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FLOORING MATERIAL AND METHOD OF MAKING SAME

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This invention relates to flooring material and particularly to that type of flooring material that is suitable for use wherever the floors are subjected to extremely severe service conditions and/or exposure to unusual or marked temperature and atmospheric changes. Such conditions are met with in factories, railroad stations, pavements, ship decks, elevators, loading platforms, docks and laboratories. However, my material is not limited to industrial uses and may well be used for purely domestic purposes.

Prior to the present invention, it was well known that leather, paper stock, or combinations of the two, reduced to fibers and remanufactured so as to expose the fiber ends to form the wearing or tread surface produced a flooring having a remarkable durability, elasticity and non-conductivity of heat and electricity as well as excellent sound deadening qualities. However, practical difficulties were encountered in the manufacture of this material and the product, besides being unattractive in appearance, lacked uniformity and sufficient waterproofness.

The primary object of this invention is to provide a thoroughly practical and commercial method for making a flooring material of this general type.

Another object is to produce a flooring material having all the desirable attributes of previously developed materials of this general type without their accompanying undesirable properties.

Further objects and aims of the present invention, more or less specific than those referred to hereinabove, will be in part obvious and in part pointed out in the course of the following description.

Stated in very general terms, my process consists of the following operations or sub-processes; namely; (1) preparing a substantially waterproof fibrous material in the form of sheets; (2) laminating a plurality of said sheets to form a block; and (3) cutting said block to form flooring slabs.

Leatherboard, or heeling board, as the material is very often termed, is usually made from a furnish composed principally of leather scrap or waste by board making processes which involve disintegration in a beating engine and subsequent formation into sheets on a wet machine. As thus prepared, the material has very many desirable qualities, including marked durability or wear resisting properties, making it suitable for use as a flooring material of the end grain type, but it is far from being water resistant or waterproof. Its water resisting properties can, however, be greatly increased by impregnation with waterproofing agents, including asphalts. Such impregnation may be carried out with or without the use of heat and/or pressure or vacuum.

I prefer for practical reasons to incorporate the waterproofing material into the board in situ; i. e. during an intermediate stage of the board making process, so that there exists a more intimate bond between the fiber of the board and the waterproofing agent. Thus, I have found it possible to produce a board so resistant to water that a sample strip thereof having a cross-section of 2 inches by .170 of an inch in thickness will absorb not more than 4.5% to 8.5% of water on being completely immersed for as long as 48 hours. Such a board is eminently suitable for a flooring material, especially since the water absorption of a properly laid flooring is considerably less than that of a block of the same material because of the more favorable relation of surface to volume.

A typical furnish which I have found suitable in practice consists of the following:—

	Pounds
Mixed papers	1200
Leather or leatherboard chips	241
Red oxide of iron	1445
Sodium silicate	98
50% clay dispersed asphalt	2845

The mixed papers and leather and/or leatherboard chips are thrown into the beater first, then the iron oxide, then the sodium silicate and finally the asphalt emulsion. The iron oxide is used merely as a filler and may be substituted in whole or in part by any other suitable material. For reasons to be pointed out later, I prefer in certain variations of the process to use a non-conducting filling material such as Celite, which is a brand of diatomaceous earth. The sodium silicate serves as a conditioner, raising and maintaining the pH, thereby stabilizing the emulsion. The asphalt is the preferred waterproofing material.

After the furnish is thoroughly mixed and incorporated in the beater, sufficient alum or other equivalent precipitant is added to bring the pH down to 4.4. This causes the asphalt to be precipitated on and about the fibers, so that in the finished board the fibers are interspersed and coated with discrete particles of asphalt.

The board is then formed on a board machine in the usual manner, care being taken, however, to maintain the pH on the machine below 6.4 to prevent the dirtying of the felt.

The sheets are prepared for laminating by drying, preferably in a tray drier and a subsequent heat or fluxing treatment at about 220° F. for about two hours. The drying step itself may be without heat, in which case the temperature is raised to the fluxing temperature after the drying is completed. The fluxing may be carried out in the tray drier or in a hot box to which the sheets may be transferred. The sheets, while still hot, are calendered between calender rolls and their thickness regulated by the proper adjustment of the gap between the rolls. The calender rolls need not be heated.

A possible variation consists in performing the fluxing operation in a heated platen press. Another alternative step is to transfer the sheets from the drier or hot box while still in the thermoplastic state to a cold press for a quick "bump". Both of these deviations render the calendering step unnecessary.

The sheets are then cooled, trimmed to desired size, coated with an adhesive and laminated to build up a block of predetermined thickness. The blocks formed in this manner are subjected to pressure to bring the laminations into intimate contact, the pressure being maintained as long as found necessary in order that the adhesive may properly set.

The blocks are then sawed into slabs. This operation is preferably performed with a saw tipped with tungsten carbide. The edges of the slab must be trued so that they are parallel and the ends are finally clipped off to give them the desired length (ordinarily 18 inches). The slabs can be given a fine polish by simply rubbing them with a felt fabric or cloth. In actual practice, a felt buffing wheel may be used for this purpose.

In order to obtain a flooring slab that will not buckle, it has been found by actual experiment that the slab should contain from 1 to 1.5% moisture. If a slab containing considerably more than 1.5% water (tests were made with slabs containing 2.5% to 3% water) is cemented to a steel backing and allowed to remain at ordinary temperatures, the evaporation of the moisture from the exposed surface will cause an uneven shrinkage through the block and an accompanying concaving of the exposed surface sufficient to bend the steel plate. The opposite effect is observed if a bone dry sample is made up in the same way. In this case the slight absorption of water causes the exposed surface to expand with a convex bowing of the exposed surface and a corresponding bending of the steel plate. If, however, about 1% of moisture is left in the slab, a substantial equilibrium between the atmosphere and the block seems to result and no bowing at all takes place.

The waterproofness of the slab and the percentage of residual water contained therein may be controlled within close limits by the use of suitable adhesives and suitable methods of applying the adhesives and laminating the board. I have, therefore, found it possible to produce a waterproof flooring slab containing about 1% of moisture, which, as pointed out above, is the ideal condition.

Experiments with various adhesives, including casein glues, modified starches, silicates of soda and asphalt, indicate clearly that the adhesive selected must be water resisting. The difficulty with aqueous glues, including starches, silicates and casein glues, is that they necessarily introduce water into the block. To all intents and purposes this water is sealed in and even after months of ageing the block is still quite wet. When the block is sawed into slabs, this moisture evaporates more readily and shrinkage naturally takes place. The slab must, therefore, be dried before the finishing operations to prevent the shrinkage.

Another disadvantage of aqueous adhesives is that the water in these adhesives weakens the board structurally so that during the sawing operation a separation occurs in the block not at the glued joint but closely adjacent thereto. The same result is observed when testing the ply adhesion of fiber boards by methods in use in the board industry, wherein the board sample is cemented with sodium silicate between blocks of wood and then subjected to strain in a plane perpendicular to the plane of the board. This loosening of plies, in the case of flooring, results in excessive damage in the subsequent edge planing or truing operation previously referred to.

It is possible to get away from the dimensional instability and lamination-loosening caused by the use of aqueous adhesives and at the same time eliminate the troublesome drying step by using non-aqueous adhesives such as asphalts.

Several methods of applying the asphalts were developed, some of which give better results than others.

One method is to apply hot asphalt of 160° F. melting point, more or less, and not too low penetration, to one or both sides of each sheet, and then press the cold sheets firmly together to cause them to adhere. The bond is satisfactory, but the floor slabs made from the blocks are not sufficiently rigid and it seems likely that the low melting point of the asphalt may cause extrusion to take place if the flooring is subjected to high temperatures such as that of concentrated sunshine. A hydrolene asphalt produced by the Sun Oil Company has proved satisfactory for the bonding operation.

The use of high melting point asphalt (200 to 210° F. melting point) was resorted to but on account of greater hardness of the adhesive, it was found necessary to warm the sheets before laminating them.

A suitable technique is to heat the sheets in an oven, coat them with molten asphalt, return to oven to restore heat, and finally press them together after removing from oven.

Experiments with cold pressing of harder asphalts produced bonds that were not wholly satisfactory.

Good results were obtained by coating sheets with thin layers of harder types of asphalts, moistening the surfaces thereof with suitable solvents such as gasolene or carbon tetrachloride and finally pressing them together firmly.

Good results were also obtained by coating the sheets with hard asphalts that had been plasticized with plasticizers or solid solvents such as naphthalene, halowax (chloronaphthalene) etc.

Though very good results are obtainable with hot asphalts, there are practical difficulties that make it necessary to turn to methods of applying asphalt at ordinary temperatures. Hot asphalt can be handled only with great difficulty and hazards to workers. Furthermore, expensive equipment is necessary.

Several practical methods of applying asphalts at ordinary temperatures have been developed. One method consists in applying the asphalt in solution and evaporating the solvent to a predetermined point so that when the sheets are pressed together, the asphalt is moist enough to cause adhesion. The effect is similar to that

produced by moistening an asphalt coated sheet with a solvent. Suitable solvents as pointed out previously are carbon tetrachloride and gasolene.

A variation of this method consists in evaporating all of the solvent and heating the sheets to give the asphalt sufficient plasticity to cause the piled sheets to adhere.

The objections to methods employing a solvent are that most solvents are expensive and inflammable, and recovery systems are cumbersome and likewise expensive, both in installation and maintenance.

Excellent methods have been developed in which the asphalt is applied in the form of an emulsion or dispersion. The emulsion may be applied by means of a roll or brush coating machine, by dipping or by spraying. The spraying method is the one that is preferred on account of its comparative simplicity. In any event most of the water must be gotten rid of, as was found necessary in case of the aqueous adhesives.

One method consists in preheating the sheets before applying the emulsion, depending upon the heat contained in the sheets to evaporate the water. It was found possible to so control the process that there was sufficient residual heat left in the sheets after the water had been evaporated to produce a satisfactory weld between the sheets. This method may be termed the residual heat method.

A better method is not to depend upon the residual heat but to put back into the sheets sufficient heat to increase the plasticity and perfect adaptation of the adhesive. In either case it is necessary to select asphalts of suitable characteristics such as melting point and penetrability. The temperature to which the sheets are heated will depend upon these characteristics.

The results of many experiments indicate that any method which involves putting back heat into a sheet which has been previously preheated to evaporate the water of the emulsion or heating the sheet to a relatively high temperature throughout is open to serious objection. Sheets of fiberboard made as previously described are thermoplastic and almost rubbery in nature when hot. If pressure is applied to a block of such sheets, there is grave danger of compressing the block too much. Too great densification increases basic weight of floor, decreasing coverage and thus increasing the cost per square foot. Furthermore, highly compressed fibrous material is considerably more dimensionally unstable than a fibrous material of loose texture and will expand much more on being immersed on water. On the other hand, insufficient pressure will produce a poor bond.

A method that is much more effective and practical than any so far described consists in coating cold sheets of fiberboard with an asphalt emulsion and then passing them through a heated zone to dry and superficially heat the sheets. This step may be carried out in an oven at a relatively high temperature. The superficial heating renders the asphalt plastic enough for an excellent weld, but the main bulk of the board is not heated through and is therefore not in a plastic state. Reasonably high pressures may, therefore, be utilized without densifying the board to an objectionable degree. In order to further decrease the amount of heat that reaches the main portion of the board, the iron oxide filler may be substituted, as has already been stated, in whole or part by means of a non-conducting filler such as diatomaceous earth. The use of fillers other than iron oxide will in many cases add to the commercial practicability of the new flooring material as the abrasive action of iron oxide on cutting tools is the source of much annoyance.

A further advantage of superficial heating is that since the total amount of heat put into the sheet is not great, the final temperature of the block (i. e. when the heat has distributed itself throughout the block) will be so low that the asphalt will have lost its plasticity and the blocks will be in condition for prompt sawing. In other methods, it is sometimes necessary to wait as long as 24 hours during which period the blocks must be kept confined between caul boards by means of retaining clamps.

However carried out, the methods of applying the asphalt by means of an emulsion has the advantage that the thickness of the film of adhesive can be completely controlled. It is, therefore, possible to produce an adhesive film so thin as to entirely eliminate the unsightly adhesive lines so characteristic of prior flooring materials of the same general type. Furthermore, as is well known in gluing practice, the thinner the adhesive film, the better the bond.

Tests have indicated the blocks made with aqueous adhesives run as high as 2.5 to 3.5% of moisture. Blocks bonded with hot asphalt run as low as 0.3 and 0.4% moisture. As has been pointed out, the ideal condition is to leave about 1% moisture in the block to obviate buckling. It is possible to control the drying of a block bonded with hot asphalt to leave this essential amount of water. When asphalt emulsions are used as the bond, the amount of moisture retained by the block is about 1% so that the procedures outlined result in a material having the characteristics necessary for a non-buckling flooring.

The flooring material made as described can be simply and inexpensively installed over any solid sub-floor. If necessary, the underfloor should be properly resurfaced and levelled. A layer of asphalt cement, or other suitable adhesive, is first troweled over the sub-floor and the slabs are laid therein in a manner similar to brick or tile laying. The slabs should be pushed tightly together but no great pressure is necessary. In this manner there is produced an end-grained flooring that is durable, resilient, water and fire resisting, sound deadening, insulating, dustless and self-healing.

The foregoing constitutes the essential and distinctive thought of my new process, but it is to be understood that while I have gone into considerable detail and utilized certain specific terms and language, the present disclosure is illustrative rather than restrictive, and that changes and modifications may be resorted to without departing from the spirit and scope of my invention. Furthermore, it is to be distinctly understood that the essence of my invention may be combined with various other steps and details without affecting the peculiar results obtained.

I claim:—

1. A method of laminating a plurality of sheets consisting in applying an emulsion containing asphalt to the surfaces to be bonded, passing each sheet through a heated zone to dry and soften the asphalt without substantially raising the temperature of the body of the sheets and uniting said sheets with the application of pressure alone.

2. A method of laminating a plurality of sheets consisting in preheating each of the sheets, applying an asphalt emulsion to the surfaces to be

united and pressing said sheets together without further heating, the preheating being sufficient to evaporate substantially all of the water of the emulsion and to produce a weld between the pressed sheets.

3. A method of producing a laminated substantially waterproof leatherboard substantially devoid of a tendency to buckle, which consists in fabricating a plurality of sheets of substantially waterproof leatherboard from a furnish containing asphalt in the form of an emulsion or dispersion, coating each of the sheets with a non-aqueous adhesive in the form of an emulsion or dispersion, heating the sheets to drive off the water of the emulsion or dispersion and pressing the sheets together.

4. A method of producing a laminated substantially waterproof leatherboard substantially devoid of a tendency to buckle, which consists in fabricating a plurality of sheets of substantially waterproof leatherboard from a furnish containing asphalt in the form of an emulsion or dispersion, coating each of the sheets with asphalt in the form of an emulsion or dispersion, heating the sheets to drive off the water of the emulsion or dispersion and pressing the sheets together.

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