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ROOFING FELT

Allen L. Simison, Toledo, Ohio, assignor to Owens-Corning Fiberglas Corporation, a corporation of Delaware

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This invention relates to felts for use, when saturated with bituminous material, as intermediate products in the manufacture of prepared roofings, for constructing built-up roofings, to serve as wall sheathing sheets, automobile body liners, waterproofing membranes, and similar products.

More specifically, this invention relates to felts of the above description having improved physical properties derived from the addition of a small amount of glass fibers to the usual felting furnish or batch or from the introduction of fibrous glass into the web of felt as it is being formed.

It is an object of this invention to provide a basic felt which is more readily dried in its initial sheet form and which has an improved capacity for the bituminous asphalt with which it is saturated.

A further object of the invention is the provision of a felt which, when saturated with asphalt, protects the asphalt from the deteriorating effects of climatic changes and otherwise extends the useful life of the asphalt in its waterproofing function.

More concisely it is an object of the invention to provide a saturated felt product more resistant to expansion and contracting forces, and accordingly of greater dimensional stability.

An additional object is the provision of an asphalt saturated felt which has superior qualities and yet which may be produced with lower cost organic fiber materials than those generally utilized.

A further object of the invention is to provide methods for producing felts of the nature described.

The various objects and advantages of the invention are preferably attained by the addition of short lengths of glass fiber strands to the felt stock. The benefits of the invention may also be gained, to a more or less degree, by adding cut lengths of fibrous glass rovings, or yarns or of milled modules of glass fibers to the prepared slurry of organic pulp of which the felt is to be created, or by the placement of continuous strands, rovings or yarns into or upon the felt as it is formed into a web.

The type of felt forming the subject of this invention is commonly formed of rag, wood, paper, jute or other fibers on a machine similar to that used for manufacturing paper. If rags are employed they are first run through a series of revolving cutter which shred them, and are then ground into a pulp with water in a beater or revolving disk pulping apparatus. The pulp is subsequently removed from the water in layer form upon wire screen cylinders and transferred therefrom to cloth belts. The latter carry the felt web through compressing and drying stations.

While graded rags originally constituted the main raw material for felts, less expensive wood pulp has replaced them to a large extent. There has also been considerable use made of paper stock.

In a manner similar to that followed in the processing of rags, base material of paper such as newsprint, corrugated stock, etc. is fiberized by being worked through shredders, digesters, and pulping apparatus.

When in its finished dry form, the felt is impregnated with asphalt, generally a blown petroleum derivative, by immersion, flowing, spraying, roller coating, or by a combination of such treatments, with excess saturant removed by scraping. The water proofing character of the asphalt is, of course, the main attribute of the final product and

the felt serves in a secondary status as a carrier and preserver of the asphalt.

Applicant is aware that the suggestion has occasionally been made that glass fibers be used for creating roofing felts. It is further within his knowledge that numerous, unrewarding attempts have been made to develop improved roof felts through the incorporation therein of fibrous glass.

Several severe misconceptions have evidently been responsible for the abandonment of such projects.

The major false premise is believed to be that the fibrous glass added to the felts would serve in its usual capacity as a reinforcing agent, joining with other constituents in establishing a superior, integrated degree of strength. This is quite a natural conclusion when considering the improved properties of various other products in which glass fibers form a part; such, for example, as woven goods containing both cotton and glass yarns, and reinforced plastics in which two widely dissimilar materials, glass fibers and plastics, are combined to produce a composite possessing mechanical properties far excelling those of the plastic alone.

When experimental samples of roofing felt in which glass fibers were incorporated were subjected to tests of tensile strength, it was discovered that the presence of the fibrous glass, instead of increasing the ultimate strength of the felt, actually lowered it. In fact, in some instances the tensile strength, according to the tests, went below the minimum limits recognized by the industry. The cause of this effect, being directly contrary to the history of fibre glass, was evidently not understood, although it was possibly due to the nature of the particular fibrous substances with which the glass fibers were combined.

In any event, since tensile strength, as determined by the prescribed tests, is the first standard by which roofing felts are professsionally graded, this failure greatly discouraged further activity in this field and tended to preclude the adoption of glass fibers therein.

Applicant has concluded, from his study of the factors involved, that there is not the intimate bonding between the ingredients of felt containing fibrous glass as is the case with other glass fiber reinforced materials. For this reason, instead of there being coaction between the vegetable fibers and the fibrous glass, there is rather independent and somewhat conflicting functioning. In submitting such felts to the ritualistic type of tests for tensile strength, the force is first and separately resisted by the less expansible fibrous glass, and separately and subsequently met by the organic fibers. Partly as a consequence of this divided resistance, the ultimate strength, which alone is apparently determined by such test, is decreased. The organic fiber content has lesser strength due to the replacement of some of the fibers by those of glass and because there is less coherence and compactness of the felted organic fibers arising from the interspersion as well as the bulking effect of the fibrous glass.

On the other hand, the initial and intermediate resistance, provided according to this invention by the glass fibers, to expansion and contraction forces applied to the felt are found by applicant to be greatly enlarged; and this added strength, not disclosed in ordinary testing for ultimate tensile strength, for surpasses the ultimate strength in importance in contributing to the durability and effectiveness of the asphalt saturated product.

Another long held belief, considered by applicant to be subject to some question, is that the conventional fiber components effectively maintain the integrity of the asphalt impregnated product. To the contrary, applicant believes that the elastic and the expansion qualities of the usual fibers permit them to follow the normal expansion and contraction of the asphaltic saturant. This movement not only deteriorates the saturant by encouraging

oxidation and cracking, but provides openings for the entrance of moisture, air and mold to attack the vegetable fibers. As a consequence the life of the asphalt is shortened and the felt is weakened by the decrease in the shape retaining and cohesive properties of the fibers. Failure from this weakness of the conventional fiber components is substantially moderated through the practice of embedding slate and other stone particles in the surface of asphalt shingles and top roofing sheets.

As felts of the types referred to are seldom required to resist forces of special weight or impact, a high ultimate tensile strength is not a prime factor in their overall performance. Of greatly more importance is their dimensional stability and their power to withstand the forces generated by changes in temperature and humidity. As indicated, here is where glass fibers have an important function, the need of which has not been previously recognized.

Because of the extremely low extent of their elasticity and their low coefficient of thermal expansion, glass fibers in the felt will early oppose expansive movement of the asphaltic impregnated material due to a rise in temperature or absorption of moisture. This expansion is not such to try the ultimate strength of the product but is one that leads to its breakdown.

While the vegetable fibers are inclined, because of their comparable qualities to encourage or at least to follow such climatically induced movements of the asphaltic component, a glass fiber network disposed uniformly through the mass acts to hold the organic fibers in place and the latter's bulk in turn then opposes any lateral expansion and contraction of the asphaltic element. The expansion is thus directed in lines normal to the flat surfaces of the roofing felt and the very slight thickening effect does not disturb the longitudinal and lateral dimensions of the felt nor the stability of the surface areas.

An example of a roofing felt to which this invention relates is one of .055 inch thickness for use as a base felt in built up roofing. It has a saturated weight of thirty pounds per hundred square feet with the felt component weighing ten and one half pounds or thirty five percent of the total weight and the blown asphalt saturant constituting sixty five percent thereof.

In such a product, thirty percent of the felt would likely be rag fiber and the balance wood fiber divided roughly between chemical and mechanically ground pulp.

In adapting this invention to a roofing felt of this conventional composition applicant would stir into the prepared pulp slurry preferably from one to eight percent, by weight, of the final dried felt, of cut strands or rovings of fiber glass in lengths desirably between one half and one and a half inches. More specifically applicant would advise that three percent by weight of glass fiber strands cut to one inch lengths be added and dispersed in the pulp slurry. This amounts to .315 of a pound of glass fibers in each hundred square feet of the finished asphalt saturated roofing felt. The glass strand could suitably be a well known commercial type about .006 of an inch in diameter providing 15,000 yards to the pound. Such a strand is usually composed of some two hundred glass filaments of a diameter close to .0004 of an inch.

This small addition of fibrous glass has a slight bodying effect upon the felt web formed from the pulp slurry. This amplifies its porosity and therefore increases somewhat the speed with which the felt is freed of its moisture while passing through the drying zones. The slightly more open structure is retained in the dried felt and makes it more readily and completely saturable by the subsequently applied asphalt. Because of the expanded form of the felt the proportion of asphalt saturant will be increased a little above that of the comparable conventional product.

In this sheet of roofing felt the chopped pieces of glass strands will lie generally in the plane of the sheet and extend in various directions therein. To indicate their frequency, should they lie uniformly in two evenly divided layers in equally spaced arrangement with all those in one layer forming continuous and parallel lines in a first direction and those in the other layer all lying in a direction normal to the first direction, a lattice configuration would be formed. The mesh openings in this grid formation would be approximately .16 of an inch in diameter with the two layers .003 apart. Another much simpler explanation is that there would be on the average twelve of the one inch strands in each square inch of the felt roofing.

Why such a comparatively sparse distribution of glass stands can be effective may be better understood by comparing certain properties of the glass strands, the asphalt saturant, and the usual saturated felt product. It is reliably established that a single fibrous glass strand of the particular type herein selected has an extreme elongation under stress of not more than three percent and has a tensile strength of from six to seven pounds. This contrasts with an elongation between fifteen and thirty percent for asphalt alone and roughly ten percent for the conventional saturated felt. Compared to the tensile strength of six to seven pounds possessed by the single glass fiber strand, a one inch strip of saturated felt of .055 thickness may have a tensile strength of approximately 3.3 pounds or half as much, while a similar one inch strip of asphalt alone has a tensile strength of only some 1.9 pounds.

It may be easily visualized how the pieces of fiber glass strands dispose themselves with portions contacting or in close proximity to adjacent pieces. Between them are more or less amounts of the organic fibers and the asphalt saturant, with the latter being present to twice the extent of the organic fibers. The asphalt would act as a bridging and binding agent between adjacent fibers whether of glass or organic material.

With such a felt secured in place in a wall as a sheathing sheet, laid horizontally as a base for built up roofing, or for whatever other duty it may be assigned, it is more or less supported and protected by associated structures. Whatever its destination, the prime purpose of such felt is that of waterproofing and its location is generally not one easily accessible. Therefore its isolated extended service is of special importance. While it is unlikely that it will be exposed to sunlight which has a strong oxidizing effect upon asphalt, it will ordinarily be subjected to extreme climatic variations.

With conventional roofing felts, as previously explained, the components permit considerable expansion and contractions resulting from thermal and humidity changes. This movement not only applies a stress to the portions of the felting by which it is fastened in place but also stretches and contracts its overall surfaces. Experience has established that this action reduces the life of the asphalt through exposing more of the asphaltic substance to the oxidizing action of air, the leaching or dissolving effect of moisture, and by promoting the creation of cracks. This expansion is further inclined to let moisture and air reach more of the organic fibrous content and to thus hasten its rotting.

The glass strands arranged within the felt according to this invention combat such thermal movement through their great strength and low ductility. Bonded together by the asphalt (which is not considered a particularly effective agent in this regard, but which need bridge across very limited spaces to form the random arrangement of glass strands into a generally integral matrix or grid) this grid of glass fiber strands is somewhat comparable in purpose to a meshed expanded metal sheet by which asphalt may be held in place against walls.

The properties which a small amount of glass fiber strands adds to a felt of otherwise standard composition may be effectively utilized in connection with organic fiber components of lesser quality and cost. The more

expensive rag constituents may be replaced by more of the wood pulps and for part of the latter, newsprint or preferably kraft paper stock may be substituted. These produce a hard stock which is not generally favored because it is more compact and hence less easily dried and less permeable by the asphalt saturant. The presence of a glass fiber component reduces this compacting characteristic, and the undesirable effects attending it, besides providing the needed strength which is lacking in these materials in almost true relation to their lower cost compared to that of the materials of higher repute.

Glass fibers in greater quantity than prescribed herein would be even more effective, but the need of such extra strength is not critical and the extra cost would be a marketing liability. A glass fiber content below the specified low limit of one percent would add resisting qualities but not to a fully satisfactory degree.

Cut strands of one inch length is presented here as a preferred size as they orient themselves easily in the flat plane of the felt and possess a length contributing substantially more strength in this particular medium. Shorter lengths, down to a quarter inch, would also serve quite effectively. Longer lengths would not be apt to cause special difficulty in positioning themselves within the comparatively thin layer of the pulp web, but are not considered as suitable from the standpoint of distribution and the creation of a sufficiently fine network. Also, the utilization of an assortment of lengths would be entirely feasible.

Likewise cut rovings having a greater diameter than the strands and having a slight twist would have greater individual strength than the strands and because of the twist would be seized more tightly by the bonding asphalt. However it is not believed necessary to utilize this more expensive form of glass fibers.

Then, of course, there are different types of strands available having different lengths per pound and a greater or lesser number of glass fibers in their structure. These should perform substantially the same as the particular strand selected herein for explanatory purposes.

Another possible modification of the invention would involve the introduction of continuous strands, rovings or yarns interiorly or exteriorly of the felt web as it is formed. A common arrangement of raising the pulp from the slurry to the cloth conveyor belt includes two revolving screen drums through which two layers of the pulp are deposited upon the cloth belt. By positioning spools adjacent thereto the continuous glass strands, rovings or yarns could be fed between these two layers longitudinally of the formed web.

These continuous strands could be spaced as desired and would add considerable strength to the felt in the longitudinal direction. Likewise, of course, such continuous threads could be laid upon the exterior surface of the felt web.

An alternate form of glass fibers which could be introduced into the readied pulp batch prior to its formation into a web would be hammer-milled nodules of fibrous glass. These fluffy particles available in screen sizes of 1/32, 1/16, 1/8 and 1/4 inch would add bulk more than strength to the impregnated felt product.

In addition to the previously specified petroleum asphalt, soft residual asphalt is likewise a suitable saturant. Also, soft coal tar pitch and other tar products, while not as weather resistant as the asphaltic materials, are effectively utilized for impregnating felts. Accordingly, it is intended to encompass these and similar bituminous substances by the term "asphalt" as used in this specification and the accompanying claims.

As shown by the preceding, applicant has devised a glass fiber reinforced roofing felt of effective performance when others have failed in numerous attempts to do so. He has recognized the special importance of dimensional stability in such products, and has perceived how the properties of glass fibers may be best adapted to produce and preserve this quality.

With the disclosure of his discoveries, the way is cleared for the adoption of this form of glass in this field and the enjoyment of the high benefits derived therefrom.

While preferred compositions and procedures have herein been presented, considerable variations and modifications thereof may be made without departure from the spirit of the invention and the scope of the appended claims.

I claim:

1. An asphalt impregnated roofing felt completely fibrous in basic nature having a minor fibrous glass component amounting to one to three percent by weight of the impregnated felt, and being in the form of short multifilament strands.

2. An asphalt impregnated roofing felt completely fibrous in basic nature containing asphalt to an extent approaching sixty five percent by weight of the impregnated felt and having a minor fibrous glass component amounting to one to three percent thereof, said glass component being in the form of short multifilament, substantially untwisted strands.

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