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MINERAL WOOL TREATING MATERIAL

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The present invention relates to material for treating mineral wool bats, especially those comprising glass wool, slag wool, rock wool or the like, to produce an unusually light weight, strong, self-sustaining, resilient bat having fixed dimensions. The invention has special application to glass wool, heat or sound insulating bats made in accordance with the teachings of the patent to Slayter and Thomas, 2,133,236.

This application is a continuation-in-part of our copending application Serial Number 221,460, filed July 26, 1938, and patented Aug 12, 1941, as No. 2,252,157.

An object of the present invention is to provide treating material for inorganic fibers that will enable them to be formed and held in the form of a fibrous bat having the aforementioned properties of strength, high resilience and fixed dimensions, combined with unusually light densities of about 1 lb. per cubic ft. and ranging up to any density, such, for example, $3\frac{1}{2}$ or 9 lbs. per cubic ft., according to the particular purposes to which the bat is to be put. Ordinarily, for house insulation material, a light density of about $1\frac{1}{2}$ lbs. per cubic ft. is desirable. Such bat may have sufficient structural rigidity so that the bats may be handled, assembled in place without reenforcing members such as a cardboard core, or outer wrappings of paper, or reenforcing stitchings.

For better heat insulating qualities desirable for use in refrigerators, stoves, bottle coolers and the like, a $3\frac{1}{2}$ lb. density, more or less, is generally desirable. Higher densities of about 5 to 7 lbs. per cubic ft. are preferable for boiler insulation, industrial ovens, board or sheet type of material or the like.

The bats treated with the material of the present invention are particularly suitable for railroad insulation where the lightest density possible is desired coupled with high structural strength capable of withstanding the jolting and vibration incident to railroad car use. A bat incorporating the material of the present invention may have an extremely light density of about $1\frac{1}{2}$ lbs. per cubic ft., and sufficient structural strength that it may be mounted inside the railroad car wall panel and not settle or gradually break up due to the destructive vibration of the train.

Another object of the present invention is to provide a treating and binding material capable of producing a heat and sound insulating body having the foregoing properties while compris-

ing a minimum amount of binding or stiffening agent.

Another object is to provide a stiffening or binding material which will maintain the properties of the bat throughout wide temperature ranges, and will prevent the bat from sagging or becoming brittle as the temperature rises or falls.

Another object of the invention is to provide a treating and binding material that will produce a bat which is self-sustaining, fluffy, and yet sufficiently resilient and pliable that it will fill out all contours of a heat insulating panel, and then permit the bat to be stiffened to permanent form after installation in the cavity. This enables strong vibration resistant insulation to be applied to a panel which may have irregular shapes or contours and yet distributed in such a way to fill all the space in the said panel.

Heretofore numerous binders have been suggested and used for bonding together mineral wool fibers into bats. Most generally such materials as asphalt, gypsum starch, rosin, linseed oil, glue, sodium silicate, pitch or the like have been attempted. These binders generally are water soluble or thermoplastic. If water soluble, they have for that reason proved unsatisfactory when subjected to moisture conditions. If thermoplastic, they are unsatisfactory when subjected to certain temperature conditions. Various other disadvantages have attended the use of these materials as, for example, the rosin is subjected to oxidation and embrittlement after only a short period during the life of the bat; sodium silicate attacked the fibrous material particularly if it contained an alkaline constituent.

We have discovered that a fibrous bat having highly superior properties may be produced by using a very small amount of thermosetting condensation product. This preferably is combined with a physically incompatible, that is, immiscible oleaginous lubricant such as oil, fatty material, or the tempering oil emulsion of the Williams and Bone patents, Nos. 2,083,132 and 2,107,284.

Various thermosetting condensation products may be used, as, for example, phenol formaldehyde, urea formaldehyde, or various modifications and variations of these synthetic materials which may be made by one skilled in the art to produce a resin originally in a liquid state, and finally in a hard, strong, solid mass. For ordinary purposes Bakelite, originally as water soluble material has been found very satisfactory.

A small amount of the thermosetting stiffening agent may be added to the tempering oil or lubricating mixture and applied directly to the blasted fibers, or the stiffening agent and the tempering oil may be applied separately as from separate spray guns directed onto the fibers. Preferably, however, the combination is first emulsified with water and then sprayed on the glass fibers as they are building up to mat formation upon a conveyor.

Various proportions of materials may be used, although it has been found that a small proportion of only about $\frac{1}{2}\%$ to $1\frac{1}{4}\%$ of Bakelite per weight of wool is sufficient for ordinary purposes.

When minute amounts of about $\frac{1}{2}\%$ to $\frac{3}{4}\%$ are used, the bat has materially increased stiffness and resilience, and reduced limpness, but it is not rigid or stiff. With increased amounts, the bat assumes a semi-rigid form, and with the higher amounts, a fair amount of rigidity and strength are attained. The bat is still resilient and tough and can withstand considerable bending or compression stress without destroying its properties.

The finished bat may thus have about $\frac{1}{2}\%$ to $2\frac{1}{2}\%$ thermosetting stiffening agent, about an equal amount of fatty acid or suitable soap, generally about 1% acting as an emulsifier if desired, and a suitable amount of oil immiscible with the thermoset stiffening agent, such as petroleum oil or the like in amounts of about 2% or so, as desired. Greater amounts of thermosetting stiffening agent may be employed to increase the stiffness and strength of the bat if desired, and the other constituents of the treating material may also be varied to adapt the treated bat to particular purposes. A bat may have, for example up to 5% or more thermosetting stiffening agent, as little as about $\frac{1}{10}\%$ fatty acid, and about 1% oil. Metallic soap, waxes, fats or the like may also be added to increase water repellancy of the bat if desired. Bentonite or the like may be added to set as an emulsifier, and to increase the heat insulating properties of the bat.

The liquid thermosetting condensation product may be mixed with the lubricant in suitable proportions to obtain the desired percentage of stiffening agent in the finished bat. If water-soluble phenol formaldehyde is employed with the tempering oil emulsion of the above Williams and Bone patents, the mixture will contain petroleum or hydrocarbon oil, stearic acid, ammonia and water in necessary proportions and water-soluble phenol formaldehyde in desired amount. A solution of Bakelite in water containing about 70% resin can be mixed with the tempering oils of the above Williams and Bone patents in about equal proportions up to about three parts resin solution to one part tempering oil as desired. This mixture is then further diluted with water, about 8 to 10 parts, to obtain the desired concentration of material in the finished mat.

The method of applying the emulsion or mixture of lubricant and binder may be similar to any of those now in use. Ordinarily it is preferable to spray the mixture onto the fibers as they build up into mat formation and are continuously withdrawn in mat formation. It is desirable to accomplish this process over the fiber deposition zone in order to control the deposition and preferably to apply sufficient heat to evaporate the aqueous phase of the emulsion, leaving the lubricant and binder or stiffening agent distributed over the fibers. After removal from the deposi-

tion zone, it is desirable to heat treat the stiffening agent and cause it to polymerize into a final set, thus adding stiffness and a controlled amount of rigidity and resilience to the bat. This may be accomplished by any of the usual methods as, for example, by passing the material between rollers or between caterpillar belts having hot air or the like passing continuously there-through in order to impart sufficient heat to polymerize the thermosetting agent. The caterpillar belt will also hold the bat down to a predetermined fixed dimension as the thermosetting binder hardens.

It is also possible and at times desirable when insulating closed panels, such as refrigerators, stoves or the like, to insert the bat in a loose, fluffy state prior to polymerization of the stiffening agent, and after it has been inserted into the cavity, apply heat and thermally set the binder in position.

The reason why such a small amount of binder, as, for example, an amount less than about 1% can effect such striking increases in strength and stiffness of the bat is not fully understood, although several reasons have been advanced to explain the phenomenon. From observations under a microscope, it was noted that a large number of intersections of fibers, it appeared that the stiffening agent congregated in very small amounts and coated the intersections with rounded smooth concave surfaces in a manner similar to a fillet, thus imparting high structural strength with a minimum quantity of material.

In accomplishing this desirable distribution, the thermosetting material originally in liquid form has a high wetting power and distributes itself at the intersections in this manner. When hardened, however, it tends to retain this form and thus structurally assume an ideal contour with respect to the adjacent fibers. The small amount involved, however, avoids rigidity to a point of brittleness, and permits the product to achieve a certain amount of flexibility and yieldability under stress.

It is also considered possible that the oleaginous lubricant would form a uniform, homogeneous coating over the individual fibers, and that an incompatible thermosetting resin acts as a binder or stiffener independently. The lubricant over the fibers, however, would provide a sufficient amount of yieldability so that the bat would attain a high degree of resilience and strength without causing excessive rigidity and embrittlement of the individual fibers.

Various modifications and variations may be resorted to within the spirit and scope of the present invention as defined in the appended claim.

We claim:

A treating material for mineral fibers comprising a stable two-phase system, one of said phases being an aqueous phase in the form of a water solution of a water-soluble, oil-insoluble thermosetting, incompletely reacted aldehyde condensation product selected from the group consisting of phenol formaldehyde and urea formaldehyde in amounts of 1 to 3 parts of a 70% solution of said product in water, and the other phase being an oleaginous lubricant incompatible with the aldehyde condensation product and emulsified with the aqueous phase in amounts of about 1 part, water in amounts of about 8 to 10 parts, and an emulsifying agent for the oleaginous lubricant.

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