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PROCESS OF PRODUCING AN IMPREGNATED, WATERPROOF, FIBROUS SHEET

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1

This invention relates to improvements in the production and application of waterproof fibrous compositions and especially in compositions that are to be used as roofing material, in the building of roads, airplane roadways, canals, and the like.

Production of waterproof surfacing in sheet or board form is an old art and the methods as practiced today are pretty well standardized. These processes invariably involve transporting to the site the prefabricated sheet in form of rolls and various types of roofing compounds mostly of solid consistency at ordinary atmospheric temperatures. The latter material is invariably high softening point bitumen or tar pitch. The standard all-time process, for instance, of constructing a built-up roof is as follows:

1. High softening point compound is melted, in situ, in kettles using direct heat.

2. The melted compound while still hot and fluid is mopped or poured on to the roof deck and the roofing felt is spread over the film of hot compound, the latter acting as the cement whereby the felt is bedded to the roof deck.

3. The roofing felt so bedded is then in turn covered with a film of compound by a similar mopping or pouring process, and another layer of roofing felt cemented on to the surface thereof. The process is repeated for each layer of roofing fixed.

The most common variations are the laying of two or more layers of tar or pitch roofing felt and the use of tar pitch compound instead of bitumen or both, but the process of bedding is similar.

The hot method of building up roofs, while it has persisted for many years without any fundamental change, has involved a number of difficulties and shortcomings.

Roofing compound, be it bitumen or tar, is invariably a high softening point product and has to be heated to, and maintained at, a high temperature to make possible spreading or mopping over relatively cool to cold surfaces. Maintenance of compound at high temperatures is, therefore, the principal means whereby to make the compound function as a cement and as a final protective waterproofing medium.

As high softening point bitumen or tar chills very rapidly upon contact with a relatively cool to cold surface, the roofer is invariably forced to heat the compound and maintain it at extreme temperatures, that is, at temperatures at which the compound is likely to decompose or carbonize. It is to be observed that there is hardly a melting kettle that has been in service for any length of time without cleaning which has not a considerable layer of solid coke on the bottom, indicating that continuous heating and maintaining of compound at high temperatures results in gradual deterioration of the material which is intended

2

to function as the cementing and waterproofing medium.

It is an established fact that bituminous cements will deteriorate upon prolonged heating. Tar pitch deteriorates very rapidly at excessive temperatures. It has been impractical to introduce temperature control on in-situ roofing jobs and the heating of compound in in-situ work has remained a rule of thumb operation. As roofing has to be carried on at atmospheric temperatures which vary considerably, difficulty with overheating has been accentuated. In cool weather the roofer often has to chance overheating and raises temperature of the compound to the danger point. If no such chance is taken and temperature of compound is maintained at a low and relatively safe point, a poor mopping and cementing job is obtained in cool weather.

Another cause of difficulty with the hot process built-up roofs is moisture. It is safe to say that in high humidity regions, and generally during wet seasons, wood or concrete roof decks are invariably damp. Often a surface may appear dry, but wood or concrete are relatively porous materials and contain sufficient moisture to prevent proper adhesion of, or by, hot compound.

Hence the frequency of blistering or separation between layers in built-up roofing, most of which are attributable to either the overheating and deterioration of compound, is due to moisture interference with adhesion, or both.

According to this invention the aforesaid compound, which at present is brought out in special containers to the job and melted in-situ, is eliminated entirely. Instead, a sheet is produced which is treated in such manner that it actually has the cementing waterproofing compound affixed on to it in the form of a fine film or in the form of a layer of compound particles which is pressed on to the sheet surface in the form of a uniform layer. Thus, the rolls of waterproofing material carrying the proper type of cementing waterproofing compounds are prepared under factory conditions and eliminate uncertain in-situ operations.

Furthermore, the waterproof compound affixed onto the fibrous sheet under factory conditions can then be an improved product and made to contain appropriate mineral fillers intended to improve the weathering qualities of the compound as well as wetting agents designed to increase adhesion or cementitiousness.

The rolls of roofing waterproofing material, with the aforementioned compound affixed on to it, is cemented on to the surface to be waterproofed in the following manner.

A solvent or flux material is applied on one side of the sheet in a uniform manner and the so-treated sheet is then placed on the roof deck, the road surface, or any other surface to be waterproofed. One or more layers can be applied

in this manner. The solvent or flux oil can be applied by either operating, brushing, or still better, by passing the sheet over a contact roller which is partially immersed in a bath of solvent or flux oil. Application by means of a contact roller is really identical to the usual lick roller used in applying a film of moisture on gummed paper.

The action is simply that the solvent or flux oil has a partial solvent action or softening effect on the waterproofing compound and converts the film of compound into an adhesive.

By this method, either a volatile or a relatively non-volatile solvent can be used. A volatile solvent can be ordinary petrol, benzol, or other low B. P. distillates which will readily dissolve high softening point bitumen. If the roofing felt or fabric or combination of felt and fabric has been saturated and coated with tar products the solvent must then be benzol or some other type of suitable tar solvent or flux. A solvent or flux that will act equally well with tar pitch, bitumen, or bituminous material may be selected.

The non-volatile solvent can be any high boiling point distillate or fluid residual capable of dissolving either bitumen or tar pitch. I have particular reference to liquid residuals from high pressure, high temperature cracking processes, deasphalting residuals and the like.

It is preferred to use non-volatile solvents such as creosote, anthracine oil or petroleum residuals from cracking processes or the like, the reason being that a relatively non-volatile solvent does not give off vapors sufficient to cause trouble by entrapped vapor forming blisters. The possibility of entrapped vapors, if a volatile solvent is used, may be remote but the possibility is there whereas, using a relatively non-volatile solvent, no trouble of this nature need be apprehended.

Another reason for the preference for relatively non-volatile high boiling point solvents is that while the solvent action of a high boiling point oil is lower than that of a low boiling point highly volatile distillate, the use of the former solvent gives the operator a greater period within which to manipulate materials and process. For instance, if benzol is used as the solvent, the interval between applying the benzol to the surface of the compound and the laying must be very brief, otherwise the solvent evaporates and the surface of the compound becomes non-tacky or insufficiently tacky to insure proper adhesion.

Other advantages in using relatively non-volatile solvents are the following:

1. Greater wetting power and improved adhesion of the compound coated roofing felt. This can be accomplished by incorporating wetting agents in the solvents such as high molecular weight fatty acids or ligneous resins such as tall-oil or other saponaceous matter which are in the nature of by-products in the pulp and paper industry.

2. Relatively non-volatile solvents are much safer to use than the high volatile solvents from the standpoint of inflammability. The non-volatile solvents are invariably of a high flash point and can be transported and handled with negligible fire hazard.

3. Non-volatile solvents are more generally available especially such as petroleum residuals that are commonly by-products from cracking processes. The tar residuals from coke gas ovens and the like are still more desirable because these residuals are excellent solvents for bituminous compounds.

4. Another reason for the use of non-volatile or relatively non-volatile solvents or flux oils is that the solvent flux oil is intended not only to plasticize the compound, but also to have the solvent flux oil combined with the compound and become part of it so that the final compound in solid form plus the solvent flux oil makes a relatively soft and plastic bond which remains pliable at low temperatures.

All this, however, does not imply that highly volatile solvents cannot be used with excellent results by taking additional care in the application of the solvents. With some training, operators can learn to take care of the time element and materially reduce evaporation of the solvent before it can convert the compound into an adhesive. Danger from entrapped vapors forming blisters can be obviated by proper compression of sheets thereby diffusing the vapors.

In this manner I obviate the use of heat required to melt the solid waterproofing compounds and reduce materially the element of error as well as simplify the old process. The use of a solvent flux oil which is relatively low in viscosity at application temperatures makes possible incorporating into this oil wetting agents in the oil as directed above.

The method of producing a waterproofed sheet or board for the above described surfacing consists of the following:

Any fibrous composition or any type of fabric is taken and the fibre or fabric sheet is impregnated with a suitable bituminous or tar waterproofing substance. This material is generally known to the trade as "saturant" and the impregnation is invariably carried out at elevated temperatures. The only departure that is made in this process is to incorporate in the saturant rot-proofing compounds usually of the metallic soap variety. It is particularly preferred that such compounds as copper naphthenate be used, but any metallic soap which will dissolve or readily disburse in the standard bituminous saturants commonly used in the roofing industry may be used.

In case a cold saturation method is used where the bitumen or tar saturant may be in the form of an oil-in-water emulsion, the metallic soaps may be incorporated during the process by first passing the sheet through the emulsion and then immediately immersing the sheet in a copper sulfate solution. The technique involved is to produce a bitumen or tar emulsion, using a fatty oil of high saponification value and by using an excess of the fatty oil, that is more fatty oil than is necessary for the actual emulsification, sufficient will be left to combine with the copper to form a copper soap which will remain disbursed throughout the structure and act as a rot-proofing compound.

In case the saturant is in the form of a cut-back, the rot-proofing compounds can be disbursed in such saturants in two ways; one, by dissolving the rot-proofing compound in the saturant at high temperatures and then converting the combination into a cut-back, or by dissolving the rot-proofing substance in a solvent and then combining it with the saturant to produce the desired cut-back.

We can describe a saturant to be any product which is sufficiently liquid to impregnate a given porous structure. There are, therefore, numerous types of saturants in the same manner as there are various type of porous structures to be saturated. In my case the purpose of satu-

rating the fabric or fibrous sheets I employ in my process, is to render the sheet waterproof, rot-proof and to materially increase the strength of the sheet by cementing the strands or fibers together. This implies that the saturant must have waterproofing and cementing characteristics. In my process I can employ three distinct types of saturant. As mentioned before, I can saturate the fabric or fibrous sheet singly or in multiple form at ordinary atmospheric temperatures without the aid of heat in which instance I can use either a bituminous emulsion or a bituminous cut-back. The bituminous emulsion I employ is considerably different from the standard products on the market in that it contains an excess of saponifiable matter over and above what is required for emulsification. Type of bitumen emulsified is about the same as in the standard emulsions, namely, 100° F. S. P. to 120° F. S. P. and 60 to 300 penetration at 77° F. The purpose of excess saponifiable matter is as mentioned before, to form a rot-proofing product by passing the emulsion impregnated sheet through a solution of copper sulphate, or the like. The saturated sheet must then be treated or handled in some way to eliminate the water or moisture.

If I employ a bituminous cut-back as the saturant, the cut-back must then be liquid enough to impregnate the fibrous sheet or sheets at ordinary temperatures. The cut-back I employ is a solution of bitumen of the same or approximately the same characteristics as used in the emulsion combined with a suitable solvent which can be benzol, or a variety of volatile petroleum naphthas. The rot-proofing substance such as copper naphthenate is then dissolved or disbursed in the cut-back, thus rot-proofing, waterproofing, and cementing the bundles of fibers at one and the same time. The volatile solvent is subsequently removed by passing the saturated sheet over hot drums, through a hot chamber or by some other suitable means.

The most common saturant, however, and the one I prefer to use is semi-solid bitumen ranging in S. P. from 100° to 120° F. and in penetration from 300 down to 60 at 77° F. Into this bitumen I admix or dissolve a bitumen soluble rot-proofing substance such as copper naphthenate. Such saturant has to be liquefied by heat and maintained at temperatures ranging from 250° F. to 400° F. in order to obtain perfect saturation.

The saturated sheet is then coated with a bitumen or tar coating of such consistency that it remains relatively pliable at low application temperatures, that is, about 40° F. A bitumen, for instance, having a softening point of 140–170° F. and a penetration at 32° F. of not less than 10, is suitable for this purpose. This coating can be applied to the required thickness by means of the standard coating machines. In this process a fairly thick layer is applied on one side, that is, about 30 to 60 ounces of coating per square yard, and a relatively thin layer on the other side of the sheet, about 10 to 20 ounces per square yard.

Then 5 to 20 ounces of a high softening point, brittle water-proofing compound is applied on to the film of the relatively soft coating. This application is on the thick film of coating. The application of the brittle, high softening point compound on the thin film of coating is considerably less, ranging approximately from 3 to 10 ounces per square yard.

While the soft coating is applied in molten state at a high temperature, the high softening point brittle compound is applied in solid state, by first converting the brittle compound into a fine powder, and then sprinkling or sifting the powder onto the hot coating film. The pulverized compound is then compressed and worked into the soft coating by passing the sheet through a series of compression rollers. The effect is that a portion of the pulverized compound dissolves, combines, or fluxes with a portion of the soft coating, and another portion of the powder remains on the surface in the form of a pressed-out, flat, relatively smooth layer.

In order to prevent sticking or possible adhesion when the sheet is wound into a roll, various types of mineral dust are applied, depending upon what is most available. The quantities of these mineral dusts depend largely on temperatures where the material is stored, but it was found that 3 ounces per square yard of finely powdered mineral matter, or thereabouts, will prevent sticking at tropical temperatures.

The high softening point brittle compounds can be either of bitumen asphalt, or tar. It was found that best results are obtained when using a brittle bitumen with a maximum penetration at 150° F. of 10 (100 grams 5 seconds), to which bitumen can be added mineral fillers, wood flour in various proportions, depending on use of final product. As a rule, the proportions used are about 20% of filler to 80% of bitumen.

Alternatively the above methods can be modified and the use of the soft hot coating eliminated in the following manner:

The sheet is saturated in such a manner that as it emerges from the saturant, it carries an excess of hot saturant with it. By using a strike-off device, the quantity of excess saturant on either side of the sheet is controlled. Then is applied the brittle, pulverized waterproofing compound of the above description directly onto the excessively saturated sheet and packed down to a smooth, uniform layer by passing the sheet through the compression rolls.

When using this method, the quantity of pulverized, brittle compound per unit area is materially increased by distributing about 30 to 70 ounces per square yard on the side that carries the greatest amount of excess saturant, and 5 to 10 ounces per square yard on the side carrying the least amount of excess saturant. The process from there on is the same as outlined above, that of dusting with mineral dust or other anti-tack substance.

Another modification of this process which makes the material suitable for special purposes, adding to the waterproofing and service qualities, is to laminate onto the saturated sheets, one or more sheets of paper. This can be done either by pressing the paper sheet onto the excessively saturated fabric as the fabric sheet emerges from the saturator, or by passing the fabric and the paper at one and the same time through the saturant, and then compressing the multiple layers. When using such method, the soft coating is applied as previously described and specified, and then finished off with an application of brittle compound in powdered form. The multiple layers can also be passed through the saturator and an excess amount of the saturant taken out with it, into which excess saturant can be incorporated the pulverized compound.

I claim:

1. The process of producing an impregnated, waterproof, fibrous sheet which comprises im-

pregnating fibrous material with a bituminous saturant, coating the saturated fibrous material on both sides with pulverized normally brittle asphalt, placing the impregnated pulverized asphalt coated fibrous material on a surface and treating the pulverized asphalt with a solvent flux to amalgamate the pulverized asphalt.

2. The process of producing an impregnated, waterproof, fibrous sheet which comprises impregnating fibrous material with a cut-back asphalt containing a wetting agent, coating said fibrous material with pulverized normally brittle asphalt on both sides, laying the coated fibrous material and adding sufficient flux oil to amalgamate the pulverized asphalt.

3. The process of producing an impregnated, waterproof, fibrous sheet according to claim 2 in which the flux oil is a relatively non-volatile oil.

4. The process of producing an impregnated, waterproof, fibrous sheet which comprises treating a fibrous material with a metallic soap and impregnating with a bituminous saturant, coating the fibrous material with pulverized normally brittle asphalt on both sides, laying the pulverized saturated material and adding sufficient flux oil to amalgamate the pulverized asphalt.

5. The process of producing an impregnated, waterproof, fibrous sheet according to claim 4 in which the metallic soap is copper naphthenate.

6. Process of producing an impregnated, waterproof, fibrous sheet which comprises impregnating a fibrous material with a bituminous saturant, covering the fibrous material with paper, impregnating the fibrous material and paper with a bituminous saturant, coating the fibrous material on both sides with a pulverized normally brittle asphalt, laying the fibrous material and adding sufficient flux oil to amalgamate the pulverized asphalt.

7. The process of producing an impregnated, waterproof, fibrous sheet according to claim 6 in which an asphalt of low melting point is used first to coat the laminated paper and fibrous material and then a pulverized normally brittle asphalt of high melting point used to coat the impregnated fibrous material and laminated paper.

8. The process of producing an impregnated, waterproof, fibrous sheet which comprises impregnating a fibrous material with a bituminous saturant containing a metallic soap in solution, coating the fibrous material on both sides with pulverized normally brittle asphalt, laying the fibrous material in a plurality of layers while at the same time treating the pulverized asphalt with a flux oil to form an amalgamated asphalt of lower softening point.

9. Process of producing an impregnated, waterproof, fibrous sheet which comprises treating a fibrous material with a bituminous saturant, coating the fibrous material with a bitumen having a softening point ranging from 140–170° F. and a penetration at 32° F. of not less than 10 on both sides, on the upper side 30–60 ounces of the bitumen per square yard and on the under side 10–20 ounces per square yard, then applying a pulverized normally brittle asphalt of high softening point to both sides in the proportion of 5–20 ounces per square yard on the upper side and 3–10 ounces on the under side, laying the coated fibrous material in a plurality of overlapping layers and treating the asphalt with a non-volatile oil to amalgamate the pulverized asphalt.

10. The process of producing an impregnated, waterproof, fibrous sheet according to claim 9 in which a mineral filler is incorporated in the pulverized asphalt in the proportion of about 20% of the filler and 80% of the pulverized asphalt.

11. The process of producing an impregnated, waterproof, fibrous sheet coat composition which comprises impregnating a fibrous material with a cut-back asphalt and coating the impregnated fibrous material with a bitumen containing a mineral filler in the proportions of 20–70 ounces per square yard on the upper side and 5–10 ounces per square yard on the under side, then applying a pulverized, normally brittle asphalt of high softening point to both sides in the proportion of 5–20 ounces per square yard on the upper side and 3–10 ounces per square yard on the under side, then applying a pulverized, normally brittle asphalt of high softening point to both sides in the proportion of 5–20 ounces per square yard on the upper side and 2–10 ounces on the under side, laying the coated fibrous material in a plurality of overlapping layers and treating the pulverized asphalt layers with a non-volatile mineral oil to amalgamate the pulverized asphalt.

12. A waterproof fibrous sheet composition having a basis of fibrous material impregnated with a bituminous saturant and having applied to at least one surface thereof a surface layer of pulverized normally brittle asphalt.

13. A waterproof fibrous sheet composition, as claimed in claim 12, wherein the pulverized coating material has been compressed onto the impregnated fibrous base to form thereon a substantially continuous, but still porous, coating layer of said pulverized asphalt.

14. A method of producing a waterproof fibrous sheet composition which comprises impregnating a fibrous sheet base with a bituminous saturant, applying to at least one surface of the impregnated fibrous base a normally brittle asphalt in powdered form and then compressing the applied powder onto the said surface to form thereon a coating layer of compressed powdered asphalt.

15. A method of manufacturing in a continuous manner a waterproof fibrous sheet which comprises passing a fabric through a bath of heated bituminous saturant material, then causing the impregnated fabric to travel through a coating zone and applying powdered normally brittle asphalt to at least one side of the said fabric, thereafter leading the fabric bearing the powdered coating material through a compression zone whereby to compress the said powdered material onto the said surface of the fabric and thereafter applying to the traveling fabric a mineral dusting material.

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