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FURTHER INVESTIGATIONS INTO THE USE OF IRON SINTER SUPPLIED BY NORANDA MINES LTD. AS A COLOURING MATERIAL IN BUILDING BRICK

by

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INTRODUCTION

Canada Brick Co. Ltd. have been attempting to use two types of waste iron sinter from Noranda Mines Ltd. as a means of producing a deeper red colour in their building brick. The first problem encountered was that scumming of the brick occurred on firing, thus masking any effect the iron sinters might have on the colour of the fired product. The prevention of scum formation by additions of barium carbonate is described in I.M. Report No. 464. It was also found that although the interiors of the briquettes made with additions of iron sinter were a darker red than those which had not been treated, a very slight scum formation on the surface of the treated briquettes made them appear to be even paler in colour than the untreated specimens. The scum formation is probably due to the calcium carbonate content of the clay and the residual sulphur in the pyrite sinter. As the briquettes are fired sulphur will be driven off to form sulphur trioxide in the oxidising atmosphere of the kiln, this in turn will react with the calcium carbonate in the surface layers of the brick to form calcium sulphate which appears as a white scum. The assumption that the oxidising kiln-atmosphere has something to do with the scum formation is borne out by the fact that when fired in a reducing atmosphere little scum is observed on the briquettes.

Experiments to produce favourable colour changes in fired brick by the addition of iron oxide have been conducted in the past. There have been few satisfactory results and the main reason for the colouring inertness has been attributed to the fact that the oxide was not in a sufficiently fine state of subdivision. The deep red colour of brick is thought to be due to the formation of iron silicates and other complex iron compounds as well as the presence of ferric oxide itself. In the case of natural red-burning clays, the iron is originally present as fine grained, widely-dispersed iron minerals such as limonite, siderite, and pyrite, or it may even be part of the clay minerals themselves. On firing, these minerals break down, and in an oxidising atmosphere ferric oxide is formed. The oxide at this time is in an extremely fine state of subdivision, very susceptible to chemical attack, and it is believed that complex iron silicates and other compounds are formed which enhance the deep red colour.

In the case of shales containing calcium carbonate, this mineral breaks down to lime during firing and reacts with iron oxide forming white compounds called ferrites. The effect of this reaction is not only to remove red ferric oxide from the system, but also to substitute for it a white compound, thus intensifying the bleaching action of the lime.

From the above considerations it was decided to experiment further with the iron sinters and determine what effect fine grinding would have upon their colouring properties.

PROCEDURE AND RESULTS

Water absorption (24 hr. soak) and shrinkage measurements were made on the fired briquettes (cone 03) which had been prepared from Queenston shale and 0, 5 and 10% additions of the two types of iron sinter. The results showed that, for specimens fired in an oxidising atmosphere, the additions of the iron sinters increased the porosity and decreased the shrinkage of the briquettes. The sinters in the form received acted as 'grog'.

In a reducing atmosphere the sinters acted as fluxes, reducing the porosity and increasing the fired shrinkage.

From earlier experiments it has been established that the black iron sinter requires 2% by wt. of barium carbonate and the red type requires 5%, in order to prevent scum formation. Consequently batches of the two sinters were ball-milled for periods of 5, 10, and 20 hrs. with the requisite amount of barium carbonate. Mixtures of the millings and the Queenston shale, supplied by Canada Brick Co., were made into briquettes and fired in a globar kiln to cone 03.

Observations are recorded in Tables 1 and 2. Specimens composed of the Queenston Shale alone were included with each firing for comparison purposes.

CONCLUSIONS

1. The addition of red iron sinter caused more colouring effect than addition of the black material, but the specimens tended to have a slight drying scum.
2. The finer the grinding the more the colouring effect observed.
3. The colours produced by the iron sinter additions and an oxidising firing atmosphere were dull and tended toward a purple hue.
4. With increasing fineness of sinter additions the percentage water absorption of the specimens at first increased then decreased. This indicates that the coarse sinter acts mainly as inert 'grog' in the briquettes, while the finer material is beginning to act as a flux and is entering into chemical action with the constituents of the shale.

Table 1 Colouring Effect of the Ground Black Iron Sinter

Hrs. milled	% Sinter	No.	Observations	% Abs. (24 hr. soak)
Shale alone		G0	Hard - medium red colour	5.2
5	10	G1	Hard - lighter than G0	7.7
	25	G2	Hard - Darker, duller red than G0	7.1
10	10	G3	Hard - Darker, duller red than G1 and G0	6.7
	25	G4	Hard - Darker than all previous specimens, dull purple tinge	8.1
20	10	G5	Hard - Darker red than G3. (Dull)	7.8
	25	G6	Hard - Darker red than previous, more pronounce purple tinge	6.9

Table 2 Colouring Effect of the Ground Red Iron Sinter

Hrs. Milled	% Sinter	No.	Observations	% Abs. (24 hr. soak)
Shale alone		G7	medium red	7.5
5	10	G8	Darker than G7	8.6
	25	G9	Darker with purple tinge	9.9
10	10	G10	Darker than G8	7.5
	25	G11	More purple than G9	7.9
20	10	G12	Red slight purple	6.9
	25	G13	Dark maroon colour	5.8

All specimens were hard

The source of the scum on the fired brick is obviously the residual sulphur in the added iron sinters. In this respect the black iron sinter is superior to the red in that the scum formation is not as great. The effect can be remedied by additions of barium carbonate to the sinters prior to treating the shale.

The lack of colouring effect of the sinter additions to the shale may be due to a combination of reasons including, the large particle size, the chemical inertness of the material at the firing temperatures and the initial dull colours of the sinters.

Fine grinding enhances the colouring effects of the sinters but the resulting shades are dull and uninteresting.

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