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CHROME REFRACTORY AND ITS METHOD OF MANUFACTURE

No Drawing.

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My invention relates to a chrome refractory and to its method of manufacture.

A purpose of my invention is to change and improve the character of bond between the chromite particles of a chrome brick.

A further purpose is to avoid the need for "boxing" chrome bricks for kiln firing.

A further purpose is to raise the fusion temperature of the bonds formed in a chrome brick by the silicious ingredients, thereby avoiding softening of the bond and undue weakening of the brick when subjected to the usual furnace temperatures of service.

A further purpose is to mix chrome ore with both nitre cake, ground magnesia and water preparatory to moulding it into bricks.

A further purpose is to obtain a chrome brick that is better adapted than existing chrome brick to maintain its strength when subjected to the high temperatures of a metallurgical furnace.

A further purpose is to obtain a chrome brick that will not spall when subjected to sudden drops in temperature.

A further purpose is to kiln-fire chrome bricks at relatively low temperature, as at about 2000° F. as opposed to the customary 2700° F. of present practice, and to promote the gradual bonding of the chromite particles and the gradual hardening of the bonding material by an interreaction incident to the addition of both ground magnesia and nitre cake to the chrome ore before moulding into bricks.

Further purposes will appear in the specification and in the claims.

In the past it has been usual to manufacture chrome bricks by moistening the ground chrome ore, moulding the moistened mass into bricks, drying the bricks and then kiln-firing the bricks at very high temperature, as for example at 2700° F., to effect the ceramic bond, the chrome bricks being "boxed in" with burned silica bricks during the kiln firing.

The ceramic bond has been due to the fluxing of the silicious ingredients of the brick which occur as impurity ingredients of the chromite ore.

The silicious ingredients of the brick flux

during kiln firing into a vitreous mass which coats the chemically neutral particles of the chromite, so as to bond them firmly together when the brick has cooled.

During the high temperature kiln firing the vitreous mass around the particles of chromite becomes molten or pasty to an extent that has made the brick during firing unable to resist squatting or deforming if more than a few rows of bricks have been piled on top of one another. This is the reason why the bricks have been "boxed in" during kiln firing.

The chrome bricks thus made have in the past softened and weakened whenever subjected to temperatures at all comparable with those at which they were kiln-fired, as for example when subjected to temperatures above 2500° F., the vitreous mass around the individual particles of chromite again softening and weakening whenever the brick has been subjected to these moderately high temperatures.

Probably the failure to materially increase the high-temperature-resisting quality of the interstitial silicious matter of the brick during the kiln firing has been due to the non-reactive character of the chromite particles, and one of the objects of my invention is to so change the character of the silicious impurity ingredient of the commercial chrome ore by means of an initial mixing with nitre cake and ground magnesia and a subsequent low temperature kiln firing of the moulded brick that the bond-forming ingredient will no longer soften under the usual temperatures of metallurgical furnaces.

I kiln fire at a temperature too low to effect any great initial softening of the brick and after the firing process is complete, I find that the bonds formed have gradually hardened at the temperature of firing so that the strength of the brick is maintained even at temperatures far above the firing temperature.

In the past the need for having the chrome bricks "boxed-in" with burned silica bricks during kiln firing has greatly reduced the output of the individual kilns and increased the cost of kiln burning the chrome bricks, as

the chrome bricks have occupied only about 40% of the content of each kiln and in addition the silica bricks have had to be replaced from time to time.

5 In accord with the present invention I suitably grind the chrome ore, add finely ground calcined magnesia and an aqueous solution of nitre cake.

10 I thoroughly mix these ingredients, mould the well mixed mass into bricks of any desired shape, preferably under pressure, dry the bricks and then kiln fire them at a relatively low temperature as at about 2000° F. as opposed to the 2700° F. that has been usual hitherto.

I find it unnecessary to "box in" the bricks as throughout the kiln firing they have ample strength to prevent deformation when piled in rows, one on top of another.

20 The actual chemical and physical changes that take place during the mixing and kiln firing are somewhat uncertain.

It is probable that during the initial mixing there is a very considerable physical dispersion and partial separation from one another of the different kinds of silicious particles that are present, the more acid and finely divided of the silicious particles being dispersed by the nitre cake solution to the strongly basic particles of magnesia, while the remaining particles are interspersed chiefly around the particles of chromite.

During the low temperature kiln firing chemical reaction takes place at the surface of each magnesia particle that raises the melting point of the silicious matter.

35 The surface reaction between the magnesia particle and its silicious coating effects a gradual hardening of the silicious coating and gives a bond that stays hard and strong at much higher temperatures than those at which chrome bricks have hitherto softened and weakened.

Whether the reaction changes that take place between the silicious ingredients of the chromite, the magnesia and the nitre cake are physical or chemical or, as seems more probable, a combination of physical dispersion during the mechanical mixing of the ingredients and a subsequent chemical reaction between the particles of magnesia and their silicious coatings, I have found the result to be a brick that has a very different and very superior bond as compared with the chrome bricks that have been manufactured hitherto.

45 I have found that brick made in accord with my process has an adaptation to withstand sudden changes of temperature to an extent that has been altogether absent in chrome bricks in the past.

50 I prefer to use calcined magnesia that has been ground to a fairly fine state of division, as for example, so that it will all pass through a 65-mesh screen.

I have found a mixture containing 10 parts of the finely ground magnesia, 90 parts of commercial chrome ore and 2½ parts of nitre cake to give good results.

70 There appears to be no objection to increasing the proportion of magnesia above 10 parts except that the magnesia is commercially somewhat more expensive than chrome ore, but the magnesia has appeared not to exert its full effect when added to an amount less than 10 parts.

75 In this connection the requisite amount of magnesia will doubtless vary with the fineness of grinding of the magnesia and also with the quantity and character of the silicious ingredients of the chrome ore.

While the best proportion of nitre cake, which is chiefly sodium bisulfate, is doubtless variant with variation in the other ingredients of the mix I have found that about 85 2½ parts of the mixture by weight has given excellent results.

I have also used other electrolytes than nitre cake and have found many alkaline and alkaline earth salts to be operative. For example, sodium sulfate, magnesium sulfate, sodium chromate, sodium dichromate, etc. Nitre cake is a by-product in the manufacture of nitric acid and I use it because of its cheapness and the fact that it works quite as well as other and more expensive electrolytes.

When properly prepared the mixture, preparatory to moulding into bricks should preferably have about the consistency of foundry 100 moulding sand, and bricks moulded from this mixture and dried in ovens or in the atmosphere have sufficient rigidity cold for kiln firing without "boxing-in" the bricks.

105 I prefer to mould the moist mixture under pressure. Even when low pressures are used the bricks are usable. The quality of the bricks is improved by using the higher pressures, say 2,000 to 10,000 pounds per square inch. These pressures are applied through the use of an hydraulic press or other suitable mechanical means. I have found a pressure of 5,000 pounds per square inch to be very satisfactory for most work.

115 I set the kiln solid with chrome brick and fire at a temperature too low for such complete fusion of the silicious ingredients of the brick as will deleteriously reduce the strength of the brick during firing.

120 The reaction between the soluble salts of the nitre cake, the magnesia and the silicious ingredients of the brick takes place to a great extent during mixing and doubtless continues during the kiln firing which is accompanied by an evolution of sulfurous gases from the decomposing nitre cake.

125 It is probable that during the firing process there is a continued reaction between the magnesia, the nitre cake and the silicious ingredients of the brick that results first in a 130

more perfect coating of the particles of chromite, and interspersed particles of magnesia with the heat softened bonding ingredients, and that the initially soft and sticky bonding ingredients gradually harden during the continued firing so that after the firing process is over the bonding ingredients are hard and are adapted to remain hard and strong at temperatures very materially higher than those at which chrome bricks have hitherto become soft and weak.

My brick resists injury by spalling during sudden temperature changes to an unusual degree. It is probable too that this is due to changes in the silicious bonding ingredients of the brick that are effected by my new method of manufacture. This resistance to spalling has greatly increased the value of the finished brick.

I am aware that it has been proposed in the past to mix chrome ore with magnesia preparatory to the moulding of the mixture into refractory bricks. However this proposed moulded mixture of chrome ore and magnesia has not adapted the bricks to kiln firing without "boxing in" the chrome bricks, nor does it permit adequate bonding by means merely of a low temperature firing such as I use. It does not give the brick the different and superior character of bond that I obtain.

I use a dispersive reaction upon the silicious particles in the chromite that requires the simultaneous presence of both the nitre cake and magnesia for bonding chrome ore and by this means have been enabled to obtain the low temperature kiln firing without the need for "boxing in" the bricks and to obtain a brick that has very superior characteristics as compared to the chrome bricks hitherto manufactured.

It will be evident that I have provided a new method of manufacturing chrome bricks that to a very considerable extent does away with the deleterious softening of the bricks at furnace temperatures and with the tendency for the bricks to spall with temperature changes and have thus effected a very material advance in the state of the art.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The step in the method of manufacturing refractory bricks which consists in intimately mixing ground chrome ore with water, nitre cake and finely divided mag-

nesia preparatory to moulding the mix to form.

2. The step in the method of manufacturing a chrome refractory which consists in intimately mixing ground chrome ore with finely divided calcined magnesia, nitre cake and water, moulding the mix to form under high pressure and in burning the forms thus moulded.

3. The method of manufacturing refractory bricks which consists in mixing ground chrome ore with nitre cake, water and finely divided calcined magnesia, in moulding the mix into bricks in piling the bricks for burning and burning the bricks at a temperature below the temperature at which the heat would cause the bricks to deform.

4. A method of manufacturing refractory bricks which includes mixing chrome ore with nitre cake, water and finely divided magnesia, in moulding the bricks, and in kiln firing the bricks at a temperature approximately 2000° F.

5. A method of manufacturing refractory bricks which includes mixing chrome ore with nitre cake, water and finely divided calcined magnesia, the amount of water being such as to give the mix about the consistency of foundry moulding sand, in moulding the mix into bricks under a pressure of 2000 pounds and upwards per square inch and in drying the moulded bricks.

6. A method of manufacturing refractory bricks which includes intimately mixing chrome ore with a little water, about 2½% nitre cake and as much as approximately 10% finely divided magnesia preparatory to moulding the mix into bricks.

7. A method of changing the bonding characteristics of the silicious ingredients of chrome ore to be used in the manufacture of a chrome refractory which includes intimately mixing the chrome ore with finely divided calcined magnesia and nitre cake in the presence of water to effect a selective dispersive reaction upon particles of the silicious ingredients of the chrome ore to the basic particles of magnesia.

8. A mix for the manufacture of refractory bricks which includes chrome ore, finely divided calcined magnesia and nitre cake.

9. A mix for the manufacture of refractory bricks which includes chrome ore, finely divided calcined magnesia to an amount as much as 10% and nitre cake.

10. A mix for the manufacture of refractory bricks which includes chrome ore, finely divided calcined magnesia and nitre cake to an amount approximately 2½%.

11. A mix for the manufacture of refractory bricks which includes chrome ore, nitre cake to an amount approximately 2½% and finely divided calcined magnesia to an amount as great as approximately 10%.

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