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## POZZOLANIC PROPERTIES OF GLASS POWDER IN CEMENT PASTE

Nafisa Tamanna<sup>1</sup>, Norsuzailina Mohamed Sutan<sup>2</sup>, Rabin Tuladhar<sup>1</sup>, Delsye Teo Ching Lee<sup>2</sup> and Ibrahim Yakub<sup>3</sup>

<sup>1</sup>College of Science and Engineering, James Cook University, QLD 4811, Australia

<sup>2</sup>Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia

<sup>3</sup>Department of Chemical and Biological Engineering, University of Sheffield, Sheffield S1 3JD, United Kingdom

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Corresponding author's email: nafisa.tamanna@my.jcu.edu.au

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**Abstract** – This paper investigates the formation of Calcium Silicate Hydrate (C-S-H) as a product of pozzolanic reactions in a cement paste with cement partially replaced with crushed recycled glass at the rate of 10% and 20%. Three different particle sizes for crushed glass used in this study were in the range of 150-75 $\mu$ m, 75-38 $\mu$ m and lower than 38 $\mu$ m; and a water to cement ratio of 0.45 was used for all specimens. This study showed that the formation of Calcium Hydroxide Ca(OH)<sub>2</sub> is decreased while the formation of C-S-H is increased simultaneously at 90 days for 75-38 $\mu$ m and <38 $\mu$ m glass powder. The use of waste glass as a partial cement replacement improves the cement strength through the formation of C-S-H due to the pozzolanic reaction with Ca(OH)<sub>2</sub> improving the strength of the mortar.

**Keywords:** Pozzolanic Properties, Calcium Silicate Hydrate, Cement Replacement, Waste Glass Powder, Hydration.

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### 1.0 INTRODUCTION

GLASS is one of the most fundamental materials that we abundantly use in our day to day life. The amount of waste glass generation also increases with the increase in the use of glass. In theory, glass is a 100% recyclable material; it can be indefinitely recycled without any loss of quality [1]. However, the recycling rate of waste glass is still low compared to other solid wastes due to the cost of cleaning and color sorting, mixing of broken pieces, inconsistency of glass properties, mixing with impurities and increasing shipping cost [2]. Use of waste glass as a partial replacement in construction industry gives a new avenue of using recycled waste glass. Recent work has shown that crushed recycled glass has pozzolanic properties which make it possible to use as a partial cement replacement in concrete and cement mortar [3 - 5].

Waste glass that exhibits either binding properties or pozzolanic properties can be used as a partial cement replacement [6 - 9]. A typical pozzolanic material features three characteristics: it should contain high silica, be X-ray amorphous, and have a large surface area. Glass has sufficient silica content and is amorphous in nature [10]. The glass may satisfy as a pozzolanic material if it is ground to activate pozzolanic behavior. Smaller size of glass will reduce the Alkali Silica Reaction as well [6, 11]. The pozzolanic properties of glass powder can be obtained from its microstructure analysis in terms of hydration. This paper deals with the formation of hydration compounds Calcium Silicate Hydrate (C-S-H) and Calcium Hydroxide (CH), which shows the pozzolanic properties of sample containing three sizes of glass powder (i.e. 150-75 $\mu$ m, 75-38 $\mu$ m and <38 $\mu$ m) through Differential Thermal Analysis (DTA) and Scanning Electron Microscope (SEM). In this experiment, glass powder is partially replaced as cement with 10 to 20 percent by weight.