ENGINEERING PROPERTIES OF CONCRETE CONTAINING COARSELY CRUSHED COCKLE SHELL AS COARSE AGGREGATE REPLACEMENT

TEH GEK YU

Thesis submitted in fulfilment of the requirements
for the award of the degree of
Bachelor of Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

JUNE 2013

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

P	Maximum load
L	Length of specimen
B	Cross-sectional dimension of specimen
R	Modulus of Rupture
b	Average width of specimen
d	Average depth of specimen
E	Chord modulus of elasticity
S_1	Stress corresponding to a longitudinal strain, ε_1, of 50 millionths
S_2	Stress corresponding to 40% of ultimate load
ε_1	Longitudinal strain of 50 millionths
ε_2	Longitudinal strain produced by stress S_2

LIST OF ABBREVIATIONS

ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
CCAA	Cement Concrete and Aggregate Australia
BS	British Standard

ENGINEERING PROPERTIES OF CONCRETE CONTAINING COARSELY CRUSHED COCKLE SHELL AS COARSE AGGREGATE REPLACEMENT

TEH GEK YU

Thesis submitted in fulfilment of the requirements
for the award of the degree of
Bachelor of Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

JUNE 2013

ABSTRACT

Various studies had been carried out by using waste products to replace the current material use for concrete. One of the wastes that can be obtained from aquaculture industry is cockle shell. It had been found out that cockle shell has the potential to replace coarse aggregate. This research presents the result on the engineering properties of coarsely crushed cockle shell as coarse aggregate replacement in concrete. Two mix proportions are used throughout this research which are 1:1.8:0.7 and 1:1:1.5 which is consist of cement to sand to aggregate. All samples were prepared with constant cement content of 500kg/m^3 and w/c ratio of 0.4. Samples are subjected to water curing for 3, 7 and 28 days. The mix proportion of 1:1:1.5 obtained better result in terms of workability, compressive strength, flexural strength and modulus of elasticity. The effect of cockle shell towards fresh concrete will reduce the workability. Cockle shell in concrete will lowered the strength but differences are insignificant. Conclusively, the results revealed that the strength of cockle shell concrete is comparable with plain concrete.

ABSTRAK

Pelbagai kajian telah dijalankan dengan menggunakan bahan buangan untuk menggantikan bahan pembinaan untuk konkrit. Salah satu daripada bahan-bahan buangan yang boleh diperolehi daripada industri akuakultur adalah kulit kerang. Kajian telah mendapati bahawa kulit kerang mempunyai potensi untuk menggantikan agregat. Kajian ini membentangkan hasil pada sifat kejuruteraan konkrit denggan menggunakan kulit kerang yang telah dihancurkan sebagai penggantian agregat. Dua kadar campuran yang digunakan sepanjang kajian ini iaitu 1:1.8:0.7 dan 1:1:1.5 yang terdiri daripada simen kepada pasir kepada agregat. Semua sampel yang telah disediakan dengan menggunakan simen sebanyak 500kg/m^3 dan nisbah air kepada simen iaitu 0.4. Sampel adalah tertakluk kepada pengawetan air selama 3, 7 dan 28 hari. Nisbah campuran 1:1:1.5 telah mendapat keputusan yang lebih baik dari segi kebolehkerjaan, kekuatan mampatan, kekuatan lenturan dan modulus keanjalan. Kesan kulit kerang terhadap konkrit akan mengurangkan kebolehkerjaan. Kulit kerang di konkrit akan menurunkan kekuatan tetapi perbezaan adalah tidak ketara. Kesimpulannya, keputusan menunjukkan bahawa kekuatan konkrit yang dihasilkan menggunakan kulit kerang adalah setanding dengan konkrit biasa.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

In Malaysia, one of the major industries is come from aquaculture industry. This is due to the strategic location where protein source can be obtained easily from sea. One of the rich protein sources that can be obtained from sea is cockle shell. According to Department of Fisheries Malaysia (2011), the annual production of cockle shell had reached 57544 tons with the value of RM75 million during the year of 2011. However, the mass production of cockle shell in aquaculture industry also indicates that the waste will be produced would increase as well. One of the major problem causes by dumped cockle shell if left untreated is the unpleasant smell which is disturbing to the surrounding (Rashidi *et al.*, 2011). The problem of waste disposal arising from the increase amount of cockle shell production leads to solution on utilizing it to become useful material for various type of application.

At the same time, construction industry grows rapidly. Therefore, the demand for concrete use in construction is increase as well. As a result, many type of concrete had been produced to fulfill the industry need. The freely available waste such as seashells from aquaculture has also been used to make concrete. Application of cockle shell in concrete would be environment friendly since it utilizes waste as construction material. By utilizing cockle shell as a replacement of coarse aggregate, it can solve the

problem of aggregate shortage and convert it to become construction or building materials.

1.2 PROBLEM STATEMENT

Malaysia produces cockle shell where the annual production reaches thousand tons. The cockle shell generated from cockle trade is dumped as waste, thus causing pollution to the environment and also discomfort to the community surrounding. Application of this waste to produce material benefiting the mankind would reduce amount of cockle shell ending as waste at landfill.

1.3 OBJECTIVES

The objectives of this study are as follow

i. To investigate the effect of coarsely crushed cockle shell as coarse aggregate replacement on the workability and compressive strength of concrete

ii. To determine the effect of coarsely crushed cockle shell as coarse aggregate replacement on the flexural strength of concrete

iii. To investigate the effect of coarsely crushed cockle shell as coarse aggregate replacement on the modulus of elasticity of concrete

1.4 SIGNIFICANCE OF RESEARCH

The main purpose of this research is to provide more information on engineering properties of concrete when coarsely crushed cockle shell is used as aggregate replacement. Utilization of cockle shell in concrete production would contribute towards reduction in amount of cockle shell disposed as waste at dumping area. This would result a cleaner environment and lesser pollution caused by cockle industry.

1.5 SCOPE OF STUDY

The main purpose of this study is to investigate the engineering properties of concrete produced using coarsely crushed cockle shell as coarse aggregate replacement. Two types of mix are prepared in this research which is cockle shell concrete and plain concrete for comparison purposes. When concrete is freshly mixed, it will be tested with workability test. After that, all specimens will be undergoes water curing for 3, 7 and 28 days. Water curing is where the specimens kept in the water tank where the temperature remains on 23 ± 2°C and 100% relative humidity. After the curing process, compression strength test, flexural strength test and modulus of elasticity test have been carried out to determine the engineering properties of crushed cockle shell concrete.

1.6 LAYOUT OF THESIS

Chapter one consists information that given general idea about the content of this thesis. It includes the background of the study with the objective that needs to be carried out. Problem statement, significance of research and scope of study is described as well in this section.

Chapter two consists of the literature review on properties of concrete and our main material which is coarsely crushed cockle shell where it is used to fully replace coarse aggregate. First, the history of utilizing waste as aggregate replacement has been briefly discussed. The review continues with methodology of the mix design and mix ingredient of concrete. After that, properties and durability of concrete is discussed. Finally, the properties of cockle shell and development of research on utilization of cockle shell in product development has been presented and discussed.

Chapter three consists of the methodology of this thesis. Materials that need to be used and preparation process is discussed at first. Then, the procedure of preparation and producing the mix of concrete is elaborated. Towards the end, the testing procedure to determine engineering properties of concrete namely workability test, compressive strength test, flexural test and modulus of elasticity test is presented.