METHOD OF INVESTIGATING THE MOISTURE CONTENT OF OUTSIDE WALLS

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A method is described for determining the moisture content of outside walls using gamma-ray irradiation by layers.

Methods of measuring water content on the site differ somewhat from analogous measurements made under laboratory conditions, when a narrow collimated beam of gamma-rays can be used. Collimation is difficult to achieve in experiments performed under natural conditions, therefore it is necessary to use a wide beam. In certain circumstances, however, it is possible to eliminate the effect of scattered radiation even when wide beams are used. This is the basis of the developed method. Laboratory experiments were used to establish the minimum possible distance between counter and source required to make the attenuation factors for the test material and water practically independent of the thickness of the absorber. The radiation source (Co^{60}) was enclosed in a lead container 2-2.5 cm in diameter, rigidly joined to the gamma-ray counter by a special frame (radioactive yoke) to synchronize the movement of counter and source. The frame was graduated in mm to make possible the precise location of the measuring position. The scaler was of the M-30 type.

The first step was to measure the moisture content of the furthermost layer on the far side of the wall; then measurements were made every 5-6 cm right up to the near face of the wall. At each point two two-minute measurements were made. To avoid errors due to random inhomogeneities in the material the measurements were made twice: source on left, counter on right, and vice versa.

A qualitative estimation of the rate of drying or wetting is made from the graph of $d\ln(I/I_0)/d\tau$ vs. τ. The figure shows this graph for one of the walls studied; it has the same form as the graph for the drying rate of each individual layer.

The moisture content in the layers at various times is determined from the difference between $\ln(I/I_0)_X$ at time τ_X (time of measuring moisture content) and $\ln(I/I_0)_0$ at τ_0 (time of parallel determination of moisture content by an independent method). The moisture content ω in weight per cent is found from the expression

$$w_M = w_0 + \Delta \ln (I/I_0) \cdot 1000 \cdot 100 / a \gamma d, \qquad (1)$$

where a is determined experimentally for the actual conditions (for the tested installation $a = 0.046$); $\Delta\ln(I/I_0) = \ln(I/I_0)_0 - \ln(I/I_0)_X$; 1000 – the density of water; 100 – to convert the relative value to a percentage; ω_0 – the moisture content of the material at time τ_0, determined by a different independent method.

The method was tested on three lightweight concrete walls in a climatically controlled room with a temperature drop across the wall. The results show that the mean square error of the difference between data obtained by the new method and by control experiments using the drying method is less than ±1% of the moisture content by weight.

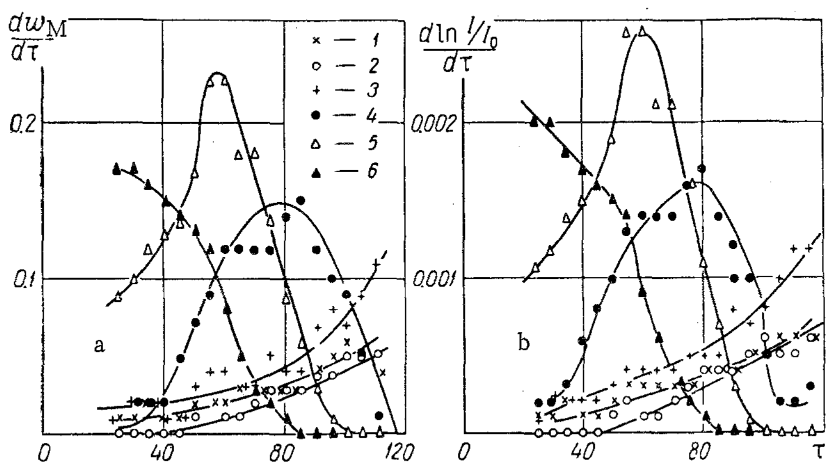

Fig. Variation of drying rate (a) and relative count rate (b) with time, for the different layers of an outside wall made of expanded-shale foam concrete blocks: 1) 26.5 cm; 2) 21.5; 3) 16.5; 4) 11.5; 5) 6.5; 6) 3.5.

Thus the developed method can be used for long-term observations of the moisture regime in walls calculated to give a clear picture of the moisture migration process during an annual cycle.

The method proposed for the measurement of water content is recommended both for laboratory use, for investigations of the dynamics of moisture processes in the walls of buildings, and for developing methods of drying large building elements.

NOTATION

I and I_0 – counts per minute for transmission through absorber and air; a – attenuation factor for water; d – distance between counter and source; γ – density of material investigated.

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