THE SLAKING TEST

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The value of the slaking test has been questioned by many soil investigators It is the purpose of this brief paper to set forth what the writer believes to be a very valuable and practical use for the slaking test

A soil that slakes down easily forms a very poor shoulder support for a pavement It is easily rutted during long continued wet weather or at the thawing out time in the spring At present, the usual method of completing a pavement contract is to shape the shoulders of the roadway with material taken from the ditches along side the road This is smoothed off by a blade grader at the height of the pavement and the shoulder is left composed only of the subsoil such as the road is built upon This shoulder is easily rutted deeply, beside the pavement, during the spring thaws Eventually it dries up, then comes a rain, fills the rut with water, and the slaking goes on rapidly until the soil has practically run out from under the edge of the pavement Heavy trucking over the road under these conditions will surely break down the edges, at least at transverse cracks or joints, and very probably form long longitudinal cracks

Where the soil slakes very slowly, or not at all, there is little danger of such damage Under the present stress to obtain enough money to actually maintain the improved highways, the matter of using gravel, slag or cinders to form a cape or solid shoulder is postponed as long as possible or until money becomes available With non-slaking soils this is certainly a wise and economic procedure, but when a quick slaking soil is encountered it would be much more economical to build the slag, gravel or cinder shoulder next to the pavement as a part of the original contract, so that the pavement will be protected from the very first This would prevent accidents, save shoulder maintenance and prevent cracks and breaks of the main pavement. The granular shoulder should be treated with oil or tar so as to shed water and keep the water away from the edge of the pavement

A practical field test should be designed to approximate the laboratory test, so that the field or resident engineer could quickly determine where immediate shoulder protection is needed and where such expense could be postponed until financial conditions permitted the added improvement

STANDARDIZED TEST

The writer wishes to present here for consideration a standardized test for the laboratory and a suggested field test, which as yet he has not had time to test out Sixteen hundred cylinders of soil were tested to secure the data for standardizing the test Eight selected types of soil were chosen for the tests These were chosen to represent a wide range of mechanical analysis of soils, soils from 0 2 to 38 8 per cent of clay were used Air dried, oven dried and sun dried briquettes were tested The briquettes were made under 800, 1,200, 1,600 and 1,875 pounds pressure Various percentages of moisture were used in preparing the briquettes Both the technique of making the briquettes and the results of the tests were carefully studied If the soil was mixed with too much water it became so plastic that the briquettes could not be made If too small an amount of water was used the briquettes crumbled too easily When high pressures were used, lower amounts of water had to be used and this caused greater difficulty in obtaining a uniform distribution of the moisture through the soil

The series of tests showed, in a majority of cases, that briquettes made at 1,200 or 1,600 pounds pressure gave higher values than either above or below those pressures It was found that the highest slaking values were secured when approximately 63 per cent of the capillary moisture was used in making the briquettes This approximates the lower plastic limit of the Atterberg tests It is sufficiently close, therefore, to adopt this limit for determining the amount of water to use in the test

A series of tests showed that the temperature of the water used in slaking made a marked difference in the rate of slaking The warmer the water the more rapid the slaking As it was more difficult to keep the temperature of the water down, it was decided, from the test, to use 20 degrees C or about 68 degrees F because it is usually nearly normal room temperature

In selecting the procedure, the idea of following the choice of such methods as would tend to separate the results obtained, making greater differences, was adopted, as, for instance, air drying instead of oven drying made larger slaking values Using 1,200 pounds pressure in making briquettes, instead of the old standard of 1,875 pounds, gave larger results as a rule, and the amount of water used in mixing also affected the values

The following procedure is suggested for the revised slaking test.

1 Use the Atterberg lower plastic limit for the water content at which to mix the soil for making briquettes

2 Use a pressure of 1,200 pounds in making the briquettes It is more easily applied and makes less trouble from pressing out the plastic clay at the bottom of the mold
3 Air dry the briquettes in normal laboratory temperatures of approximately 70 degrees to 80 degrees F for 48 hours
4 Be careful to obtain a thorough distribution of moisture through the soil Ripen the moisture soil in a damp box for 15 or 18 hours before making briquettes
5 Use the ring method of slaking that is used in the present slaking method
6 Slake the briquettes in water at a temperature of 68 degrees F.
7 The time in minutes which it takes to slake the cylinder until it falls through the ring is the slaking factor adopted. Tentative limits only may be given at present to slaking values that indicate dangerous or safe soils When a large number of soils have been tested and compared with field results, more accurate limits may be set

The limits suggested are

Quick slaking soils below	20
Questionable soils between	20 to 30
Soils fairly stable ..	30 to 50
Excellent soils	50 up

FIELD TEST

A practical field test may be carried out as follows Mix the soil to be tested with sufficient water to make a stiff dough that is just plastic enough to roll into one-inch diameter cylinders in the hands without crumbling Take sufficient soil to make a ball about 3 or 4 inches in diameter Add water or dry soil as mixing proceeds until the proper consistency is reached, and continue to mix until the mass is uniformly damp throughout

Roll three or four cylinders approximately one inch in diameter, tamp the ends of the cylinders upon a table or hard flat surface to smooth up and make the ends true, making the cylinders approximately one inch in length Set these cylinders away in a warm, dry place to dry for 48 hours Then place them in a glass of water, temperature about 70 degrees F , and take the time in minutes which is required to slake these down to conical piles, approximately three-quarters of an inch high Observe the time for each briquette and take an average of the three closest figures This average in minutes is the slaking value to use

In practice, therefore, any soil which slakes down in less than

TABLE I
DATA FOR DETERMINATION OF SLAKING VALUE METHODS

Soil	Sand	Silt	Ultra clay	Total clay	Moist equiv	Capill moist	Slaking V Air oven minutes	Pressure	Per cent Moisture	Per cent of Capillarity	Atterberg plastic limit	Slaked damp	Volumetric change
131	1 5	5 7	13 8	92 6	35 1	35 0	34 42	1200	24 8	71 0	25 3	126	25 9
							29 39	800	24 8			1600 lb	
							19 20	1600	21 8			at 18 8%	
42	0 2	8 8	17 7	91 0	43 1	40 5	58 46	1200	18 0	44 4	22 5		30 2
							54 45	1600	18 0				
							46 39	800	21 0				
21y	11 8	11 1	7 7	77 1	24 9	32 0	16 12	800	20 4	63 8	20 9	30	24 0
							15 12	1600	20 4			1600 lb	
							8 18	1875	17 4			20 4%	
34	6 5	33 6	7 4	59 9	25 4	34 2	33 33	1600	21 4	62 6	17 4	73	13 8
							26 27	1200	18 4			1600 lb	
							27 25	1600	18 4			15 4%	
15x	15 1	37 4	3 3	47 5	20 7	25 5	13 12	1875	15 0	58.8	18 6		10 5
							13 10	1600	15 0				
							9 11	1875	18 0				
126	16 5	37 0	1 2	45 5	25 9	27 2	19 40	1200	20 3	74 6	19 0		12 6
							18 38	800	20 3				
							10 22	1200	17 3				
74	29 4	31 3	4 9	39 3	17 9	30 2	19 21	1875	22 6	74 8	18 2	44	15 3
							19 19	1600	22 6			1600 lb	
							17 15	1600	19 6				
182	38 8	39 0	4 8	22 2	12 0	29 6	13 13	1600	16 33	55 2	20 4	30	10 6
												800 lb	
									Average	63 0		15	
												1200 lb	

thirty minutes, suggests to the field engineer that the road shoulders along the edges of the pavement should be reinforced with slag, gravel, cinders or broken stone, thoroughly bound with fine soil or sand and water proofed with tar or oil

Soils which slake down in from 30 to 50 minutes should be kept under constant supervision for proper maintenance which may take the form of the addition of a few stone chips or gravel from time to time

Table I presents the data from which the standardizing factors for the test were determined.

A STUDY OF THE MOISTURE CONTENT OF OHIO SOILS

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Because of the well-known fact that saturated soils lose most if not all of their bearing value it was early decided to carry on a series of observations upon the water content of different soils at different depths and throughout the year in order to determine if possible how the soils received the water held in them and what maximum and minimum amounts of water different soils would hold in the field Further, it was considered a necessary observation to make at all locations where levels were being taken upon pavements to determine the vertical displacement taking place during the year

Therefore at all displacement stations, and quite a number of other places, a number of soil moisture stations were established As the observation trips, over the rather extended circuit of displacement stations, could not well be taken much oftener than once a month, it was decided to run two or more observation points upon the campus near the laboratory so that weekly moisture readings could be made and a rough check kept upon the changes in soil moisture content

The general field stations were all numbered, but the two local points were lettered Two sets of readings were taken at each of the two home points A point on the high ground near the laboratory and a second point on the low land near the Olentangy River were selected for the check stations At each of these points a concrete slab, 3 inches thick and 30 inches square, was placed upon a well drained and cleaned surface Then each week borings were made and soil samples taken from beneath the slabs and also from the open ground within five or ten feet of the slabs

The soil samples were taken in tight, seamless tin cans, taken to the laboratory, weighed, dried, reweighed and the moisture contained