



## OFFICE MEMORANDUM

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DATE: October 29, 1987

TO: C. J. Arnold  
Engineer of Research

FROM: R. W. Muethel, Geologist  
Petrography and Hydrology Group

SUBJECT: Development of Test for Calcium Carbonate Precipitation  
in Aggregate, Research Project 87 TI-1237  
Research Report No. R-1286

Inspections of prefabricated drainage system (PDS) installations have revealed calcium carbonate deposits plugging geotextile filters. The deposits have occurred in systems using steel furnace slag as open graded drainage course (OGDC). The findings resulted in a Departmental moratorium on the use of steel furnace slag in PDS installations. This project was established to develop a laboratory test to identify aggregates which would produce carbonate deposits in drainage installations.

### Development of the Test

Calcium carbonate deposits in drainage systems using open-hearth slag are described in a report by B. A. Ross<sup>1</sup>. The report also describes a process for neutralizing the slag by aeration with carbon dioxide gas to induce precipitation of the calcium carbonate. This process, which is similar to the natural process of carbonate precipitation in caves (and in the drainage system installations), was used as the basis for the laboratory test.

A laboratory procedure was developed in which a small amount of crushed aggregate is immersed in distilled water in a flat evaporating dish and then exposed to interaction with the carbon dioxide in room air for 24 hours. Lime-forming aggregates were found to readily produce calcium carbonate deposits on the surface of the prepared leachate.

The procedure for the test is as follows:

### Test to Identify Carbonate Precipitation from Aggregates

1. Prepare approximately 100 g of representative aggregate.
2. Using distilled water, rinse aggregate over a No. 200 sieve, then oven-dry.
3. Crush aggregate to passing No. 4, retaining all material.
4. Reduce sample to approximately 25 g, then place in a Petri dish.
5. Add distilled water to immerse aggregate.
6. Using pHDrion pH test paper, determine leachate pH.
7. Let sample stand exposed to room air for 24 hours.
8. Examine surface of leachate and aggregate for carbonate deposits.
9. Test deposits with hydrochloric acid. Carbonate will effervesce and dissolve.
10. Report results.

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<sup>1</sup>Ross, B. A., "Evaluation of Carbondioxide Treated Open-Hearth Slag as a Subbase Aggregate," Wayne County Road Commission Report, December 1970.

## REMARKS:

A high pH leachate and the presence of carbonate deposits indicate that an aggregate has a high potential for producing carbonate deposits.

Trial Tests

Selected aggregates including steel furnace slag, blast furnace slag, crushed portland cement concrete (PCC), crushed limestone, and crushed dolomite were tested using the laboratory procedure. The steel furnace slag and crushed concrete aggregates produced heavy carbonate deposits. No deposits formed from the blast furnace slags, limestone, or dolomite. The following tabulation includes the results of the tests:

## CARBONATE PRECIPITATION FROM AGGREGATES

Aggregate	Leachate pH	Results of Tests
Steel Furnace Slag A	11.5	Heavy Carbonate Deposit
Steel Furnace Slag B	11.0	Heavy Carbonate Deposit
Steel Furnace Slag C	11.5	Heavy Carbonate Deposit
Steel Furnace Slag D	11.5	Heavy Carbonate Deposit
Blast Furnace Slag A	5.0	No Carbonate Deposit
Blast Furnace Slag B	5.5	No Carbonate Deposit
Blast Furnace Slag C	5.0	No Carbonate Deposit
Blast Furnace Slag D	5.0	No Carbonate Deposit
PCC A (Gravel)	11.5	Heavy Carbonate Deposit
PCC B (Gravel)	11.0	Heavy Carbonate Deposit
PCC C (Gravel)	11.5	Heavy Carbonate Deposit
PCC D (Gravel)	10.5	Heavy Carbonate Deposit
PCC E (BF Slag)	11.5	Heavy Carbonate Deposit
Crushed Limestone	5.0	No Carbonate Deposit
Crushed Dolomite	5.0	No Carbonate Deposit

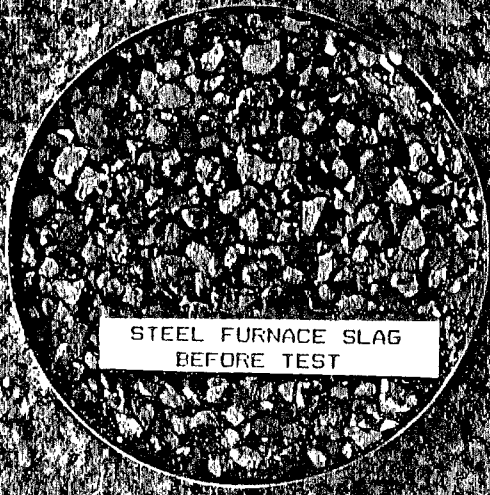
## REMARKS:

Leachate pH values are approximate as measured with pHyrion test strips. The distilled water for leachate preparation had a pH of 5.0.

Photographs of selected aggregates, before and after testing, are attached.

MATERIALS AND TECHNOLOGY DIVISION

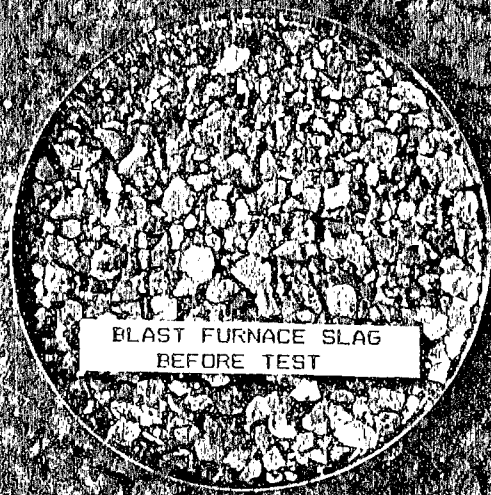
*R. W. Muttel*



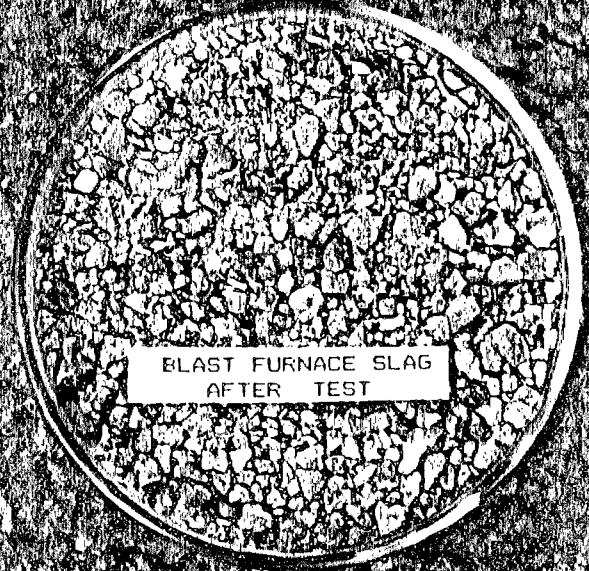
STEEL FURNACE SLAG  
BEFORE TEST



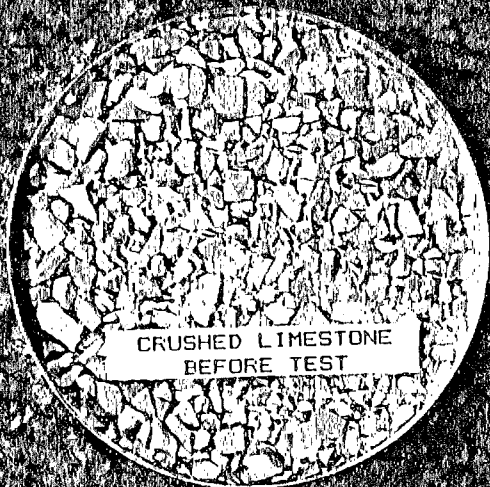
STEEL FURNACE SLAG  
AFTER TEST



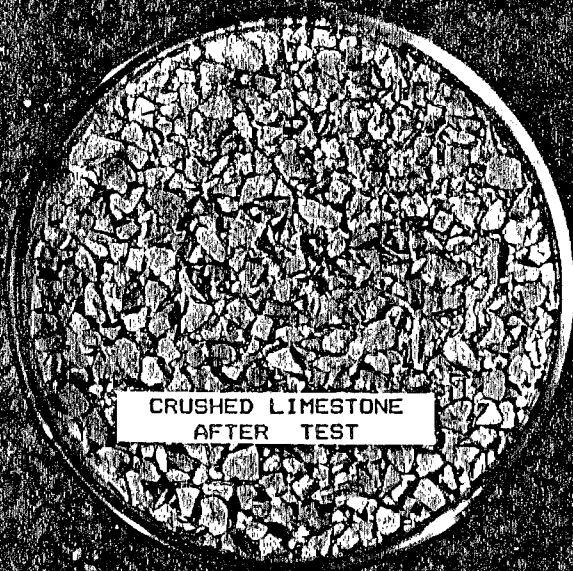
BLAST FURNACE SLAG  
BEFORE TEST



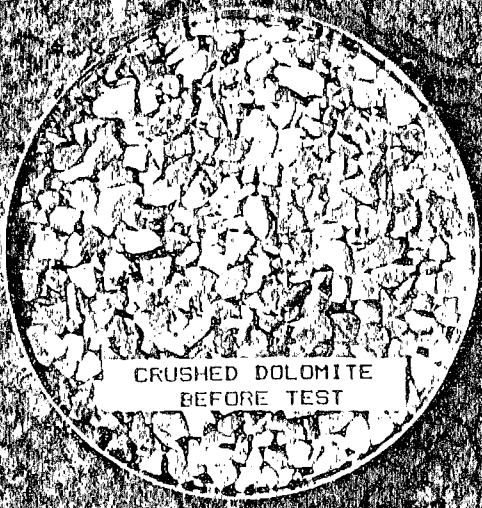
BLAST FURNACE SLAG  
AFTER TEST



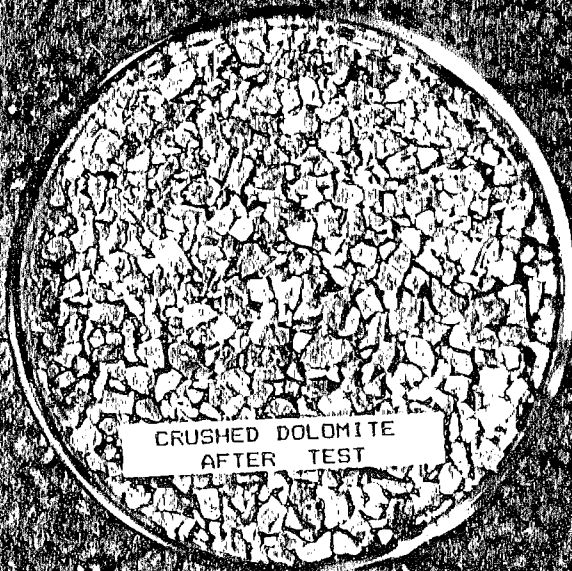
CRUSHED LIMESTONE  
BEFORE TEST



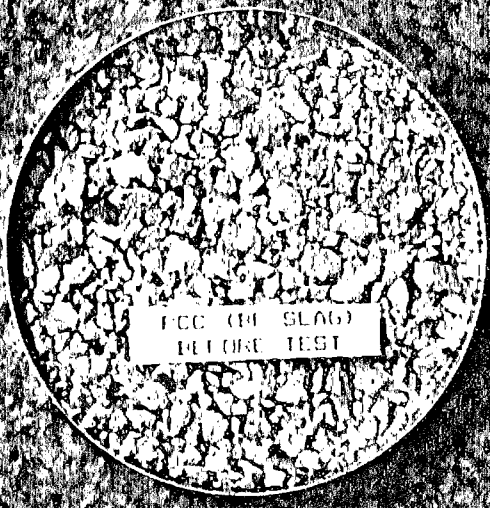
CRUSHED LIMESTONE  
AFTER TEST



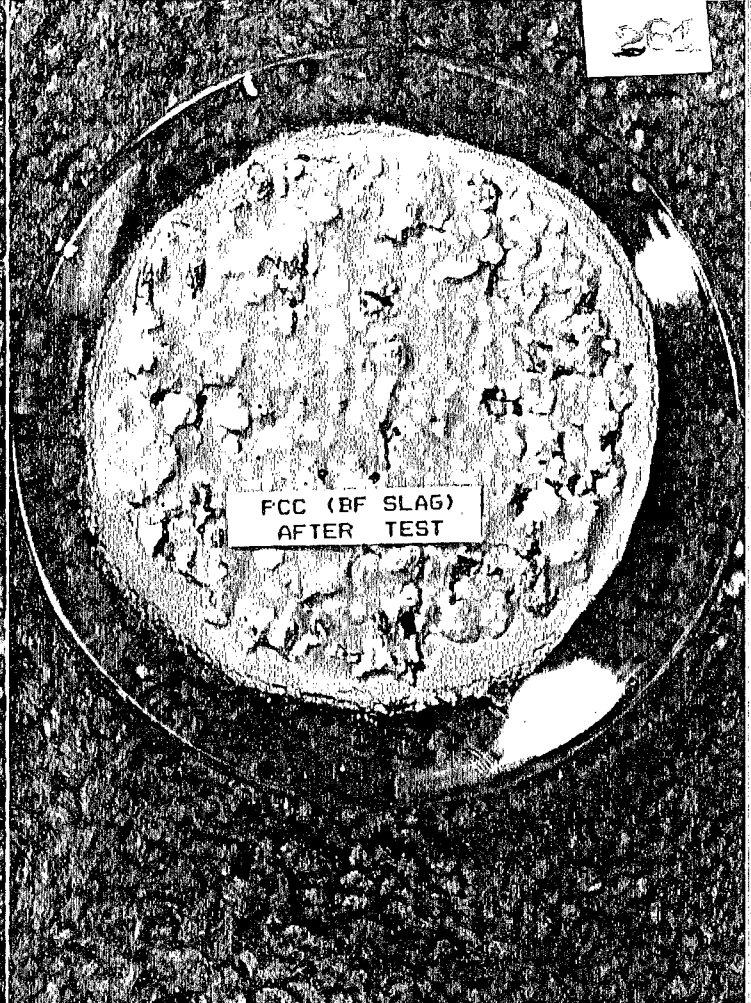
CRUSHED DOLOMITE  
BEFORE TEST



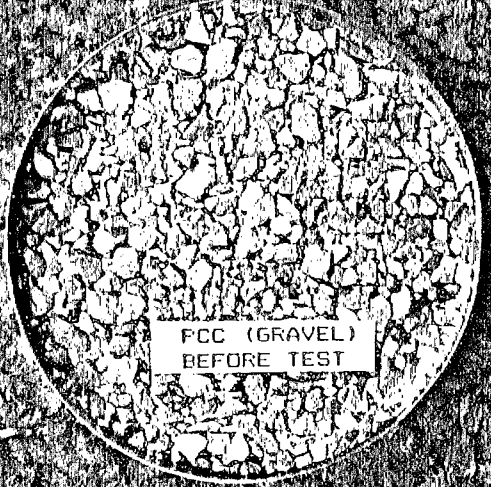
CRUSHED DOLOMITE  
AFTER TEST



FCC (BF SLAG)  
BEFORE TEST



FCC (BF SLAG)  
AFTER TEST



FCC (GRAVEL)  
BEFORE TEST



FCC (GRAVEL)  
AFTER TEST