A Spring-Actuated Maximum Temperature Indicator[1]

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Highlight

Studies of range restoration problems required determination of seasonal variation of maximum air temperatures near the soil surface. More accurate sampling of this important environmental factor is now possible with responsive, easily read, maximum temperature indicators, operating between 38 and 62 C.

Measurement of maximum temperature with temperature-sensitive wax products has been frequently reported. Recently, Hallin (1968) described their use in measuring maximum surface temperatures on cutover lands in the Oregon Cascade Range. Shearer and Hammer (1968) described the use of these waxes to indicate soil temperatures at different depths during prescribed slash burning.

Use of these waxes depends on the ability of the observer to determine that the melting point of the wax has been reached. Change in surface texture of a mark made with a specified wax crayon or actual melting of a wax bead or pellet signifies the presence of an above-melting-point temperature. In situations where an observer is not present, the problem frequently arises of assessing the appearance of the resolidified wax mark or pellet which may not have been appreciably changed by the melting process. In these cases, inclusion of surface materials or deformation of the wax pellet suggests above-melting-point temperatures, but changes in surface characteristics or color are a poor index. Normally, sizable pellets of dissimilarily colored waxes are used for indicators. In field studies, differential heating by the sun of the wax itself may occur due to these varying wax colors.

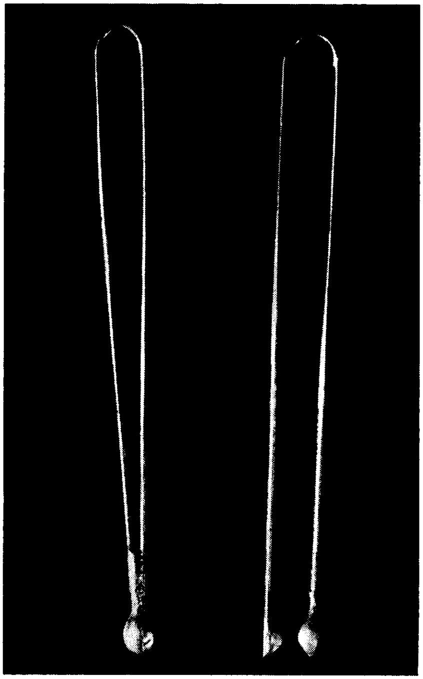

FIG. 1. Temperature indicators before (left) and after (right) exposure to excess temperature.

In a current study of the problems of forest-associated range rehabilitation in eastern Washington, knowledge of the maximum air temperature near the soil surface was required. Although a wax-based indicator appeared suited to this study, solution of some of these customary measurement problems with a more readable, accurate, and inexpensive indicator was attempted. A simple spring wire carrier with a uniformly reflective overcoat of an attached wax drop was found to be a satisfactory compromise. Figure 1 shows two of these indicators, one having been exposed to a temperature in excess of the wax melting point.

In production of these indicators,

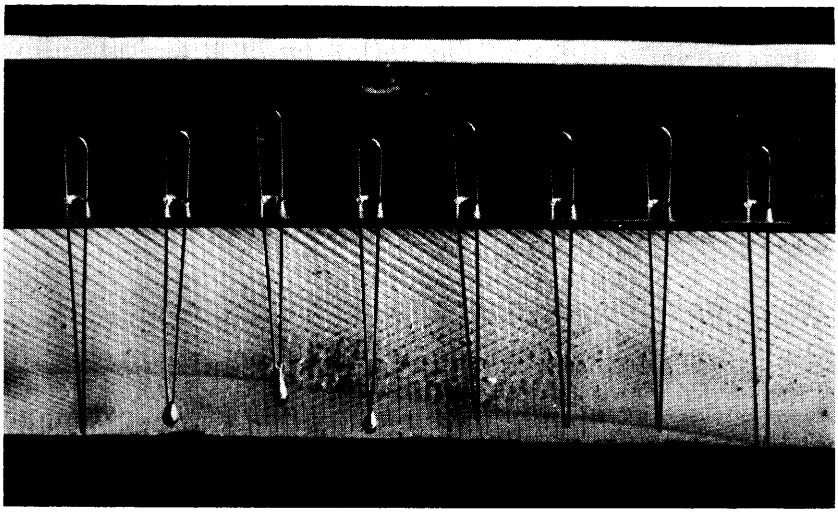

FIG. 2. Coated indicators and wire carriers in dipping jig.

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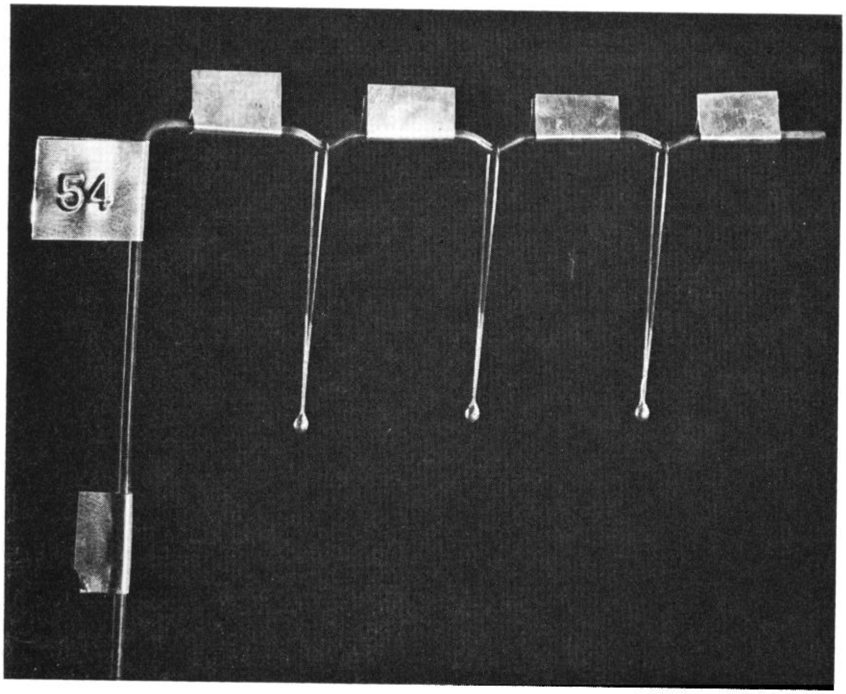

FIG. 3. Wire rack used to support carriers near soil surface. Low temperature carriers loaded at free end.

determining proper spring tension for the carriers and selection of material for the final reflective coating of the wax drop were the primary problems. A satisfactory carrier, one which would not rupture the wax drop below the melting point but would open as the melting temperature was exceeded, was formed from 0.013-inch spring steel wire (music wire). Length of carrier was 1.5 inches with a 0.125-inch separation between wire ends. Dipping the carrier in acrylic floor wax and dusting aluminum powder onto the wet surface produced a durable coating.[2] Other coatings were found to be too strong, holding the carrier closed even after the wax had completely melted.

Figure 2 shows a section of the jig used for producing the indicators. The holes are slightly less than 0.125 inch, which forces the free ends of the carriers to touch when they are inserted. Wax, gently heated in small containers, is applied to each carrier, producing a small bead. A single dip is normally sufficient.

Care is required in heating the wax material since temperatures much in excess of the melting points may cause irreversible changes; i.e., the drop may not solidify. Proper attachment of the bead requires removal of oils and grease from the carriers prior to dipping.

The waxes we used melted at 38, 43, 48, 55, and 62 C. They were selected to separate the melting points by about 5 C and because they formed the most satisfactory beads. (The 48 C wax is quite crystalline and requires some practice to form a good bead. It is also the most susceptible to excessive temperature during the dipping process.)

Air and water bath calibrations were used to test the carriers, both for determination of actual release point and for batch testing of a large number of indicators. Batch testing consisted of subjecting all indicators to temperatures within one degree centigrade of known release temperatures. Actual release temperatures were found to be within 0.5 C among indicators at specified temperatures, and their release point did not vary more than 2 C from the manufacturer's specifications.[3]

Since the waxes cannot be identified after coating, except possibly by some small differences in the bead, a simple rack was provided to support the carriers in a prescribed arrangement (Fig. 3). Originally, wind currents caused some problems (notches in the rack were not deep enough), necessitating the addition of the small metal wings. Lowest temperature indicators were placed closest to the free end. An alternate procedure is to place the indicators directly on the soil surface or at any other height where a maximum temperature determination is desired.

Carriers are reusable if retrieved and cleaned of residual wax. They do not lose spring tension in normal use, even over long periods of time. No care is required in storage or transportation other than maintenance of a temperature below the wax melting point. This may require transportation of the low-temperature indicators in some cooled container.

Literature Cited

HALLIN, W. E. 1968. Soil surface temperatures on cutovers in southwest Oregon. Pacific Northwest Forest & Range Exp. Sta., U.S. Dep. Agr. Forest Serv. Res. Note PNW-78. 17 p.

SHEARER, R. C., AND R. G. HAMMER. 1968. Root mortality following burning of logging slash. Paper presented at 41st Annu. Meeting, Northwest Sci Ass., Ellensburg, Wash., March 22–23, 1968.

[2] Sears No Buffing Acrylic Floor Wax; United States Bronze Powders, Inc., No. 53 Aluminum, Extra Bright. Mention of a specific product does not constitute endorsement.

[3] Tempil Corporation, 132 W. 22nd Street, New York.

Summer Meeting

The Board of Directors and Advisory Council will hold their official midyear meetings immediately prior to the 2nd AIBS Interdisciplinary Meeting, University of Wyoming, Laramie, June 26–27, 1970.