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METHOD OF PRODUCING ASBESTOS-CEMENT SHEETS CONTAINING CELLULOSIC FIBER

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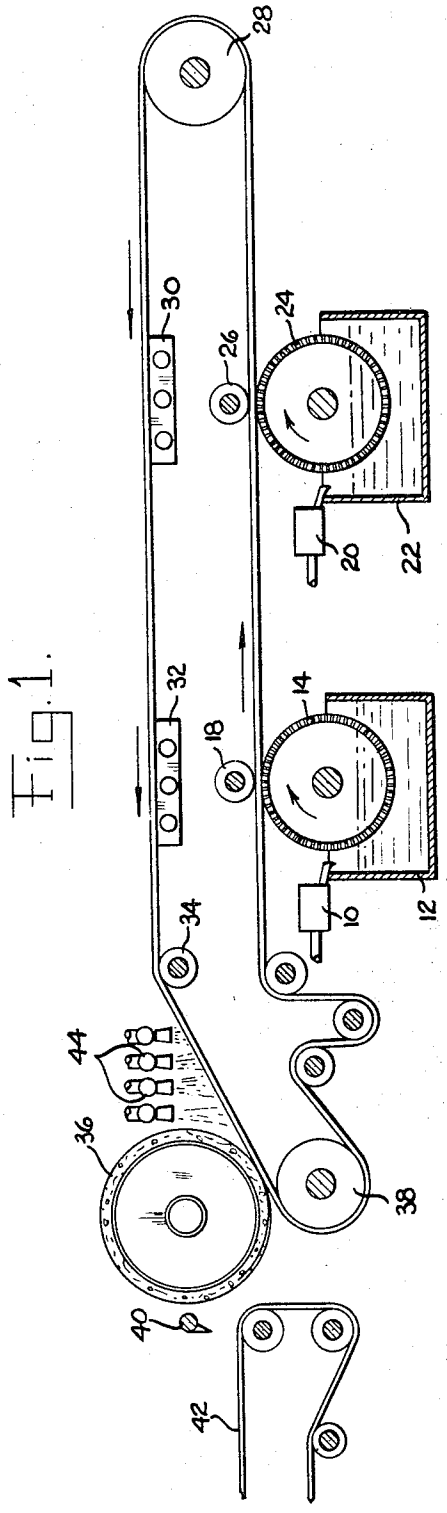


Fig. 1.

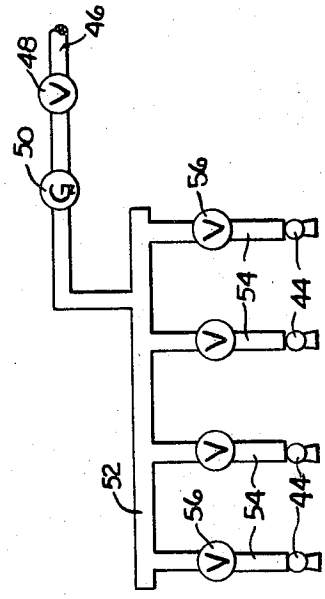


Fig. 3.

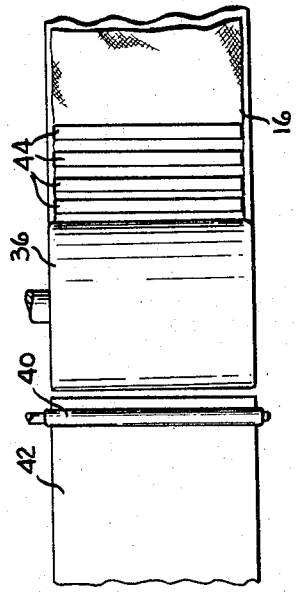


Fig. 2.

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METHOD OF PRODUCING ASBESTOS-CEMENT SHEETS CONTAINING CELLULOSIC FIBER

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This invention relates to the manufacture of asbestos-cement sheets containing cellulosic fibers; more particularly, it relates to the manufacture of such sheets on a Hatschek machine.

The use of cellulosic fibers in asbestos-cement compositions is known to enhance the properties of certain asbestos-cement products. Asbestos-cement sheets, for example, which contain sufficient quantities of cellulosic fibers are relatively tough and flexible, have a relatively low density, and can be nailed and sawed in the manner of wooden sheets. Roofing and siding shingles, clapboards, batten strips, and sheathing panels are examples of asbestos-cement products which could benefit from the addition of cellulosic fibers in the composition.

Previous proposals to utilize cellulosic fibers in asbestos-cement compositions generally have contemplated manufacture by processes employing a press operation or a batch vacuum molding operation. Such processes are not commercially practicable, however, because of the high cost of manufacture and the low quantities of production involved. It would be highly desirable to manufacture such compositions by a high production, low-cost method such as the wet process method of manufacturing asbestos-cement sheets.

This process typically is carried out, with respect to asbestos-cement sheets, on a Hatschek machine which conventionally includes a vat containing an aqueous cementitious slurry, and a rotating drum, carrying a peripheral screen, rotating in the vat. The thin layer of particles which the drum picks up during rotation through the slurry is transferred to a moving endless felt, which subsequently transfers the layer to a rotating accumulator roll. This process is continued until the desired thickness of material is built up on the accumulator roll, after which the material is stripped from the roll and subsequently is trimmed and cured. A large amount of water in the layer of material on the moving felt drains out by gravity and by added suction through the felt so that by the time the layer reaches the accumulator roll it contains enough water to cause the material to adhere to the material or wrap already on the roll, but not so much water as to cause the layer to be crushed or squashed between the accumulator roll and the opposition roll.

When it is attempted to manufacture asbestos-cement sheets containing cellulosic fibers on the Hatschek machine, however, proper adhesion between successive wraps of material is difficult to obtain. This defect may appear immediately, during manufacture, or it may not show up until after the sheets are cured. In fact, some sheets manufactured by this process may exhibit adequate interlaminar strength. But in order to manufacture the sheets in a commercially acceptable manner, that is, one which results in a very low percentage of rejects, it is necessary to correct the tendency for poor interlaminar adhesion between wraps. It is believed that this tendency is a result of the faster filtering rate of asbestos-cement stock containing cellulosic fibers. The cellulosic fibers act as a bulking agent, opening up the stock somewhat and permitting water to drain rapidly out of the layer of material as it is carried by the felt. This causes the material to be too dry to adhere adequately to the outer wrap of material on the accumulator roll, and the interlaminar strength of the final sheet product is adversely affected.

One corrective measure which at first would seem to solve the problem is to reduce the vacuum that is used to help draw out water from the layer of material on the felt, thus offering a wetter laminate to the accumulator roll. The difficulties involved with this suggestion, however, are that the amount of water drawn out by the vacuum is not easily controllable, and there is a tendency to leave too much water in the layer. As mentioned previously, the pressure applied by the accumulator roll will crush or squash the layer if it contains too much water. Furthermore, even when the vacuum can be controlled to leave a greater amount of water in the layer than is usual without increasing the danger of crushing, the water tends to be distributed more in the interior and lower portions of the layer, due to the rapid drainage of the material, often leaving the upper surface of the layer too dry for adequate adhesion to the accumulator roll.

If more water is added to the mix initially to attempt to combat excessive drainage, danger of crushing at the accumulator roll exists. At times it is possible to reduce the accumulator roll pressure somewhat, but ordinarily, except for the conventional practice of automatically lowering the pressure as the thickness of the wraps increases for the purpose of avoiding stretching of the outer wraps, a relatively high roll pressure, in the order of at least about 100 pounds per linear inch, is required in order to effect a transfer of material from the felt to the roll.

Other possible methods of combatting inadequate interlaminar adhesion which might occur to those in the art are to repress the formed sheet before it is cured, in the hope of bonding the layers together, and to better control the curing cycle to prevent excessive conditions in the steam room, if the sheets are autoclaved, from interfering with interlaminar adhesion. While these methods may be effective with the usual asbestos-cement composition sheets, and while some improvements may be noted to result from their use in the interlaminar adhesion of asbestos-cement sheets containing cellulosic fibers, problems of interlaminar adhesion and strength are not consistently overcome by employing such methods.

It is apparent that for commercial production on a Hatschek machine of asbestos-cement sheets containing cellulosic fibers, some means are necessary to overcome problems of inadequate interlaminar adhesion and interlaminar strength.

It is an object of this invention to provide a method of manufacturing asbestos-cement sheets containing cellulosic fibers on a wet process machine.

Another object of the invention is to provide a method of manufacturing such sheets on a Hatschek machine in such a way that successive wraps of material adequately adhere to the accumulator roll and to each other, and so that the formed sheet possesses good interlaminar strength.

A further object of the invention is to provide a simple, economical method of manufacturing such sheets with consistently good interlaminar adhesion, and without requiring extensive and expensive modifications to be made to existing equipment.

Briefly, the objects of this invention are carried out by applying water to the surface of the layer of material while the layer is supported on the felt and after a substantial amount of water has been drained from the layer. Surprisingly, by applying the water at a location near the nip of the accumulator roll and the opposition roll in amounts sufficient to cause the material to adhere to the accumulator roll or to material previously transferred to the accumulator roll, the material does not become so wet that there is danger of its being crushed at the nip of the rolls.

It is preferred that water be applied by spray means arranged to control the amount of water sprayed. By

maintaining the amount of water sprayed within predetermined limits, the variables involved which dictate how much water must be added are taken into account. Furthermore, the addition of water according to the invention does not create unsatisfactory manufacturing conditions, as might be expected.

The nature of the invention will be more fully understood and other objects may become apparent when the following detailed description is considered in connection with the accompanying drawings, wherein:

FIG. 1 is a diagrammatic representation of a wet forming Hatschek machine with which the present invention is adapted to be used;

FIG. 2 is a partial plan view of the machine, showing the accumulator roll and adjacent apparatus; and

FIG. 3 is a diagrammatic representation of an illustrative piping arrangement for supplying water to the spray nozzles.

Referring to FIG. 1 of the drawing, a feed box **10** supplies the vat **12** with cementitious slurry, and the cylinder **14**, which carries a screen about its periphery and which continuously rotates partially in the vat, picks up a layer of material from the slurry. This material is transferred to the underside of the moving endless felt **16** from the portion of the cylinder **14** which is at the zenith of its travel and is opposite the pressure roll **18**. If desired, any number of vats and vacuum cylinders may be provided to build up on the felt a thicker layer of material, later to be transferred to the accumulator roll. For purposes of illustration, another material pick-up station comprising feed box **20**, vat **22**, cylinder **24**, and pressure roll **26** have been shown. This equipment functions in the same manner as the similar equipment described above, except that instead of being transferred directly to the felt **16**, the material picked up by the cylinder **24** is transferred to the layer of material previously deposited on the felt by the cylinder **14**. No problem of lamination adherence is encountered here because the material is very wet at this point.

As the felt **16** reverses direction by moving around roll **28**, the cementitious material adhered to the felt becomes disposed on the upper side thereof, and water drains by gravity from the material through the felt. To assist in removing additional water so that the material is not crushed when it later is subjected to the pressure of the accumulator roll, vacuum boxes **30** and **32** are positioned beneath the path of the felt as the felt moves toward the accumulator roll. The felt then travels over the transition roll **34**, between the accumulator roll **36** and the opposition roll **38**, around the opposition roll, and back toward the vat **12** to pick up more material. In the manufacture of asbestos-cement sheets, the material on the felt is transferred to the accumulator roll **36** as it is subjected to the pressure exerted by the accumulator roll and the opposition roll **38**, and the material readily adheres to the accumulator roll or to the previous wrap of material on the accumulator roll, as the case may be. When the desired thickness of material on the accumulator roll has been reached, a knife **40** is actuated and the formed sheet is transferred to a take-off conveyor **42**, which transports the sheet to other stations, for purposes such as trimming and stacking.

As previously explained, due to the fast drainage of asbestos-cement compositions containing cellulosic fibers, successive wraps of material on the accumulator roll often do not adhere properly. This problem is solved by providing spray nozzles **44** above the felt **16** at a relatively close distance from the nip of the rolls **36** and **38**. The actual distance from the nip may vary, but it should be such that water sprayed from the nozzles **44** does not have time to substantially soak into the material, which might leave the surface relatively dry, and does not create a puddle or overflow of water at the nip, which might cause some squashing of the material at that point and which creates generally unsatisfactory manufacturing conditions. In order to avoid these undesirable conditions at the nip, it is not contemplated to spray water on the material already on the accumulator roll instead of, or in addition to, spraying water on the material while it is on the felt. Water sprayed on a wrap of material on the accumulator roll tends to run down the roll, due to gravity, and collect at the nip, thus aggravating the conditions that are sought to be avoided. An additional reason why water tends to run off material on the roll is because such material has been densified to a degree which greatly decreases its absorptivity, thus providing a less porous surface which is more conducive to runoff. As shown in FIG. 2, the nozzles **44** extend over the entire width of the felt **16** so that all surface portions of the material thereon receive the spray. Alternatively, smaller nozzles which emit a fan-shaped spray or a number of smaller units can be employed, so long as the spray reaches all parts of the material.

The total amount of water required to be sprayed on the layer of material depends upon several variables. The condition of the felt affects the amount of water required considerably. If the pores of the felt are relatively open, as is usually the case with a new felt, water drains from the material down through the felt rapidly, so that by the time the material reaches the spraying area a large quantity of water will have drained out and the layer will require relatively large quantities of water to be sprayed on the surface. If the felt is relatively old, on the other hand, and the pores are clogged with cement and are relatively closed, water does not drain through the felt so rapidly, and more water is retained in the layer, thus requiring smaller quantities of water to be added.

The amount of water sprayed may also vary with the amount of cellulosic fibers in the composition. Generally, the greater the percentage of cellulosic fibers in the mix, the faster water will drain from the layer of material on the felt, and the more water will have to be added.

The total quantity of water sprayed on the layer of material on the felt also varies with the width of the felt and with the felt speed. The wider the layer of material lying on the felt and the greater the speed of the felt, the greater is the volume of water required to be added per unit of time.

It has been found that if water is sprayed on the material, as described above, in the approximate quantities of 0.0014 to 0.0163 gallon per square foot of material, successive wraps of material on the accumulator roll will adhere to each other with no trouble, and the interlaminar strength of the finished, cured sheet will be adequate. This rate of water addition takes into account the variables previously mentioned. If a relatively small amount of cellulosic fibers is utilized in the composition, and if the pores of the felt are relatively closed, both conditions tending to oppose rapid drainage, water should be sprayed in amounts nearer the minimum rate mentioned above. Conversely, if a relatively large amount of cellulosic fibers is utilized in the composition, and if the pores of the felt are relatively open, both conditions tending to promote rapid drainage, water should be sprayed in amounts nearer the maximum rate mentioned above. Generally, cellulosic fibers will be present in amount, by weight of the total ingredients of the composition, of at least about 5% and preferably no more than about 30%. The minimum percentage is required to provide the product with the desired properties imparted by the cellluosic fibers, while the maximum percentage, in order to avoid forming problems caused by too great an amount of cellulosic fiber, should not be exceeded.

By multiplying the above rate of water addition by the width of the material on the felt and by the felt speed, the total quantity of water required per unit of time can be computed. For example, if the minimum rate of 0.0014 gallon per square foot were applied to a layer of material 50 inches wide on a felt traveling at 85 feet per minute, the

amount of water required would be about 0.5 gallon per minute. At the maximum rate of 0.0163 gallon per square foot, a layer of material 50 inches wide and moving at 88 feet per minute would require about 6 gallons of water per minute. While the range of water spray rates specified above in terms of gallons per square foot of material may seem to be small, it can be seen that in terms of the amount necessary per minute it is not. Even at the minimum rate of application, the water applied to the layer of material makes the surface very noticeably wet.

A simple way of providing for different quantities of water to be sprayed is illustrated diagramatically in FIG. 3. Water under pressure is supplied through pipe **46**, which is provided with a valve **48** and a pressure gauge **50**, to a common header **52**. Four spray pipes **44**, extending across the width of the felt, are connected by conduits **54** through valves **56** to the header. By providing one spray pipe which, under a predetermined pressure, discharges 0.5 gallon of water per minute, and by providing three other spray pipes which have discharge rates of 1, 2, and 3 gallons per minute, respectively, a number of different spray rates can be obtained by opening one or more of the valves **56** and utilizing one of, or a combination of, the spray pipes **44**. For greater variation, the discharge rate can also be changed by utilizing pressures other than the one for which the discharge rates of the spray pipes are calibrated.

The following examples illustrate practical applications of the method of the present invention:

Example No. 1.—Using water sprays located about 40 inches above the felt and spaced from the accumulator roll about 48 inches, one gallon per minute was sprayed on the surface of asbestos-cement material containing, by weight, about 14.5% cellulosic fibers. The layer of material extended about 50 inches in width, was about 0.06 inch thick, and was supported on a felt moving at 85 feet per minute. The felt had been in use for some time prior to this run, and it was not as free draining as a newer or cleaner felt would have been. Successive wraps of material adhered to each other on the accumulator roll and there was no difficulty with the interlaminar strength of the cured sheets.

Example No. 2.—Water sprays situated in the same manner as those described in Example No. 1 discharged water at a rate of about 5 gallons per minute onto material 50 inches wide, 0.06 inch thick, and supported on a felt traveling at 84 feet per minute. The cellulosic fiber content of the material was about 12.5%, by weight. At the time of the run, the felt was relatively new and permitted rapid drainage therethrough. No difficulty was encountered in adhering successive wraps on the accumulator roll, and the interlaminar strength of the cured sheets was adequate.

It is to be understood that variations and modifications of the present invention may be made without departing from the spirit of the invention. It also is to be understood that the scope of the invention is not to be interpreted as limited to the specific embodiments disclosed herein, but only in accordance with the appended claims, when read in the light of the foregoing disclosure.

What we claim is:

1. A method of manufacturing asbestos-cement sheets containing cellulosic fibers, comprising the steps of

(a) forming an aqueous slurry comprising cement, asbestos fibers, and cellulosic fibers, the cellulosic fibers comprising, by weight, between about 5% and about 30% of the total solids in the slurry,

(b) depositing a layer of material from the aqueous slurry on a moving porous felt,

(c) draining a substantial amount of water from the layer of material,

(d) transferring the layer of material to a rotating accumulator roll, the material being exposed to pressure exerted by the accumulator roll at the time of transference, and

(e) wetting the exposed surface of the layer of material with water, at the rate of about 0.0014 to about 0.0163 gallon per square foot, just prior to transferring the layer to the accumulator roll and wrapping it in laminations thereon, thereby effectively combatting the tendency for poor interlaminar adhesion and poor interlaminar strength in the final product resulting from the presence of the cellulosic fibers.

2. A method of manufacturing asbestos-cement sheets containing cellulosic fibers on a Hatschek machine, including a moving, endless felt, an accumulator roll, and an opposition roll, comprising the steps of

(a) depositing on the felt a wet layer of material comprising intermingled cement particles, asbestos fibers, and cellulosic fibers, the cellulosic fibers being present in the layer, by weight, in amount between about 5% and about 30%,

(b) spraying the surface of the layer with water at the rate of about 0.0014 to about 0.0163 gallon per square foot just prior to transferring the layer to the accumulator roll, and

(c) transferring the layer to the accumulator roll, by subjecting the layer to pressure exerted on it by the accumulator roll and the opposition roll, and

(d) wrapping the layer on the accumulator roll to form a plurality of laminations thereon, thereby effectively combating the tendency for poor interlaminar adhesion and poor interlaminar strength in the final product resulting from the presence of the cellulosic fibers.

3. In a method of manufacturing asbestos-cement sheets containing between about 5% and about 30%, by weight, of cellulosic fibers on a Hatschek machine comprising a moving endless felt, an accumulator roll and an opposition roll, wherein solids from an aqueous slurry comprising a mixture of asbestos, cement and cellulosic fibers are deposited as a layer on the moving felt, and the layer is transferred to the accumulator roll substantially at the nip of the accumulator roll and the opposition roll in successive wraps forming a plurality of laminations on the accumulator roll, the improvement comprising

(a) applying water at the rate of about 0.0014 to about 0.0163 gallon per square foot to the surface of the layer of solids while the layer is supported on the felt and after a substantial amount of water has been drained from the layer,

(b) the water being applied at a location relatively near the nip of the accumulator roll and the opposition roll so that the surface of the layer remains sufficiently wet, thereby effectively combating the tendency for poor interlaminar adhesion and poor interlaminar strength in the final product resulting from the presence of the cellulosic fibers, but not so wet as to be crushed under the pressure exerted by the rolls.

4. In a method of manufacturing asbestos-cement sheets containing between about 5% and about 30%, by weight, of cellulosic fibers on a Hatschek machine comprising a moving endless felt, an accumulator roll, and an opposition roll, wherein solids from an aqueous slurry comprising a mixture of asbestos, cement, and cellulosic fibers are deposited as a layer on the moving felt, and vacuum is applied to the layer as it travels toward the accumulator roll to assist in draining water from the layer of solids and in thereby compacting and integrating the layer as it travels toward the accumulator roll, and wherein the layer is transferred to the accumulator roll substantially at the nip of the accumulator roll and the opposition roll in successive wraps forming a plurality of laminations on the accumulator roll, the improvement comprising,

(a) applying water at the rate of about 0.0014 to about 0.0163 gallon per square foot to the surface of the layer of solids while the layer is supported on the felt and after the vacuum has been applied and a substantial amount of water drained from the layer

and before the layer has reached the accumulator roll,

(b) the water being applied at a location relatively near the nip of the accumulator roll and the opposition roll so that the surface of the layer remains sufficiently wet, thereby effectively combating the tendency for poor interlaminar adhesion and poor interlaminar strength in the final product resulting from the presence of the cellulosic fibers, but not so wet as to be crushed under the pressure exerted by the rolls.

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