HIGH STARCH LIGHT WEIGHT GYPSUM WALLBOARD

This application is a continuation of U.S. patent application Ser. No. 11/449,177, filed Jun. 7, 2006, now U.S. Pat. No. 7,731,794 which claims priority to U.S. Provisional Patent Application No. 60/688,839, filed Jun. 9, 2005, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

This invention pertains to a method making gypsum slurries containing a pregelatinized starch and a naphthalenesulfonate dispersant, and products made therefrom. It also pertains to a method of increasing dry strength of gypsum-containing products including wallboard by using a naphthalenesulfonate dispersant in combination with pregelatinized starch in the slurry used to make the products.

BACKGROUND OF THE INVENTION

Certain properties of gypsum (calcium sulfate dihydrate) make it very popular for use in making industrial and building products, such as gypsum wallboard. Gypsum is a plentiful and generally inexpensive raw material which, through a process of dehydration and rehydration, can be cast, molded or otherwise formed into useful shapes. The base material from which gypsum wallboard and other gypsum products are manufactured is the hemihydrate form of calcium sulfate ($CaSO_4.1/2H_2O$), commonly termed "stucco," which is produced by heat conversion of the dihydrate form of calcium sulfate ($CaSO_4.2H_2O$), from which 1½ water molecules been removed.

Conventional gypsum-containing products such as gypsum wallboard have many advantages, such as low cost and easy workability, although substantial amounts of gypsum dust can be generated when the products are cut or drilled. Various improvements have been achieved in making gypsum-containing products using starches as ingredients in the slurries used to make such products. Starch can increase flexural strength and compressive strength of gypsum-containing products including gypsum wallboard. Known gypsum wallboard contains board starch at levels of less than about 10 lbs/MSF.

It is also necessary to use substantial amounts of water in gypsum slurries containing pregelatinized starch in order to ensure proper flowability of the slurry. Unfortunately, most of this water must eventually be driven off by heating, which is expensive due to the high cost of the fuels used in the heating process. The heating step is also time-consuming. It has been found that the use of naphthalenesulfonate dispersants can increase the fluidity of the slurries, thus overcoming the water demand problem. In addition, it has also been found that the naphthalenesulfonate dispersants, if the usage level is high enough, can cross-link to the pregelatinized starch to bind the gypsum crystals after drying, thus increasing dry strength of the gypsum composite. Trimetaphosphate salts have not in the past been recognized to affect gypsum slurry water requirements. However, the present inventors have discovered that increasing the level of the trimetaphosphate salt to hitherto unknown levels in the presence of a specific dispersant makes it possible to achieve proper slurry flowability with unexpectedly reduced amounts of water, even in the presence of high starch levels. This, of course, is highly desirable because it in turn reduces fuel usage as well as the process time associated with subsequent water removal process steps. Thus the present inventors have also discovered that the dry strength of gypsum board can be increased by using a naphthalenesulfonate dispersant in combination with pregelatinized starch in the slurry used to make the wallboard.

BRIEF SUMMARY OF THE INVENTION

The invention generally comprises a slurry including stucco, naphthalenesulfonate dispersant, and pregelatinized starch. The naphthalenesulfonate dispersant is present in an amount of about 0.1%-3.0% by weight based on the weight of dry stucco. The pregelatinized starch is present in an amount of at least about 0.5% by weight up to about 10% by weight based on the weight of dry stucco in the formulation. Other slurry additives can include accelerators, binders, paper or glass fibers and other known constituents. The invention also comprises the gypsum-containing products made with such slurries.

The invention also comprises a slurry including stucco, trimetaphosphate salt, naphthalenesulfonate dispersant, and pregelatinized starch. The sodium trimetaphosphate is present in an amount of at least about 0.12% by weight based on the weight of stucco. In a preferred embodiment, the trimetaphosphate salt is present in an amount of about 0.12-0.4% by weight based on the weight of dry stucco. The naphthalenesulfonate dispersant is present in an amount of about 0.1%-3.0% by weight based on the weight of dry stucco. The pregelatinized starch is present in an amount of at least about 0.5% by weight up to about 10% by weight based on the weight of dry stucco in the formulation. Other slurry additives can include accelerators, binders, paper or glass fibers and other known constituents. The invention also comprises the gypsum-containing products made with such slurries.

A preferred gypsum-containing product is gypsum wallboard. In this embodiment, the invention constitutes gypsum wallboard comprising a set gypsum composition formed between two substantially parallel cover sheets, the set gypsum composition made using the gypsum-containing slurry of water, stucco, pregelatinized starch, and a naphthalenesulfonate dispersant. The gypsum-containing slurry can optionally contain a trimetaphosphate salt, for example, sodium trimetaphosphate. This gypsum wallboard made in accordance with the invention has a high strength, yet much lower weight than conventional boards. In addition, much less dust is generated on cutting, sawing, snapping, or drilling the wallboards made according to this embodiment.

In another embodiment the invention constitutes a method of making gypsum wallboard by mixing a gypsum-containing slurry comprising water, stucco, pregelatinized starch, and a naphthalenesulfonate dispersant, wherein the pregelatinized starch is present in an amount of at least about 0.5% by weight up to about 10% by weight based on the weight of stucco. The resulting gypsum-containing slurry is deposited on a first paper cover sheet, and a second paper cover sheet is placed over the deposited slurry to form a gypsum wallboard. The gypsum wallboard is cut after the gypsum-containing slurry has hardened sufficiently for cutting, and the resulting gypsum wallboard is dried. The gypsum-containing slurry can optionally contain a trimetaphosphate salt, for example, sodium trimetaphosphate. Other conventional ingredients will also be used in the slurry including, as appropriate, accelerators, binders, paper fiber, glass fiber, and other known ingredients. A soap foam is normally added to reduce the density of the final gypsum wallboard product.

DETAILED DESCRIPTION OF THE INVENTION

According to one embodiment of the present invention, there are provided finished gypsum-containing products