METHOD OF SAMPLING AND TESTING
MT 232-16
SOIL CORROSION TEST
(*Montana Method*)

1 Scope

1.1 This test method covers procedures and apparatus for determining the pH, conductivity and sulfate content of a soil in corrosion testing.

1.2 The intent of these tests is to supplement soil-resistivity measurements and thereby identify conditions under which the corrosion of metals in soil may be accentuated.

1.3 At the discretion of the Chief Chemist, MT 532 may be used to determine sulfate content of soils.

2 Referenced Documents

AASHTO
M 231 Weighing Devices Used in the Testing of Materials

MT Materials Manual
MT 532 Determination of Sulfate Content In Soils by Ion Chromatography

3 Apparatus

3.1 *Sieves* – A series of sieves of the following sizes: 1/4 in. (6.3 mm), No. 4 (4.75 mm), No. 10 (2.00 mm) and a pan

3.2 *Balance* – A balance with an accuracy of at least 0.1 percent and conforming to the requirements of AASHTO M 231

3.3 *Drying Apparatus* – A suitable device capable of drying samples at a temperature of 140°F (60°C)

3.4 *Pulverizing Apparatus* – Either a mortar and a rubber-covered pestle or any device suitable for breaking up the aggregations of soil particles without reducing the size of the individual grains.

3.5 *Sample Splitter* – A suitable riffle sample splitter or sample splitter for proportional splitting of the sample and capable of obtaining representative portions of the sample without appreciable loss of fines. The width of the container used to feed the riffle splitter should be equal to the total combined width of the riffle chutes. Proportional splitting of the sample on a canvas cloth is also acceptable.

3.6 *pH Meter* – With electrodes suitable for laboratory analysis

3.7 *Standard Buffer Solutions* – Buffer solutions with known pH values of 4.0, 7.0, 10.0

3.8 *Beakers* – 100 ml and 250 ml wide mouth glass beakers with a watch glass for cover

3.9 *Glass stirring rods*

3.10 *Conductivity Meter* - Suitable for laboratory or field analysis

3.11 *Muffle Furnace* – The muffle furnace shall be capable of operation at the temperatures required and shall have an indicating pyrometer accurate within ±25°C, as corrected, if necessary, by calibration.

3.12 *Platinum Crucible* – Platinum crucibles for ordinary chemical analysis should preferably be made of pure unalloyed platinum of 15 to 30-ml capacity. Where alloyed platinum is used for greater stiffness or to avoid sticking of crucible and lid, the alloyed platinum should not decrease in mass by more than 0.2 mg when heated at 1200°C for one hour.

3.13 *Filter Paper* – Fast filter paper (Whatman #41) and slow filter paper (Whatman #42)

4 Sample Preparation

4.1 The sample as received shall be in a moist condition for pH purposes. If the sample is too wet, it may be dried to a moist condition in air or a drying apparatus not to exceed 140°F (60°C) prior to sample selection (Note 1). A representative test sample to perform the pH test shall then be obtained with a sampler or by splitting or quartering.

Note 1 – Samples dried in an oven or other drying apparatus at a temperature not exceeding 140°F (60°C) are considered to be air dried.

5 Determination of pH

5.1 Place a sufficient amount of soil into a 100 ml glass beaker or other suitable container to fill to the 80 ml mark.

5.2 Stir enough distilled water into the sample to produce a soil slurry and then cover with a watch glass.

5.3 Let the sample stand for a minimum of one hour, stirring every 10 to 15 minutes. This is to allow the pH of the soil slurry to stabilize.

5.4 Measure the temperature of the soil and adjust the temperature controller of the pH meter to that of the sample temperature. This adjustment should be done just prior to testing.

5.5 Calibrate the pH meter by means of the standard solutions provided.

5.6 Stir the sample with a glass rod immediately before immersing the electrode into the soil slurry solution and gently turn the beaker or container to make good contact between the solution and the electrode. **DO NOT** place the electrode into the soil, only into the soil slurry solution.

5.7 Immerse the electrode in the solution for at least 30 seconds to allow the meter to stabilize. If the meter has an auto read system, it will automatically signal when stabilized.

5.8 Read and record the pH value to the nearest tenth of a whole number.

5.9 Rinse the electrode well with distilled water, then dab lightly with tissues to remove any film formed on the electrode. Caution: Do not wipe the electrode as this may result in polarization of the electrode and consequent slow response.

5.10 Add approximately 1 gram of calcium carbonate ($CaCO_3$) to the soil slurry and set aside for approximately 24 hours. Determine the marble pH by following sections 5.4 to 5.9.

6 Determination of Conductivity

6.1 Place a sufficient amount of soil on a 100 mm watch glass to completely cover the watch glass. Let stand overnight to allow the sample to dry.

6.2 Sieve the dry sample over a No. 10 sieve (2.00 mm) and then pulverize the material remaining on the sieve (+2.00 mm) with a mortar and pestle in such a manner so as to break up the aggregations without fracturing the individual grains. If the sample contains brittle particles, pulverize carefully and with just enough pressure to free the finer material that adheres to the coarser particles.

6.3 Place a portion of the pulverized soil in a 100 ml beaker and add distilled water at a ratio of 1 part soil to 2 parts water and let stand for 30 minutes.

6.4 After conditioning, pour the water from the beaker into the sample container of the conductivity meter and determine the conductivity to the nearest 0.01 m. mhos.

7 Determination of Sulfate Content

7.1 Place 3 grams of the pulverized soil prepared in Section 6 into a 500 ml Erlenmeyer flask.

7.2 Add 150 ml of distilled water; stopper the flask and shake to mix.

7.3 Centrifuge the sample for 30 minutes.

7.4 Decant the liquid into a 250 ml beaker and add 2 ml of dilute Hydrochloric acid (50% strength), to flocculate the suspended particles. Cover with a watch glass and place onto a hot plate until the sample boils.

7.5 Remove the beaker from the hot plate and immediately filter through a fast filter paper (Whatman #41).

7.6 Add 10 ml of a 10% Barium Chloride ($BaCl_2 \cdot 2H_2O$) solution to the filtered sample to determine the presence of sulfate. (The liquid will become milky in the presence of sulfate).

7.7 Cover the beaker with a watch glass and return to the hot plate until the sample boils.

7.8 Remove the beaker from the hot plate and immediately filter through a slow filter paper (Whatman #42). Wash the filter with several hot water rinses.

7.9 Place the filter paper in a tared 30 ml platinum crucible, place the crucible into a muffle furnace and slowly raise the temperature to 1000°C to burn off filter paper.

7.10 Remove the crucible from the muffle furnace and desiccate until cool. Weigh to the nearest 0.0001 grams and record weight as W.

7.11 Sulfate Calculation

$$\% \text{ Sulfate } (SO_4) = [(W*0.4115)/S]*100$$

Where:
W = Sulfate weight
S = Soil sample weight

8 Report

Include the following parameters in the report:
pH
Marble pH
Sulfate as % SO4
Conductivity in m. mohs

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