

# OFFICE MEMORANDUM

R-648



MICHIGAN  
DEPARTMENT OF STATE HIGHWAYS

August 4, 1967

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To: L. T. Oehler, Director  
Research Laboratory Division

From: H. L. Patterson

**Subject:** Use of a Concrete Sealant on the High Level Bridge, I 75, Detroit (B01 of 82194G). Research Project 63 NM-96. Research Report No. R-648.

In relation to R. L. Greenman's oral request to you on July 17, 1967, concerning the application of concrete sealant on the deck of the High Level Bridge (B01 of 82194G), and the recommendation by C. J. Arnold (Research Report No. R-608), to use a preventive maintenance sealant on this bridge deck, the following information and conclusions are submitted.

At present, work is progressing on the evaluation of various sealants under Research Project 63 NM-96. One phase of the work, which is now complete, evaluated the sealant characteristics of several materials using linseed oil-naphtha as a reference. The materials evaluated were: clear and white "Euco" from the Euclid Chemical Co. of Detroit, Michigan (Containing "Parlon," a chlorinated rubber compound manufactured by the Hercules Corp.); "Epoxeal," a penetrating epoxy manufactured by Protective Products Corp. of Gulfport, Mississippi; and tung oil, as furnished by the Pan-American Tung Research and Development League of Hattiesburg, Mississippi. The tung oil was diluted 1:1 with a mineral spirit thinner and was packaged for use in that state. The linseed oil was diluted 1:1 with naphtha in the laboratory prior to application. Both tung oil and linseed oil sealants were applied in two coats; the first coat was applied at the rate of 300 sq ft per gal, and the second at 500 sq ft per gal. The other sealants were applied in a single coating at the rate of 200 sq ft per gal.

The concrete specimens used for evaluating the sealants were 9 by 12 by 2-1/2 in. scaling slabs with mortar dikes around their perimeter, 3 by 4 by 1 in. absorption blocks, and 3 by 4 by 1 in. "weatherometer" blocks. All concrete used was made with six sacks of Type I cement per cu yd, five and one-half gal of water per sack of cement, sand, and gravel aggregate, and no air-entraining admixtures. The top surface of the slabs and the entire surface of the blocks were coated with the sealants after a 14 day moist cure, and a seven day air cure, in the laboratory.

The scaling slabs were alternately filled one-quarter inch deep with fresh water and salt water (a three percent sodium chloride solution) to more closely simulate field conditions. The slabs were then frozen each night, thawed each day, and evaluated at the end of 15, 30, 45, and 60 cycles. The evaluations were made

by visual inspection where the degree of scaling was rated between "1" (no scaling) and "5" (severe scaling).

The absorption blocks were weighed prior to, and after, soaking in water for 6, 24, 48, 72, and 96 hours. The data was then reduced and the amount of water absorbed was calculated for each block. The weatherometer blocks were placed in the weatherometer (simulating sunshine and rain) for 15 cycles, evaluated, returned for 15 more cycles and evaluated again. The evaluation consisted of visual examination and the same absorption determination as described for the absorption blocks. The results of the first phase of this work are shown in the graphs and table.

The data from the unweathered absorption blocks (Fig. 1) indicated that the sealants providing the best initial protection against water penetration were, in the order of their effectiveness: linseed oil, white Euco, clear Euco, tung oil, and penetrating epoxy.

The weatherometer blocks were identical to the absorption blocks in physical dimensions and sealant coatings, but underwent 30 abusive cycles in the weatherometer. At the end of the testing it was obvious from their appearance that many of the sealants had suffered damage. The data obtained from soaking these blocks in water confirmed such damage and showed that the only sealants providing any protection against water penetration were linseed oil and tung oil (Fig. 2).

The data obtained from the scaling slabs (Table 1), after undergoing 45 freeze-thaw cycles, showed that the sealants providing the best protection from surface scaling were, in the order of their effectiveness: tung oil, linseed oil, penetrating epoxy, white Euco, and clear Euco. The scaling slabs also showed that the concrete sealants applied to cured concrete were much more effective in the prevention of scaling than were the same sealants when sprayed on fresh concrete. The clear and white Euco materials plus a regular white membrane compound only, were tried on fresh concrete. It was also theorized that the sealants, when applied to a sand-blasted surface, would secure better penetration and would thus provide better protection against scaling than the same sealants applied to the original cured surface. Therefore, the surfaces of series A and B scaling slabs were sand-blasted and will be compared with the surfaces of series C which were not sand-blasted. The scaling slabs are still undergoing tests and at present it is not conclusive whether or not the sand-blasted surface provides superior sealant protection.

This is an interim report and does not include all the types of sealants being considered for testing. Additional sealants to be included in the second phase of this study are as follows: 1) Clear and white "Tri Kote" from T. K. Products, Inc. of Minneapolis, Minnesota (Contains "Parlon," a chlorinated rubber com-

pound manufactured by the Hercules Corp. ); 2) "Guardkote 250," formulated by the H. B. Fuller Co. of Detroit, Michigan; 3) Epoxy polysulfide grout, formulated by Allied Materials of Detroit, Michigan; 4) "Iso-Flex," a polyurethane material formulated by the Harry S. Peterson Co. of Highland Park, Michigan; and 5) Linseed oil-naphtha. A complete report including data and evaluation of all materials tested will be written after the research has been completed.

Based on the results of the present data obtained from this research project, the sealants which would be most effective as a concrete sealant would be either tung oil or linseed oil. Tung oil, as delivered (diluted 1:1 with mineral spirits), is already in a prepared state and can be applied directly; linseed oil, of the boiled type, should be diluted 1:1 with naphtha before application. Both sealants should be applied to a dry concrete surface that has had at least two drying days since the last rain, and should be applied by brushing. The initial coverage should be 300 sq ft per gal and the second coverage, applied the next day, should be 500 sq ft per gal.

For the High Level Bridge, whose concrete deck was cured with a white membrane curing compound, it would be advisable to remove the curing compound with either a truck-mounted wire brush roller or sand-blasting equipment before applying any concrete sealant. The rippling condition that exists on the bridge deck surface, where the valleys or depressions are present over the bars of the top reinforcing steel, is not as bad for the application of the sealant as if the ridges or high points were over the bars. This is because the sealant will tend to collect in the valleys, thus insuring maximum sealant penetration over the reinforcing bars--the portion of the bridge deck most vulnerable to spalling.

OFFICE OF TESTING AND RESEARCH

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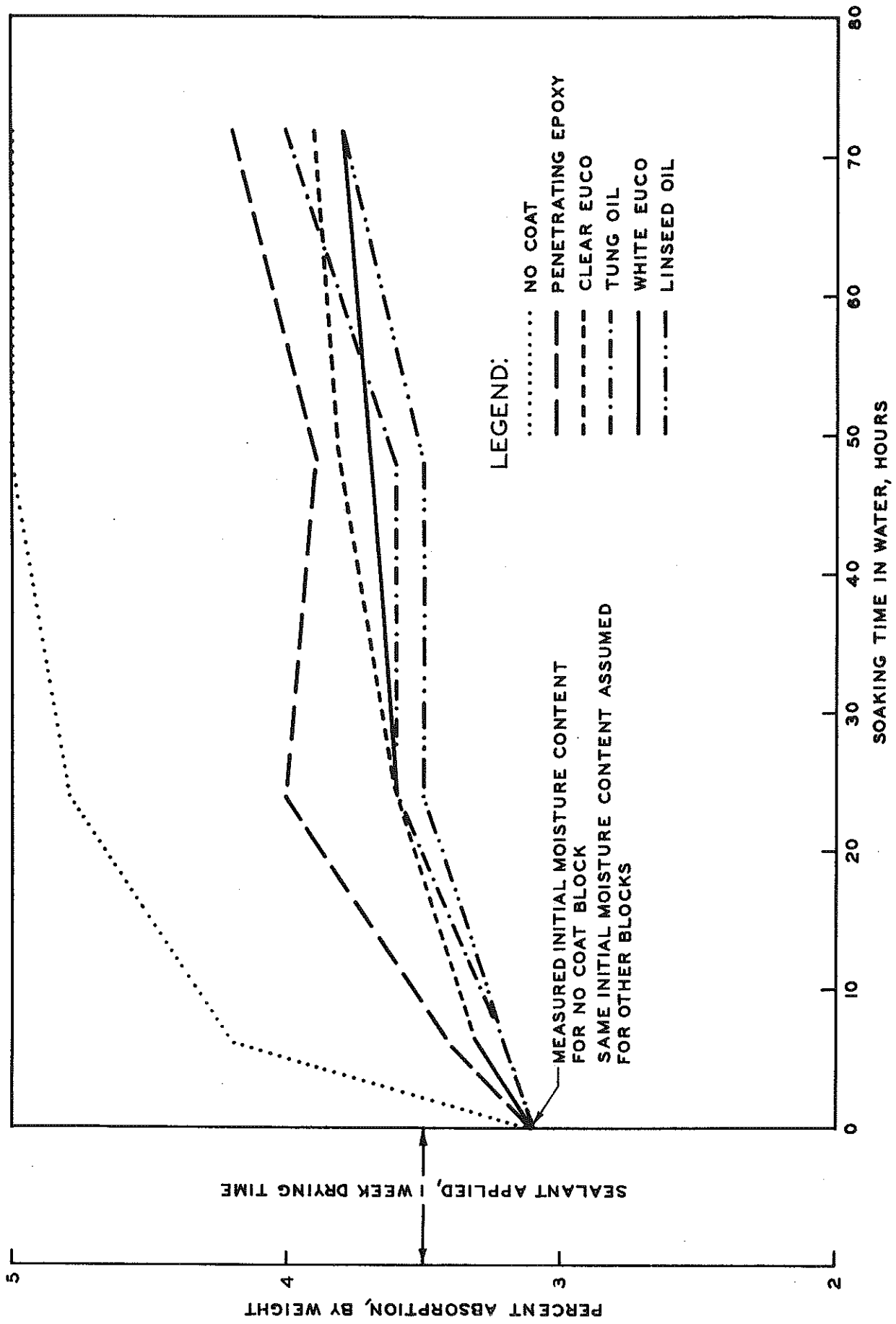


Figure 1. Absorption on treated and unweathered specimens.

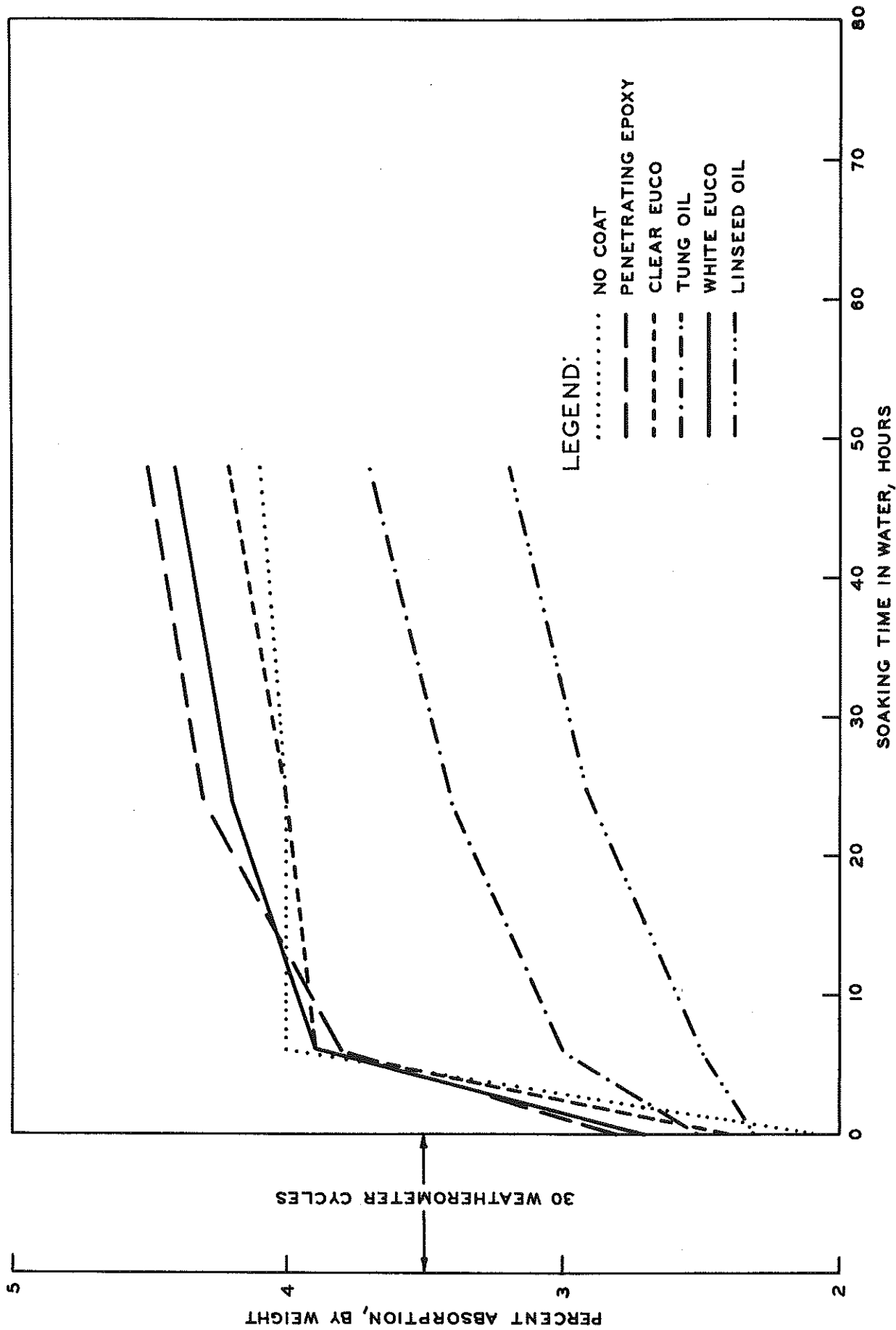


Figure 2. Absorption on treated and weathered specimens.

TABLE 1  
 SCALING SLAB RATINGS AFTER 45 FREEZE-THAW CYCLES

Rating Range  
 1 (no scale) through 5 (severe scale)

Scaling Slab Series	Linseed Oil-Naptha	Tung Oil-Mineral Spirits	Penetrating Epoxy	Clear Euco	White Euco	No Coat (Blank)
A	2	1	2	3	3	5 (15 cycles)
B	1	1	2	2	2	5 (15 cycles)
C	2	1	2	3	3	4
Average	<u>1.7</u>	<u>1</u>	<u>2</u>	<u>2.7</u>	<u>2.7</u>	<u>2.7</u>