

THE MOISTURE EQUIVALENT IN RELATION TO THE MECHANICAL ANALYSIS OF SOILS

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Mechanical analysis has been used as a basis for the classification of soils for several years. This method of classification is not altogether satisfactory in many respects, but it is the only method so far devised which gives comparable results by routine methods.

Moisture equivalent is defined as the maximum percentage of moisture which a soil can retain in opposition to a centrifugal force equal to 1000 times the force of gravity. The objects of the present investigation were to determine whether or not the moisture equivalent could be used as a basis to assist in the classification of soils, and what relation, if any, existed between the moisture equivalent and the mechanical analysis.

The moisture-equivalent determinations were made according to the method of Briggs and McLane (1), on samples of soil received by the Division of Physical Investigations from the Division of Soil Survey for mechanical analysis.

The apparatus for the determination consists of a metal cylinder attached to the shaft of a vertically mounted electric motor. The motor is provided with a governor which keeps the speed within the desired limits, a speed of 2440 revolutions per minute being necessary for a centrifugal force equal to 1000 times the force of gravity. The cylinder holds 16 soil boxes which have wire gauze bottoms permitting the escape of the excess moisture. The gauze bottoms are covered with filter paper to prevent the loss of soil particles, and then the soil is placed in the boxes, a sufficient amount of soil being taken to give a packed layer approximately 1 cm. thick. Duplicate determinations are made, the duplicate samples being placed opposite to one another in the cylinder. The samples, after being placed in the boxes, are thoroughly moistened and allowed to stand in a saturated atmosphere for 24 hours, a little more water is added, and they are placed in the cylinder of the machine. The machine is run for forty minutes at the desired speed, the samples are removed, and a moisture determination made upon each one. The percentage of moisture, based upon the weight of the dry soil, is the moisture equivalent. A total of 172 duplicate determinations were made on samples from counties in various states as follows:

| | |
|------------------------------|-----|
| La Salle, La..... | 26 |
| Horry, S. C..... | 19 |
| Morgan, Ala..... | 20 |
| Waupaca, Wis..... | 17 |
| Bertie, N. C..... | 12 |
| Brawley, Cal..... | 9 |
| El Centro, Cal..... | 9 |
| Newberry, S. C..... | 2 |
| Willits, Cal..... | 3 |
| Bannock, Ida..... | 1 |
| Kent, Del..... | 1 |
| Fort Laramie, Wyo..... | 2 |
| Lubbock, Tex..... | 5 |
| Adair, Iowa..... | 4 |
| Cheyenne, Nebr..... | 23 |
| Braxton and Clay, W. Va..... | 2 |
| Chenango, N. Y..... | 5 |
| Aroostook, Me..... | 17 |
| Total..... | 172 |

In order to determine whether or not the moisture equivalent could be used as a basis of classification, the determinations were divided into classes as determined by their mechanical analysis. The results of this grouping are shown in table 1. The mean value of the determinations in each class shows

TABLE 1
Moisture equivalent of soils grouped according to soil classification

| NUMBER OF SAMPLES | DESCRIPTION | MOISTURE EQUIVALENT | | |
|----------------------|----------------------|---------------------|---------|-------|
| | | Minimum | Maximum | Mean |
| 2 | Coarse sand..... | 2.15 | 7.80 | 4.98 |
| 3 | Sand..... | 3.00 | 6.55 | 4.77 |
| 7 | Fine sand..... | 6.65 | 11.35 | 8.50 |
| 3 | Very fine sand..... | 9.70 | 12.85 | 10.75 |
| 9 | Sandy loam..... | 8.95 | 14.80 | 12.88 |
| 47 | Fine sandy loam..... | 9.75 | 25.25 | 16.56 |
| 9 | Sandy clay..... | 15.55 | 34.25 | 22.76 |
| 24 | Loam..... | 15.40 | 29.15 | 22.29 |
| 19 | Silt loam..... | 18.25 | 41.25 | 26.75 |
| 20 | Clay loam..... | 16.35 | 32.90 | 22.29 |
| 12 | Silty clay loam..... | 19.80 | 29.90 | 26.90 |
| 17 | Clay..... | 20.85 | 40.20 | 29.25 |

a gradual increase, on the whole, from class to class, with the notable exception of silt loam, but the minimum and maximum determinations show considerable variation and overlapping among the various classes. From the results shown in this table it is readily seen to be impossible to base a classification upon the moisture equivalent which would be in agreement with the present classification. However, it shows the value which the moisture equivalent may have in the interpretation of the mechanical analysis.

Since there was no correlation between the classification of soil and the moisture equivalent, there remained to be determined whether any relation existed between the moisture equivalent and the mechanical analysis. Briggs and McLane, in their work with the Bureau of Soils (2), determined that such a relation existed, but in their work the moisture retentiveness of the soil under a centrifugal force of 3000 times gravity was taken as the moisture equivalent and the effect of the organic matter in the soil was included, so the formulae derived by them were not applicable to the present work.

Briggs and Shantz (3) have derived a formula for calculating the moisture equivalent from the mechanical analysis which is as follows:

$$\text{Moisture equivalent} = 0.02 \text{ sand} + 0.22 \text{ silt} + 1.05 \text{ clay} \quad (1)$$

This formula was applied to several of the samples under consideration and found to give results which were considerably higher than the observed values, due no doubt to the high coefficient for the clay.

In order to determine whether a more satisfactory equation could be derived, an observation equation for each of the 172 samples considered was made up in the following form: x (per cent of sand) + y (per cent of silt) + z (per cent of clay) = moisture equivalent (as determined by observation). These equations were then examined by the method of least squares (4) and the values of the three unknown coefficients x , y , and z , which would most nearly satisfy the 172 observed equations, were determined, as follows: $x = 0.0627$; $y = 0.2912$; $z = 0.4257$. These values substituted in the above equation give the equation

$$0.063 \text{ sand} + 0.291 \text{ silt} + 0.426 \text{ clay} = M \quad (2)$$

where M represents moisture equivalent.

The determinations were then divided into three groups, and in a like manner an equation was derived for each group.

Group A. Soils containing less than 20 per cent silt and clay:

$$0.02 \text{ sand} + 0.40 \text{ silt} + 0.53 \text{ clay} = M \quad (3)$$

This equation was based on 15 observations.

Group B. Soils containing 20 to 50 per cent silt and clay:

$$0.02 \text{ sand} + 0.35 \text{ silt} + 0.63 \text{ clay} = M \quad (4)$$

This equation was based on 65 observations.

Group C. Soils containing more than 50 per cent silt and clay.:

$$0.11 \text{ sand} + 0.27 \text{ silt} + 0.40 \text{ clay} = M \quad (5)$$

This equation was based on 92 observations.

Groups B and C were further subdivided into their respective classes and an equation derived for each class. Group A was omitted on account of the small number of observations in each class.

TABLE 2
Calculated moisture equivalent compared with observed moisture equivalent, showing relative value of equations

| SAMPLE NO. | DESCRIPTION | OBSERVED* MOISTURE EQUIVALENT | CALCULATED MOISTURE EQUIVALENT | | | | | | | | | | MECHANICAL ANALYSIS | | | | |
|------------|----------------------|----------------------------------|--------------------------------|-------|------------|--------------|-------|------------|--------------|-----|------------|--------------|---------------------|------------|------|------|------|
| | | | Equation No. | M | Difference | Equation No. | M | Difference | Equation No. | M | Difference | Equation No. | M | Difference | Sand | Silt | Clay |
| 331760 | Coarse sand..... | 4.30 | 2 | 9.31 | 5.01 | 3 | 6.57 | 2.27 | | | | 1 | 8.06 | 3.76 | 89.5 | 5.6 | 4.8 |
| 242924 | Sand..... | 4.30 | 2 | 9.38 | 5.08 | 3 | 6.83 | 2.53 | | | | 1 | 6.15 | 1.85 | 88.5 | 8.4 | 3.2 |
| 331757 | Sand..... | 5.65 | 2 | 9.38 | 3.73 | 3 | 7.41 | 1.76 | | | | 1 | 9.59 | 3.94 | 87.2 | 6.6 | 6.1 |
| 331718 | Fine sand..... | 7.60 | 2 | 11.10 | 3.50 | 3 | 9.42 | 1.82 | | | | 1 | 10.85 | 3.25 | 82.4 | 10.8 | 6.5 |
| 450850 | Fine sand..... | 9.25 | 2 | 11.33 | 2.08 | 3 | 9.80 | 0.60 | | | | 1 | 10.01 | 0.76 | 80.6 | 13.8 | 5.1 |
| 575221 | Very fine sand..... | 6.30 | 2 | 7.80 | 1.50 | 3 | 4.33 | 1.97 | | | | 1 | 4.44 | -1.86 | 94.7 | 4.1 | 1.5 |
| 450872 | Very fine sand..... | 8.20 | 2 | 11.03 | 2.83 | 3 | 9.51 | 1.31 | | | | 1 | 9.00 | 0.80 | 81.6 | 14.4 | 4.0 |
| 242925 | Sandy loam..... | 7.70 | 2 | 12.70 | 5.00 | 4 | 11.89 | 4.19 | 6.11 | 3.1 | 3.61 | 1 | 13.01 | 5.31 | 76.7 | 15.9 | 7.6 |
| 331744 | Sandy loam..... | 15.50 | 2 | 16.46 | 0.96 | 4 | 17.94 | 2.44 | 6.15 | 1.7 | -0.33 | 1 | 21.29 | 5.79 | 64.1 | 21.3 | 14.6 |
| 331736 | Fine sandy loam..... | 14.85 | 2 | 15.68 | 0.83 | 4 | 17.15 | 2.30 | 7.16 | 7.2 | 1.87 | 1 | 16.33 | 1.48 | 60.7 | 31.5 | 7.8 |
| 234712 | Fine sandy loam..... | 16.30 | 2 | 17.07 | 2.17 | 4 | 18.66 | 2.36 | 7.17 | 6.1 | 3.33 | 1 | 20.42 | 4.12 | 60.0 | 27.2 | 12.6 |
| 272012 | Fine sandy loam..... | 17.20 | 2 | 19.37 | 0.77 | 4 | 22.25 | 5.05 | 7.20 | 5.3 | 1.31 | 1 | 24.45 | 7.25 | 51.4 | 32.9 | 15.4 |
| 331738 | Fine sandy loam..... | 18.45 | 2 | 20.23 | 1.78 | 4 | 24.09 | 5.64 | 7.20 | 8.1 | 2.36 | 1 | 30.51 | 12.06 | 52.6 | 24.6 | 22.9 |
| 234729 | Sandy clay..... | 20.60 | 2 | 21.69 | 1.09 | 4 | 26.99 | 6.39 | 8.29 | 9.6 | 9.36 | 1 | 38.34 | 17.74 | 51.6 | 16.4 | 32.1 |
| 234713 | Sandy clay..... | 27.00 | 2 | 22.52 | -4.48 | 4 | 28.74 | 1.74 | 8.31 | 1.3 | 4.13 | 1 | 42.96 | 15.96 | 50.4 | 11.7 | 37.5 |
| 450810 | Loam..... | 17.20 | 2 | 19.46 | 2.26 | 5 | 20.67 | 3.47 | 9.23 | 6.9 | 6.49 | 1 | 22.17 | 4.97 | 49.4 | 38.5 | 12.1 |
| 234714 | Loam..... | 18.80 | 2 | 20.33 | 1.53 | 5 | 21.24 | 2.44 | 9.22 | 5.0 | 3.70 | 1 | 22.94 | 4.14 | 45.0 | 42.4 | 12.1 |
| 272002 | Loam..... | 21.25 | 2 | 22.38 | 1.13 | 5 | 22.93 | 1.68 | 9.21 | 8.5 | 0.60 | 1 | 29.64 | 8.39 | 40.2 | 40.4 | 19.0 |
| 450833 | Loam..... | 21.65 | 2 | 22.95 | 1.30 | 5 | 23.28 | 1.63 | 9.25 | 0.5 | 3.40 | 1 | 28.43 | 6.78 | 36.9 | 46.6 | 16.6 |
| 560858 | Loam..... | 23.70 | 2 | 21.18 | -2.52 | 5 | 22.05 | -1.65 | 9.22 | 7.2 | 0.98 | 1 | 27.02 | 3.32 | 44.8 | 38.5 | 16.8 |
| 234730 | Silt loam..... | 17.00 | 2 | 22.84 | 5.84 | 5 | 22.93 | 5.93 | 10.28 | 2.7 | 11.27 | 1 | 23.05 | 6.05 | 32.9 | 57.9 | 9.2 |
| 331791 | Silt loam..... | 20.10 | 2 | 23.77 | 3.67 | 5 | 23.64 | 3.34 | 10.27 | 8.2 | 7.72 | 1 | 25.01 | 4.71 | 29.9 | 59.4 | 10.8 |
| 272001 | Silt loam..... | 25.25 | 2 | 23.78 | -1.47 | 5 | 23.77 | -1.48 | 10.27 | 4.4 | 2.19 | 1 | 28.42 | 3.17 | 32.3 | 51.8 | 15.6 |
| 450834 | Clay loam..... | 22.90 | 2 | 23.29 | 0.39 | 5 | 23.62 | 0.72 | 12.23 | 0.8 | 0.18 | 1 | 31.41 | 8.51 | 36.9 | 42.2 | 20.4 |

| | | | | | | | | | | | | | | | | |
|---|----------------------|-------|---|-------|-------|---|-------|--------|----------|--------|---|-------|-------|------|------|------|
| 331799 | Clay loam..... | 23.95 | 2 | 25.52 | 1.57 | 5 | 25.41 | 1.46 | 12.21.89 | - 2.06 | 1 | 37.87 | 13.92 | 31.1 | 41.9 | 26.7 |
| 272043 | Clay loam..... | 24.15 | 2 | 24.72 | 0.57 | 5 | 24.75 | 0.60 | 12.22.06 | - 2.09 | 1 | 36.12 | 11.97 | 33.9 | 40.7 | 25.2 |
| 450806 | Clay loam..... | 30.40 | 2 | 24.92 | -5.48 | 5 | 24.88 | - 5.52 | 12.23.02 | - 7.38 | 1 | 34.71 | 4.31 | 31.9 | 45.1 | 23.0 |
| 272021 | Silty clay loam..... | 25.70 | 2 | 26.04 | 0.34 | 5 | 25.73 | 0.03 | 13.26.13 | 0.43 | 1 | 35.42 | 9.72 | 27.4 | 50.7 | 22.6 |
| 331789 | Silty clay loam..... | 26.55 | 2 | 27.15 | 0.60 | 5 | 26.53 | - 0.02 | 13.27.80 | 1.25 | 1 | 38.30 | 12.75 | 23.8 | 51.1 | 25.3 |
| 331788 | Silty clay loam..... | 29.70 | 2 | 27.60 | -2.10 | 5 | 26.85 | - 2.85 | 13.27.58 | - 2.12 | 1 | 38.71 | 9.01 | 21.8 | 53.1 | 25.3 |
| 560816 | Silty clay loam..... | 29.75 | 2 | 30.75 | 1.00 | 5 | 28.99 | - 0.76 | 13.27.06 | - 0.69 | 1 | 42.45 | 12.70 | 7.3 | 64.9 | 26.7 |
| 234715 | Clay..... | 33.75 | 2 | 32.65 | 1.10 | 5 | 31.30 | - 2.45 | 14.32.03 | - 1.72 | 1 | 61.79 | 28.04 | 14.8 | 33.6 | 51.5 |
| 272018 | Clay..... | 33.95 | 2 | 29.97 | -3.98 | 5 | 29.04 | - 4.91 | 14.26.80 | - 7.15 | 1 | 51.99 | 18.04 | 20.2 | 38.6 | 41.0 |
| 450858 | Clay..... | 39.35 | 2 | 29.60 | -9.75 | 5 | 26.76 | -12.59 | 14.26.44 | -12.91 | 1 | 51.28 | 11.93 | 21.4 | 37.8 | 40.5 |
| Probable error of a single determination..... | | | | ±2.25 | | | | ± 2.53 | | ± 3.48 | | | ±6.76 | | | |

*Average of two determinations.

| | | | |
|----------------------|---------|--|------|
| Sandy loam..... | 9 obs. | 0.05 sand + 0.26 silt + 0.44 clay = M | (6) |
| Fine sandy loam..... | 47 obs. | 0.04 sand + 0.36 silt + 0.43 clay = M | (7) |
| Sandy clay..... | 9 obs. | 0.12 sand + 0.58 silt + 0.83 clay = M | (8) |
| Loam..... | 24 obs. | 0.31 sand + 0.19 silt + 0.09 clay = M | (9) |
| Silt loam..... | 19 obs. | 0.36 sand + 0.26 silt + 0.15 clay = M | (10) |
| Clay loam | | | |
| (a) Surface..... | 5 obs. | 0.04 sand + 0.19 silt + 0.57 clay = M | (11) |
| (b) Subsoil..... | 15 obs. | 0.22 sand + 0.34 silt + 0.03 clay = M | (12) |
| Silty clay loam..... | 12 obs. | 0.18 sand + 0.065 silt + 0.80 clay = M | (13) |
| Clay..... | 17 obs. | 0.00 sand + 0.11 silt + 0.55 clay = M | (14) |

In order to determine the value of these equations, 36 samples of soil were taken at random, the only considerations being that each class should be represented, and that they should be distributed as widely as possible. Two of these samples were later rejected, one because of the very high content of organic matter and the other because it puddled in the centrifuge, giving an unsatisfactory determination of the moisture equivalent.

The moisture equivalent was determined for each of the 34 samples and compared with the moisture equivalent as calculated by each of four different formulae. The results are shown in table 2. The distribution of the samples was as follows:

| | |
|-----------------------|----|
| Black Hawk, Iowa..... | 10 |
| Beaufort, N. C..... | 6 |
| Mahoning, Ohio..... | 6 |
| Canadian, Okla..... | 7 |
| Yamhill, Ore..... | 2 |
| Marlboro, S. C..... | 2 |
| Brawley, Calif..... | 1 |
| Total.... | 34 |

The results shown in this table indicate that equation (2) gives values for the moisture equivalent which on the average more nearly approximate the observed values than any of the others. Equations (3), (4), and (5) give practically the same results. Equation (3) is to be preferred to equation (2) for the soils of Group A, as equation (2) tends to give high results in this particular group. In the other two groups there seems to be little difference, but equation (2) is probably to be preferred on account of the greater ease of manipulation.

For the rapid calculation of the moisture equivalent by means of equation (2) a logarithmic chart was prepared (fig. 1). The products of the percentages of sand, silt, and clay multiplied by their respective coefficients may be read directly from the chart as illustrated in the example, then the sum of the three terms is the calculated moisture equivalent. This chart gives results which are in as close agreement as those obtained by the use of an ordinary slide rule and for the purpose of rapid calculation is more convenient.

Equations (6) to (14) give results at slightly wider variance, which seems to be an anomaly as an equation which is derived for a particular class of soil should evidently give a more accurate result than one which embodies all classes. However, because of the smaller number of observations considered in the derivation of these equations the relation existing between the sand, silt and clay, and the moisture retentiveness is not established as closely as

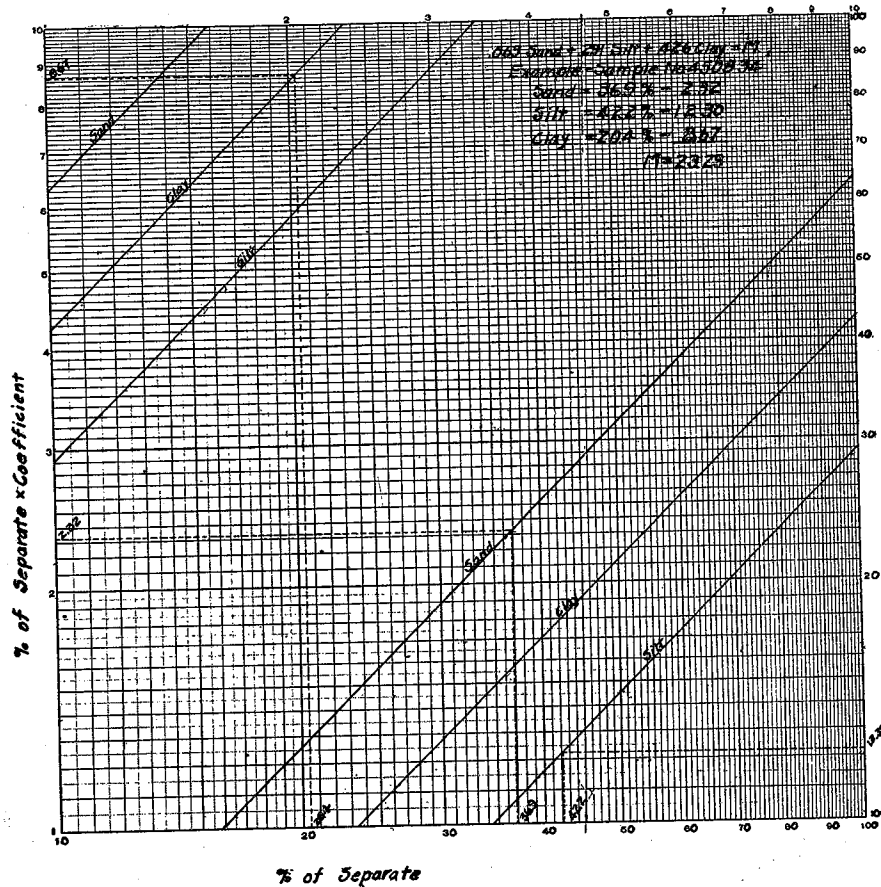


FIG. 1. LOGARITHMIC CHART FOR THE CALCULATION OF MOISTURE EQUIVALENT.

in the case where a larger number of observations are considered. This indicates also that the relation existing is practically constant in all classes of soils—differences, if any, being due to the presence of organic matter, variations in the amount of the different grades of sand, and other factors which are not taken into consideration in the application of the equations.

In order to determine the effect of a large amount of organic matter upon the moisture equivalent and to determine the relative value of the above

equations for soils of this character, determinations were made on 30 samples of soil from Traill County, North Dakota, practically all of which were high in organic matter.

TABLE 3
Observed moisture equivalent compared with calculated moisture equivalent, showing effect of organic matter

| SAMPLE NUMBER | DESCRIPTION | OBSERVED MOISTURE EQUIVALENT | CALCULATED MOISTURE EQUIVALENT | | | | | |
|---|----------------------|------------------------------|--------------------------------|------------|-----------------------|------------|------------|------------|
| | | | Equation 2 | Difference | Equations 3, 4, and 5 | Difference | Equation 1 | Difference |
| 351701 | Fine sandy loam..... | 27.00 | 17.15 | - 9.85 | 17.67 | - 9.33 | 18.23 | - 8.77 |
| 351702 | Loam..... | 23.85 | 23.24 | - 0.61 | 21.13 | - 2.72 | 25.52 | 1.67 |
| 351703 | Loam..... | 23.45 | 22.67 | - 0.78 | 22.24 | - 1.21 | 23.67 | 0.22 |
| 351704 | Fine sandy loam..... | 17.55 | 12.97 | - 4.58 | 13.27 | - 4.28 | 15.17 | - 2.38 |
| 351705 | Coarse sand..... | 4.90 | 5.01 | 0.11 | 5.01 | 0.11 | 6.02 | 1.12 |
| 351713 | Silt loam..... | 33.55 | 26.89 | - 6.66 | 25.23 | - 8.32 | 28.75 | - 4.80 |
| 351714 | Silt loam..... | 29.40 | 27.35 | - 2.05 | 24.37 | - 5.03 | 28.43 | - 0.97 |
| 351715 | Fine sandy loam..... | 25.60 | 18.40 | - 7.10 | 19.51 | - 6.09 | 21.07 | - 4.53 |
| 351716 | Clay..... | 37.55 | 28.84 | - 8.71 | 28.41 | - 9.14 | 53.36 | 15.81 |
| 351717 | Fine sandy loam..... | 15.05 | 11.26 | - 3.79 | 10.79 | - 4.26 | 11.48 | - 3.57 |
| 351718 | Fine sandy loam..... | 25.75 | 18.90 | - 6.85 | 19.26 | - 6.49 | 18.55 | - 7.20 |
| 351724 | Fine sandy loam..... | 26.80 | 20.36 | - 6.44 | 22.70 | - 4.10 | 26.69 | - 0.11 |
| 351725 | Sandy loam..... | 26.35 | 17.26 | - 9.09 | 21.20 | - 5.15 | 27.44 | 1.09 |
| 351729 | Loam..... | 33.80 | 22.96 | -10.84 | 21.78 | -12.02 | 25.67 | - 8.13 |
| 351730 | Clay loam..... | 27.90 | 22.25 | - 5.65 | 23.11 | - 4.79 | 31.62 | 3.72 |
| 351747 | Clay loam..... | 30.65 | 25.72 | - 4.93 | 25.64 | - 5.01 | 39.39 | 8.74 |
| 351748 | Fine sandy loam..... | 37.45 | 19.99 | -17.46 | 21.62 | -15.83 | 23.79 | -13.66 |
| 351749 | Fine sandy loam..... | 32.85 | 17.52 | -15.33 | 19.47 | -13.38 | 22.03 | -10.82 |
| 351750 | Clay loam..... | 27.30 | 23.16 | - 4.14 | 23.56 | - 3.74 | 31.69 | 4.39 |
| 351751 | Fine sandy loam..... | 22.35 | 13.63 | - 8.72 | 13.32 | - 9.03 | 14.01 | - 8.34 |
| 351752 | Fine sandy loam..... | 18.90 | 13.47 | - 5.43 | 13.27 | - 5.63 | 15.76 | - 3.14 |
| 351753 | Loam..... | 27.50 | 22.85 | - 4.65 | 23.31 | - 4.19 | 30.68 | 3.18 |
| 351754 | Fine sand..... | 12.70 | 11.32 | - 1.38 | 9.69 | - 3.01 | 11.46 | - 1.24 |
| 351755 | Fine sand..... | 8.35 | 9.93 | 1.58 | 7.49 | - 0.86 | 9.39 | 1.04 |
| 351756 | Clay loam..... | 34.45 | 24.03 | -10.42 | 24.32 | -10.13 | 34.55 | 0.10 |
| 351757 | Clay loam..... | 36.00 | 24.39 | -11.61 | 24.54 | -11.46 | 36.40 | 0.40 |
| 351758 | Fine sandy loam..... | 28.65 | 16.45 | -12.20 | 17.83 | -10.82 | 20.51 | - 8.14 |
| 351759 | Sandy clay..... | 21.50 | 22.71 | 1.21 | 28.99 | 7.49 | 43.72 | 22.22 |
| 351760 | Loam..... | 38.20 | 21.26 | -16.94 | 22.14 | -16.06 | 28.01 | -10.19 |
| 351761 | Clay loam..... | 29.50 | 26.37 | - 3.13 | 26.41 | - 3.09 | 40.67 | 11.17 |
| Probable error of a single determination..... | | | ± 5.65 | | | ± 5.44 | | ± 5.32 |

Briggs and McLane (2) determined that organic matter has practically the same effect as an equal amount of clay in increasing the moisture equivalent. This fact is borne out in the results of the determinations as shown in table 3. In nearly every case the observed was higher than the calculated value. The results also indicate that with soils of this character the indirect determination is not as reliable as with ordinary soils, the probable error of a single

determination being approximately twice as great. It is interesting to note in this connection that equation (1), which gives results at widest variance, as shown in table 2, gave better results with soils of this character and had the least probable error. The similarity of the results of equation (2) and equations (3), (4), and (5) are borne out also, the latter in this case having a slight advantage.

SUMMARY

The moisture equivalent may not be used as a basis for the classification of soils, but may be of valuable assistance in the interpretation of the mechanical analysis.

There is a direct relationship between the moisture equivalent and the percentages of sand, silt, and clay in the soil as determined by mechanical analysis. This relation may be expressed as

$$0.063 \text{ sand} + 0.291 \text{ silt} + 0.426 \text{ clay} = \text{moisture equivalent}$$

The presence of considerable amounts of organic matter in the soil tends to increase the moisture equivalent and to disturb the relation between the moisture equivalent and the mechanical analysis.

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