



Effect of copper slag on mechanical properties of self-compacting concrete

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Abstract

The building industry is turning increasingly to the use of self-compacting concrete (SCC) in order to improve many aspects of building construction as SCC offers several advantages in technical, economical and environmental terms. Fresh SCC flows into place and around obstruction under its own weight to fill the formwork completely and self-compact without any segregation and blocking. Copper slag is a by-product obtained during the matte smelting and refining of copper. Current options of management of this slag are recycling, recovering of metal, production of value added products and disposal in slag dumps or stockpiles. This paper presents the result of a study undertaken to investigate the feasibility of using copper slag as a fine aggregate in self-compacting concrete. The results indicate that 30% of copper slag can be successfully used as sand replacement to obtain SCC with comparable strength characteristics.

Keywords: Self-compacting concrete, Copper slag, Silica fume, Mechanical properties.

1. INTRODUCTION

Self-compacting concrete (SCC) is a concrete mix that in its fresh phase, homogeneously flows by its own weight, and fills out the formwork properly and encloses the reinforcement without any external vibration. It was in the middle of 1980th that self-compacting concrete first was developed and introduced at Tokyo University [1].

Aggregates are considered one of the main constituents of concrete since they occupy more than 70% of the concrete matrix. In many countries there is scarcity of natural aggregates that are suitable for construction while in other countries there is an increase in the consumption of aggregates due to the greater demand by the construction industry. In order to reduce dependence on natural aggregates as the main source of aggregate in concrete, artificially manufactured aggregates and artificial aggregates generated from industrial wastes provide an alternative for the construction industry. Therefore, utilization of aggregates from industrial wastes can be alternative to the natural and artificial aggregates [2]. In the last few decades there has been rapid increase in the waste materials and by-products production due to the exponential growth rate of population, development of industry and technology and the growth of consumerism. Copper slag (CS) is one of the materials that is considered as a waste material which could have a promising future in construction industry as partial or full substitute of either cement or aggregates [3]. It is a by-product obtained during the matte smelting and refining of copper. To produce every ton of copper, approximately 2.2–3.0 tons copper slag is generated as a by-product material. In Iran approximately 360,000 tons of copper slag is produced every year [4]. Utilization of copper slag in applications such as Portland cement substitution and/or as aggregates has threefold advantages of eliminating the costs of dumping, reducing the cost of concrete, and minimizing air pollution problems [5]. Numerous investigations have been conducted on high strength concrete using copper slag as a fine or coarse aggregate [6] but there are relatively no or very few studies on self-compacting concrete containing copper slag aggregate, so this research study was conducted to investigate the fresh and hardened properties of SCC made with copper slag as a fine aggregate.