HEAT CONDUCTIVITY AS AN INDEX OF SOIL MOISTURE

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Electrical conductivity methods of measuring soil moisture have failed because the conductivity of the soil at a given moisture content varies greatly with changes in the salt concentration of the soil solution. A successful method of measuring changes in soil moisture will necessarily be one that uses some property of the soil and the soil solution that is not influenced by changes in the salt content. Heat conductivity should be a property of such a system which would not be materially affected by the presence of ions in solution, since rather large changes in the concentration of a dilute salt solution have very little influence on the thermal conductivity.

The heat conductivity of a dry porous medium, such as soil, must of necessity be low, since the solid materials make only point contacts. The area for continuous heat flow through soil materials is very small. A negligible amount of the heat is conducted by the air in the pores, since air is a much poorer conductor than the soil solids. As water is added to the soil, the area through which heat can flow will increase tremendously since the water will form wedges around the points of contact. Water is not as good a conductor of heat as the solid soil material, but it is a far better conductor than air. Thus, it is to be expected that the heat conductivity of a soil will increase with its moisture content. The investigations of Patten bear out this conclusion.

In view of the above considerations, an investigation of the heat conductivity of soil was undertaken with the following objectives: (1) To find a relatively simple method of measuring the changes in heat conductivity of a soil at various moisture contents; (2) to study the relationship between heat conductivity and moisture content; (3) to verify the conclusion that variations in the concentration of salts in the soil solution will not affect the conductivity of heat, and (4) to study the possibilities of using heat conductivity as an index of the changing moisture conditions of the soil in situ.

The instrument devised for measuring the changes in heat conductivity of a soil at varying moisture contents is shown diagrammatically in Fig. 1. It is an adaptation of the Wheatstone bridge. \( R_1 \) is a fixed manganin resistance of about 7 ohms; \( R_2 \) is a variable resistance box; \( B \) and \( C \) are the other two arms of the bridge. They consist of euresistant coils (about 8 ohms) of No. 40 enameled copper wire wound on 6-mm glass tubing. Leads of large copper wire go through the walls of the glass tubing and are soldered to the fine wire. The tubes are sealed water tight. These coils are held stationary by tightly fitting water proof plugs in the bottom of 3/4-inch circular chambers drilled through a cylindrical brass block 3 inches in diameter and 3 inches high. The chambers are closed at the top by rubber stoppers. The brass block is used to maintain equal external condi-

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