

BUILDING BOARD WITH ACOUSTICAL FOAM**TECHNICAL FIELD**

[0001] This disclosure relates to a building board construction. More specifically, the present invention relates to a building board with an acoustical foam.

BACKGROUND OF THE INVENTION

[0002] Building board, also known as wallboard, plasterboard, or drywall, is one of the most commonly used building components in the world today. Building board is frequently used within the interior of a dwelling, where it functions both as a finished wall covering and as a structural room partition. Building board can also be used on the exterior of a dwelling, where it serves as a sheathing to provide weather protection and insulation. Building board can also be used as an interior facing for other structures as well, such as stairwells, elevator shafts, and interior ducting.

[0003] One particularly popular form of building board is known as gypsum board. Gypsum board is constructed by depositing a layer of cementitious gypsum slurry between two opposing paper liners. Gypsum slurry is the semi-hydrous form of calcium sulfate and has many physical characteristics that make it suitable for use as a building component. For example, gypsum boards generally have a smooth external surface, a consistent thickness, and allow for the application of finishing enhancements, such as paint. Gypsum board is also desirable because it provides a degree of fire resistance and sound abatement.

[0004] An example of a paper-covered gypsum board is disclosed in U.S. Pat. No. 2,806,811 to Von Hazmburg. Von Hazmburg discloses a board that primarily consists of a thick gypsum core that is encased in a fibrous envelope consisting of both a manila sheet and a newsprint sheet. These sheet layers can be made from a conventional multi-cylinder paper making process.

[0005] Another popular form of building board is known as glass reinforced gypsum (GRG) board. An example of one such board is disclosed in U.S. Patent No. 4,265,979 to Baehr et. al. Baehr discloses a building board constructed from opposing glass fiber mats with an intermediate gypsum core. This construction provides a hardened external surface and is an improvement over earlier paper faced boards.

[0006] Yet another type of gypsum board is disclosed in commonly owned U.S. Patent No. 4,378,405 to Pilgrim. Pilgrim discloses a GRG board that is faced on one or both sides with a porous, nonwoven glass mat. The glass mat of Pilgrim is fully embedded into the slurry core. This is accomplished by vibrating the gypsum slurry to cause it to pass through the porous openings in the mat. Embedding the mat within the core as taught in Pilgrim results in a thin film of slurry being formed on the outer surface of the board. Building boards with this construction are referred to as embedded glass reinforced gypsum (EGRG) boards.

[0007] These various building board constructions offer many beneficial characteristics. However, none of these constructions provide for increased acoustical properties. As a result, these boards offer little, if any sound absorption or insulation, they act as a sound barrier. Sound absorption and insulation are especially important when the building board is used as a room partition or even as an exterior building component. Thus, there exists a need in the art for building boards with increased acoustical properties. More specifically, there is a need in the art for a board that absorbs sound waves. The present invention is aimed at achieving these and other objectives.

SUMMARY OF THE INVENTION

[0008] The building boards of the present disclosure have several important advantages. In particular, the disclosed building boards provide increase sound absorption without sacrificing any structural characteristics of the board.

[0009] A further advantage is realized by providing increased acoustical properties via the inclusion of a polymer sheet within the core of the building board.

[0010] Still yet another possible advantage of the present system is achieved by incorporating a polymer sheet via a continuous manufacturing method, thereby enabling the building board of the present disclosure to be manufactured quickly and inexpensively.

[0011] Another advantage of the present system is attained by including a series of sound absorbing polymeric cubes within the core of the building board.

[0012] Still yet another possible advantage of the present system is achieved by incorporating polymeric cubes or as a powdered material via a continuous manufacturing method, thereby enabling the building board of the present disclosure to be manufactured quickly and inexpensively.

[0013] A further advantage is recognized by incorporating sound absorbing materials into a gypsum building board via a continuous manufacturing method.

[0014] Various embodiments of the invention may have none, some, or all of these advantages. Other technical advantages of the present invention will be readily apparent to one skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] For a more complete understanding of the present disclosure and its advantages, reference is now made to the following descriptions, taken in conjunction with the accompanying drawings, in which:

[0016] FIG. 1 is a diagram of one possible manufacturing process for the building boards of the present disclosure.

[0017] FIG. 2 is a diagram of another possible manufacturing process for the building boards of the present disclosure.

[0018] FIG. 3 is a diagram of another possible manufacturing process for the building boards of the present disclosure.

[0019] FIG. 4 is a cross sectional view of an embodiment of the building board of the present disclosure.

[0020] FIG. 5 is a cross sectional view of an alternative embodiment of the building board of the present disclosure.

[0021] FIG. 6 is a cross sectional view of an alternative embodiment of the building board of the present disclosure.

DETAILED DESCRIPTION OF THE DRAWINGS

[0022] The present disclosure relates to a building board with enhanced acoustical properties. In one possible embodiment, the board is a gypsum board with opposing facing sheets and an intermediate set gypsum core. An opened celled polymeric sheet

is formed within the gypsum core and gives the resulting board enhanced sound absorption. In an alternative embodiment, individual pieces of polymeric foam are used in stead of the polymeric sheet. Also disclosed are various manufacturing methods whereby boards with enhanced acoustical properties can be formed in a continuous process. The various components of the present disclosure, and the manner in which they interrelate, are described in greater detail hereinafter.

[0023] FIGS. 1-3 illustrate various production lines (**34a**, **34b**, and **34c**) for constructing the building boards of the present disclosure. FIGS. 4-6 are cross sectional views of various board constructions (**20a**, **20b**, **20c**) of the present disclosure. The boards of the present disclosure are generally a core layer **22** of a set gypsum core and opposing paper of fibrous sheets **24**. In the particular embodiment illustrated in Figure 4, board **20a** has upper and lower mats **24** which are formed from a series of non-woven, randomly aligned inorganic fibers. These mats are preferably porous with interior and exterior faces. Paper facing sheets can also be used and are likewise represented by element **24**.

[0024] With continuing reference to FIG. 4, upper and lower mats **24** are each coated with a layer of dense set slurry **26**. Dense slurry **26** preferably penetrates the upper and lower mats **24**. As a result the exterior surface of each mat **24** is substantially covered by set slurry. Core layer **22** of set gypsum extends fully between and bonds with the upper and lower slurry layers **26**. In one embodiment, core slurry layer **22** has a density that is less than the density of the upper and lower slurry layers **26**.

[0025] The enhanced acoustical properties are achieved via the inclusion of a polymer sheet **28** into core slurry layer **22**. In the preferred embodiment, sheet **28** is formed from a melamine resin and is formed into an opened cell foam. Melamine resin is a thermoset polymer. A suitable foam is Basotect® which is manufactured and sold by BASF Corporation. Basotect® foam preferred because it provides a three-dimensional network of slender and easily shaped webs. Basotect® foam also gives the resulting board sound absorption, and chemical and fire resistance. However, the use of other polymer foams is also within the scope of the present disclosures. For a 1/2 inch thick building board, a polymer sheet **28** of 1/8 inch is preferred.

[0026] Sound waves entering the cells of the foam are subsequently attenuated and dissipated, thereby giving sheet **28** its sound absorbing characteristics. As such, it is important that the cells of the foam remain free to gypsum slurry during the formation of the board. Polymer sheet **28** is design to be positioned within, but not penetrated by, the core slurry layer **22**. Because polymer sheet **28** does not absorb the slurry layer **22**, and because it preferably extends over the majority of the width of board **20a**, a series of apertures **32** must be formed through the thickness of sheet **28**. Apertures **32** permit the slurry **22** to extend through sheet **28** to thereby fully integrate building panel **20a**. In the absence of apertures **32**, building panel **20a** would be prone to separation along the boundary of sheet **28**. In the event that polymer sheet **28** could absorb slurry layer **22**, apertures could be eliminated **32**. In the preferred embodiment, the thickness of core layer **22** is substantially larger than the thickness of polymer sheet **28**.

[0027] FIG. 1 illustrates a gypsum board production line **34a** that has been modified in accordance with the present disclosure. Production lines **34a** includes a series of forming tables **36** for supporting building panel **20a** during its formation. As is known in the art, the mats that form panel are under tension by way of a series of downstream belts. Once panel has been formed, it is passed to a series of board dryers. Dryers function in driving out excess moisture and causing the gypsum slurry to set. This results in the formation of a dried composite panel.

[0028] As further noted in FIG. 1, gypsum board **20a** is formed from first and second fibrous mats **24** which a volume of gypsum slurry being deposited from a mixer **38**. Paper mats can alternatively be used in place of fibrous mats. In either event, mats **24** are initially stored in large rolls **42** that are unwound in a continuous manufacturing method. A first roll **42** is unwound onto forming table at location 1a. A dense slurry layer **26** can optionally be deposited over the first mat **24** after it is unrolled beneath a first mixer outlet **44**. Rollers push the dense slurry layer through the mat at location 1b. Additional slurry is thereafter dispensed from mixer **38** at a second mixer outlet **46** to form core slurry layer **22**. A second roll **42** is ideally positioned downstream of first roll. A second mat **24** is unwound from this roll over top of the deposited gypsum core **22** to create sandwich or panel. The formed panel is noted at location 1c. Mixer **38** includes a third outlet **48** for supplying a dense slurry layer **26** over the second mat **24**. The

polymer sheet **28** is initially stored in a wound roll **52** and is dispensed immediately downstream of second mixer outlet **46**. This positions sheet **28** in approximately the center of core **22**.

[0029] An alternative production line **34b** is disclosed in FIG. 2. Line **34b** is the same in all respects to the production line of FIG. 1; however, the rolled polymer sheet **28** is replaced by a hopper **54** containing a plurality of polymer cubes **56** or a volume of a granulated polymer. In the preferred embodiment, cubes of approximately 1/2 inch are employed. Other shapes and sizes can also be used instead of 1/2 inch cubes. Basotect® foam can be used to produce polymer cubes **56**. Cubes **56** are dispensed from a hopper **54** to a chute to deliver cubes **56** into core slurry layer **22**. In still yet additional embodiments, the Basotect® foam is added to the slurry in a grated or granular form.

[0030] The resulting building board **20b** has a cross section as illustrated in FIG. 5. Each of the polymer cubes **56** or granulated material includes an opened cell foam. Cubes **56** or granules are randomly distributed within slurry layer **22**; however, slurry **22** does not penetrate the individual pieces or cubes **56**. The composite board **20b** is fully integrated as core layer **22** extends about the individual polymer cubes **56**. In still yet another embodiment, the polymer foam can be grated to form very small bits of foam that agglomerate into a foam fluff. This foam fluff can then be distributed into slurry core **22**.

[0031] A further embodiment of the production line **34c** is depicted in FIG. 3. This embodiment uses a polymeric sheet **28**, which may have the same construction as the sheet described in connection with FIG. 1. However, instead of sheet **28** being delivered into slurry core **22**, it is secured to the lower mat **24** via an adhesive. More specifically, a roll **58** of the polymeric sheet is dispensed over top of mat **24** prior to the mat being delivered to the forming table **36**. The cross sectional view of the resulting building board **20c** is depicted in FIG. 6. As illustrated, sheet **28** is now oriented in facing relation with the first mat **26**. It is also within the scope of the present invention to apply sheet **28** directly to one of the upper or lower dense slurry layers. This would avoid sheet **28** being secured to mat **24**. Either of these embodiments may be used in connection with either of the previously described embodiments.

[0032] Although this disclosure has been described in terms of certain embodiments and generally associated methods, alterations and permutations of these embodiments and methods will be apparent to those skilled in the art. Accordingly, the above description of example embodiments does not define or constrain this disclosure. Other changes, substitutions, and alterations are also possible without departing from the spirit and scope of this disclosure.

WHAT IS CLAIMED IS:

1. A composite, multi-layered building panel with enhanced acoustical properties, the panel comprising:

coplanar opposed upper and lower mats formed from non-woven, randomly aligned inorganic fibers, the mats being porous and having interior and exterior faces;

upper and lower layers of a set slurry coating the upper and lower mats, the upper and lower layers penetrating the upper and lower mats, whereby the exterior surface of each mat is substantially covered by set slurry;

a core layer of set gypsum having a thickness extending between the upper and lower layers, the core slurry layer having a density that is less than the density of the upper and lower slurry layers;

a polymer sheet have a thickness, the polymer sheet positioned within but not penetrated by the core slurry layer, the sheet being formed from a melamine resin and containing a plurality of opened cells throughout its thickness, the polymer sheet having sound-absorbing characteristics, a series of apertures formed through the thickness of the polymer sheet to allow the polymer sheet to bond to the core layer, the thickness of the core layer being larger than the thickness of the polymer sheet.

2. A composite, multi-layered building panel with enhanced acoustical properties, the panel comprising:

coplanar opposed upper and lower paper sheets, the sheets having interior and exterior faces;

a core layer of set gypsum having a thickness extending between the upper and lower paper sheets;

a polymer sheet have a thickness, the polymer sheet positioned within but not penetrated by the core slurry layer, the sheet containing a plurality of opened cells throughout its thickness.

3. The composite building panel as described in claim 2 wherein the sheet is formed from a thermoset polymer.

4. The composite building panel as described in claim 2 wherein the sheet is formed from a melamine resin.

5. The composite building panel as described in claim 2 wherein the opened celled foam enhances the sound-absorbing characteristic of the building panel.

6. The composite building panel as described in claim 2 further comprising a series of apertures formed through the thickness of the polymer sheet to allow the polymer sheet to bond to the core layer.

7. The composite building panel as described in claim 2 further comprising upper and lower layers of a set slurry coating the upper and lower paper sheets, wherein the upper and lower layers of set slurry have a greater density than the core slurry layer.

8. A composite, multi-layered building panel with enhanced acoustical properties, the panel comprising:

- coplanar opposed upper and lower mats having interior and exterior faces;
- upper and lower layers of a set slurry coating the upper and lower mats;
- a core layer of set gypsum having a thickness extending between the upper and lower layers;
- an opened celled polymer positioned within the core slurry layer.

9. The composite building panel as described in claim 8 wherein the upper and lower mats are porous mats formed from non-woven, randomly aligned inorganic fibers.

10. The composite building panel as described in claim 9 wherein the upper and lower layers of set slurry penetrate the upper and lower mats, whereby the exterior surface of each mat is substantially covered.

11. The composite building panel as described in claim 8 wherein the opened celled polymer is a melamine resin.

12. The composite building panel as described in claim 8 wherein the opened celled polymer gives the building board sound-absorbing characteristics.

13. The composite building panel as described in claim 8 wherein the core slurry layer has a density that is generally less than the density of the upper and lower slurry layers.

14. The composite building panel as described in claim 8 wherein the polymer comprises a plurality of open celled polymer pieces.

15. The composite building panel as described in claim 14 wherein the polymer pieces are formed from a melamine resin.

16. The composite building panel as described in claim 14 wherein the core layer extends around but does not penetrate the individual polymer pieces.

17. The composite building panel as described in claim 8 wherein the polymer comprises a blanket of a foamed polymer.

18. The composite building panel as described in claim 17 wherein the blanket gives the building board sound-absorbing characteristics.

19. The composite building panel as described in claim 17 wherein the blanket is formed from a melamine resin