Crushing Strength of Aggregated Soil Materials

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In a study of methods for use in assessing the physical status of soils under plot experimentation at several federal and state dry land agricultural stations, it was decided to investigate the resistance of broken clods or aggregates to rupture under compressive forces. A review of soils literature furnished no clues to the relationships that may exist between hardness and other physical properties of soils. The nearest approach found was that of Russian workers (4, 5) who reported that the maximum mechanical strength of dried masses of soil, kneaded when wet, was greatest if manipulation occurred at a certain optimum moisture content. The present experiment was suggested by the work of Hardesty and Ross (1) who investigated the factors affecting the hardness of granulated fertilizer materials.

MATERIALS AND PROCEDURE

The crushing equipment, modeled after that of Hardesty and Ross, was based upon a common platform-type spring household scale. A manually operated rack and pinion, held by an arm attached to the scale base, operated a plunger which descended upon the soil specimen placed upon a small base or anvil upon the scale platform. Pressure upon the specimen was indicated by a hand moving around the face of the scale. A follower hand or telltale recorded the maximum pressure, which occurred at the instant of sample fracture. The capacity of the scale was 400 ounces. An effort was made to orient the specimen so that the direction of applied force fell within the base. This avoided excessive side thrusts and promoted sudden and complete shattering.

The soil samples, taken from plots at the Ft. Hays Branch Experiment Station, were those used in early analysis studies (3, 2). The soil, tentatively mapped as the Munjor silty clay loam, is located in a chernozem area but has a slight claypan. Samples, taken at three depths, 7-11, and 16-20 inches, were broken at field moisture, passed a 1/2-inch screen, air dried, and stored for later use. Specimens, quartered from these samples for crushing, were natural aggregates, field clods, or broken clods. These terms are used indiscriminately in this report in reference to the fractured material.

The preliminary investigation, concerned with the effect of soil moisture upon crushing strength, employed surface and subsoil samples from a wheat border at Hays, samples from a wheat plot in the soil fertility series at the College Agronomy Farm at Manhattan. These samples were collected by Nijhawan and Olmstead (2), and stored at field moisture. Sample material taken from these containers was air dried and the aggregates sorted into size classes before adjusting them to the desired moisture contents.

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2 Graduate student and Physicist, respectively.

3 Since this report was submitted for publication H. F. Rhoades has called the authors' attention to a paper by Fitt and Rhoades on "Chemical Treatment of Slick Spots" published in volume 8 of these Proceedings, pp. 432-436, in which results of clod strength are reported.

4 Figures in parentheses refer to "Literature Cited", p. 46.