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EXPERIENCE IN THE USE OF CARBON BLACK  
AS A COLOR PIGMENT IN CONCRETE PAVEMENT

by  
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A summary of an investigation pertaining to the  
use of Colored Concrete in Highway Construction

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## EXPERIENCE IN THE USE OF CARBON BLACK AS A COLOR PIGMENT IN CONCRETE PAVEMENT

Early in 1947 tests were begun in the Research Laboratory to determine the effect of black pigments on the durability of concrete. These tests supplemented observations of construction projects in which black colored concrete was used to facilitate traffic flow in the Willow Run industrial area during the war.

The results of these tests, as well as observation of concrete pavements constructed with black coloring materials, clearly indicate that emulsified carbon black, at least of the type and in the quantities used here, increased the tendency of the concrete to scale and decreased its resistance to freezing and thawing.

The deleterious effect of the emulsified carbon black is more pronounced in concretes made without air-entraining agents, but persists definitely even in air-entrained concrete. In the latter case we suspect that, in addition to other possible effects, emulsified carbon black inhibits the entrainment of sufficient air to produce durability. In a series of laboratory mixes for comparative durability tests we noticed that the drop in unit weight of the concrete produced by identical amounts of an air-entraining agent added to the batch was only 1-1/2 pounds per cubic foot for the mix containing emulsified carbon compared to 5 and 8 pounds for iron oxide black and no color respectively.

Both surface scaling and freezing and thawing tests were run on specimens of the above series. In the former, calcium chloride was used

to the ice on the surfaces of 10" x 10" x 5" concrete specimens, and in the latter 3" x 5" x 15" beams were frozen and thawed in plain tap water. These mixes contained 1-3/4 pounds of color per sack of cement and 5.5 sacks of cement per cubic yard of concrete. Specimens containing emulsified carbon black, with and without air-entraining agent, failed without exception in both tests long in advance of those made with iron oxide black and no color. The following is a brief summary of the laboratory freezing and thawing tests:

Mix	Without Air-Entraining Agent			With Air-Entraining Agent		
	Std. Concrete	Emulsified Carbon Black	Iron Oxide Black	Std. Concrete	Emulsified Carbon Black	Iron Oxide Black
Slump-in.	2	2-1/2	1-1/4	2	1-7/8	1-3/8
Unit Wt.	153	155.5	156	147	154	147
No Cycles	198	62	225	421	350	414

Surface scaling tests, in which calcium chloride was used to thaw the ice on concrete specimens, gave similar results. Durability tests of mortar cubes frozen and thawed in 10 per cent calcium chloride solution still further confirm these tests. Freezing and thawing in water of cores taken from concrete pavements placed with a surface course only containing emulsified black caused progressive disintegration and sloughing off of the colored cap long before any evidence of failure in the uncolored portion.

As mentioned previously, our experience in the field corroborates these results, air-entrained concrete made with emulsified carbon black showing a tendency to bleed and segregate more and entrain less air than those made either with no color or with the iron oxide pigments, and which

of course resulted in considerable scaling under the action of chloride salts used for ice control. On the basis of this experience with black coloring materials, the Department has not permitted the use of unactivated carbon black in any of its concrete structures since May, 1947.