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Methylene Bromide as a Manometer Liquid for Tensiometers[1]

Tensiometry is an established method of determining soil pore water pressures. Appropriate use of tensiometers provides data from which the direction and rate of soil water movement can be computed. Commercially available tensiometers use either a mercury manometer or a Bourdon gauge (1) as the pressure indicating device. However, commercially available instruments were insufficiently sensitive to meet our requirements for detecting small changes in pore water pressure in a study of subsurface water movement on the west slopes of the Cascade Range in Oregon. Here, soil water pressure potentials varied between 7 and −30 cm of water during the winter rainy season. The large number of tensiometers required, budget limitations, and the physical characteristics of the study area precluded our use of the more sensitive pressure transducer system (2) or water manometers. For these reasons, we constructed tensiometers with special manometers from commercially available porous ceramic cups, polyvinylchloride pipe, and 0.32-cm diameter nylon pressure tubing. The translucent tubing served both to connect ceramic cups to manometers and filler tubes and to form the manometer tubes.

We used methylene bromide (CH_2Br_2) as the manometer liquid to provide greater sensitivity in measuring pore water pressures. To our knowledge, CH_2Br_2 has not previously been used as a manometer liquid. This chemical is a liquid between −52° and 97°C and has a density of 2.5 g/cm^3 and a coefficient of thermal expansion of 6.24×10^{-4} per °C between 0° and 15°C. It is stocked by major suppliers of chemicals and costs < $10 per 400 cm^3. Because CH_2Br_2 is colorless, it must be dyed so that its interface with water may be seen in the manometer tubes. Calco aviation oil blue was ideal for this purpose.

Manometers were designed to measure a soil water pressure potential of −100 cm of water at a depth of 150 cm. A millimeter rule attached to the manometer support was used to rapidly determine the position of the manometer liquid. A change in height of 0.05 cm corresponds to a change in pressure potential of 0.125 cm of water.

Caution must be used in handling CH_2Br_2 because its vapors are toxic. Mixing solutions, dyeing, and density measurements should be done in a well-ventilated space. Also, the liquid must not contact eyes, skin, or clothing.

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