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MINES BRANCH INVESTIGATION REPORT IR 58-106

INVESTIGATION TO PRODUCE A COATED LIGHTWEIGHT
AGGREGATE FROM EXPANDED SLAG SAMPLE SUBMITTED
BY NATIONAL SLAG LIMITED, HAMILTON, ONTARIO.

by

H. S. Wilson
Industrial Minerals Division

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COATING EXPANDED SLAG

LIGHTWEIGHT AGGREGATE

Introduction

The tests described here were made to determine if a coating could be applied to an expanded slag lightweight aggregate. Expanded slag is quite porous and makes a harsh plastic concrete. If the aggregate was coated, the porosity and harshness could be reduced. The coating would have to be permanent, so that it would not be removed when the aggregate is mixed with cement and water in the preparation of concrete.

The expanded slag used in these tests was produced by National Slag Limited, Hamilton, Ontario. Coarse slag, minus 3/8 inch plus 4 mesh was used. It had a unit weight of 40.2 pounds per cubic foot.

Scope of Investigation

Two methods of coating the expanded slag aggregate were considered; (1) heating to fusion of the aggregate, and (2) the use of a coating material which after application on a wet surface of the aggregate could be fused by heating. The first method was not considered a practical approach by laboratory methods available, so that only the second method was pursued further. A number of materials were used in the coating experiments and trial runs were made in both stationary and rotary kilns. The products obtained were evaluated in terms of hardness of the coating, unit weight, and absorption.

Procedure

A. Coating.

This phase of the work was done in a small cement mixer. Batches of the aggregate weighing approximately two pounds were dampened and the coating material sprinkled on the aggregate as the mixer revolved. The wetting and coating were continued alternately until a sufficient coating was built up so that the majority of the exposed voids in the aggregate were covered. The following materials were used as coating:

1. Clay (57-8B) used by Booth Brick Ltd., Weston, Ont.
2. Clay (57-19) from deposit about 2 miles west of Cappison Corners, Ont.
3. Fly ash from Ontario Hydro.
4. Limestone.
5. Silt from Steep Rock Lake, Ont.
6. Nepheline Syenite, pottery grade.
7. Hydrated lime.

A binder was used with the fly ash and nepheline syenite. It was an eight per cent solution of waste sulphite liquor, which is a by-product of the paper industry. This solution was used to dampen the aggregate. With the other coating materials only water was used.

B. Preliminary Firing

These coatings were only mechanically bonded to the aggregate. To develop a permanent chemical bond, it was necessary

to heat the coated aggregates until some fusion of the coating occurred.

Small portions of each coated aggregate were fired in a small stationary, gas-fired kiln. A retention time of 12 minutes was used at various temperatures to determine how much heat would be needed to develop a permanent bond. The results of these tests are shown in Table 1.

TABLE 1.
Preliminary Firing Tests

Coating	Temperature	Condition of Coating
Clay 57-8B	2000°	not steel hard
	2100°	steel hard
	2200°	severe agglomeration
Clay 57-19	2000°	not steel hard
	2100°	slight agglomeration
	2200°	severe agglomeration
Fly ash	2000°	not steel hard
	2100°	slight agglomeration
	2200°	severe agglomeration
Limestone	2000°	poor adherence
	2100°	soft
	2200°	not steel hard
Steep Rock Silt	2300°	not steel hard
	2000°	nearly steel hard
	2100°	slight agglomeration
Nepheline Syenite	2200°	severe agglomeration
	2000°	not steel hard
	2100°	steel hard
Hydrated Lime	2150°	steel hard
	2200°	moderate agglomeration
	2250°	severe agglomeration
	2000°	soft, poor adherence
	2100°	soft, poor adherence
	2200°	soft, poor adherence
	2300°	soft, poor adherence
	2400°	not steel hard, poor coverage

C. Rotary Kiln Firing

All the materials tested, with the exception of hydrated lime appeared to form to a good coating. Consequently, the other six materials were fired in a 5-foot by 5-inch, propane-fired rotary kiln. The temperature used in each case was chosen from the preliminary firing tests. The time of passage of each batch through the kiln was approximately six minutes. The unit weight, absorption of each product were measured to compare with the uncoated aggregate. Firing temperature and results are shown in Table II.

TABLE II
Rotary Kiln Tests

Coating	Temp. (°F)	Condition of Coating	Colour	Unit Weight (lb/cu.ft.)	Absorption* (%)
Clay 57-8B	2050-2100	steel hard	buff	45.5	19.5
Clay 57-19	2075-2130	part not steel hard	light brown	46.7	17.9
Fly ash	2090-2130	part not steel hard	brown to blue-black	44.1	21.2
Limestone	2225-2275	not steel hard	dark brown	46.4	24.0
Steep Rock Silt	2075-2100	part not steel hard	brown	46.9	19.5
Neph.Syenite	2110-2140	steel hard	grey-white	47.5	18.0
None	-	-	-	40.2	22.4

*

Based on 48 hour immersion in water.

All of the coatings appear permanent as soaking the aggregate in water had no effect; none of the coating came off.

Conclusions

It is possible to apply a permanent coating to coarse aggregate using relatively inexpensive material. Hydrated lime does not appear suitable as it did not adhere to the aggregate when subjected to heat. The absorption of the aggregate was not reduced to any great degree by applying the coating. The absorption of the limestone-coated aggregate was higher than the uncoated aggregate. The limestone coating had not been fired high enough to harden the limestone sufficiently to reduce the absorption of the coating. The temperature used was about the maximum for the kiln. The workability of aggregate should be considerably improved by the addition of the coating as the aggregate became fairly well rounded.



H. S. Wilson