United States Patent Office 3,221,082 Patented Nov. 30, 1965

3,221,082

PRODUCTION OF DEAD BURNED MAGNESIA IN A SHAFT KILN

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No Drawing. Filed Nov. 28, 1961, Ser. No. 155,445
6 Claims. (Cl. 263—53)

This invention relates to the production of dead burned magnesia, and it is among the objects of the invention to provide for the production of that material by the firing of briquettes of magnesia in a shaft kiln by a procedure that is simple and easily controlled and which avoids serious difficulties that are encountered in the absence of such control.

Customarily, dead burned magnesia is made in rotary kilns from such materials as magnesium carbonate and magnesium hydroxide in bulk or unconsolidated form. It has been proposed to achieve greater density at higher purity than is to be had with such rotary kilm products by dead burning the magnesia in the form of briquettes. Rotary kilns are not suited for this purpose because the magnesia briquettes are damaged or destroyed by the tumbling action in the kiln with the production of dust that is largely lost to the stack, and apart from that the product is deficient in the desired density. For these reasons shaft kilns are more generally useful for burning briquetted magnesia.

The successful operation of a shaft kiln depends primarily on the ability to move the charge at a constant rate down through the firing zone of the kiln while blowing a sufficient amount of air upwardly through the kiln countercurrently to the movement of the charge. The firing zone must be maintained at a temperature sufficiently high to sinter the charge properly. The ease of this countercurrent movement of air and feed is governed by the porosity of the charge and the temperature of the firing zone. With a maintained uniform size of briquettes and a minimum amount of fine particles, the packing of the charge moving through the kiln will be such that no difficulty is encountered in forcing the necessary amount of air through the descending load with the required firing zone temperatures.

Economically, the operation of a shaft kiln requires maximum throughput. In attempts to dead burn magnesia briquettes in accordance with what would be considered normal practice with a conventional shaft kiln in which unfired briquettes are fed at the top and fired briquettes are discharged at the bottom, with an intermediate zone heated to dead burning temperatures and air blown upwardly from the bottom of the kiln, we have found that the briquettes spall or break up into fines to such an extent that the load bridges over and will no longer move down the kiln. This condition necessitates cutting back the throughput of the kiln and reducing the amount of air blown in at the bottom of the kiln in order to get the load moving down kiln again.

The velocity of the gases moving from the burning zone into the upper and cooler part of the kiln decreases as the gas cools. As long as the porosity of the charge remains constant this decrease of velocity is not significant. However, when the amount of fine material, say less than 28 mesh Tyler standard, increases, for instance due to breakage of the briquettes into small pieces, the low velocity due to the cooling of the gases in the upper part of the kiln is not able to sweep the fines up through the load and out of the top of the kiln. The fines are carried up only to a certain point and then drop out of the gas stream to travel down the kiln again thus building up a recirculating load of the fines. This recirculating load

accumulates until the charge becomes compacted into a sort of mat or heavy layer wholly lacking the clear passages open enough to allow the free upward movement of gases upon which the successful operation of a shaft kiln depends. This mat becomes so dense that the pressure of the air from below is sufficient to support the weight of the charge above it, and causes the load to stop moving down the kiln. As the load below such a mat moves downwardly, an empty space is formed between the stationary mat and the top of the moving charge.

If the load is started moving again, either by cutting off the air supply or by poking the clogged area, the cold briquettes near the top of the kiln drop suddenly into a region where the temperature may be 2000° to 3000° F. higher, and this abrupt transition of the cold briquettes to such high temperature causes serious spalling and further aggravates the existing condition. Eventually it becomes necessary to empty the kiln, recharge it with burned briquettes and start again. Unburned briquettes cannot be used in restarting because they would spall and shatter upon entering the hot kiln.

We have discovered, and it is upon this that our invention is in large part predicated, that the foregoing difficulties can be overcome and continued satisfactory operation of the kiln maintained by control of the thermal gradient from the hot zone, usually located at about the center of the kiln, to the top where the cold briquettes enter the kiln. More in detail, we have found that the aforesaid spalling and shattering of the briquettes with consequent interference with kiln operation due to excessive formation of fines can be avoided by controlling that thermal gradient so that the cold briquettes in passing from the entry of the kiln are heated at a rate not exceeding about 200° F. per minute until they reach a zone at a temperature of at least about 2000° F., and that especially desirable results are attained when the briquettes are heated at about 75° to 100° F. per minute. The rate of heating from about 2000° F. to the dead burning temperature, which may range from about 3000° or 3200° F. and higher, say 4500° F., is less critical provided the rate of heating just described up to about 2000° F. is maintained. If desired for any reason, however, this controlled rate of heating may be established from the entry of the kiln to the full dead burning zone temperature. In this way we avoid objectionable spalling and fines production and the interference with kiln operation attendant thereon.

Control of the thermal gradient is achieved readily, as those familiar with such operations will recognize, by the amount and type of fuel which determines the length and temperature of the dead burning zone, the feed rate, and the amount of excess air passed upwardly into the kiln from the bottom region.

Dead burned magnesia produced in accordance with this invention is particularly suited to the production of basic refractories, especially bricks and other shapes of high density and low apparent porosity as desired by refractory uses.

In similar fashion, and applying the same parameters, the invention is applicable likewise to the production of high quality refractory grain by the burning of dolomite or lime or mixtures thereof as well as mixtures of magnesia with dolomite or lime. As an example, a grain of, by weight, about 90 percent MgO, remainder CaO, gives excellent service in the oxygen converter when tar bonded into brick.

According to the provisions of the patent statutes, we have explained the principle of our invention and have described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the inven-

tion may be practiced otherwise than as specifically described.

We claim:

1. That method of making dead burned basic refractory grain comprising the steps of:

(1) continuously passing a charge of briquettes of at least one material of the group consisting of magnesia, dolomite and lime into the upper end of a vertical shaft kiln for movement to the lower end of the kiln;

(2) supplying sufficient heat at an intermediate zone of the kiln to heat the briquettes in that zone to a dead burning temperature of at least about 3000° F.;

(3) passing air upwardly through a lower portion of the kiln countercurrent to the downwardly moving charge of briquettes;

(4) controlling the air flow so the downwardly moving briquettes, from their entry to the kiln until they reach a temperature of about 2000° F. are heated at a rate not exceeding about 200° F. per minute;

(5) subsequently subjecting the 2000° F. briquettes to dead burning; and

(6) continuously withdrawing dead burned briquettes from the lower end of the kiln.

2. A method according to claim 1, the briquettes being heated at about 75° to 100° F. per minute until they reach a temperature of about 2000° F.

3. A method according to claim 1, said heating rate being maintained up to said intermediate zone.

4. A method according to claim 1, said material being magnesia.

5. A method according to claim 4, the magnesia briquettes being heated at about 75° to 100° F. per minute until they reach a temperature of about 2000° F.

6. In methods of dead burning material selected from the group consisting of magnesia, dolomite and lime, in a vertical shaft kiln, in which a charge of selected material is passed downwardly through the kiln in countercurrent flow to upwardly moving gases, and in which the dead burning is carried out in a zone intermediate the ends of the kiln, the improvement which comprises maintaining the heating rate of the charge from its point of entry to the kiln until it reaches a temperature of about 2000° F. at less than about 200° F. per minute, whereby excessive formation of fines in the kiln is avoided.

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