THE EFFECT OF CURING CONDITIONS ON THE TENSILE STRENGTH OF SUPER CEMENT MORTARS

THESIS FOR DEGREE OF B. S.

R. O. AVERY

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THESIS

The Effect of Curing Conditions on the Tensile Strength of Super Cement Mortars.

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by

R.O. Avery.

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Peerless Super Cement is made by the Peerless Portland Cement Co. at Union City, Mich. It is a discovery of an Englishinvestigator and was successfully used in Great Britian a number of years before its introduction into Canada in 1920.

Super Cement is merely a more efficient form of Portland Cement and is rendered so by the incorporation of a substance known as "Catacoll" during the manufacturing Process. Catacoll itself has no more cementing value than raw gypsum ordinarily used in the manufacture of Portland Cement, a portion of which Catacoll replaces. It occupies no greater volume and is anything but a water repellant. The strength and impermeability developed in Super Cement mortars are derived from the reactions which occur between the mixing water and the constituents of the clinker. The function which Catacoll accomplishes is to facilitate these reactions and thus insure that they will be more complete than in the case of Portland Cement.

Super Cement hydrates more thoroughly than Portland. Cement depends upon this property for its strength and density. Consequently, greater strength in bond, tension and compression can be expected from Super Cement mortars.

Super Cement is more efficient as a lubricant to the mix thus minimizing the tendency toward segregating in handling. As a result of this greater efficiency, Super Cement produces a concrete of sufficient density which is so impervious that no other means of water proofing is necessary.

Exactly the same machinery is used to powder Super Cement as is used for Portland, but the Super Cement seems

to be more finely ground. It has no initial set but produces a uniform set curve from cast to final set. The forgoing was taken from a bulletin published by the Peerless Cement Co.

In testing for the effects on the tensile strength of mortar produced by different methods of curing, a I:3 mix of normal consistiency was used. The normal consistiency of neat cement was 25% and of a I:3 mix, I5% of water by weight. The sand used was clean, sharp and dry, and passed a No. 20 sieve. The specimens were of the standard size adopted by the American Society of Testing Materials and were tested at the end of I,2,3,5,7,I4, and 28 days. Four briquettes were used for each test and the average strength of the four taken as the final result. If a specimen showed signs of weakness, i.e. poorly tamped etc. and the strength fell much below theaverage of the others, it was discarded.

Different methods of curing were obtained by varying the time that the specimens were left in dry air, moist air, and water and also by changing the briquettes from one medium to another at different ages of the curing. The standard method adopted by the A.S.T.M. is to place the specimens in moist air for the first 24 hours and the balance of the time in water. This method was varied by curing the first day in moist air and then changing to dry air the 2nd, 3rd, 4th and 5th, 6th and 7th, 2nd week and the last two weeks, testing the specimens at the above mentioned intervals. Also specimens were cured by placing in moist air, dry air, and water for the full 28 days. Modifications were also made from these by changing to other mediums at different ages of the curing.

The results obtained from the series of tests seem to be rather mystifying. It is a recognized fact that to expose Portland cement concrete to dry air is detrimental to the final strength of the concrete. This does not seem true for Super Cement mortars, unless the exposure to dry air is very prolonged. Exposure to dry air not only hastens the set of the mortar but actually seems to increase the final strength at the end of the 28 day period. It was found that the mortars could be exposed to dry air for the first 5 days and the rest of the time in water and no harm done. In fact, the strength at the end of 28 days was greater than that obtained by curing the standard way. The highest strength, tho, was obtained by curing the standard way for the first two weeks and then exposing to dry air the last two weeks. Curing the full 28 days in dry air gave practically no strength at all. the mortar almost crumbling at the touch.

The final strength of those cured the full 28 days in water was almost as much as those cured the standard way, but the set for the first few days was greatly retarded. Also, great care had to be exercised when placing the specimens in water or much of the mortar would wash away.

The conclusions arrived at thru the series of tests indicate that to get the strongest concrete, cure the standard way, i.e. keep the concrete as wet as possible for the first two weeks and then expose to dry air after that. Also great care must be exercised when placing Super Cement concrete under water or much of the fine mortar will wash out and the strength of the concrete will be greatly reduced.

The following is a table of the actual strengths as tested. The letters under the ages at which the specimens were tested denote how the specimen was cured from the precceding testing day to the one at which the test was made. For example, D under the second day means that the specimen was cured in dry air for the second day, or D under the 3rd day means that the specimen was cured in dry air the third day or from the 2nd testing period to the 3rd testing period etc.

Legend: D- dry air.

M- moist air.

W- water.

The numbers under the letters give the average strengths in pounds per square inch as tested.

Table of tested strengths.

	Age of specimen (days)					
I	2	3	5	7	I4	28
M -	W 60	W 90	W I40	W 2I0	W 240	W 260
M -	D 60	W I45	W? I85	W 200	W 220	W 260
M -	W 60	D I6C	W I85	W 200	W 250	W 295
M -	W 55	W 95	D 225	W 230	W 250	W 290
M -	W 60	W 85	W I50	D 220	W 255	W 275
M -	W 60	W 90	W I45	W 200	D 245	W 300
M -	W 65	W I00	W I50	W 2I5	W 250	D 400
D 50	D I00	D I20	D I30	D I30	D II0	D 80

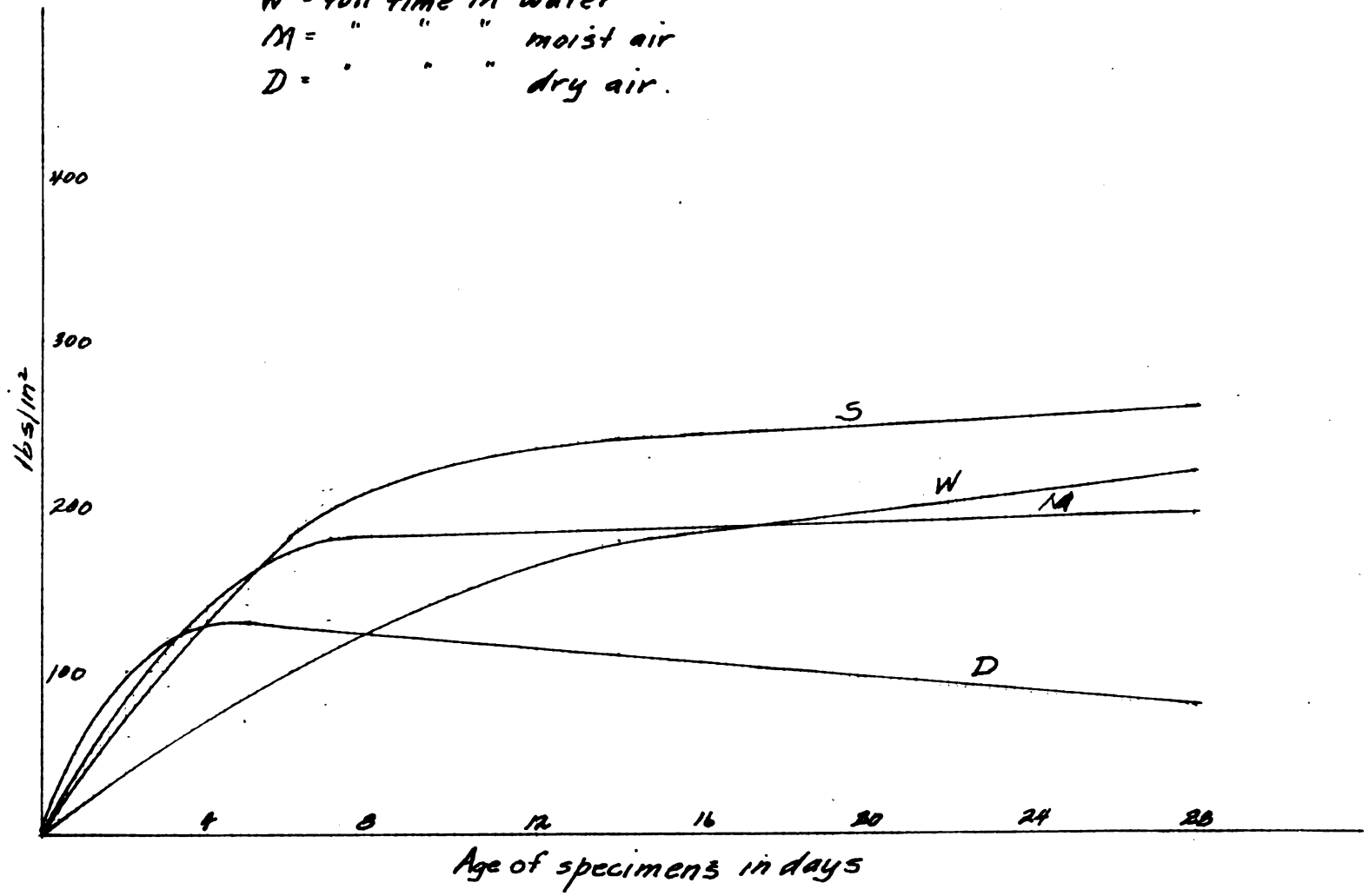
Table of tested strengths, continued.

Age of specimens (days)						
I	2	3	5	7	I4	28
M –	M 80	M 80	M I50	M I60	M I75	M I95
M –	M –	M –	M –	M –	M –	W I55
M –	M –	M –	M –	M –	W I60	W I70
M –	M –	M –	M –	W I80	W 200	W 220
M –	M –	M –	W II0	W I20	W I60	W 200
M –	M –	W 60	W 90	W I35	W I90	W 2I0
M –	M –	M –	M –	M –	M –	D 225
M –	M –	M –	M –	M –	D I90	D 2I0
M –	M –	M –	M –	D –	D –	D I85
M –	M –	M –	D –	D –	D –	D I60
M –	M –	D –	D –	D –	D –	D 95
W –	W –	W 40	W 70	W 80	W I80	W 220
W –	W –	M 40	W 65	W 65	W I40	W I90
W –	W –	D 40	D 70	D 55	D 65	D 90
W –	W –	M 40	M 70	M 80	M I75	M 2I0

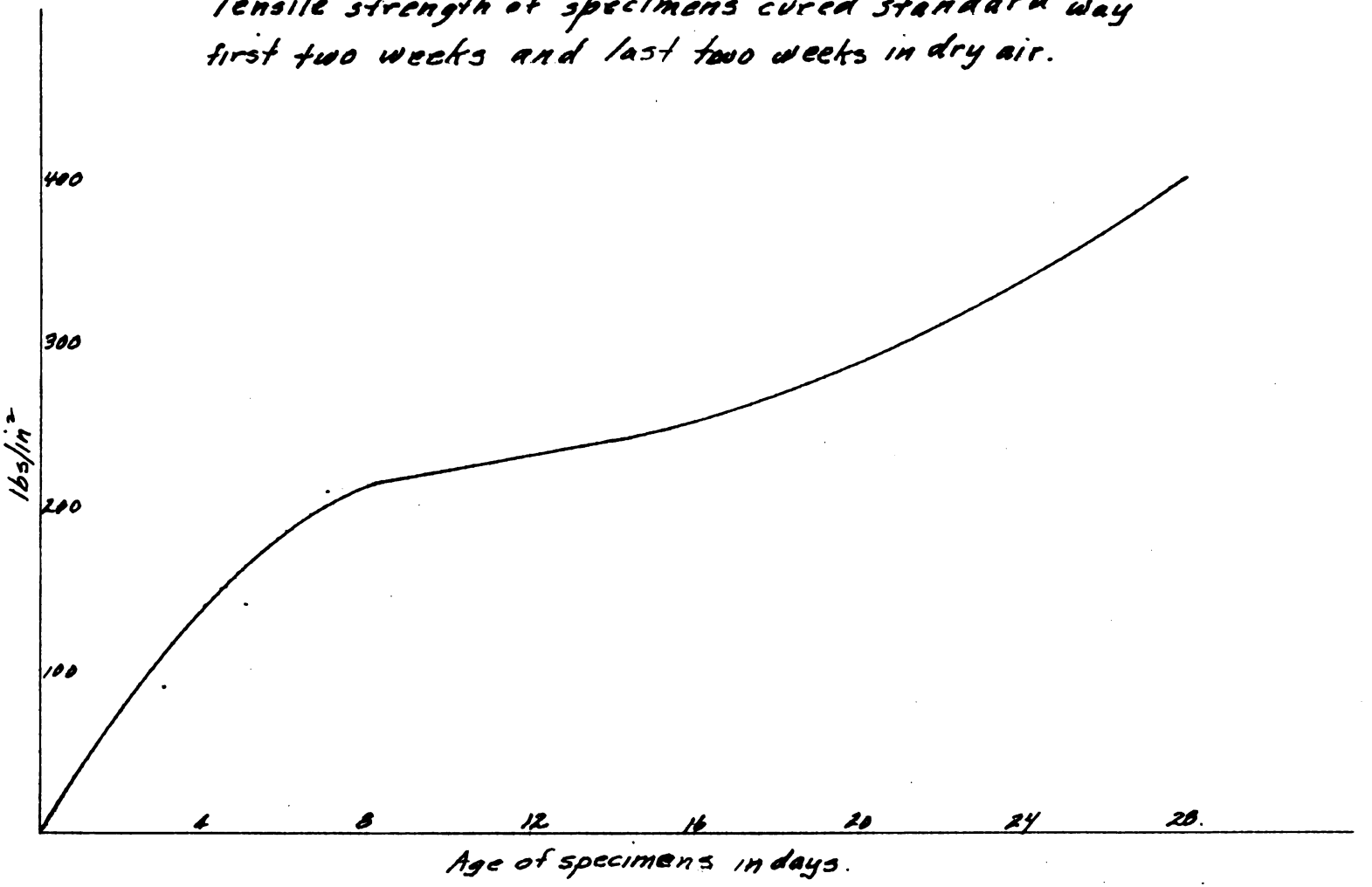
Table of tested strengths, continued.

Age of specimens (days)						
I	2	3	5	7	I4	28
M –	M 80	M 80	M I50	M I60	M I75	M I95
M –	M –	M –	M –	M –	M –	W I55
M –	M –	M –	M –	M –	M I60	W I70
M –	M –	M –	M –	M I60	M 200	M 220
M –	M –	M –	W II0	W I20	W I60	W 200
M –	M –	W 80	W 90	W I30	M I90	W 2I0
M –	M –	M –	M –	M –	M –	D 225
M –	M –	M –	M –	M –	D I30	D 2I0
M –	M –	M –	M –	D –	D –	D I85
M –	M –	M –	D –	D –	D –	D I60
M –	M –	D –	D –	D –	D –	D 95
W –	W –	W 40	W 70	W 80	W I80	W 220
W –	W –	M 40	W 65	W 65	W I40	W I90
W –	W –	D 40	D 70	D 55	D 65	D 90
W –	W –	M –	M 70	M 80	M I75	M 2I0

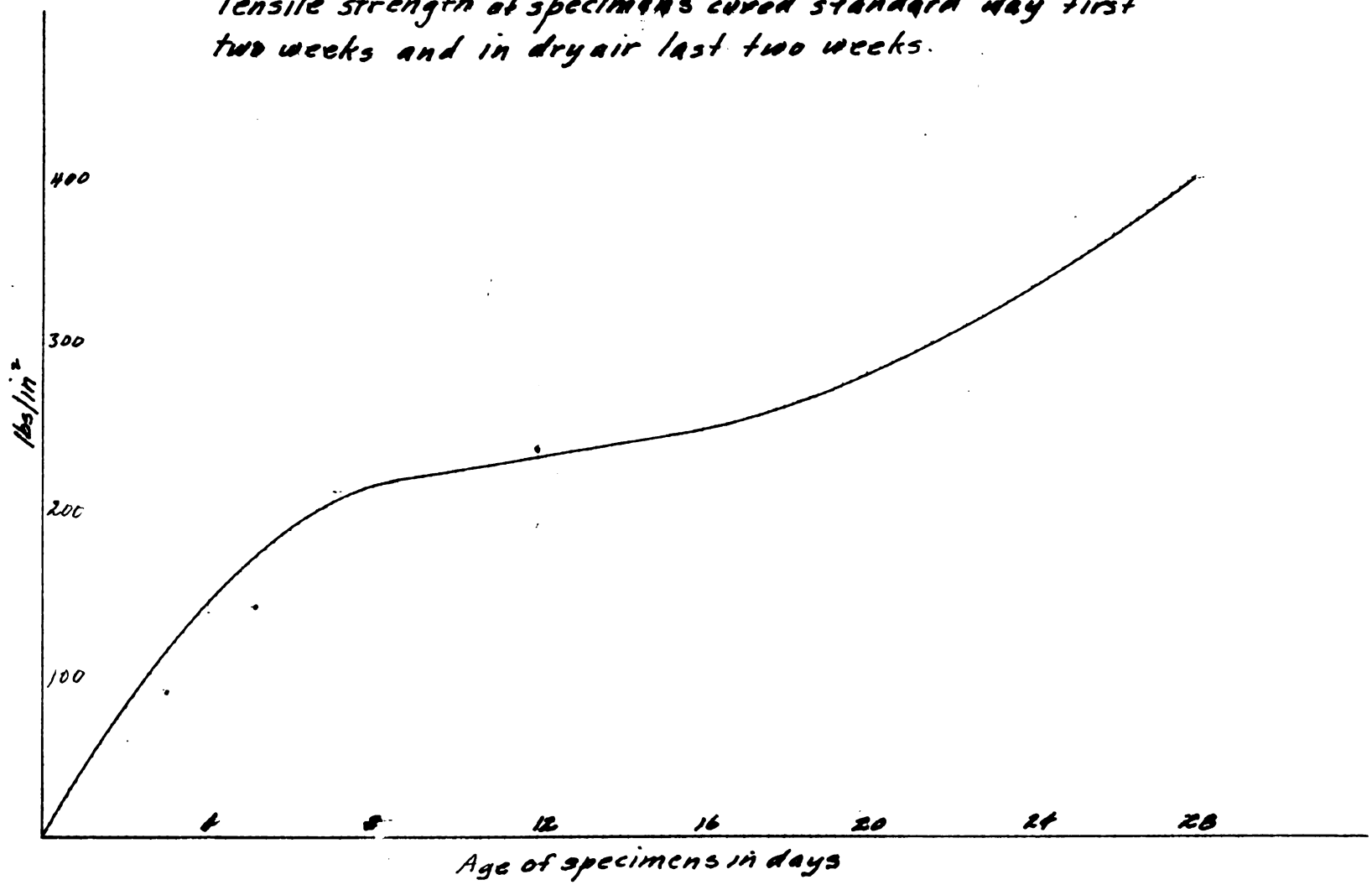
Comparative Tensile Strengths for curing 28 days in
S = standard way
W = full time in water
M = " " " moist air
D = " " " dry air.



Tensile strength of specimens cured standard way first two weeks and last two weeks in dry air.



Tensile strength of specimens cured standard way first two weeks and in dry air last two weeks.



Comparative Tensile Strength of specimens cured the standard way except for being placed in dry air at different days of the period.