be designed to withstand earthquake shocks prevalent on the West Coast by incorporating a high flexure strength made possible by addition of higher concentrations of the wood fiber and sisal ingredients. The product may be made resistant to wind and ice storms by incorporating higher concentrations of cement and fly ash to enhance strength and water-impermeability characteristics. Similarly, the composition may be protected from the adverse effects of salty air found in the Gulf Coast states, and use of the monolithic pour technique vastly reduces the chance of overturning and collapse under load.

Other advantages of the composition of this invention are found in the features of self-reinforcement, which eliminates the need for steel reinforcement necessary in conventional concrete structures, and the capability of mill mixing to exact specifications, which produces a mixture requiring only the addition of water and mixing to ready the composition for pouring. As heretofore noted, the composition is also characterized by a rapid curing period after which the forms may be removed, and is shrink resistant, a feature which eliminates cracking and checking in the finished wall. Mod-wall concrete has an average flexural strength of 340 p.s.i., which compares to approximately 100 p.s.i. for conventional concrete, and is essentially completely inert, as heretofore noted. The poured wall is also characterized by low density, a factor which produces excellent noise reduction qualities.

Having described my invention with particularity, what is claimed is:

1. A construction composition comprising a volume percentage of from about 15% to about 20% gypsum, from about 9% to about 29% vermiculite, from about 15% to about 40% portland cement, from about 8% to about 28% wood fibers, from about 1% to about 2% sisal, and water in sufficient quantity to make said composition fluid.

2. The construction composition of Claim **1** further comprising from about 0.25% to about 1% fly ash.

3. The construction composition of Claim **1** further comprising from about 0.25% to about 1% calcium chloride.

4. The construction composition of Claim **1** further comprising from about 0.25% to about 1% fly ash and from about 0.25% to about 1% calcium chloride.

5. The composition of Claim **1** further including limestone in a volume percentage of from about 0.25% to about 1% and calcium chloride in a volume percentage of from about 0.25% to about 1%.

6. The composition of Claim **4** wherein:

(a) said gypsum is present in a volume percentage of about 20%;

(b) said vermiculite is present in a volume percentage of about 29%;

(c) said portland cement is present in a volume percentage of about 20%;

(d) said wood fibers are present in a volume percentage of about 28%;

(e) said calcium chloride is present in a volume percentage of about 1%;

(f) said fly ash is present in a volume percentage of about 1%;

(g) said sisal is present in a volume percentage of about 1%; and

(h) said water is present in a concentration of about 3½ gallons per cubic foot of said composition.

References Cited

UNITED STATES PATENTS

3,565,648	2/1971	Mori et al.	106—89
493,152	3/1893	Culver	106—115
662,643	11/1900	Griswold	106—99
767,434	8/1904	Perkins	106—99
1,961,525	6/1934	Offutt	106—99
3,093,505	6/1963	Conway	106—99

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