DOMINIKA STAŃCZAK
BEATA JAWORSKA

INFLUENCE OF AGRICULTURAL BIOMASS FLY ASH CEMENT SUBSTITUTION ON THE CARBONATION OF CEMENT AND POLYMER-CEMENT COMPOSITES

WPŁYW POPIOŁU LOTNEGO Z BIOMASY ROLNICZEJ NA KARBONATYZACJĘ KOMPOZYTÓW CEMENTOWYCH I POLIMEROWO-CEMENTOWYCH

Structure and Environment No. 2/2020, vol. 12, p. 66 DOI: 10.30540/sae-2020-007

Abstract

Practical use of a new type of combustion waste such as an agricultural biomass fly ash in the building materials requires an assessment of its performance. The paper presents the investigation results on the influence of cement substitution (5% and 30%) by this ash on the cement and polymer-cement composites resistance to carbonation. The composites resistance was assessed on the basis of carbonation process over time (up to 360 days) using the phenolphthalein method. It was found that fly ash from agricultural biomass increases the susceptibility to carbonation of polymer-cement composites to a lesser extent than cement composites compared to composites containing siliceous coal fly ash.

Streszczenie

Praktyczne wykorzystanie w materiałach budowlanych nowego odpadu, jakim jest popiół lotny z biomasy rolniczej, wymaga oceny jego właściwości użytkowych. W pracy zaprezentowano wyniki badań wpływu substytucji cementu (5% i 30%) tym popiołem na odporność kompozytów cementowych i polimerowo-cementowych na karbonatyzację. Odporność kompozytów oceniono na podstawie przebiegu procesu karbonatyzacji w czasie (do 360 dni) za pomocą metody fenoloftaleinowej. Na podstawie wyników stwierdzono, że popiół lotny z biomasy rolniczej powoduje zwiększenie podatności na karbonatyzację kompozytów polimerowo-cementowych w mniejszym stopniu niż kompozytów cementowych w porównaniu do kompozytów zawierających popiół lotny krzemionkowy.

REFERENCES

[1] Johannesson, B. and P. Utgenannt, *Microstructural changes caused by carbonation of cement mortar*. Cement and Concrete Research, 2001. 31(6): p. 925-931.
[2] Papadakis, V.G., C.G. Vayenas, and M.N. Fardis, *Fundamental Modeling and Experimental lnvestigation of.* ACI Materials Journal, 1991. 88(4).
[3] Emmons, P. and A. Vaysburd, *System concept in design and construction of durable concrete repairs*. Construction and Building Materials, 1996. 10(1): p. 69-75.
[4] Vaysburd, A. and P. Emmons, *How to make today's repairs durable for tomorrow corrosion protection in concrete repair*. Construction and Building Materials, 2000. 14(4): p. 189-197.
[5] Ohama, Y., *Polymer-based admixtures*. Cement and Concrete Composites, 1998. 20(2-3): p. 189-212.
[6] State of the art report on polymer-modified concrete, in ACI Manual of Concrete Practice, Part-5, A.C. Institute, Editor. 2000: Famington Hills, USA.
[7] Ohama, Y., *Principle of latex modification and some typical properties of latex-modified mortars and concretes adhesion; binders (materials); bond (paste to aggregate); carbonation; chlorides; curing; diffusion*. Materials Journal, 1987. 84(6): p. 511-518.
[8] Mirza, J., M. Mirza, and R. Lapointe, *Laboratory and field performance of polymer-modified cement-based repair mortars in cold climates*. Construction and Building Materials, 2002. 16(6): p. 365-374.
[9] Aggarwal, L., P. Thapliyal, and S. Karade, *Properties of polymer-modified mortars using epoxy and acrylic emulsions*. Construction and Building Materials, 2007. 21(2): p. 379-383.
[10] Nepomuceno, A.A. and C. Andrade, *Steel protection capacity of polymeric based cement mortars against chloride and carbonation attacks studied using electrochemical polarization resistance.* Cement and Concrete Composites, 2006. 28(8): p. 716-721.
[11] Al-Zahrani, M., et al., *Mechanical properties and durability characteristics of polymer-and cement-based repair materials*. Cement and Concrete Composites, 2003. 25(4-5): p. 527-537.

[12] Wieczorek, G., J. Bryłka, and M. Bołtryk, *Korozja zbrojenia inicjowana przez chlorki*. Cement Wapno Beton, 2002. 7(69, nr 4): p. 158-162.
[13] Woliński, P., P. Woyciechowski, and G. Adamczewski, *Effect of calacreous fly ash on the carbonation progress in concrete*. Mater. Bud, 2015. 12: p. 24-25.
[14] Brandt, A., et al., *Zastosowanie popiołów lotnych z kotłów fluidalnych w betonach konstrukcyjnych*. Studia z zakresu inżynierii, 2010. 72: p. 339-351.
[15] Woliński, P., et al. *The influence of the mineral additives on the carbonation of cement composites*. in MATEC Web of Conferences. 2018. EDP Sciences.
[16] Wang, S. and L. Baxter, *Comprehensive study of biomass fly ash in concrete: Strength, microscopy, kinetics and durability*. Fuel Processing Technology, 2007. 88(11-12): p. 1165-1170.
[17] Teixeira, E.R., et al., *Recycling of biomass and coal fly ash as cement replacement material and its effect on hydration and carbonation of concrete*. Waste Management, 2019. 94: p. 39-48.
[18] PN-EN 196-1 *Methods of testing cement*. *Determination of strength*.
[19] PN-EN 13295:2005 *Products and system for the protection and repair of concrete structures - test methods - determination of resistance to carbonation*. 2005.