DETERMINATION OF THE MOISTURE CHARACTERISTICS OF BUILDING MATERIALS BY MEANS OF A SECTIONAL COLUMN

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A method is presented for finding moisture characteristics in terms of the moisture potential using a sectional column. The method of conducting the experiments and a discussion of results obtained by this method are given.

In carrying out moisture transfer calculations on multi-layer building elements based on the moisture potential, we use curves giving the dependence of the moisture content of the material on the potential and the coefficients of specific moisture capacity and moisture conduction over the practical range of moisture potential values.

The sectional column takes the form of a vertical prism consisting of layers of test material and a standard material (Fig. 1). These serve as moisture-content "meters." The layers of test material are prepared in the form of plates measuring 40 X 40 X 10 mm. The thickness of 10 mm allows the moisture potential gradient in the layers to be assumed constant without serious error.

Filter paper is used as the standard material and for convenience of working may be bound into packets weighing 0.5 g. Each layer of filter paper in the column consists of two packets or half layers. It is assumed that each half layer measures the potential of the surface with which it is in direct contact. Determination of the potential from the moisture content of the sheet of filter paper directly in contact with the surface of the test plate gives large errors if the moisture is determined gravimetrically, owing to the small weight of a single sheet.

The prism is moisture-proofed at the sides by means of metal screens lined with sheet rubber. To avoid evaporation at the junction between screens and prism a thin rubber strip is laid under the screen. The screens are secured by a screw clamp. It is recommended to start by fitting two opposite parallel screens, after first packing with rubber strip. Thus it is possible visually, and otherwise, to inspect the degree of contact between the test and standard materials. A tight joint between two screens prevents any separation of the layers on further assembly.

The assembled column is supported in a beaker of water, fed through a wick. The gap between beaker and prism is sealed, so that water can evaporate only through the upper face.

Under the influence of the difference in moisture potential between the ends of the column, moisture moves upwards, saturating the layers of test and standard materials and partially evaporating from the upper face. After a time sufficient for all the layers to attain a state of moisture equilibrium, the quantity of water entering the lower face becomes equal to the quantity of moisture evaporating. The onset of this condition is determined from the curve of change in weight of the apparatus with time. The column is then dismantled, and the weight of water in the layers of the test material and the half layers of filter paper is determined. The moisture in the standard material is converted to degrees moisture by the generally accepted method.

Each layer of test material gives one value of the moisture content or coefficient of moisture conduction as a function of the moisture potential.

To obtain $U = f(\Theta)$ for a particular layer $k$, it is sufficient to know the mean moisture content of this layer $U_k$ kg/kg and the mean value of the moisture potential $\Theta_k^{av}$. The $\Theta_k^{av}$ corresponding to this $U_k$ (Fig. 2) in the apparatus is

$$\Theta_k^{av} = (\Theta_k^u + \Theta_k^l)/2.$$
The coefficient of specific moisture capacity \( \eta = \frac{\partial U}{\partial \Theta} \) is determined by differentiation of the moisture content with respect to the moisture potential.

\[
U_k \to \Theta_k^{av} \quad \eta = \frac{\partial U}{\partial \Theta} \quad \kappa_k = \frac{1}{\Delta_k} \left( \frac{U_k - U_{k+1}}{\Theta_k^{av} - \Theta_{k+1}^{av}} \right)
\]

**Fig. 2.** Determination of moisture characteristics by the sectional column method

The coefficient of moisture conduction \( \kappa_k \) for layer \( k \) of the test material is given by:

\[
\kappa_k = i \left[ \left( \frac{\Theta_k^{av} - \Theta_k}{\Delta_k} \right) \right]^{-1}
\]

The value of \( \kappa_k \) obtained relates to the mean value of the potential \( \Theta_k^{av} \).

Tests show that in the construction of the apparatus good contact was achieved between the standard and test materials, especially for moisture contents greater than 150°M. At lower values, of the order of 40°M, the filter paper becomes stiff and more care is necessary to ensure a tight contact. With the help of this apparatus moisture characteristics were determined in the range from 20 to 1100-1200°M. Under the conditions existing in the apparatus a potential of 1100-1200°M corresponds to complete moisture saturation of the filter paper.

The experiments did not last longer than two months.

**Fig. 3.** Moisture characteristics of vibrated cellular concrete (\( \gamma_0 = 8110 \) newton/m\(^3\)), obtained by the sectional column method on moistened (1 – \( \kappa \), 2 – U, 3 – K) and non-moistened (4 – \( \kappa \), 5 – U, 6 – K) specimens

On this apparatus to obtain characteristics at low values of the potential it is necessary to vary the distance \( h \) (Fig. 1) between the water and the end of the column or partially to moisture-proof it.