

Mix proportion for medium grade concrete with silica fume as cement replacement for general purpose construction

A Rashidi^{1*}, M I S Mohammad Zain¹ and R Ahmadi¹

¹ Department of Civil Engineering, Faculty of Engineering, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia.

*Corresponding author: razida@unimas.my

Abstract. There are many demands of concrete in construction leading to the use of industrial waste as mineral additive or supplementary filler to improve the concrete performance and lower production cost. Silica fume is a distinct industrial waste. The making of silica fume concrete is made by case basis based on specific needs especially for the production of prescribed High Performance Concretes. In this study, the use of silica fume for low/medium grade concrete for general production is investigated [1]. It is an attempt to find a mix proportion with recommended silica fume replacement to produce a medium grade concrete for general purpose construction. Silica fume as cement replacement greatly increase the mechanical and durability properties of concrete. The concrete mix with 10% silica fume replacement gives the most practical replacement percentage resulting to a 32% strength increase compared to concrete with no silica fume. It is also possible to produce a normal grade concrete using a standard M40 mix proportion. Concrete samples with less than 10% cement replacement did not show significant differences in mechanical and durability properties compared to the reference sample.

1. Introduction

Concrete has a significant use in construction world that has made it became an important material in construction. The increasing demand of cement which requires production of cement at large scale consequently result in environmental problems, depletion of natural resources and increasing price [1-2]. To overcome these problems, numerous researches on the use of industrial waste as mineral additive or supplementary filler to improve the concrete performance to lower cost [3]. In Sarawak, most of these industrial waste included silica fume (SF), are categorized as schedule waste. As such it is expensive to dispose these waste materials. Latest advancement in new concrete almost invariably use mineral admixtures due to numerous advantages especially for the improvement of strength, durability, economy and ecological factors [4]. Despite its high price, silica fume's addition as one of the concrete admixtures seems to be promising when the aspect of very high strengths and durability are needed [4]. The silica fume is among the most popular industrial-by-product cementitious material from the smelting process in the silicon and ferrosilicon industry [1]. Silica fume is known to be a very reactive pozzolan because of the chemical content and physical properties. Due to its smaller size than cement, which is 100 to 150 times smaller, it acts as filler and contribute towards improving the properties of concrete. Silica fume is added to concrete mixtures for better workability, strength, high density, low permeability and resistance to chemical attack [3].

Extensive researches had been done to formulate silica fume as supplementary addition to cement in conventional concrete [1-4]. Bhanja et al [4] suggested a modified water-cementitious material ratio

