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Frost resistance and biocorrosion of ceramic composites

Vojo Jovanov[a*], Snezana Petrovic[b], Sinisa Markov[b], Biljana Angjusheva[a], Emilija Fidancevski[a], Jonjaua Ranogajec[b]

[a] *Ss. Cyril and Methodius University in Skopje, Faculty of Technology and Metallurgy, Skopje, Republic of North Macedonia*

[b] *University of Novi Sad, Faculty of Technology, Novi Sad, Serbia*

*vojo@tmf.ukim.edu.mk

Frost resistance mechanisms and biocorrosion as major processes that leads to weathering of ceramics are of great practical and scientific interest upon their exposure to surrounding environmental conditions.

The aim of this work was to define the influence of different deterioration mechanisms regarding both frost and biocorrosion actions on ceramic composites in which a significant part of the clay (40 wt.%) was replaced with fly ash. The ceramic composites made of local clay and fly ash from thermal power plant "REK" Bitola, were fabricated in laboratory conditions by pressing (P = 45 MPa) and sintering at 1100ºC, with heating rates of 3 and 10 º/min.

The frost resistance investigation was conveyed through a double approach: calculating durability through textural characteristics (obtained by mercury intrusion porosimetry and low-temperature nitrogen adsorption method) and performing low-temperature dilatation measurements on water saturated and dray samples.

Based on the obtained results and estimated susceptibility to different frost action mechanisms (closed container, micro ice lens and hydraulic pressure) it can be concluded that the balance of all three mechanisms indicates good frost resistance and that the ceramic structure was capable for regulating and compensating possible local stresses during the freezing. In addition, the ceramic composite sintered at 1100ºC with heating rate of 10º/min showed slightly higher stability to frost action deterioration and it was used for biocorrosion investigation.

The biocorrosion was performed by following Aspergillus niger colonization on ceramic composite. Only aesthetic changes on the surface of the ceramic composite without any internal and chemical degradation were detected.

In summary, the obtained durability investigations are encouraging, showing that utilization of fly ash (40 wt.%) in ceramic composites is possible, without significant negative impact on their frost resistance and biocorrosion properties.

Keywords: ceramic, frost action mechanisms, biocorrosion, porosity, fly ash