XV International Conference on Durability of Building Materials and Components
DBMC 2020, Barcelona
C. Serrat, J.R. Casas and V. Gibert (Eds)

Improving Frost Durability Prediction based on Relationship between Pore Structure and Water Absorption

Mohamed A. Aldabibi[1], Michelle R. Nokken[2] and Hua Ge[3]

[1] Ph.D. Candidate, Dept. of Building, Civil & Environment Engineering, Concordia University, Montreal, Canada, M_aldabibi@yahoo.com

[2] Professor. Dept. of Building, Civil & Environmental Engineering, Concordia University, Montreal, Canada, m.nokken@concordia.ca

[3] Associate Professor, Dept. of Building, Civil & Environmental Engineering, Concordia University, Montreal, Canada, Hua.Ge@concordia.ca

Keywords: *Clay Brick, Frost Resistance, Water Absorption, and Pore Structure.*

1 Introduction

In North America, clay bricks are qualified as durable if they meet either the ASTM C216 or CAN/CSA A82.1 standard. The CSA A82.1 standard depends on a direct determination of compressive strength and water absorption (WA). In other words, three conditions should be met which are the minimum compressive strength, maximum water absorption (*i.e.*, 24-h CWA), and maximum saturation coefficient (C/B) (CSA-A82.1, 2006). Although these standards are widely used in North America, they have not been linked with pore Structure (PS). Furthermore, moisture content and pore structure (PS) are two significant parameters that influence the performance of clay bricks during the freezing-thawing process. Thus, finding a relationship between them will lead to a quick assessment of WA and frost resistance (FR). This work aims to investigate the mutual relationship between the PS and WA of clay bricks.

Five different types of clay bricks, as shown in Table 1, were examined. WA of brick samples was determined according to CAN/CSA A82.1 standard. Mercury Intrusion Porosimetry (MIP),which has been known as a suitable method to examine the PS of mineral building materials since 1970 (Rubner and Hoffmann, 2006), was used to determine total porosity and pore size distribution (PSD). The variation of 24-h cold water absorption (CWA) among samples of each type of brick was analyzed and each type of brick was divided into three groups according to their 24-h CWA: low – medium – high. The PSD of bricks was also divided into several ranges based on the pore size. The results indicated that some types of brick have a wide variation in 24-h CWA, which could affect the frost resistance evaluation. The strong relationship between WA and PSD was found, which could be used as a base for determining 24-h CWA.

Table 1. Different types of bricks used in this study.

Brick Type	Brick name	Samples number	Nomenclature
Reclaimed exterior brick	LAPRAIRIE	35	PO
	OUTREMONT	35	UO
New exterior brick	BRGG52	35	B52
	OLD ENGLAND	35	OE
Reclaimed interior brick	MOLLE	35	MO

The results from WA test and PSD determination were plotted against each other. The regression analysis was used to derive a correlation between 24-h CWA and PSD. The results indicated that some types of brick have a wide variation in 24-h CWA, which could affect the frost resistance evaluation. The variation may attribute to manufacturing process control and conditions exposed through their service life for reclaimed bricks. The strong relationship between 24-h CWA and PSD also was found, which could be used as a base for determining 24-h CWA. Furthermore, a study about the relationship between the critical degree of saturation and PSD will be worthwhile to add a good contribution to the evaluation of frost resistance of clay brick.

ORCID

Mohamed A. Aldabibi: http://orcid.org/0000-0003-2146-9062
Michelle R. Nokken: http://orcid.org/0000-0002-5090-0248
Hua Ge: http://orcid.org/0000-0003-1368-4301

References

CSA-A82.1. (2006). *Fired Masonry Brick Made from Clay or Shale, Canadian Standards Association.* Canadian Standard Association.

Rubner and Hoffmann (2006). Characterization of mineral building materials by mercury - intrusion porosimetry. *Particle systems characterization* , 20-28.