

1

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MANUFACTURE OF ACOUSTIC FIREPROOF TILES

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4 Claims. (Cl. 25—156)

This invention relates to the manufacture of fireproof acoustic tiles, or the like.

The primary overall purpose and/or objective of this invention is to provide a fireproof tile or the like having a frangible crumbly porous core with the properties of high heat insulation and high absorption of sound, and with the surfaces thereof which are exposed when in use, having a tough covering with open pores communicating with the porous core.

It is also an overall purpose and/or objective of the invention to employ suitable ceramic, slow burn-out and glazing materials, which can be mixed with water or other suitable liquid to produce a plastic mass from which tile forms can be easily made, and said materials being in such proportions, and having such fusing or fluxing relationships that with the one heat treatment of a predetermined maximum range, a tile is formed having the properties and characteristics above described.

Other general objects of the invention are that the tile be inexpensive to manufacture, both as to the materials employed and the shaping and heat treatment required for producing the article of manufacture; that the relative amounts of the materials employed be not critical; and that the steps for providing the plastic mass, the shaping of tile or the like therefrom, and for assuring the complete manufacture of each tile with the one heat treatment, are simple, and involve no expensive or complicated operations.

Another important object of the invention is that the tile be comparatively light in weight which is an advantage in handling and securing the same to walls or ceilings. A reduction in the weight of the tile is secured by not glazing one face thereof. In other words, by leaving a face of the tile unglazed, its weight is reduced.

This application is a continuation in part of my co-pending application, Serial No. 324,852, filed December 8, 1952, now abandoned.

The method of this invention comprises the formation of a wet plastic mass of diatomaceous earth, a carbonaceous material, such as sawdust, and a dispersion in a suitable vehicle of a glazing frit in addition to a substantial amount of water. The mass should preferably have as much water as it will hold and still permit it to retain a given shape.

The mass is thoroughly mixed and formed into tile of desired shape and then fired in a kiln at a temperature in the burning range of the diatomaceous earth which will also be above the burning point of the carbonaceous material, and below the fluxing point of the diatomaceous earth or of any other ceramic material which might be admixed therewith. A preferred range is about 1700° to 2200° F., although this range may be varied to suit the particular frits to be used. Under these conditions, steam first evolves from the pieces due to the high water content, and then gases from the burning of the carbonaceous material. The evolution of the steam retards the formation of the gases so that the

2

total time of evolution of both steam and gases is sufficient to permit a setting up of the tiles with sufficient rigidity to prevent them from collapsing and destroying the pores developed by the steam and gases.

When the evolution of gases is completed or nearly completed, the frit material exudes to the surfaces of the tile pieces as a surface glaze leaving the interior substantially free of, or unaffected by, said material.

In lieu of sawdust for the burn-out material, other suitable combustible materials may be substituted, including coal dust, peat, comminuted corn cobs, bagasse, and various other agricultural waste products, or any similar slow burning materials. The amount of the burn-out material used is determined by the tile porosity desired. Likewise, there is no limitation upon the type of glazing material that may be used; the amount is dependent upon the thickness of the glazing desired which can be determined by trial. Some of the glazing materials are water soluble; others may require an acid medium for making them soluble. Mineral acids such as nitric, hydrochloric, sulphuric and phosphoric acids are suitable.

Some of the glazing materials that may be used are aqueous solutions of acetate salts of aluminum, barium, sodium, silver, calcium, iron (ferrous and ferric), magnesium, manganese, potassium and zinc; nitrates and halides (bromides, chlorides, fluorides and iodides) of the same element; mineral acid solutions of an arsenite of barium, sodium, calcium, iron, manganese, magnesium, silver or zinc; an acid solution of an oxide of aluminum, tin, chromium, cobalt, gold, iron, lead; and other base salts. The solubilities of the various known glazing materials are well known.

Exemplary of a mix for the plastic mass from which tiles can be formed comprises two pounds of diatomaceous earth to which there has been added 4 ounces of sodium silicate (Na_2SiO_3). These materials are mixed with 1 pound and 13 ounces of sawdust and water, to make a total of about 7 pounds and 12 ounces. Part of the diatomaceous earth, but generally not more than about 50% may be replaced by various clays such as potter's clay, fire clay, kaolin, etc., or mixtures thereof.

Exemplary of the mixture in proportional amounts, it may comprise 15 to 30 parts of ceramic materials, about 7 to 30 parts of carbonaceous material, about $1\frac{1}{4}$ to $2\frac{1}{2}$ parts of glazing materials, and 10 to 70 parts of water. Good results have been obtained by using a mixture of about 70% of diatomaceous earth to 30% of clay for the ceramic materials. The amount of water used should be such as is best for forming the tiles from the plastic mass, and best for holding their shape. In case of excess water it may be reduced by shaping the tiles under pressure.

My process or method of manufacture essentially consists of three procedures, the first being preparing the mixture of the materials I have heretofore specified with water for forming a plastic mass; the second being to shape the tiles from the plastic mass; and the third being to subject the tiles to a one heat treatment for producing a finished product. Any suitable equipment may be used for shaping the tiles. The oven should have suitable pallets on which the tile forms are placed. The temperature is raised as quickly as possible to the predetermined degree. The tile forms may be placed in the oven at any time. The most practicable moment is when the oven has reached about 600° F. The time period for producing the frangible crumbly porous core and the porous glaze surface, or, in other words, the time for producing a finished tile, is about $1\frac{1}{2}$ to $3\frac{1}{2}$ hours.

The matter of tile baking temperature is highly important, i. e., that the maximum temperature be not more than is necessary for the fusing or fluxing of the glazing

materials and complete combustion of the burn-out materials employed; but never sufficiently high to fuse or flux the ceramic materials used. If excessive temperature is used the glazing materials will tend to run into the surface pores and decrease the efficiency of the tile to absorb sound waves. I have found that a suitable range of temperatures for these purposes is between 1700° and 2300° F., depending upon the specific materials employed for the mix which can be determined through trial.

Through the procedures or steps above defined, there is produced a fireproof acoustic tile, with a porous glaze covering, except as to the side or face thereof which rests on the pallet during the baking treatment. More specifically, there is produced a tile of the shape and thickness previously determined, having a frangible crumbly porous core which is covered with a tough glazed surface having pores which communicate inwardly with the porous core; the glazing being only on the edges and one face of the tile, i. e., the surface of the tile which rests upon the pallet, while undergoing heat treatment, does not receive a glaze covering.

The present invention is concerned with a method of simultaneously manufacturing a porous tile with a glazed porous surface. The interior of the tile is relatively soft. Only the surface acquires the hard glaze.

This invention has the further advantage in that it permits the utilization of clay and other raw ceramic materials to yield some glaze. For example, some clays naturally contain ferrous aluminum hydroxide which, in a form of greater purity, is used as a glazing compound. It is also found as an impurity in commercial diatomaceous earth. The amount thus present, however, is not sufficient alone to produce a glazing by the method of the present invention. Thus, there is the need of supplementing through adding additional glaze in dispersion as heretofore noted.

It appears that to a great extent the success of this invention depends upon the presence of both a burn out material which can absorb a high degree of water, like sawdust, and thus provide the mix with a high water content. The water begins its conversion to steam before the burn out material starts to decompose. Hence, there is established an initial evolution of steam followed by the evolution of gases from the decomposition of the sawdust to maintain the porous structure until the baking has proceeded to a point where sufficient rigidity has developed in the core to maintain the pore walls against collapsing. Steam alone is not sufficient to accomplish this purpose. On the other hand, a relatively drier mix becomes distorted when the gases evolve from the sawdust apparently due to the fact that at that temperature the material is less pliable and cannot yield to the development of porosity as well as it can in its initial stages of heating under the evolution of steam. The steam also appears to act somewhat as a lubricant to assist in the formation of the pores.

During the heat treatment there first appears a black deposit on the exposed surfaces of the tile which gradually disappears under a blue flame leaving a white deposit. This white deposit which constitutes the glazing material that has exuded to the tile surface, upon cooling is extremely porous, but at the same time provides a tough covering for all surfaces exposed when the tile is in use. The covering assures against breakage of the tile in handling the same or when applying to walls or ceilings.

It should be noted that the unglazed side or face of the tile has no detrimental effects respecting the acoustical properties of the tile. On the contrary, I have found that this unglazed face, perceptibly increases the acoustical properties of the tile because the core material is more friable than would be the case if the inner face of the tile were glazed. In other words, the tile produced is more effective in the absorption of sound waves. In the application of the tile, this unglazed face is placed against the wall or ceiling which the tiles cover.

What I claim is:

1. A method for the manufacture of acoustic fireproof tile which consists, first in preparing a plastic mix comprising 13 to 30 parts of diatomaceous earth, 7 to 30 parts of carbonaceous combustible material capable of absorbing a relatively large amount of water, $1\frac{1}{4}$ to $2\frac{1}{2}$ parts of glazing material in dispersion and having a lower fluxing temperature than the diatomaceous earth, 10 to 70 parts of water to obtain a mix with as much water as it will hold but still retain a given shape, next forming or shaping a tile core from the mix, and finally, subjecting the core to a baking temperature from 1700° to 2300° F. between $1\frac{1}{2}$ to $3\frac{1}{2}$ hours whereby steam from the water held in the mix provides pores extending from the inner part of the core through the surface thereof, and in conjunction with the gases from the carbonaceous material the walls of the pores are given rigidity to maintain the same, and the glazing material in the mix is deposited therethrough on the surface of the core, which is fluxed and thus forming a glaze for the core with pores in register with pores of the core, said core having a soft-like and crumbly central area with high sound absorption capacity and high fire protection properties.

2. A method for the manufacture of acoustic fireproof tile which consists first in preparing a plastic mix comprising 13 to 30 parts of ceramic materials, approximately 70% diatomaceous earth and 30% clay containing a natural glazing frit, 7 to 30 parts of carbonaceous combustion material capable of absorbing a relatively large amount of water, and sufficient glazing frit in dispersion to supplement the glaze in the clay for making a total of $1\frac{1}{4}$ to $2\frac{1}{2}$ parts of the mix, said glazing frit having a fluxing temperature lower than that of the ceramic materials, 10 to 70 parts of water to obtain a mix with as much water as it will hold but still retain a given shape, next forming or shaping a tile core from the mix, and finally, subjecting the core to a baking temperature from 1700° to 2300° F. between $1\frac{1}{2}$ to $3\frac{1}{2}$ hours whereby steam from the water held in the mix provides pores extending from the inner part of the core through the surface thereof, and in conjunction with the gases from the carbonaceous material the walls of the pores are given rigidity to maintain the same, and the glazing material in the mix is deposited therethrough on the surface of the core, which is fluxed and thus forming a glaze for the core with pores in register with pores of the core, said core having a soft-like and crumbly central area with high sound absorption capacity and high fire protection properties.

3. A method for the manufacture of acoustic fireproof tile which consists, first in preparing a plastic mix comprising 13 to 30 parts of ceramic materials, approximately 70% diatomaceous earth and 30% clay containing a natural glazing frit, 7 to 30 parts of sawdust, and sufficient glazing frit in dispersion to supplement the glaze in the clay for making a total of $1\frac{1}{4}$ to $2\frac{1}{2}$ parts of the mix, said glazing frit having a fluxing temperature lower than that of the ceramic materials, 10 to 70 parts of water to obtain a mix with as much water as it will hold but still retain a given shape, next forming or shaping a tile core from the mix, and finally, subjecting the core to a baking temperature from 1700° to 2300° F. between $1\frac{1}{2}$ to $3\frac{1}{2}$ hours whereby steam from the water held in the mix provides pores extending from the inner part of the core through the surface thereof, and in conjunction with the gases from the carbonaceous material the walls of the pores are given rigidity to maintain the same, and the glazing material in the mix is deposited therethrough on the surface of the core, which is fluxed and thus forming a glaze for the core with pores in register with pores of the core, said core having a soft-like and crumbly central area with high sound absorption capacity and high fire protection properties.

4. As an article of manufacture a product prepared in accordance with the method of claim 1.

(References on following page)

5

References Cited in the file of this patent

UNITED STATES PATENTS

1,742,515	Mandell	Jan. 7, 1930
1,842,186	McBerty	Jan. 19, 1932
1,898,839	Kern	Feb. 21, 1933
1,938,170	Bellamy	Dec. 5, 1933
1,941,804	Kern	Jan. 2, 1934

5

1,992,916
1,999,371
2,127,867
2,266,646
2,702,748
2,733,592
2,791,020

6

Johnson	Feb. 26, 1935
Parsons	Apr. 30, 1935
Harvey	Aug. 23, 1938
Lower	Dec. 16, 1941
Heine	Feb. 22, 1955
Burchend et al.	Feb. 7, 1956
Heine	May 8, 1957