

Accepted Manuscript

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PII: S0958-9465(16)30378-X

DOI: [10.1016/j.cemconcomp.2017.11.010](https://doi.org/10.1016/j.cemconcomp.2017.11.010)

Reference: CECO 2940

To appear in: *Cement and Concrete Composites*

Received Date: 15 July 2016

Revised Date: 29 September 2017

Accepted Date: 7 November 2017

Please cite this article as: P.P. He, C.S. Poon, D.C.W. Tsang, Comparison of glass powder and pulverized fuel ash for improving the water resistance of magnesium oxychloride cement, *Cement and Concrete Composites* (2017), doi: 10.1016/j.cemconcomp.2017.11.010.

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10 **Abstract:** The water resistance of magnesium oxychloride cement (MOC) incorporating
11 glass powder (GP) and pulverized fuel ash (PFA) with and without CO₂ curing was
12 investigated in terms of the strength retention coefficient and the volume stability. The
13 microstructure was studied using quantitative X-ray diffraction (QXRD), thermogravimetry
14 (TG), scanning electron microscopy (SEM) and transmission electron microscopy (TEM).
15 The results show that the effect of incorporating GP on the water resistance is much lower
16 than that of PFA due to the lower pozzolanic activity of GP generating a lower amount of
17 magnesium silica hydrate gel (M-S-H gel). The MOC incorporated with GP or PFA showed
18 high water resistance after CO₂ curing due to the higher quantity of amorphous gel that
19 formed a much denser interlocking network.
20

21 **Keywords:** Magnesium oxychloride cement (MOC); CO₂ curing; microstructure; gel
22 formation; water resistance
23

24 1. Introduction

25 Magnesium oxychloride cement (MOC) is formed by mixing magnesium oxide with an
26 aqueous solution of magnesium chloride. This is a potential cementitious material used for
27 fire protection[1], grinding wheels[2, 3] and industrial flooring[4] due to its better
28 performance over conventional Portland based cements, such as good fire resistance[5], good
29 resistance to abrasion[6] and low thermal conductivity[7]. Besides, it does not need wet
30 curing and provides a high early strength[8].
31

32 However, its application is mainly limited by the instability of MOC in water[9, 10]. It was
33 reported that the residual compressive strength of MOC paste cured for 15 days in a dry
34 environment was reduced by about 90% after additional 28 days of immersion in water[9].
35 The reason is that the main hydration products in MOC, Phase 5 (5Mg(OH)₂•MgCl₂•8H₂O)
36 and Phase 3 (3Mg(OH)₂•MgCl₂•8H₂O), are unstable in water and progressively decompose to
37 Mg(OH)₂ and other soluble ions, thus leading to the significant decrease of compressive
38 strength[11]. Adding water-soluble phosphate was considered to be a simple and efficient
39 method to improve the water resistance. The compressive strength of MOC paste hardened in
40 air for 28 days decreased only by 15.5% after 3 months of water immersion after the addition
41 of 0.5% H₃PO₄ and 5% K₃PO₄ (by weight of mixture of additives and magnesia)[12].
42 However, adding additives increases the cost of MOC based products. On the contrary, the

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