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BINDER ADDITIVE FOR MAKING ORE PELLETS

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In various metallurgical operations ore may be encountered in a very finely divided condition either because it occurs naturally in this condition or because it may have been reduced to this condition for the purposes of beneficiation. Typical of the latter is the situation in which taconite, a very low-grade iron-containing rock, is reduced to a finely divided condition and then subjected to a beneficiation procedure in order to concentrate the iron and to make available an ore of the required richness for conventional blast furnace operation.

In the further processing of such finely divided ores it may be necessary to agglomerate the finely divided particles into sinters, briquets or pellets. This is particularly true in the case of taconite since the enriched taconite ore is conventionally reduced to iron in a typical blast furnace. Unless the taconite is converted into pellets the finely divided ore presents many dust problems in handling and may be blown out of the furnace by the blast of air and combustion products sweeping up through the blast furnace. In other metallurgical operations on other ores similar difficulties may be presented which make it desirable to have the ore present in the form of pellets even though in its preceding processing it may have been in a very finely divided form.

While the invention is applicable to any finely divided ore, for purposes of illustration it will be described with reference to taconite. In taconite processing the finely divided ore is converted into pellets which are almost spherical and have a diameter varying from ½ to 1 inch or more. These pellets are formed by rolling wet taconite in balling drums and then sintering in a furnace. During the sintering operation the pellets dry out, become weaker and may crush by the weight of the pellets above them. These crushed pellets produce dust which is very undesirable. Some attempts have been made to reduce the dusting problem by inclusion of certain binders such as bentonite and gelatinized starch products which increase the crushing strength of the pellets so that dusting is less of a problem. We have discovered an improved binder which makes possible the production of improved metallic ore pellets at reduced cost. It is, therefore, an object of the present invention to provide an improved binder additive for making metallic ore pellets.

The improved binder additive of the present invention is composed of alkaline soybean meal in combination with a small amount of bentonite. The soybean meal employed may be the ordinary soybean meal of commerce which is subjected to a toasting operation as a final step in the processing. Preferably, however, the soybean meal is employed in the untoasted condition inasmuch as it is more effective in this form. The soybean meal is employed with some alkaline material such as sodium or potassium hydroxides or carbonates, or other alkaline material. The preferred material is sodium carbonate employed in a quantity of from 4 to 30 parts by weight per 100 parts by weight of soybean meal. The other alkaline materials should be employed in a quantity to give acomparable alkalinity.

As little as 0.03% of the alkaline soybean meal based on the weight of the pellets increases the dry strength of iron pellets materially and generally it is not necessary to employ more than 0.1% of the alkaline soybean meal for this purpose. Larger quantities of the soybean meal do not appear to present any advantage over the 0.1%. In combination with the soybean meal from 0.2 to 0.5% of bentonite is employed. When these materials are used together the dry strength of the iron pellets increases from 30 to 100% as compared with pellets containing a comparable amount of bentonite but no soybean meal.

The binder may be prepared and sold as such in the form of a composition containing the bentonite and the alkaline soybean meal. In such a composition from 65 to 95% may be bentonite and the balance the alkaline soybean meal. The relative proportion of the alkaline material employed relative to the soybean material may be as described previously.

Example

Iron concentrate from magnetic taconite ore was dried in an oven at 100° C. until most of the moisture was removed. This permits the ore to be readily sifted through a 65 mesh screen. The dry ore (−65 mesh) was then blended with the dry additives in a mixing machine for 30 minutes. Two thousand gram aliquots of the mix were then placed in a large bowl of a food mixer and mixed with sufficient water to bring the moisture content up to 8%.

The taconite pellets were made from the moist iron ore by rolling in a 12 inch drum, rotated at 56 R. P. M. or 176 lineal feet per minute. First a handful of ore was rolled until "seeds" or small pellets were formed. A spray of water was used to aid the growth of these seeds. The contents of the drum were then removed and screened over a 20 mesh screen, the particles larger than 20 mesh being returned to the drum, sprayed and rolled with more ore. Periodically the balls are screened and sized over successively larger screens until all of the balls were uniformly larger than ¾ of an inch. This required from 60 to 120 minutes with an average of about 80 minutes. From each batch 40 balls were selected for testing, 20 being dried at temperatures up to 120° C. and 20 more being placed in a closed container for testing of wet or green strength.

The balls were tested for crushing strength with a Thwing-Albert tester. This instrument crushes the balls at a uniform rate and automatically measures the load at which the break occurred. The average of the 20 tests was taken as the crushing strength. Variations were found in the individual balls since there are variations in the degree of rolling and the quantity of water picked up by the individual balls. The results obtained by the use of a variety of additives are shown in the following table:

Percent bentonite	Other Additives	Wet	Dry
0	0	4.1	2.8
0.5	0		14.6
0.3	0	7.5	13.9
0.2	0	6.7	7.2
0	0.1% Soymeal and Na_2CO_3	6.1	8.6
0.5	0.1% Soymeal and Na_2CO_3	7.1	27.3
0.5	0.05% Soymeal and Na_2CO_3	8.1	30.3
0.3	0.03% Soymeal and Na_2CO_3	7.3	20.6
0.2	0.02% Soymeal and Na_2CO_3	6.7	9.8
0.3	0.01% Na_2CO_3	6.7	10.1

The table shows that the inclusion of a small amount of the soybean meal with the bentonite materially improves the strength of the pellets. Furthermore in order to obtain a pellet of comparable strength to one obtained where bentonite is used alone it is possible to lower the quantity of bentonite such that the total cost of the addi-

tive is less. It is thus possible to effect a savings in the total quantity of additive and obtain a comparable strength. Moreover, in the event that it is desired to obtain a pellet of very high strength it is apparent that the present invention also makes this possible. In general, however, dry strengths of 8 to 10 pounds appear to be satisfactory for taconite operations.

Now, therefore, we claim:

1. A mineral ore pellet composed of an agglomerate of finely divided ore particles held together by a binder in which the binder includes from 0.03 to 0.1% of alkaline soybean meal and from 0.2 to 0.5% of bentonite.

2. A taconite pellet comprising finely divided taconite particles held together with a binder which includes from 0.2 to 0.5% bentonite and from 0.03 to 0.1% of alkaline soybean meal.

3. A binder for mineral ore pellets comprising from 65 to 95% bentonite and from 5 to 35% alkaline soybean meal.

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