# UNIVERSITI TEKNOLOGI MARA

# PHYSICOCHEMICAL AND MECHANICAL PROPERTIES OF SELF CONSOLIDATING LIGHTWEIGHT FOAMED CONCRETE CONTAINING RECYCLED CONCRETE AGGREGATE

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# ABSTRACT

Recycling waste materials began decades ago. However, the continuous use of recycled materials has only recently begun. Not left behind in the recycling current is the concrete material. Generally, tonnes of Construction and Demolition Wastes (C&DW) are raised daily. The situation is similar to the cement industry where a large amount of cement is generated every day and at the same time will affect the environment due to the carbon dioxide emission during the production of the cement and devastating harmful impact on the surroundings. For these reasons, there are two main reasons for the rationale for recycling concrete waste as aggregate, the first is the need to save natural aggregate resources that will be reduced in the future, and the second is to address the problem of waste disposal and preserve the environment. Acceptance of the use of concrete waste as an aggregate source is limited if the question of its strength and durability is not ascertained. Hence, an effort made in this regard is the development of Self-Consolidating Lightweight Foamed Concrete (SCLFC). SCLFC is a novel material that involves innovation in the production and casting of concrete. It is a type of concrete that might not require vibration for placing it and could be produced by reducing the density of concrete. Therefore, the main objective of this research study is to explore the possibility of producing SCLFC made with recycled material by examining its basic mechanical and physicochemical properties. This research dealt with the manufacture of SCLFC that could fulfil the self-compatibility criteria and achieved a 28-day compressive strength of 30 $N/mm^2$ with the density of SCLFC being 1800 $kg/m^3$ or below. The sub-objectives of this study are divided into two phases, namely: (i) to identify the effect of significant parameters mixtures such as foaming agent, limestone powder, and silica fume on the physicochemical, fresh, and compressive strength properties of SCLFC and (ii) to determine the physicochemical and mechanical properties of SCLFC with different levels of replacement of coarse Recycled Concrete Aggregate (RCA) contents. The influence of silica fume and limestone powder content in the range from 0% to 20% of cement replacement and addition to the slump flow test and strength characteristic level of SCLFC was identified and compared with SCC made of normal mixes. For phase 1 in this research, four (4) series of concrete specimens were cast with different water-cement ratios (0.53, 0.45, 0.40, and 0.30). The concrete specimens were subjected to strength at the age of 3, 7, 14, 21, and 28 days. For phase 2, there are three (3) series of concrete specimens were cast with different water-cement ratios (0.40, 0.35, and 0.30). The concrete specimens were subjected to all tests at the age of 3, 7, 14, 21, 28, 90, and 180 days. The curing test for this research is ambient curing. The influence of RCA content in the range from 0% to 100% of Natural Aggregate (NA) on the strength properties, drying shrinkage, and durability properties level of SCLFC containing optimum silica fume and limestone powder was identified and compared with SCLFC made of normal mixes. The result indicated that the mechanical, deformation and durability properties of SCLFC containing 100% RCA replacement give better performance than the 0% RCA replacement. Based on the finding, SCLFC containing 100% RCA replacement can be categorized same as conventional concrete, hence it can be utilized for construction purposes. RCA can also act as an alternative replacement in concrete for replacing the NA.

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