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A new technique for measuring the air permeability of near-surface concrete

R. K. Dhir, P. C. Hewlett, E. A. Byars and I. G. Shaaban

Contribution by B. K. Nyame

I was interested to read the paper by Dhir, Hewlett, Byars and Shaaban on their new technique for the air permeability of near-surface concrete. The vacuum technique has incredible potentials for durability testing in everyday concrete technology.

Firstly, they noted from their tests that: 'Air bubbles started to emerge from the concrete surface, around the chamber, and the top 20 mm of the cube sides'. This type of flow is typical of poor seal, poor quality, or flow through cracked concrete. The resulting steady vacuum pressure at tests may therefore be used to indicate the concrete quality and the probability of loss of durability. Next, air contains 78% nitrogen. In nitrogen adsorption tests¹ for pore structures, in vacuum, there are ink bottle pore effects to consider, particularly at low temperatures. These will indicate much lower calculated permeability if using the gas transport theory of Dhir *et al.*, which considers the Knudsen molecular flow, slip flow and Poiseuille viscous flow. Ink bottle pores, usually at the paste–aggregate interfaces, and in the cement pastes, have large cavities, but narrow entrances for the air and vapour flow in concrete.

Finally, Dhir, Hewlett, Byars and Shaaban may care to comment on:

- (a) the effects of blocked ink bottle pores and temperature on their permeability calculations
- (b) the use of their data of the steady state vacuum pressure, before the pressure recovery commences, to indicate durability levels.

Reply by the authors

The authors would like to thank Mr B. K. Nyame for expressing this interest in their new technique for measuring air permeability of near-surface concrete. That the method has potential for the non-destructive testing of concrete for the assessment of its durability is indeed very encouraging.

It is unlikely, within the ambient temperature ranges that would be experienced by the equipment, that temperature will have a profound effect on measured permeability values, although testing below freezing point would not be recommended for obvious reasons. As Mr Nyame points out, ink bottle pores are likely to affect

permeability measurements. However, this technique aims to assess general surface quality and thereby durability in a non-destructive manner, and therefore such porosity features are unlikely to have a profound effect on such an assessment.

The suggestion of using steady state vacuum pressure as a means of assessing durability is an interesting possibility. As discussed in the paper, it was decided to minimize seepage by coating the surrounding surfaces

with grease. Therefore, no meaningful steady state data are available. However, this possible additional means of assessment of the quality of concrete certainly merits investigation.

Reference

1. GREGG J. and SING K. W. S. *Adsorption, surface area and porosity*. Academic Press, London, 1967.