MICHIGAN
STATE HIGHWAY DEPARTMENT
G. Donald Kennedy
State Highway Commissioner

PROGRESS REPORT

MEMBRANOUS CURING COMPOUND

By

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MICHIGAN
STATE HIGHWAY DEPARTMENT

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RESEARCH DIVISION
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MEMBRANOUS CURING COMPOUNDS FOR CONCRETE PAVEMENT SLABS

The use of membranous coatings has been used for curing concrete for some time. The term "membranous coating" implies any material that may be applied to a surface with the formation of a continuous, uniform coating or membrane. With reference to concrete curing, it usually means spraying liquid which, upon evaporation, leaves a more or less water-impervious residue.

Early use of this type of coating was limited to bituminous materials. The principle objections to its use have arisen from its undesirable appearance and from its tendency to promote excessive cracking in concrete as a result of its high heat absorption when exposed to sunlight.

The so-called clear membranous curing compounds have been used rather extensively for curing concrete. The advantages claimed for this type of material are:

1. It provides a satisfactory retention of moisture.
2. The excessive heat absorption is eliminated.
3. The concrete is maintained in its natural appearance.
4. It aids in securing a hard dense surface, free from hair checking and scaling.
5. The fact that no further attention is required after the membranous coating is applied is desirable on certain construction projects.

The most popular curing compounds have as their major solid ingredient, combinations of waxes, paraffin and vegetable oils or gum resins, cut with petroleum solvent. The three well-known proprietary membranous curing compounds being widely used today are; Aquastatic, Truscon and Rite-Cure.

Aquastatic

Aquastatic concrete curing compound is a red colored liquid having a specific gravity of 0.810 at 20°C as received. The red color matter is a fugitive dye which will fade within 24 hours after application and exposure to sunlight. The dye serves to insure proper application and inspection.

The solid ingredient in Aquastatic is a resinous matter which burns with a sooty flame and contains only 0.2 percent ash. It has a specific gravity of 0.975 at 20°C and melts at 110°C to a liquid with viscosity of a medium lubricating oil. At 20°C the film material is hard and brittle. There are approximately 40 percent non-volatile materials in the curing liquid. The solid ingredient settles out and must be stirred occasionally during application. Complete settlement requires 3 days. The turbidity does not change noticeably before 1 hour.

Aquastatic is manufactured by the Solvents and Plastics Company, Louisville, Kentucky. Prices quoted, effective as of March 9, 1942, are:

1 to 15 drums	-	$ 1.30	per gallon
15 to 30 drums	-	1.25	" "
30 to 45 drums	-	1.20	" "
45 to 60 drums	-	1.15	" "
Carloads	-	1.10	" "

Prices are f.o.b. Louisville, with the exception of the carload quantities which are delivered and are subject to terms of 1 percent 10 days, net 30 days.

Aquastatic is applied by spray or brush, upon completion of final finishing operations and immediately after disappearance of free surface moisture at a rate not to exceed 200 - 250 square feet per gallon of Aquastatic.

Truscon

Truscon curing compound is a red liquid having a specific gravity of 0.803 and containing 24.6 percent non-volatile material at 110°C. The non-volatile material is soft and waxy in character with a specific gravity of 0.902 and melts at 110°C to a liquid of the viscosity of a medium lubricating oil. The residue remains greasy to touch when applied to concrete surface. The non-volatile matter settles out upon standing and, therefore, must be agitated before application.

This material is manufactured by the Truscon Laboratories, Detroit, Michigan. They recently quoted a price of $1.00 pergallon in large quantities delivered in Michigan. They recommend the application by spray 300 to 400 square feet of area per gallon of material one application. The color fades upon exposure to sunlight.

We have been informed that they have changed their formula recently whereby the non-volatile material will be a resinous material instead of a wax. No data is available concerning this material since it is now under test by the company. The material is applied in the same manner as Aquastatic.

Rite-Cure

Rite-Cure is manufactured and marketed by the Johnson-March Corporation, 52 Vanderbilt Ave., New York City.

This compound is a green colored liquid with a specific gravity of 0.88 at 20°C and contains 45 percent non-volatile material at 110°C. The non-volatile residue has the consistency of hard bees wax and melts at 110°C to a clear liquid with the viscosity of a heavy lubricating oil. The solid material has a specific gravity of 1.015. The non-volatile material is completely soluble in the solvent and does not settle out upon standing.

Rite-Cure is applied in the same manner as the other curing materials at a recommended rate of 270 - 360 square feet coverage per gallon of liquid.

The latest price for Rite-Cure is $1.20 per gallon, f.o.b. Long Island in carload lots.

Laboratory Study

A comparative evaporation loss study has been made including the three materials discussed above. The results of this study as illustrated in the attached graphs show that these materials will perform their intended function of preventing moisture loss within the limitation generally prescribed for this kind of curing. 85 percent moisture retention in 7 days is the usual requirement for these materials.

These materials have been used widely throughout the United States for curing concrete structures and it seems only logical that in such times as these we should include membrane curing in our specifications.

I would suggest that we get an authorization to try out several types of these materials on a definite construction project for the purpose of studying

SOME RESULTS ON COMPARATIVE CURING STUDIES

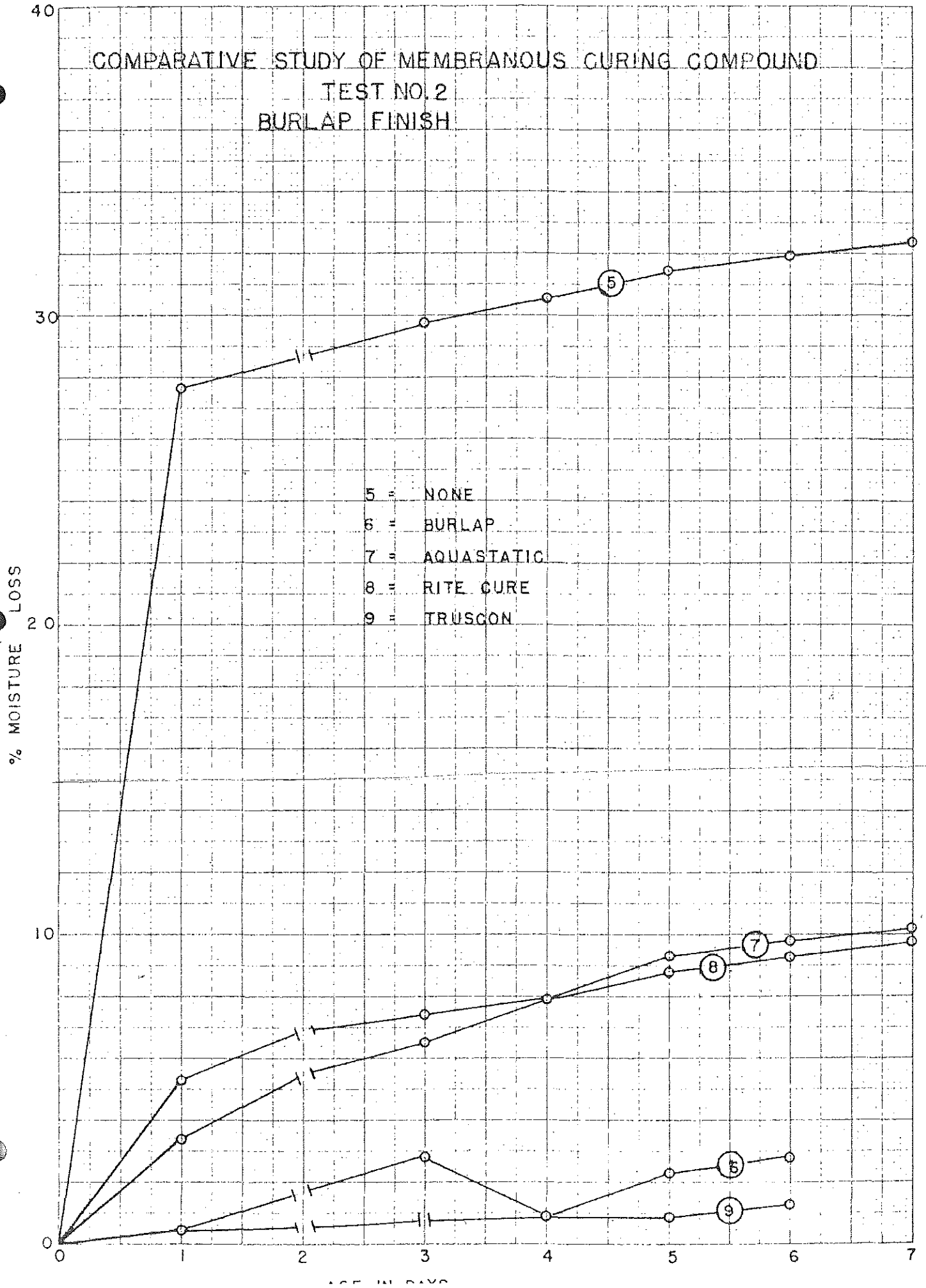
Series I - Trowel Finish

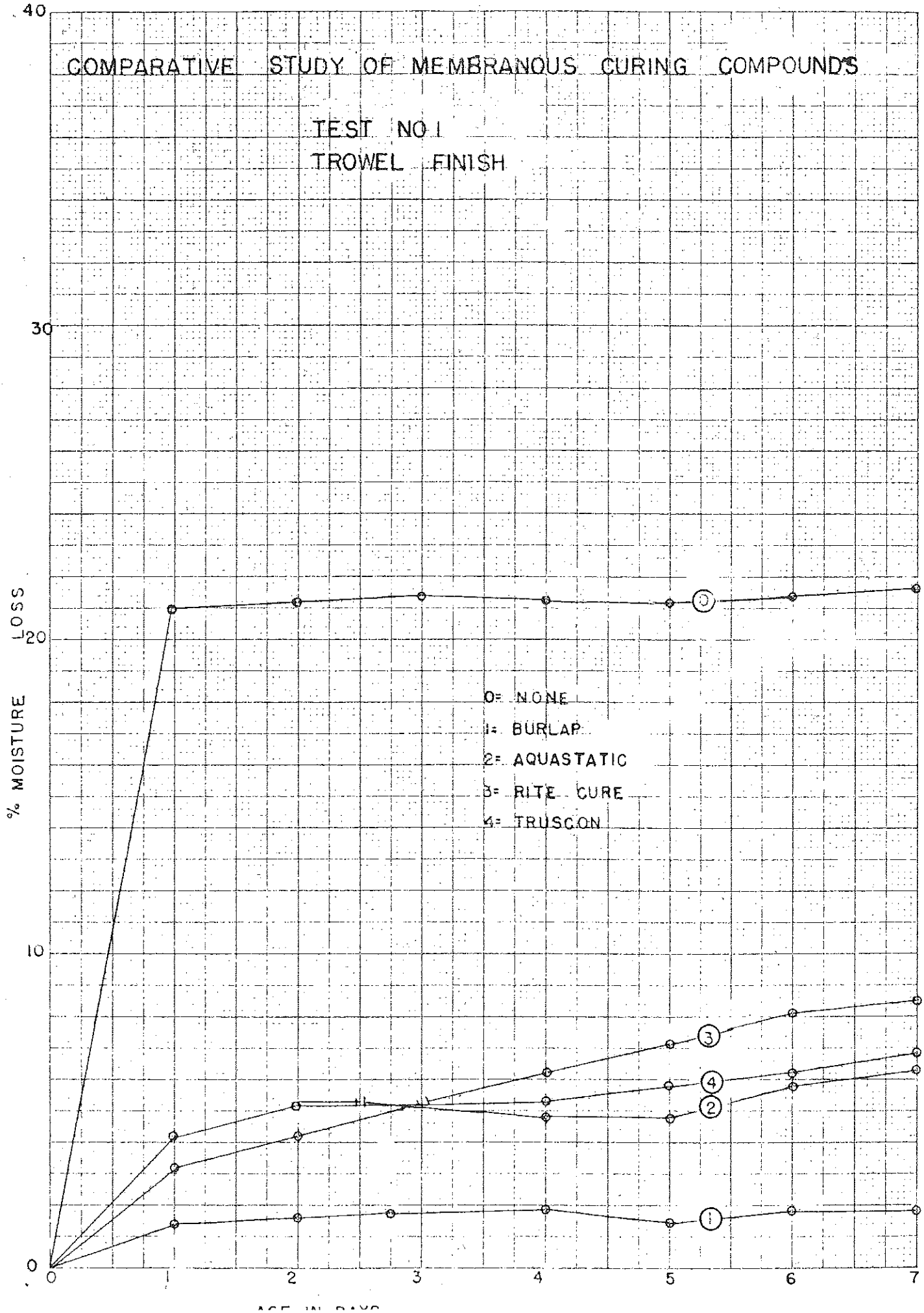
Type of Curing	Orig. Water Content, gm.	Water Loss in Percent of Original Water Content — Days Curing						
		1	2	3	4	5	6	7
Air	211.2	25	26	-	26	26	27	28
Aquastatic	208.9	4.3	5.3	-	4.8	4.8	5.8	6.3
Rite-Cure	211.0	3.3	4.3	-	6.2	7.1	8.1	8.5
Truscon	208.3	4.3	5.3	-	5.3	5.8	6.2	6.7

Series II - Burlap Finish

Air	215.8	27.3	-	29.7	30.6	31.5	31.9	32.4
Aquastatic	215.2	4.2	-	7.4	7.9	9.3	9.8	10.2
Rite-Cure	214.3	2.3	-	6.5	7.9	8.9	9.3	9.8
Truscon	216.5	0.5	-	-	-	0.9	1.3	1.3

15 percent loss is considered the maximum which should be permitted and still obtain desirable curing conditions.


COMPARATIVE STUDY OF MEMBRANOUS CURING COMPOUND
TEST NO. 2
BURLAP FINISH
5 = NONE
6 = BURLAP
7 = AQUASTATIC
8 = RITE CURE
9 = TRUSCON
% MOISTURE LOSS
AGE IN DAYS
0
10
20
30
40
0
1
2
3
4
5
6
7


COMPARATIVE STUDY OF MEMBRANOUS CURING COMPOUNDS
TEST NO 1
TROWEL FINISH
% MOISTURE LOSS
AGE IN DAYS
0= NONE
1= BURLAP
2= AQUASTATIC
3= RITE CURE
4= TRUSCON
0
10
20
30
40
1
2
3
4
5
6
7

these materials under actual field conditions in order that we may obtain additional data for use in developing a specification for this particular type of curing.

As a matter of interest, we are attaching a copy of the specifications for membrane curing of concrete surfaces as used by the Missouri State Highway Department. This specification seems to cover membranous curing thoroughly and no doubt would be applicable as is for the present.

SUPPLEMENTAL SPECIFICATIONS FOR MEMBRANE CURING OF CONCRETE PAVEMENT SURFACES

(Missouri - 1942 Specification)

Curing concrete pavement surfaces with membrane curing agents may be used only when specifically provided on the plans or in the proposal.

In addition to the requirement for concrete pavement in section 4.14 of the Standard Specifications, the following requirements shall apply:

Transparent Membrane Curing Material

Transparent membrane curing solution shall comply with the following requirements:

(a) It shall consist of a transparent blend of waxes and/or oils and/or resins held in solution in a volatile solvent and shall not settle out hard on continued standing. The solution shall form a membrane which will adhere to moist concrete. It shall become dry to touch within four hours when applied to the concrete under ordinary conditions and shall not be tacky nor track off of the concrete when walked upon, nor impart a slippery surface to the pavement. It shall be suitable for application under a pressure of not to exceed fifty (50) pounds per square inch at a minimum temperature of 40°F. and shall be sufficiently low in viscosity to result in an even uniform coating when applied by spraying.

(b) The solution shall contain not less than twenty-five (25) per cent by weight that is non-volatile at 105° C.

(c) The solution shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from that of the natural concrete at the conclusion of the curing period. The solution shall, however, contain a dye of color strength sufficient to render the film distinctly visible on the concrete for a period of at least four (4) hours after application.

(d) The curing solution shall be delivered to the job only in the manufacturer's original container which shall be marked with the manufacturer's name, trade name of the material, and lot number with which test samples may be correlated.

(e) Application and Moisture Retent. The transparent curing material when applied at the rate of not less than one gallon per two hundred (200) square feet on concrete specimens in accordance with the tests prescribed in A.S.T.M. Method C156-40T shall provide a film which will cause at least eighty-five (85) per cent of the original water used in the concrete mix to be retained at the end of seven (7) days.

Application of Membrane Curing Materials

After the concrete has been finally finished and the free water has left the surface, the entire area of the pavement surface shall be sealed by spraying thereon a uniform application of the transparent membrane curing solution. The solution shall be applied in one or two separate applications as may be recommended by the manufacturer and as directed by the

Engineer. If the solution is applied in two increments, the second application shall follow the first application within thirty (30) minutes.

The Contractor shall provide satisfactory equipment and means to properly control and assure the direct application of the curing solution on the pavement surface so as to result in a uniform coverage on the pavement at the rate of one (1) gallon for each two hundred (200) square feet of area.

Satisfactory equipment and means to control and apply the curing solution shall be construed as being whatever appliances and methods that are needed to prevent the loss of any of the solution during the application; also, an approved means of measuring the quantity to be applied.

If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the Contractor will be required to apply a new coat of material to the affected portions equal in curing value to that above specified. All areas cut by finishing tools, subsequent to the application of the curing solution shall immediately be given new applications at the rate specified above.

The Contractor shall provide on the job sufficient burlap for the protection of the pavement in case of rain or breakdown of the spray equipment. In the event that hair-checking develops before the transparent membrane can be applied, the procedure as set forth above shall be modified in that initial curing with wet burlap as specified in 4.14.03 (t) shall be performed before the transparent membrane is placed.

WAR DEPARTMENT OHIO RIVER DIVISION
(CINCINNATI TESTING LABORATORY) March 7, 1942

STANDARD SPECIFICATION FOR CONCRETE
FOR PAVING
(Highway or Airfield)

Membrane Curing

(d) Curing compound, if used, shall be Aquastatic (clear), as produced by Solvents and Plastics Co., Louisville, Kentucky, or approved equal. In the event that any other compound is proposed for use, it will be tested by the Government, and shall not under any circumstances be used until written notification has been given by the contracting officer that its performance equals or exceeds that of "Aquastatic (clear)." Samples consisting of at least one gallon, of any compound proposed for use, shall be sent directly to the Cincinnati Testing Laboratory, U.S. Engineer Office, Mariemont, Ohio, at least 30 days previous to the date upon which it is proposed to use the material.

(e) "Aquastatic (clear)", if used shall be uniformly sprayed, in a single coat, by approved pressure spraying equipment, on all concrete surfaces, at a rate not to exceed 200 square feet per gallon in place; as soon as all standing water has been removed from horizontal surfaces. If concrete surfaces have become dry, they shall be thoroughly moistened with water, immediately previous to application of the compound. When curing compound is used on surfaces to which new concrete is to be bonded, any compound remaining at the expiration of the curing period shall be carefully removed by sand blasting or the adequate use of steel wire brooms or brushes.

(f) In the event that the use of any compound other than "Aquastatic (clear)" is permitted, detailed specifications for its application based on laboratory tests, will be issued by the contracting officer.

(g) In freezing weather, concrete shall be maintained at or above 50°F. for at least the first five days of the curing period.