CHAPTER 1
INTRODUCTION

1.1 General

Mortar and concrete made with Portland cement has been a popular construction material in the world for the past 170 years or more (Yoshihiko, 1995). Concrete is used in all types of construction throughout the world because of its capacity to be formed into a variety of sizes and shapes, the readily availability of the raw materials from which it is made and its relatively low cost if compare with steel or timber. Although concrete is an excellent building material, there are certain limitations to its use. These relate mainly to its relatively low tensile strength, delayed hardening, large drying shrinkage, its tendency to crack with changes in temperature and moisture and its deterioration because of permeability, absorption and chemical attack. Therefore, improvements in these properties could significantly extend the usefulness of concrete.

Deterioration and concrete durability are very much part and parcel of the whole construction industry's problems. Materials, workmanship, and design are three contributing sources of this shortcoming. If not duly looked into, it will have financial implication on the end user. The concrete repairs companies are mushrooming significantly in Malaysia occur due to the ever-increasing concrete deterioration problems. Deterioration often does not cause by one single factor acting alone. Numerous attacks can take place simultaneously. Amongst the attacks are sulphate, chloride,

carbonation, and alkali-silica reaction. Identification of the right concrete ingredients to face the continuous onslaught by these deleterious agents is hence very important. It is surmountable to address this issue if the correct mix proportions of ingredients are used to improve the quality of the concrete cast (Zhang, Lastra, and Malhotra, 1996 (a)).

This project attempts to identify new mix proportions is it new ingredients of concrete that can help improve to get rid deterioration problems by providing the right concrete for the right kind of exposure condition. In this research, commonly used cement replacement materials such as silica fume and pulverized fuel ash will be employed as these materials are recognized as durability enhancers in the construction industry. Nevertheless, even though this is so, durability problems still prevail and this leads to the utilization of local waste products such as rice husk, oil palm, coconut shell, and metakoalin which are in abundance in Malaysia.

A recent effort to achieve these improvements has been to produce namely, silica fume (SF), pulverized fuel ash (PFA) and microwave incinerator rice husk ash (MIRHA) concrete with multiple blended binders deriving from waste products. These products are to replace partially the Portland cement.

Some aspects of hydration and the microstructure of the interfacial zone between the aggregate and microwave incinerator rice husk ash (MIRHA) paste and concrete process the influence on the compressive strength of concrete are discussed and the results are compared with those obtained with the control Portland cement concrete and concrete incorporating silica fume.

For this research, multiple blended binders used waste products with the concrete will be investigated an six parameters namely Compressive Strength, Ultrasonic (UPV), Rebound Hammer, Splitting Tension Test, Flexural Strength Test and Gas Permeability. MIRHA admixture for 5%, 7.5% and 10%, SF admixture for 8%, PFA admixture for 10% and 1% SP of cement content is added to the mix. By varying the percentage of MIRHA, SF and

PFA admixture, it is anticipated that an optimum dosage could be determined that give satisfactory results for those six parameters. The MIRHA, SF and PFA admixture is considered as a partial substitution for sand and water.

Standard testing for the Ultrasonic (UPV) and Rebound Hammer, Splitting Tension Test, Flexural Strength Test and Porosity/ Permeability will be undertaken for concrete age 28 days, 56 days and 90 days. But the standard testing for the compressive strength will be undertaken for concrete age 3 days, 7 days, 28 days, 56 days, and 90 days. This research research also focus on the workability of the fresh concrete by doing the slump test.

1.2 Problem Statement

Many waste materials have been used in concrete and some of the examples are foundry sand, mill scale (steel production), recycled plastic, glass, palm oil fuel ash (POFA), blast furnace slag, metakaolin, silica fume, fly ash and rice hush ash.

Waste material and by-product are undesirable materials for our environment that are the result of continuous expansion of industrialization or agricultural activities. These materials are eventually disposed off in landfills that are becoming scarce and expensive at the same time, leading to a waste disposal crisis.

The environmental issues resulted from OPC production has taken the progress of polymer researches further nowadays. Depletion of raw material and CO_2 emission resulted from fuel combustion and decomposition of limestone has put cement industry as one of the main source of environment pollutants (M.F. Nuruddin, N.Shafiq, N.L.Mohd Kamal, 2008).

The encouragement to produce environmental-friendly concrete can be achieved by limiting the utilization of raw material, decreasing pollutant rate from respective OPC production, and diminishing the cement portion in concrete. Employment of waste material like fly ash, rice husk ash and other cement replacement material (CRM) can only replace cement portion until up to ten percentage.

Many developing countries produce huge quantities of agro residues that are used inefficiently and cause extensive pollution to the environment. Current researches have shown that partial replacement of OPC with RHA will improve the concrete performance in terms of either its strength or durability. Rice Husk Ash (RHA) produced from the burning process of paddy husk is a pozzolanic material that contains substantial amount of silica.

Green Concrete as the name suggests is eco-friendly and saves the environment by using waste products generated by industries in various forms like rice husk ash, micro silica etc. to make resource-saving concrete structures. Use of green concrete helps in saving energy, emissions and waste water. Green concrete is often also cheap to produce as it uses waste products directly as a partial substitute for cement, thus saving energy consumption in production of per unit of cement. Over and above, all green concrete have greater strength and durability than the normal concrete.

As the husk is hard to handle, normally people just burn it and bury under paddy fields as organic manure. By controlling the burning temperature, RHA can be a green material and re-utilized in construction materials. Therefore, burning procedure to obtain RHA that is highly reactive needs to be established so that it can be used as cement replacement, and the optimum replacement percentage of OPC by RHA that improves the quality of concrete need to be identified.

Rice husk burnt at properly controlled temperatures produces ash consisting pure silica in the amorphous form. High silica content and porous structure of the ash lead to a very high pozzolanic activity comparable with that of silica fume. RHA in some respects resembles silica fume, particularly in its large specific surface area and huge content of amorphous silica.

These materials are basically waste materials that need costly disposal when fulfilling the stringent environmental requirement imposed by the authority. Therefore, the utilization of these pozzolanic materials not only provide a viable solution to concrete problems, but also reducing the environmental problems due to inefficient disposal. Consequently, the cost of disposing these materials can be saved.

Open burning also produces expensive measures of these waste local products and hence increases impact to the environment. Therefore it contributes to environmental problem.

OPC cement is required highly in concrete industry. At the same time, the rate of buying the OPC cement always increases from time to time. In other word, the new materials for cement replacement in concrete are higher demand in construction industry.

Cement replacement material (CRM) affects the workability of concrete. The multiple blended binders used local waste product also reduce the workability especially the effect of MIRHA. When that effects are known, several mix proportions based on the various combination of CRM can be obtained. However this mix design need to be consider to their mechanical behavior and durability.

In the industry, multiple blended binders are not made easily during the implementation because of awareness of the inductry. Therefore, database/computer program for the engineers to choose from should be handy and helpful. The program will guide the engineer on what type of mix design that can be adapted, if a certain criteria is needed to be fulfilled.

1.3 Objectives of the Study

The purpose of this research is to justify the concrete with multiple blended binders better than normal concrete in mechanical behavior.

The objectives are as follows:

1) To develop and evaluate the effect of mix proportions of multiple blended binders on the workability of fresh concrete.

2) To develop and evaluate the effects of multiple blended binders on the mechanical characteristics of concrete.

3) To develop a computer programme of mix proportions computing multiple blended binders that can be used to identify the strength, durability and the concrete cost.

1.4 Scope of the Research

Samples of mix proportions of multiple blended binders modified concrete are compared with normal concrete. In each test done on mix proportions of multiple blended binders modified concrete, compressive strength, NDT, Splitting Tension Test, Flexural Strength Test and Gas Permeability Test are done on corresponding normal concrete.

The scope of this research encompasses the following :

a) Investigation of mix proportions of multiple blended binders as an alternative to normally used plain concrete in the production of concrete.

b) All the samples use moulds of 150x150x150mm cube 15 nos for strength test, 150mm diameter x 150mm cylinder 9 nos for spiltting test and 100x100x500mm prisms 9 nos for flexural test for every each batch.

c) Plain concrete and multiple blended binders concrete were cast and the strength developments are monitored.

d) In each test done on mix proportions of multiple blended binders, strength, durability and workability, similar tests are done on corresponding normal concrete.

e) Standard testing for the Ultrasonic (UPV) and Rebound Hammer, Splitting Tension Test, Flexural Strength Test and Porosity/ Permeability will be undertaken for concrete age 28 days, 56 days and 90 days. However, the standard testing for the compressive strength will be undertaken for concrete age 3 days, 7 days, 28 days, 56 days, and 90 days. This research also focuses on the workability of the fresh concrete by doing the slump test.

1.5 Layout of Thesis

The thesis consists of five chapters. They are introduction, literature review, material characteristic and test procedures, Mechanical Properties, Conclusions and recommendations.

Chapter one is an introduction to a research title and overview of works, problem statement, objective and scope of research.

In chapter two, an introduction to the pozzolanic materials used and it performance in the production of high strength concrete is presented. Existing knowledge on the effect of pozzolanic materials used as mineral admixture or replacement material to produce multiple blended binders cement in high strength concrete, which are related to this study, are reviewed.

Chapter three outlines the pozzolanic sample preparations and productions that were used in the investigations. The mixing, casting, curing procedure, experimental design and program on theory and method are also presented.

In chapter four, the mechanical properties of multiple blended binders containing pozzolanic materials used throughout the experimental program are evaluated. The influence of different percentage replacement level of the MIRHA in multiple blended binders cementitous system compared to OPC cementitous system are evaluated based on the tests specified by British Standard Specification. Presents the influence of multiple blended binders cement in high strength concrete on the engineering properties compared to binary binders cement and OPC cementitous system. The engineering properties considered on high strength concrete performance is on its fresh state and harden state properties such as workability, compressive strength, surface hardness, flexural strength, tensile splitting test and permeability. The result and discussion on the effects of pozzolanic materials used as minerals replacement in multiple blended binders cement compare to binary binders cement and OPC on the durability performance of high strength concrete are presented.

In chapter five, the computer program has been developed for industry friendly user. It helps to identify the volume mix proposal under blended binders using waste product dealing with strength. These programs developed by using table mix of multiple blended binders used MIRHA, SF and PFA based on their strength, surface hardness and durability.

Finally, conclusions on the research works are made and recommendations for future studies are presented in chapter six.