GYPSUM WALLBOARD MANUAL — Section 3

1965 EDITION

MANUFACTURE of GYPSUM WALLBOARD and GYPSUM LATH

Board Products

Gypsum Wallboard, Lath and Sheathing are composed of a core, hydrated calcined gypsum fibers and other ingredients, surfaced on both sides with smooth, uniform, specially-prepared paper forming the finished surfaces and serving as a reinforcement.

Each raw material used in the manufacture of these products is for a specific purpose, and only those that meet our rigid specifications are used. The quality and structural value of each board product depends upon its composition and fabrication during manufacture. To thoroughly understand the quality, properties, uses, etc., of each product, its composition and manufacture should be known. Therefore, the manufacturing may best be followed by starting with the raw materials and following their course, step by step, through the process.

1. RAW MATERIALS

(a) Paper:

Bestwall manufactures in its own paper plants, most of the special paper used for surfacing wallboard, lath and sheathing. A different kind of paper is used for each finished product. Bestwall's three paper mills are located at Pryor, Oklahoma; Thorold, Canada; and Delair, New Jersey. Some paper, as necessary, is purchased from outside sources in accordance with our own specifications.

The papers are manufactured on seven or eight cylinder paper machines, which means that there are seven or eight separate layers of paper stock felted together to form the solid finished sheet. The finished sheet as formed consists of 3 parts which are known as the face liner, filler, and bond liner. By building up the solid sheet in this manner, the composition of each part of the sheet can be controlled so as to produce a paper which will have the properties required by the finished gypsum board products.

All papers used for wallboard, lath and sheathing have certain properties in common:

1. The bond liner in all cases is made from unsized stock and is designed to produce perfect bond to the gypsum core. The bond to the gypsum core is accomplished by the bond liner absorbing the saturated gypsum solution from the gypsum slurry used for forming the core. Gypsum crystals grow in this saturated solution that has been absorbed by the bond liner and interlace into the crystals of the core, thereby producing the bond.

Manufacture of Gypsum Wallboard & Gypsum Lath (Continued)

2. The filler of all our paper is made from a specially-treated (sized) paper stock to render it water resistant. The water resistance of the filler is very important. It is one of the features of the paper which we use for all types of board, lath and sheathing. The filler is designed to prevent the free water present in the slurry and core from percolating through the face and back papers to the surfaces while the board is being manufactured. If this water filtered through the face and back papers, it would cause unsightly water marks, stains, etc. on the finished sheet.

   The water resistant filler in lath paper prevents the passage of free water present in gypsum plaster mortar when it is applied on the surface of gypsum lath, from passing through the covering paper into the core of the lath.

3. The face liner used for wallboards is made from a special paper stock which is colored, highly sized, and treated to render it water and scuff resistant. The finished surface is smooth, uniform, and non-absorptive. The face liner of lath paper is water absorbent exactly the same as the bond liner (as explained in 1 above), because its surface must have the properties of bonding to the gypsum plaster applied to the lath.

   The face liner of gray wallboard back paper is made from stock that is slightly sized so as to render it scuff-resistant. The face liner of the paper used on sheathing is made from paper stock which is colored black, highly sized, and treated to render it water resistant, and scuff resistant. The finished surface is smooth, uniform and non-absorptive.

(b) Stucco:

The stucco used for manufacturing the core is designed especially for this purpose. It is of proper fineness and is low in water carrying capacity. This produces a core which has the proper hardness and strength.

(c) Glass Fiber:

The glass fiber used in Bestwall gypsum wallboards is the continuous textile grade which is soft and non-irritating to the skin. It has a very high tensile strength, being stronger than many steels. It is obtained in multiple strands wound in spools, and is cut to proper length continuously in synchronization with the belt speed of the board machine. The glass fiber is used under Bestwall Gypsum Company's Patent No. 2,681,863.

(d) Paper Fiber:

Paper Fiber is used along with glass fiber in all lath and board products except Firestop Bestwall, which contains only glass, lath and fiber. The paper fiber is scrap paper purchased from outside sources or waste paper from the wallboard operation. The paper is beaten up in water in a hydro-pulper in either a 2½ or 3 percent

concentration. It is pumped to the mixer by a variable speed pump which proportions the proper amount of paper pulp, depending upon the type of product being made and the speed of operation.

The glass fiber and paper pulp are added to the core for the following reasons:

1. To give proper nailing properties to the core and to eliminate chipping and shattering of the core at open edges of the board.

2. To reduce the brittleness of the core.

3. To produce a wallboard that has the required flexibility and which can be handled without breakage.

4. To reduce the weight of the board.

(e) Adhesives:

The gypsum crystals which form the core and bond it to the bond liner of the paper used are very fine and brittle. To protect these crystals, and to add to the bond between the core and the bond liner of the paper, a special adhesive is used. This adhesive is mixed into the ingredients in the core. It is water soluble and, therefore, concentrates between the gypsum crystals where the core is in contact with the bond liner. This reinforces the crystalline structure and adds to the bond between the core and the paper covering. This concentration of the adhesive at the surfaces of the core is somewhat similar to the action of the soluble gum added to produce the case-hardened surfaces of statuary casting plaster.

(f) Accelerator.

The gypsum core must be set hard by the time the board reaches the cut-off knife, which is near the end of the board machine, so that the board can be cut into the required lengths. This makes it necessary to use an accelerator to regulate the setting time of the slurry. The accelerator which we use is ordinary pulverized gypsum rock. Chemical accelerators such as potassium sulphate, ammonium sulphate, etc. may also be used.

(g) Foam:

The foam added to the slurry used for producing the core is made from a solution of rosin soap or other foaming agent. This solution is passed through special equipment that beats it into a stable, uniform-structured, small-bubble foam. The foam produces microscopic air voids throughout the gypsum core. The soap solution reacts with the gypsum to form insoluble calcium salts which further reinforce the void structure of the gypsum core. Foam is added to the slurry to:

1. Increase the thermal insulation value of the board.

2. Reduce the brittleness of the core.

3. Add to the flexibility of the board.

4. Reduce the weight of the board.

2. PROCESS OF MANUFACTURE:

Each step in the process of manufacture is carefully controlled to produce quality and uniformity in the board, lath or sheathing. Quality depends upon the combination of the face and back paper used and the structure of the core (the paper has been described above). The paper and the structure of the core controls rigidity, structural strength and durability of the finished product. The required hardness and strength of the core can be achieved by proper formulation of the dry ingredients and control of the water-plaster ratio.

The proper mixing of the dry ingredients, the addition of the foam, paper pulp, glass fibers and the proper wet mixing before the slurry is poured onto the paper covering are all very important. A very rigid system of inspection, testing and control is maintained at all our plants to make sure that the proper percentage of each raw material is used, and that the mixture is thoroughly dry mixed and wet mixed before it is used for forming the core.

(a) Dry Mixing:

It is essential to thoroughly mix the glass fiber, accelerator and adhesive into the dry stucco so that a uniform mixture is obtained. Dry mixing is accomplished in the conveying equipment as the material is delivered to the wet end of the machine.

(b) Wet Mixing:

The dry ingredients are fed into a high-speed centrifugal mixer and are blended with mixing water, paper pulp and foam. The consistency of the slurry is accurately controlled by regulating the mixing water through the use of a recording water meter. The weight of the slurry is controlled by varying the foam content as required to produce a slurry of a definite density. Slurry from the mixer is discharged in three streams so that three streams of gypsum lath may be made at one time. For other boards, the streams all blend together at the forming rolls except where two streams of sheathing are made in which case only two streams are used.

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(c) Edge Formation:

Square Edge, Tapered Edge, Tongue & Groove Edge, and Beveled Edge Boards are made by cutting grooves along the edges of the face paper after it leaves the paper rack. The inside grooves regulate the width of the finished product. As the grooved paper approaches the forming rolls, it is folded into the various shapes along the grooves which are required for the particular type edge being made by means of edge folding devices. Spaces between grooves are set depending upon the type product being made and its thickness. Gypsum lath paper is not grooved along its edges (continued on next page)

but is passed through edge forming devices which fold the paper in a semi-circle on each side producing a "round" edge product.

As the papers pass through the forming rolls, adhesive is applied to each edge of the back paper which serves to stick the edges of the back paper to the folded edges of the face paper.

(d) Thickness:

Thickness of the various products is controlled by the spacing of the forming rolls.

(e) Length of the Machine:

As the gypsum board or lath leaves the forming section, it is carried on wide rubber belts and carrier rolls to allow time for the gypsum core to harden (set). The total length of the machine depends to a considerable degree upon the speed operated. Our longest machine is at Brunswick where this distance is 949 ft.

(f) Cut-Off Knife:

All plants use rotary knives for cutting the board into various lengths. The drive for the cutting mechanism is adjustable so that lengths can be varied as needed for various products.

(g) Transfer Table:

After the boards are cut to length, they are picked up by a transfer table and carried sideways to a tipple table which feeds the boards into the dryer. The dryer runs parallel with and alongside the board machine. As 48" wide wallboards are transferred, they are inverted so that the ivory face is turned up. This preserves the finish of the ivory paper from blemishes, slick spots, etc. which may occur when the paper is in contact with the kiln rolls.

(h) Drying

The board from the transfer is fed by the tipple table into the dryer which has 6 or 8 decks, and is wide enough to take 2 streams of board 4' wide, 3 streams 32" wide, 4 streams 24" wide, and 6 streams 16" wide. Our dryers are heated either by steam coils or by direct combustion of natural gas. The temperature is carefully controlled in the various zones into which the dryer is divided so as to dry the products properly. Large circulating fans blow the hot gases over the boards and laths and the moisture which is evaporated is blown out through exhaust stacks.

(i) Take-off:

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In all plants except Blue Rapids, wallboard products are grouped into pairs face to face automatically and conveyed through a bundling machine where the end tapes are applied. The bundled packages are

stacked automatically and handled to the warehouse or loading dock by fork trucks. Lath is handled on a separate system where it is bundled into 6 pieces to the bundle (5 at Sigurd). At Blue Rapids, board and lath are unloaded from the kiln by hand and fed into the packaging machines.

(j) Pinholath

Pinholath is made under exclusive license from the Pinco Co. under Patent No. 3,879,662. The pinholes puncture the paper and permit water from plaster applied thereto to be absolbed into the core in a controlled amount. This serves to rigidify the plaster next to the paper face and is designed specifically for use with machine applied plaster.

(k) Perforated Lath

The perforating is done by a punching machine at the end of the board machine; the operation being performed on the wet lath before it is cut into 48" lengths. The perforations are 3/4" in diameter and spaced 4" apart.

(l) Reclaiming Department

In this department, re-cutting equipment is available so that the damaged goods can be cut into smaller sizes and reclaimed for shipment to the trade.

(m) Loading Cars & Trucks

Loading cars of wallboard, lath and sheathing is done under close supervision. All possible precautions are taken to insure delivery of board in good condition. To illustrate the precautions which are taken, here is the routine which is followed in loading cars:

All cars are carefully inspected before they are accepted for loading wallboard, lath & sheathing. Any cars with leaky roofs, broken or unusually dirty floors, etc., are rejected. All loose nails are pulled from the floors & sides. Any loose boards are fastened to prevent damage to the load. After the cars have been cleaned and prepared, the floors are covered with dunnage board and the walls covered with paper. Only then does loading start. While loading the cars, paper pads are attached to the side of the cars to protect the ends & edges of the piles of board, lath or sheathing. Special care is used to brace, tie and protect the piles, and to prevent shifting or damage enroute.

Wherever possible, gypsum board products are now loaded into box cars or on flat cars by fork lift trucks. By this method, whole units are set in place at one time. Spacers are placed between each unit so that the forks of the lift truck can be easily inserted and withdrawn.

Flat cars are covered & the load held in place with steel strapping.

3. INSPECTION:

All raw materials and entire process of manufacture are under the supervision of competent inspectors. An inspector is on duty at all times and on all shifts and is responsible for the quality of the products produced on that shift. Every step in the process is checked hourly or at fixed intervals as a matter of control. Finished boards are tested hourly or more often for thickness, width, length, bond, nailing properties, flexibility, strength, weight, appearance, resistance to moisture, etc. All tests and inspections are recorded on standard report forms which are made up in duplicate. These reports are watched by the board plant superintendent as the entries are made throughout the day. The reports when completed are signed by the inspectors and turned over to the board plant superintendent and plant manager for approval. One copy of the report is sent to the Paoli Laboratory. These reports are carefully analyzed by all concerned and then filed for reference.

4. SAMPLES:

All samples of wallboard, lath and sheathing are cut from standard production at Fort Dodge where the sample department is located.