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1

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SOUND DEADENING COMPOSITION

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This invention relates as indicated to a sound deadening composition, and more particularly to a fireproof sound deadening composition which is adapted to be applied to steel panels, partitions and the like, as well as to the usual wall and other surfaces.

Water glass (a water solution of sodium silicate) has long been utilized as a binder material for various purposes including the binding together of certain inert aggregates for the purpose of forming building materials such as tiles, blocks, and surfacing compositions. Ordinarily, however, such materials will have rather poor sound deadening and acoustical properties due to the inherent hardness of the silicate binder when dried. To improve such properties, selected inert aggregates or filler materials such as vermiculite have been included in the composition, and in some cases surficants and foaming or frothing agents have been employed to impart a more porous or cellular structure to the hardened product. Such materials previously available, however, have nevertheless not been very effective for sound deadening purposes, particularly when applied to relatively thin sheet metal panels and partitions which, of course, tend to have a metallic ring and to be objectionably resonant when installed in offices, factories and the like.

It is accordingly a primary object of our invention to provide a fireproof sound deadening composition having desirable acoustical properties and particularly adapted to be applied and adhered to surfaces such as sheet metal panels and partitions, for example, in a relatively thin layer or coating.

Another object of our invention is to provide such panels and partitions, and more particularly sheet metal panels and partitions having our new composition adhered thereto to render the same non-resonant in use.

A further object of our invention is to provide such composition which may be applied to such panels or partitions and either air dried or oven dried simultaneously with the baking of the usual enamel or other coatings or finishes commonly applied to the other surface of the same.

Still another object is to provide such composition which when thus dried will retain its adhesive and cohesive properties as well as its efficiency as a sound deadening material under all atmospheric conditions normally encountered in use.

Other objects of our invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention then comprises the features herein-after fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

We have discovered that when water glass is employed as a binder and adhering agent for sound deadening and insulating materials it is most important that the alkali content of the composition be regulated to ensure the retention of a certain minimum percentage of water, approxi-

2

mately 15% by weight of the composition, and retained water should constitute from about 15% to about 40% by weight of the final coating under normally prevailing conditions of humidity and temperature. If substantially less than 15% moisture is retained after drying, the coating composition will be relatively hard and lose a great deal of its sound deadening effectiveness despite the inclusion of porous aggregates in the composition or the provision of pores and voids by the inclusion of frothing or foaming agents therein. If the composition normally retains substantially more than 40% moisture content, there is likewise a decrease in sound deadening effectiveness and at the same time the composition may tend to be undesirably soft and non-adherent, particularly to sheet metal and other relatively smooth surfaces. Preferably, the alkali content of our composition will be regulated to ensure the retention of from about 20-35% moisture in the applied coating under prevailing conditions of humidity and temperature with consequent exceptional sound-deadening qualities. While some benefit will be derived from the use of our composition when the water content of the "dried" coating is as low as 10% or as high as 45% there is a rapid falling-off of desirable properties in the region of these limits so that every effort should be made to keep within the 15%-40% range and preferably the 20%-35% range referred to above. Unusual fluctuations in atmospheric conditions will then be less likely to have deleterious results.

While a variety of inert aggregates or filler materials may be employed in accordance with our invention such as cork, wood, bagasse, cotton and other vegetable fibers, pumice, asbestos, glass wool, mineral wool, perlite aggregates and others, we prefer exploded mica or vermiculite which is light, fireproof, has excellent insulating properties, and is readily combined with our special water glass binder. In general, the fireproof fillers will be preferred.

As the binding agent we employ water glass (a water solution of sodium silicate preferably of 41° Baumé (specific gravity 1.39) having a percentage composition by weight of 8.9% Na₂O, 28.7% SiO₂, and 62.4% H₂O), together with a proportion of sodium hydroxide such that the ratio of SiO₂ to Na₂O of the composition will lie within the range of from 1.3/1 to 2.3/1. Such 41° Baumé solution has a SiO₂/Na₂O ratio of 3.23/1 so it is apparent that a certain amount of sodium hydroxide will be required to bring it within the prescribed range. Obviously, any commercial water solution of sodium silicate may be employed regardless of its SiO₂/Na₂O ratio provided it is then appropriately modified as taught herein. This range is quite critical in that if the ratio of SiO₂ to Na₂O is higher than specified, the end product will become relatively hard and brittle, lose much of its adhesive and cohesive properties, and will be relatively inefficient as a sound absorbing and sound deadening agent. If the ratio is less than 1.3/1, it becomes quite difficult to dry the composition after application to a metal surface or the like, and excessive moisture absorption will occur during periods of high humidity, resulting in a very considerable reduction in sound deadening properties and the ability to adhere to the surface to which it is applied. Potassium hydroxide or equivalent alkali may be employed in the composition instead of sodium hydroxide but such are, of course, ordinarily more expensive so that sodium hydroxide will normally be utilized. Sufficient water will be included in the coating composition to render the same plastic and readily adherent to metal and other surfaces. After application of the coating composition to the supporting surface, the excess moisture may be removed therefrom either by air drying or oven drying, the final coating having the inherent characteristic of retaining a proper moisture content for maximum sound

3

deadening effectiveness under normally prevailing conditions of humidity and temperature.

An example of a preferred coating composition (as applied) may be given as follows:

	Per cent by weight
Vermiculite (exploded mica)-----	24
Water glass (41° Baumé)-----	50
Sodium hydroxide-----	6
Added water-----	20

Such composition will be seen to comprise 47.40% ingredients other than water, whereas when the composition has been "dried" such ingredients may comprise 75%, for example, with the vermiculite accounting for 38%. It will be seen that in the above formulation the $\text{SiO}_2/\text{Na}_2\text{O}$ ratio is 1.58 to 1, this approximating what will ordinarily be a proper ratio for ideal moisture retention properties.

Further examples within the limits of the specified range may be given as follows:

	Per cent by weight
Vermiculite-----	24
Water glass (41° Baumé)-----	34
Sodium hydroxide-----	2
Water-----	40
(SiO ₂ /Na ₂ O ratio of 2.3/1)	

	Per cent by weight
Vermiculite-----	26.5
Water glass (41° Baumé)-----	61.0
Sodium hydroxide-----	2.5
Water-----	10.0
(SiO ₂ /Na ₂ O ratio of 2.3/1)	

	Per cent by weight
Vermiculite-----	23
Water glass (41° Baumé)-----	33
Sodium hydroxide-----	6
Water-----	38
(SiO ₂ /Na ₂ O ratio of 1.3/1)	

	Per cent by weight
Vermiculite-----	24
Water glass (41° Baumé)-----	57
Sodium hydroxide-----	10
Water-----	9
(SiO ₂ /Na ₂ O ratio of 1.3/1)	

The vermiculite or other porous aggregate ordinarily may be varied from about 20% to about 45%, and preferably from 20% to 35%, of the total weight of the coating composition, and the size of the individual particles of such aggregate may be varied over a considerable range depending upon the particular physical properties desired. The various filler materials mentioned above, and others, may be substituted for the vermiculite in these formulations but fireproof materials will be preferred. Compatible agents which produce foaming, etc., may be included to obtain a more porous or cellular structure. The filler material may generally comprise from about 30-50% of the "dried" composition.

By controlling the $\text{SiO}_2/\text{Na}_2\text{O}$ ratio as specified, excellent cohesion and adhesion of the "dried" coating is obtained, whether such coating be applied to metal or other surfaces. Furthermore, the rate of drying may readily be controlled so that such coating composition may be force dried in the same drying ovens through which enameled sheet metal partitions are processed at temperatures ranging as high as several hundred degrees Fahrenheit. Such baking and drying operations may therefore be combined in a single step without blistering of our new coating composition.

The ratio of binder to inert filler as above indicated is also of considerable importance since if too much filler is employed the resultant product will have relatively poor adhesive and cohesive properties and the finished coating will tend to be friable and have poor sound absorbing

4

qualities. On the other hand, if the binder content is too high, the final product will frequently tend to be relatively hard and brittle and to have poor adhesive properties. In either case, the coating material will respond poorly to forced drying and will result in an inferior product.

One important reason, in addition to appearance and convenience, for the employment of sheet metal partitions in building is, of course, the fact that such partitions are entirely fireproof. These partitions ordinarily comprise opposed slightly spaced sheet metal panels having an enameled or like finish on their outer surfaces and with rock wool or like insulating material inserted therebetween. A coating or layer of our new sound deadening material preferably utilizing vermiculite or similar fireproof material as a filler may be applied to the respective opposed inner surfaces of such panels prior to assembly of the latter, such layer being at least one-sixteenth inch and preferably one-quarter inch in thickness, greatly reducing the resonant characteristics and metallic ring of the panels and adhering well thereto despite the impacts commonly received in use. Such coating employing vermiculite as the filler is entirely fireproof as it will neither burn nor support combustion. Furthermore, when heated, it will not release combustible fumes, vapors, or toxic gases and will not char or readily disintegrate. Being alkali in nature, the coating is non-corrosive to the metal surface and actually serves as an excellent rust retardant. It also has good heat insulating properties.

Our coating composition may be applied in various ways but will ordinarily either be sprayed or trowled on. If in properly sealed containers, it may be stored in unheated warehouses for many months without deterioration.

The coating will retain a degree of plasticity when dried, due to the moisture content of the same, enabling it to withstand flexing of the surface to which it is applied, as for example a sheet metal surface. If desired, the dried coating may be painted, preferably by spraying paint thereon, without deleteriously affecting its sound absorbing properties.

In general, it will be seen that we have provided a novel sound deadening coating composition comprising from 20-35% by weight of an inert aggregate, 30-60% by weight of 41° Baumé water glass, 2-10% by weight (anhydrous) of an alkali hydroxide such as sodium hydroxide and a water content sufficient to make a plastic, adherent, readily applicable mass, the proportion of alkali hydroxide to sodium silicate being sufficient to ensure the retention of at least 15% water in the composition when air dried under conditions of normal room temperature and humidity. In a specific preferred application, we have provided a novel article of manufacture in the form of a thin metal (ordinarily steel) sheet having a plastic, fireproof, sound deadening acoustical coating at least one-sixteenth inch thick firmly adhered thereto comprising a mixture of vermiculite, sodium silicate, sodium hydroxide and water in which the ratio of $\text{SiO}_2/\text{Na}_2\text{O}$ is from 1.3/1 to 2.3/1 with a consequent inherent water retention capacity of from 15% to 40%.

Our new composition may, as indicated, be applied to exposed wall surfaces and the like but a principal use is as a coating on the inner or hidden sides of ornamental steel panels and partitions where it effectively subdues the usual metallic ring which has been an objectionable feature of the same in the past. This result is moreover obtained without any sacrifice of the fireproof qualities of such panels and partitions which have caused them to be employed in ever-increasing quantity in the building trade.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

5

We therefore particularly point out and distinctly claim as our invention:

1. A novel sound deadening coating composition comprising from 20-35% by weight of an inert low density porous aggregate, 30-60% by weight of 41° Baumé water glass, 2-10% by weight (anhydrous) of sodium hydroxide and a water content sufficient to make a plastic, adherent, readily applicable mass, the $\text{SiO}_2/\text{Na}_2\text{O}$ ratio of such composition lying in the range of from 1.3/1 to 2.3/1 to ensure the retention of at least 15% and not more than 40% water in the composition when air dried under conditions of normal room temperature and humidity.

2. A novel coating composition comprising 24% by weight of vermiculite, 50% by weight of 41° Baumé water glass, 6% by weight (anhydrous) of sodium hydroxide and 20% by weight of added water, said vermiculite and the mixture of the other ingredients therewith normally having substantial water retentiveness.

3. A novel coating composition comprising 24% by weight of vermiculite, 34% by weight of 41° Baumé water glass, 2% by weight (anhydrous) of sodium hydroxide and 40% by weight of added water, said vermiculite and the mixture of the other ingredients therewith normally having substantial water retentiveness.

4. A novel coating composition comprising 24% by weight of vermiculite, 57% by weight of 41° Baumé water glass, 10% by weight (anhydrous) of sodium hydroxide and 9% by weight of added water.

5. As a new article of manufacture, a thin sheet metal panel having a plastic, fireproof, sound deadening acoustical coating at least one-sixteenth inch thick firmly adhered thereto consisting essentially of a mixture of inert low density porous bulk-affording filler material, sodium silicate, sodium hydroxide and water in which the ratio of $\text{SiO}_2/\text{Na}_2\text{O}$ is from 1.3/1 to 2.3/1 with a consequent inherent water retention capacity of from 15% to 40%, the proportion of filler material to the other ingredients being selected effectively to bind said filler material together.

6. As a new article of manufacture, a thin sheet metal panel having a plastic, fireproof, sound deadening acoustical coating at least one-sixteenth inch thick firmly adhered thereto consisting essentially of a mixture of vermiculite, sodium silicate, sodium hydroxide and water in which the ratio of $\text{SiO}_2/\text{Na}_2\text{O}$ is from 1.3/1 to 2.3/1 with a consequent inherent water retention capacity of from 15% to 40%, the proportion of vermiculite to said other ingredients being selected effectively to bind the mixture together.

7. As a new article of manufacture, a thin sheet metal panel having a plastic, fireproof, sound deadening acoustical coating at least one-fourth inch thick firmly adhered

6

thereto consisting essentially of a mixture of vermiculite, sodium silicate, sodium hydroxide and water, in which the ratio of $\text{SiO}_2/\text{Na}_2\text{O}$ is from 1.3/1 to 2.3/1 with a consequent inherent water retention capacity of from 15% to 40%, the proportion of vermiculite to said other ingredients being selected effectively to bind the mixture together.

8. As a new article of manufacture, a thin steel panel having a plastic, fireproof, sound deadening acoustical coating approximately one-fourth inch thick firmly adhered thereto comprising a coherent mixture of from about 30-50% vermiculite with the balance consisting essentially of sodium silicate, sodium hydroxide and water, in which the ratio of $\text{SiO}_2/\text{Na}_2\text{O}$ is from 1.3/1 to 2.3/1 with a consequent inherent water retention capacity of from 15% to 40%, the proportion of vermiculite to said other ingredients being selected effectively to bind the mixture together.

9. As a new article of manufacture, a thin sheet metal panel having a fireproof, insulating, sound deadening coating firmly adhered thereto comprising a coherent mixture of from about 30-50% inert low density porous bulk-affording filler material with the balance consisting essentially of sodium silicate, sodium hydroxide and water, in which the ratio of $\text{SiO}_2/\text{Na}_2\text{O}$ is from 1.3/1 to 2.3/1 with a consequent inherent water retention capacity under prevailing atmospheric conditions of from 10% to 45%, the proportion of said filler material to said other ingredients being selected effectively to bind the mixture together.

10. A dried, sound deadening, coating on a supporting surface consisting essentially of an inert low density porous bulk-affording filler and a binder therefor comprising sodium silicate and sodium hydroxide in amounts affording a $\text{SiO}_2/\text{Na}_2\text{O}$ ratio of from 1.3/1 to 2.3/1, with water retained in such coating comprising from 15% to 40% of the same by weight, the proportion of said filler material to said other ingredients being selected effectively to bind the mixture together.

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