

43-032 SHRINKAGE OF DISTURBED SAMPLES (COLE rod)**1. Application**

1.1 COLE is the measure of linear extensibility which is the 1-dimensional length change of a soil body between two moisture contents. If facilities are available, this test can be run between any standard moisture content and oven dry.

Most soils change volume with change in water content. The coefficient of linear extensibility (COLE) is a commonly used measure of the shrink-swell capacity of soil and can be determined for disturbed as well as undisturbed samples. For disturbed soils COLE is defined as

$$\text{COLE} = \frac{L_m - L_d}{L_d} = \frac{L_m}{L_d} - 1$$

where L_m = length of moist sample and L_d = length of dry sample.

2. Apparatus and Materials

- 2.1 Paper cups 200 mL
- 2.2 Spatula
- 2.3 25 mL plastic syringe with a 1 cm diameter orifice
- 2.4 Calipers or travelling microscope

3. Reagents

- 3.1 Water

4. Procedure

- 4.1 Fill a paper cup about half full with <2 mm soil. Add water and mix with a spatula until a paste slightly drier than saturation is obtained. After covering, allow the paste to equilibrate for 24 hours.
- 4.2 Readjust the paste to the proper moisture content. The paste should glisten slightly, but should not flow when tilted. The surface of the paste should become smooth after repeatedly tapping the cup on the table. With the plunger removed and using the spatula, load the syringe with soil paste. Insert the plunger and tap on the table to get rid of any bubbles that may be present in the paste.
- 4.3 After discarding the first 3 cm, extrude as many rods as possible that are 5-7 cm long. The surface on which the rod is laid is important because the rod may curl. Teflon is superior because of its low coefficient of friction and wet soil will not adhere to it. To prevent the rod from curling when placed on any other surface the rod must be rolled 1/4 turn after measuring the length and the exterior starts to dry.

4.4 Measure the lengths of the rods. After the rods are air dry (about 48 hours) remeasure the lengths. Experiments have shown that making a groove at each end of the rod and measuring with calipers is fairly accurate, but inserting a fine wire through each end of the rod and measuring with a travelling microscope is much more accurate.

5. Calculations

$$5.1 \text{ COLE rod} = \frac{L_m - L_d}{L_d}$$

where L_m = length moist and L_d = length dry

6. Interpretation of Results

6.1 The COLE rod value for a sample is determined by averaging the values obtained for many rods. COLE rod values are less than 0.2.

7. References

7.1 Schafer, W.M. and Singer, M.J. 1976. A new method of measuring shrink-swell potential using soil pastes. *Soil Sci. Soc. Am. J.* 40:805-806.