CEN REPORT

RAPPORT CEN

CEN BERICHT

CR 13902

May 2000

ICS

English version

Test methods for determining the water/cement ratio of fresh concrete

This CEN Report was approved by CEN on 10 April 2000. It has been drawn up by the Technical Committee CEN/TC 104.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. CR 13902:2000 E

Contents

Page

1 Introduction

1.1 General

In prEN 206-1, Concrete - Performance, production and conformity, there is a statement, in clause 5.2.2.2 Cement content and water/cement ratio, that if required, water/cement ratio may be determined by an agreed test method. This Technical Report reviews the test methods which are available for this purpose.

Before proceeding further, it is important to consider the definition of relevant terms in pr EN 206-1 and the possible constituents of cement listed in pr EN 197-1, Composition, specifications and conformity criteria for common cements.

1.2 Definitions in pr EN 206-1

Cl. 3.27 Cement (hydraulic binder): "A finely ground inorganic material which, when mixed with water, forms a paste which sets and hardens by means of hydration reaction and processes and which, after hardening, retains its strength and stability even under water".

Cl. 3.28 Effective water content: "The difference between the total water present in the fresh concrete and the water absorbed by the aggregate.

The total water is the added water plus water already contained in the aggregates and on the surface of the aggregates plus water in the admixtures and in additions used in the form of a slurry and water from any added ice or steam heating".

Cl. 3.29 Water/cement ratio: "Ratio of the effective water content to cement content by mass in the fresh concrete".

1.3 Possible constituents of cements in pr EN 197-1

Cl. 5 Constituents: The sub-clauses in this main clause describe the main constituents of the different types of common cement as:

Portland cement clinker
Granulated blastfurnace slag
Pozzolanic materials (natural and artificial)
Fly ashes (siliceous and calcareous)
Burnt shale
Limestone
Silica fume

1.4 Points of significance for the determination of water/cement ratio

As a consequence of the definitions in prEN 206-1 and the possible constituents of cements in prEN 197-1, two major points of significance emerge for test methods to determine water/cement ratio:

(1) The quantity of water to be used in any determination of water/cement ratio, must exclude any water contained within the aggregate in the concrete.

(2) Some of the constituents of cements which may be used in concrete are possibly indistinguishable, chemically and mineralogically, from additions and some aggregates.

It follows from these two points that the problem of measuring water/cement ratio on a sample of fresh concrete about which nothing is known is very difficult and probably impossible. The problem is simplified if certain constituents are known to be present, together with information on their chemical or physical properties. The more that is known, the more tractable the problem and the more certain the result from any measurement.

2 Available test methods:

2.1 General

The subject of the measurement of water content, cement content and water/cement ratio has been very well reviewed by Grube of VDZ [(1)]. Consequently this report limits itself to considering the more important of the available methods.

2.2 Water content

Water content by weight can be determined by simple weight loss during drying, using a conventional or microwave oven. In order to determine the effective water content by volume (l/m^3) in the fresh concrete, the density of the fresh concrete must be measured, using EN 12350-6, Determination of density of fresh concrete. Then, allowance must be made for the water absorbed by the aggregate. The water absorbed by the aggregate may be measured by firstly separating it from a sample of fresh concrete by wet sieving and then measuring the weight loss on drying as before.

The water content of fresh concrete can also be measured from the change in chemical concentration of a standard solution when mixed with the fresh concrete. Sodium chloride solution is mentioned in reference 1. The method requires calibration curves to relate the change in concentration to the water content. Its advantage is that it directly measures the effective water content i.e. no correction is required for water absorbed by the aggregate.

Measurement of the water content is also part of the analysis of fresh concrete by methods described later in this report.

According to reference 1, the methods of measuring the water content of fresh concrete are capable, at best, of an accuracy of 6-7kg/m^3 and with coefficients of variation of 3-5%.