

Colorimetric Field Test for Organic Matter in Mineral Soils

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The organic matter of soils in the field is commonly estimated by the blackness of soil color. Because iron oxide stains often cause serious error, a colorimetric procedure has been developed, based on measurement of residual chlorine after a 6-minute exposure to soil organic matter. The residual chlorine is determined with a solution of *o*-tolidine; the intensity of yellow color is proportional to the amount of organic matter oxidized. No attempt is made to compare the colors with an accuracy of better than 0.5% organic matter content. Results obtained by this method compare favorably with the standard chromic acid method. When compared with typical humid region soils, the results were well within the 0.5% limit specified. The tests require only a few minutes for each soil sample. The procedure should be helpful to soil surveyors, land appraisers, and soil technicians.

THE BLACKNESS OF COLOR OF MINERAL SOILS remains the popular field method for estimating the organic matter content of soils. However, this can be misleading, as many red soils with relatively high organic matter will reveal only the color of iron oxides, causing an erroneous estimation of the percentage of organic matter. A simple test for organic matter should be of value to soil surveyors, land appraisers, soil technicians, and other specialists desiring a rapid field test for this important component of soils.

Edson and Thornton (2) modified the chromic acid procedure of Peech and others (4) to test for organic matter colorimetrically, and estimated the organic matter content as between 0 and 4%. The latter figure is considered high for Coastal Plains soils. A procedure which includes a similar rating for organic matter in Coastal Plains soil is described by Purvis and Blume (5). All modifications of the chromic acid methods for quick testing are restricted to the laboratory because of the necessity of using concentrated mineral acids and weighing small amounts of soil. The need for accurate balances and the danger of corrosive acids limit their use under field conditions for the average soil investigator.

The colorimetric test for organic matter described herein utilizes large volumes of soil, and the colors are developed by reagents that are safe and easy to use. The method should be well suited to field workers who wish to estimate the organic matter content of soils to the nearest 0.5%. The method is a modification of one for determining organic matter in water, which utilizes active chlorine as the oxidizing agent (1). For simplicity, a com-

mercial preparation containing approximately 1% available chlorine by weight may be used.

The method is based on a measurement of the residual chlorine after a 6-minute exposure to soil organic matter. Active chlorine is stabilized by the soil extracting solution, as the chloramine, and the excess ammonium ions tend to prevent any interference from soils high in colloidal substances. The residual chlorine is readily determined by a solution of *o*-tolidine. The yellow to orange color developed is proportional to the amount of organic matter oxidized. These colors are compared directly with permanent liquid standards and the percentage of organic matter is recorded.

Test Solutions

Chlorine Solution. Commercial preparation containing approximately 1% available chlorine. (Of those available at present time, Zonite has been found satisfactory.)

***o*-Tolidine Solution.** Dissolve 1.35 grams of *o*-tolidine dihydrochloride in 500 ml. of distilled water. Add this solution with stirring to 500 ml. of dilute hydrochloric acid (mixture of 350 ml. of distilled

water and 150 ml. of concentrated hydrochloric acid).

Extracting Solution. A 0.1% solution ammonium sulfate in distilled water.

Reference Standards

As the basis for the reference standards, soil samples from Alachua County, Florida, were used. These soils were collected and analyzed by the personnel of the U. S. Department of Agriculture and Florida Agricultural Experiment Station, using the standard chromic acid method (3). Tests were conducted on these soils by the quick colorimetric method, and permanent color reference solutions were prepared to represent known amounts of organic matter present in soils (Table I).

Procedure

Several cores of soil to plow depth should be taken from each soil type under investigation and composited.

After the fresh soil has been screened through a 20-mesh sieve, a level teaspoonful of the soil (assuming about 5-gram weight for mineral soils) is struck off with a spatula and placed in a large test tube containing 20 ml. of the extract-

Table I. Known Soil Standards and Equivalent Permanent Color Reference Solutions

Soil Type ^a	Depth of Soil, Inches	Known O.M. Content, ^b %	10% K ₂ Cr ₂ O ₇ in 1% HCl, Ml.	1% HCl, Ml.	Organic Matter Rating, %
Silica sand	..	None	15.0 ^c	None	0
Hernando f.s.	5	1.18	7.0	10.0	1 low
Parkwood f.s.	5	2.02	2.0	14.0	2 medium
Fellowship f.s.	5	3.10	0.5	15.0	3 med. high
Parkwood f.s.	4	4.17	0.2	15.0	4 high

^a F.S. (fine sand).

^b Recorded data from soil survey of Alachua County.

^c 10% K₂Cr₂O₇ in 13% HCl.

Table II. Organic Matter Content of Typical Humid Region Soils

Soil Type ^a	Depth of Soil Sampled, Inches	Organic Matter, %	
		Standard chromic acid ^b	Colorimetric quick test
Orlando f.s.	3	4.29	4.0
Scranton s.	6	3.68	3.5
Scranton s.	5	3.16	3.0
Ducker s.l.	6	4.06 ^c	4.0
Gainesville l.f.s.	7	2.42	2.5
Leon s.	5	1.82	1.5
Plummer f.s.	8	1.53	2.0
Blanton f.s.	3	1.23	1.5
Rex f.s.	8	1.84	2.0
Blanton f.s.	3	1.76	1.5
Greenville l.f.s.	6	0.90	1.0
Gainesville l.f.s.	4	3.79	4.0
Arzell f.s.	3	0.27	0.0
Brookston c.	6	2.50 ^d	2.5
Montgomery s.c.l.	6	3.15 ^d	2.5
Bono c.l.	6	>4.0 ^d	4.0
Rafferty s.c.l.	6	>4.0 ^d	>4.0
Chalmers s.c.l.	6	4.0 ^d	3.5

^a F.S. (fine sand), s (sand), l.f.s. (loamy fine sand), c (clay), s.c.l. (salty clay loam), c.l. (clay loam).

^b Recorded data from survey of Alachua County, Florida.

^c Recorded soil samples, College of Agriculture, University of Florida.

^d Selected group of northern humid region heavier textured soils.

ing solution. Two drops of the chlorine solution are added; the tube is immediately sealed over with the thumb and shaken vigorously for exactly 1 minute (oxidation time is critical). After shaking, the suspension is allowed to settle for exactly 5 minutes. The entire soil suspension is now filtered through a

Whatman No. 1 filter paper, and 2 ml. of the clear filtrate is caught in a marked 16 × 150 mm. test tube. Immediately, 3 drops of the o-tolidine solution are added, the tube is swirled for mixing, and then a period of 15 minutes is allowed for the full color to develop.

The shade of deep orange to pale

yellow color is compared directly with the liquid standards and the amount of organic matter is estimated to the nearest 0.5%.

Results

Results obtained with the colorimetric test for organic matter in some typical humid region soils are given in Table II. Comparisons are made with several soil types which have been tested for organic matter by the standard chromic acid procedure.

Literature Cited

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Received for review April 18, 1955. Accepted June 13, 1955.

GLUTAMIC ACID DETERMINATION

Paper Chromatography in Routine Determination of Glutamic Acid in Production

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The determination of glutamic acid in protein hydrolyzates by McFarren's quantitative chromatographic method has been applied successfully to the analysis of products obtained in glutamic acid production. The addition of 2-butanol to the phenol solvent improved the separation of glutamic acid from the other amino acids and led to the formation of round and compact spots.

IN THE PRODUCTION OF GLUTAMIC ACID from gluten it is important to have a reliable and convenient method for determining glutamic acid. Irrespective of the method used to separate this amino acid from the gluten hydrolyzate, it is essential to check the glutamic acid content of a wide variety of process liquors and salt cakes, some of which may contain a high concentration of sodium chloride.

The chromatography of amino acids on buffered paper was undertaken by Haugaard and Kroner (1) and was later adapted by McFarren and Mills (3) to the quantitative estimation of amino

acids in protein hydrolyzates. The latter authors employed papers buffered at pH 12 and a phenol-buffer solvent at the same pH, for the quantitative estimation of glutamic acid. The salt was removed from the hydrolyzates by extraction with a 95% solution of di-2-ethylhexylamine in chloroform.

The present paper describes a procedure for the estimation of glutamic acid on buffered paper (pH 12) using a solvent system made up of buffer (pH 12) saturated phenol containing a small amount of 2-butanol. The important features of this solvent system are a clean separation of glutamic acid from the

other amino acids, even in the presence of a high concentration of sodium chloride, and the formation of round and compact spots of uniform size, which greatly reduces the error involved in estimating the concentration of amino acid by direct densitometry. The results obtained using the paper chromatography method have been compared with those obtained by Olcott's method (4).

Materials

Buffered Filter Papers. Whatman No. 1 (18 × 1/2 × 22 1/2 inches) filter