Chapter 5
Gravimetry

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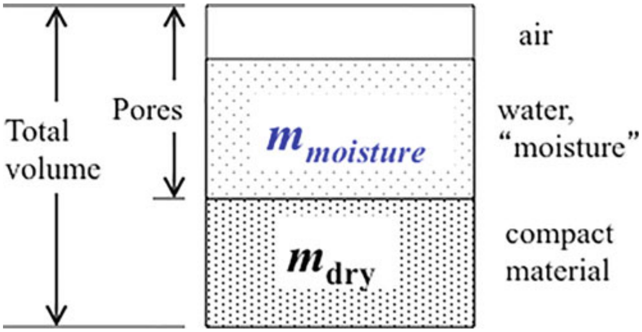
The principle of using gravimetry to measure the moisture content of a sample or a specimen is to determine the weight by a balance before and after drying.

$$m_{\text{wet}} = \text{weight of the wet sample (kg)}$$
$$m_{\text{dry}} = \text{weight of the dry sample (kg)}$$

where m_{wet} equals $m_{\text{moisture}} + m_{\text{dry}}$.



From these two weights the moisture ratio can be presented as by dry weight

$$u = \left(m_{\text{wet}} - m_{\text{dry}}\right)/m_{\text{dry}}\,(-) \tag{5a}$$

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or by wet weight

$$u_{\text{wet}} = \left(m_{\text{wet}} - m_{\text{dry}}\right) / m_{\text{wet}} (-) \tag{5b}$$

In most cases these moisture ratios are given as per cent by dry or wet weight.

The dry weight depends of course on the drying procedure being used. This is described in Chap. 3.

5.1 Errors and Uncertainties

The main errors when using gravimetry to determine the moisture ratio of a sample are five, in principle:

- drying of the sample during sampling and handling, before the wet weight is determined
- loss of material from the sample during handling
- wrong temperature or vapour content in the drying chamber
- incomplete drying
- lack of representativity of a sample of a heterogeneous material.

The moisture loss before the wet weigh determination is mainly connected to the procedure for sampling. This is further described in Chap. 22.

Errors connected to an incomplete drying are possible mostly when drying is carried out directly on-site, as in the case of portable thermo-balances. Here the weight measurement is performed very frequently (intervals of some minutes) and complete drying is not necessarily achieved when measurement stops; moreover weight measurement might be affected by wind, vibrations, etc.

The error connected to lack of representativity can be reduced by taking a larger sample, whose size must be determined on the basis of the nature of the material. Another alternative is to determine the degree of capillary saturation DCS, see Sect. 5.2 and Chap. 27.

5.2 Uncertainty Due to Sample Inhomogeneity

If a composite material consists of a mix of a porous part that can contain moisture and a non-porous part that has no moisture content, the determination of the moisture ratio of such a material depends on the representativity of the sample taken. With small samples from a material with large non-porous parts the representativity might be extremely bad. An obvious example is a small sample from a concrete with large aggregate particles.

The error E of the representativity can be expressed by

$$E = \Delta m_{\mathrm{dry}} \big/ m_{\mathrm{dry}} (-) \tag{5.2.1}$$

where m_{dry} is the dry weight of a perfectly representative sample and Δm_{dry} is the weight of the "additional" amount of non-porous parts making the sample non-representative.

The moisture ratio u of such a sample would be

$$u = \left(m_{\mathrm{wet}} - m_{\mathrm{dry}}\right) \big/ \left(m_{\mathrm{dry}} + \Delta m_{\mathrm{dry}}\right) \tag{5.2.2}$$

which is equal to

$$u = \left(m_{\mathrm{wet}} - m_{\mathrm{dry}}\right) \big/ \left(m_{\mathrm{dry}}(1 + \mathrm{E})\right) = u_0/(1 + \mathrm{E}) \tag{5.2.3}$$

where u_0 is the moisture ratio of a perfectly representative sample. The error in the moisture ratio is a factor of 1/(1 + E).

The error is of course smaller the larger sample (larger m_{dry}) that is taken. To overcome the drawback when it is essential to take small samples from a heterogeneous material the degree of capillary saturation can be determined, see Chap. 27.