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Kurzfassung / Summary

Thema: **Comparability of two methods to test frost resistance of concrete**

Vergleichbarkeit von zwei Laborprüfverfahren zur Untersuchung des Frostwiderstands von Beton
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Short Summary

In Germany there are essentially two methods normally used to test the frost resistance of concrete. External damage is simulated in the cube test according to the German Cement Works Association (VDZ). The CIF test is used to assess external and internal damage.

In the present investigations, a correlation was sought between scaling during the cube test and the internal damage measured during the CIF test, in order to unify the regulations on the testing methods of frost resistance. In the case of a correlation between the cube test and the CIF test, it would be possible to use all previous results from the cube test in the evaluation of the frost-resistance of concrete.

Specimens were cast with standard concrete mixes containing different cement types (w/c = 0.60 and 0.50 with cement contents of 300 and 320 kg/m³, respectively). Additionally four high performance concretes were tested: two self-compacting concretes (SCC) with fly ash and ground limestone, one mass concrete and one grouting. In all cases, the usual fresh concrete properties were determined and the compressive strengths measured at an age of 28 d. The frost resistance was tested according to the cube and the CIF test.

The investigations concentrated on finding a correlation between the results of the cube test (using concretes with w/c = 0,60 and cement content 320 kg/m³) with the results of the CIF test (using concretes with w/c = 0.50 and cement content 320 kg/m³).

A correlation between the total mass of scaling material in the cube test and the internal damage in the CIF test specimen could be proven for concretes compositions with different cements confirming to DIN 1045. The acceptance criterion in the cube test was a maximum of 10 wt.% total amount of scaled material after 100 freeze-thaw cycles; the acceptance criterion of the CIF test was a maximum decrease of the relative dynamic modulus by 40 % after 56 freeze-thaw cycles. Concretes that had a high frost resistance according to the cube test showed mostly an even high frost-resistance over all 56 freeze-thaw cycles of the CIF test.

However, this correlation was not found for concretes with high contents of small particles < 0.125 mm. The high performance concretes (e.g. SCC) investigated had a small total mass of scaling material after the cube test (100 freeze-thaw cycles), but a high degree of internal damage after the CIF test (56 freeze-thaw cycles). According to the above mentioned acceptance criterion for the CIF test, these concretes are classified as having no frost-resistance. However, if the results are evaluated according to a guideline published by the German Federal Waterways Engineering and Research Institute (Merkblatt der Bundesanstalt für Wasserbau) where a maximum decrease of the relative dynamic modulus of 25 % after 28 freeze-thaw cycles is accepted, all these concretes have sufficient frost resistance. The results illustrate the importance of one generally accepted criterion to assess the frost resistance of all types of concrete including high performance concretes (e.g. SCC). This requires the definition of a suitable acceptance criterion based on the present results.