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POFA CONCRETE

THEORY AND APPLICATION

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PREFACE

It is without doubt that the inclusion of siliceous admixtures as an essential component of concrete mixture imparts significant enhancement to the basic characteristics of the resulting concrete, both in its fresh and hardened states. The use of pozzolanic materials in concrete is expected to increase as the incorporation of these materials such as fly ash (FA), silica fume and natural pozzolans in concrete, contributes to the enhancement of quality of concrete in terms of its strength and durability. In addition, the incorporation of pozzolanic materials also contributes to the reduction in bleeding, improves workability, reduces heat of hydration, increases the resistance to aggressive chemical attack and minimizes the environmental pollution.

A series of research programmes has been initiated in the Faculty of Civil Engineering of the Universiti Teknologi Malaysia (UTM) to examine various aspects of strength and durability of blended cement concrete since the early nineties. Established in the year 2001, the Faculty of Civil Engineering and Earth Resources of Universiti Malaysia Pahang (UMP) also joined the research league to discover the potential of waste materials for the development of modern sustainable concrete which is in tandem with the Malaysian government policy to implement green technology in the local construction industry. Amongst the features of concrete that were considered significant to the construction sector were the performance behaviour of Palm Oil Fuel Ash (POFA) concrete in marine exposure, the development of high strength concrete using Timber Industrial Ash (TIA) and the application of slag cement based grout for concrete repair in tropical climate. The development of green lightweight aggregates concrete containing waste materials also offers attractive solution to the industry in managing environmental polluting wastes and in-house made lightweight concrete for more economical structural design.

As with the diversified use of the waste materials having pozzolanic character, more products are likely to be materialised for use in concrete. Blended cements are cements where there is a partial replacement of ordinary Portland cement (OPC) with an alternative cementitious material. Recently, blended cements, based on industrial and agricultural wastes, are well known for their improved long-term strength and durability. Pozzolanic materials, either naturally occurring or artificially made, have long been in practice since the early civilisation. FA is the most commonly used artificial pozzolans globally. With the increasing demand of concrete with high-performance characteristics, the need for such pozzolanic materials is also getting higher.

This book, however, presents a comprehensive review of the engineering properties of blended cement concrete incorporating POFA in various concrete types for different applications. The results comprise of test data from the past 20 years investigation carried out at UTM Civil Engineering Laboratory. The contribution of experimental results and research findings from researchers of the Faculty of Civil Engineering and Earth Resources, UMP is also included in this book. It was demonstrated that the use of cement replacement materials not only improved workability but also reduce bleeding significantly. Results on compressive strength reveal that it is possible to replace cement by 30% of POFA without any loss of strength, as explained in Chapter 1.0. Chapter 2.0 highlights the engineering properties of aerated concrete containing POFA as cement replacement. The ensuing chapter, Chapter 3.0 focuses on the mechanical properties of oil palm shell lightweight aggregates concrete produced using palm oil fuel ash as a mineral admixture.

Along with the strength, a number of durability performance data of concrete in aggressive chemical environments were also presented and discussed in Chapter 4.0. The more recent topic on blended cement concrete is the inclusion of nano-size material to enhance the concrete performance. Chapter 5.0 of the book discusses the effect of nano POFA as cement replacement in mortar and concrete. One of the key findings of the study is that the incorporation of 20% nano POFA by weight of cement into concrete exhibits better durability properties than OPC concrete. Furthermore, as CO₂ emissions have become a matter of increasing importance in the construction industry, concrete that uses less cement in its production and utilises a greater amount of waste, such as POFA, offers an environmentally viable solution. Moreover, 100% cement free geopolymer concrete, as described in Chapter 6.0, can be produced by using blended ash such as POFA and FA.

Conclusively, all the scientific results presented highlight the role of POFA in the development of sustainable construction material. Therefore, it is hope that this book will inspire the researcher and industries to collaborate in developing a green material “from waste to wealth”.

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