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DRY PRESS INSULATING FIRE BRICK

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1 Claim. (Cl. 106—41)

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My invention relates to the manufacture of insulating fire brick by dry press method and has as its principal object the elimination of important defects inherent in the manufacture of such insulating fire brick by the stiff mud and slop mud methods heretofore commonly used in the manufacture thereof, such as the necessity for making the brick oversize to allow for the high degree of shrinkage in drying and burning and to correct the deformation resulting from drying, as well as to minimize the loss resulting from grinding oversized brick or dobies to correct size and shape.

Such insulating fire brick are of a light weight porous structure due to the presence in the mix of small particles of sawdust, coke or other combustibles which are burned out in the process of burning the brick. Because of the low percentage of clay in such fire brick, it has heretofore been thought necessary to temper the mix to a soft consistency by the addition of a large amount of water; and an important object of the present invention is to reduce the amount of water required in the manufacture of such insulating fire brick. Other objects and advantages of the invention will appear hereinafter.

The invention consists principally in the use of plaster of Paris, sawdust and fire clay grog in a mix that has a dry press consistency and is molded into green blanks by the customary dry press process and apparatus, although the amount of water in the mix is larger than is added in the usual dry press process. The invention also consists in the process, in the proportions of ingredients in the mix and in the sequence of operations hereinafter described and claimed.

Typical examples of insulating fire brick for whose manufacture my process is particularly well adapted are the lighter weight types designated by the American Society for Testing Materials as 1600° F. and 2000° F. types, that is, suitable for use at those temperatures. The approximate mix by weight for making these two types of brick by my process is as follows:

	1600°	2000°
Plaster of Paris (No. 2 molding plaster)	11.6	12.8
Sawdust (dry basis) not larger than 6 mesh and including substantial amounts of fines	17.4	18.1
Plastic Fire Clay, size 20-28 mesh, but including some fines	25.6	28.1
Fire Clay Grog, size 28 mesh, but including some fines	7.0	7.6
Water	38.4	33.4

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The sawdust is shown on the dry basis, but in practice, it is desirable to mix the water with the sawdust in the portion of about 110 to 120% of water to the sawdust, before the sawdust is added to the mix. Sawdust from any type of wood may be used, but hard woods such as oak, walnut or cherry are preferred sources.

The sawdust may be obtained in wet form, as by being wetted and weathered in outside storage piles, or water may be added to dry sawdust.

As indicated in the table of ingredients, the sawdust should have a maximum size of approximately 6 mesh and it is desirable to include substantial amounts of smaller sizes or fines.

In the tempering operation, the sawdust, the plastic fire clay and calcined fire clay (grog) are added and water (either in the sawdust or added separately to the mix) are mixed until a uniform mixture is obtained. The plaster of Paris is then added, and the mixing continued until a uniform mix is obtained. If sufficient water was not added to the sawdust originally, it may be necessary to add more water during the mixing operation. As above indicated, it would be possible to add all of the water in the course of the mixing and tempering operation, but it has been found more advantageous to add all or most of the water to the sawdust.

The mixing operation must be one simulating the action of the hands in rolling and stirring the mix in a pan. A mulling or squeezing action is not permissible, because it would compress the mix too much and cause the resulting brick to be too heavy. A properly tempered mix, ready for pressing, is relatively free from balls or lumps, the presence of which indicates too much mulling or squeezing during the mixing and tempering operation and requires a disintegrating operation to eliminate the balls and lumps.

The actual water content of the mix is somewhat higher than that of usual heavy fire clay mixes for making dry pressed brick but the consistency of the mix is substantially the same as that of the ordinary dry press mix, so that it is possible to form the brick in the conventional manner on a standard type dry pressing machine. The similarity in consistency of the two mixes, notwithstanding the higher water content of my mix, is believed to be accounted for by the high water carrying capacity of the sawdust in the mix; just as in the case of the ordinary use of sawdust in a soft mud hand mold mix, the water content is from 80 to 90 per cent, as compared with the 18 to 23 per cent water content of a

soft mud fire clay grog mix without sawdust. The term "dry press consistency" herein refers not to the actual water content of the mix but to the physical consistency and characteristics of the mix.

In forming the brick in a dry press machine, care must be exercised against the use of excessive pressure, which would cause the brick to pressure crack and to swell on leaving the mold box. In my process, the pressure is in the order of 300–600 pounds per square inch, as compared with the usual pressure in the order of 2000–4000 pounds per square inch in the case of ordinary heavy fire clay mixes which can stand such higher pressure without the formation of pressure cracks or swelling. It is necessary, of course, in the case of my mix, as in the case of ordinary dry press mixes, to have sufficient pressure to satisfactorily fill out the brick to obtain uniform structure and satisfactory bond.

The green brick leaving the dry press, have sufficient strength to permit them to be easily handled. Because of the relatively low water content of the green brick of my process, as compared with green brick of the usual slop mud process, little or no preliminary drying is required before burning. Such partial or total preliminary drying is permissible, but not required, it being feasible to set the brick as they come from the dry press directly into the burning kiln and to do the drying in the preliminary stages of the burning operation.

Green brick of the mix hereinbefore illustrated for the lighter weight types of insulating fire brick are relatively weak during the burning process and considerable deformation and marking will result if the green brick are set more than one or two deep on edge. Because of the low permissible setting height, it is desirable to burn the brick as rapidly as possible, as a matter of economy. Except for the matter of economy, it is not necessary to burn the brick rapidly nor to dry and burn the brick in a single operation in order to obtain a satisfactory final product. The brick can be dried in a separate operation and burned slowly in the conventional manner and still produce a final product of the desired weight and strength, the only objection, as above stated, being the higher cost of manufacture, due to the low permissible setting height of the green brick.

A burning schedule requiring seven to ten hours to reach the firing temperature of 2250 to 2350° Fahrenheit may be used for burning green brick made from the above mix and set one deep. Only eight to ten hours is required to cool the burned brick from burning temperature to approximately room temperature. Insulating fire brick made by the above process have a manufacturing shrinkage (total drying and burning shrinkage) of approximately one-half to three-fourths inch per foot as compared to the manufacturing shrinkage of approximately one and one-half to one and three-fourths inches per foot for insulating fire brick made by the soft mud process. The low manufacturing shrinkage of the brick made by my process and the setting of the green brick only one deep during the burning operation permit their being manufactured within comparatively small tolerance limits as to size and shape; so that it is necessary to do little, if any, grinding to obtain brick of uniform size. This elimination or reduction of grinding is an important economy feature of my process.

The properties of refractories made as herein-

before set forth, when tested in accordance with A. S. T. M. Method C93–39T are as follows:

	1600°	2000°
Weight per Cubic Foot.....Pounds..	34.7	40.8
Modulus of Rupture Strength Pounds per Square Inch	60.0	77.0
Linear change when reheated 24 hours at 1550° Fahrenheit.....Percent expansion..	0.44	
Linear change when reheated 24 hours at 1950° Fahrenheit.....Percent expansion..		0.50

By making suitable modifications in the proportions of the mixes, the tempering operation and the drying and burning operations, insulating fire brick of heavier and stronger types such, for example, as those used for 2300° and 2600° Fahrenheit service may be produced. Examples of such mixes follow:

	2300°	2600°
	Per cent	*Per cent*
Plaster of Paris (No. 2 molding plaster)	10.0	1.3
Sawdust (dry basis) 6 mesh	10.7	15.4
Plastic Fire Clay, 20–28 mesh	30.0	
Missouri Bituminous Coal, 16 mesh	15.0	9.9
G–1 Georgia Kaolin, 28 mesh, but including some fines		29.6
Raw Georgia Kyanite, 28 mesh but including some fines		5.0
Fire Clay Grog, 28 mesh	17.5	14.8
Water	16.8	24.0

In the case of these heavier and stronger brick intended for high temperature use, the sawdust, coal, grog, clay and water are first placed in the pan and mixed for approximately one minute. The plaster of paris is then added and the tempering continued for an additional period of one minute. It is desirable that the mixing and tempering operation be such as to produce a squeezing or mulling action and cause lumping and balling of the mix. It is then necessary to disintegrate the balls and lumps of the mix before pressing. The pressing operation is the same as that in the case of the light weight brick.

These green brick intended for final high temperature use are much heavier and stronger and may be piled as many as seven courses deep without objectionable deformation or marking. If sawdust alone is used, the same rapid schedule may be followed for burning as in the case of the lower temperature brick, but if coal is used with the sawdust, the burning schedule must be lengthened by as much as six to eight hours because of the longer time required for oxidization of the coal than of the sawdust particles and higher temperatures are permissible.

The properties of these higher temperature refractories, when tested in accordance with A. S. T. M. Method C93–39 are as follows:

	2300°	2600°
Weight Per Cubic Foot.....Pounds..	50.5	53.7
Modulus of Rupture Strength, Pounds per Square Inch	122	104
Linear Change When Reheated 24 hours at 2250° Fahrenheit.....Percent contraction..	1.84	
Linear Change When Reheated 24 hours at 2550° Fahrenheit.....Percent contraction..		1.13

The hereinbefore described process has the very important advantage of making insulating fire brick of uniform size and shape, thereby minimizing grinding and other sizing operations and minimizing loss due to warpage and shrinkage in burning. The resulting insulating fire brick are fully equal to those produced by the usual stiff mud or slop mud process, if not actually

superior thereto. I have given typical examples of mix, but it will be obvious that variations may be made as required by differences in types of clay and the like and I do not wish to be limited to the precise proportions of ingredients hereinbefore set forth.

Reference is made to my copending divisional applications Serial No. 704,521, filed October 19, 1946, and Serial No. 704,522, filed October 19, 1946, for matter disclosed but not claimed in this application.

What I claim is:

The process of making insulating refractories which comprises mixing and tempering to dry press consistency about 10.0% by weight of plaster of Paris, about 10.7% by weight of sawdust, about 30.0% by weight of plastic fire clay, about 15.0% by weight of Missouri bituminous coal, about 17.5% by weight of fire clay grog and about 16.8% by weight of water, dry pressing said mix into green brick and burning said green brick.

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