BENCHMARKING OF GREEN CEMENT TECHNOLOGY FOR MALAYSIAN CEMENT INDUSTRY
CASES STUDY AT LAFARGEHOLCIM MALAYSIA AND YTL CEMENT

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APPROVAL

'I hereby acknowledge that I have read this works and in my opinion this works is sufficient interms of scope and quality for the submission and award of a Bachelor Degree of Technology Management (Technology Innovation) with Honors'

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DECLARATION

"I hereby declare that this thesis entitle "Benchmarking of Green Cement Technology for Malaysian Cement Industry: Cases Study At LafargeHolcim Malaysia and YTL Cement" is my own work except for the quotations summaries that have been duty acknowledged"

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DEDICATION

I dedicated this research to:

My family, who give their undivided support and patience for me to complete this research. And also their love and giving me strength when I needed it most. Especially for my parents that always cheer me up when I stressed out.

My supervisor for this research, Prof. Madya Dr Chew Boon Cheong, who guide me patiently to the right path and share with me with his vast knowledge. And also working so hard and try his very best to motivate and guide me to complete this research.

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ABSTRACT

Cement is one of the key materials used in civil engineering construction and building. The cement industry faces a number of challenges that include depleting fossil fuel reserves, growing environmental concerns on the emission of carbon dioxide emission that have brought negative effects to our ailing world economy. The process in producing the Ordinary Portland Cement (OPC) is highly energy-intensive with carbon dioxide emission during the clinker-making process. Producing Green cement is one of the methods to reduce or eliminate CO2 emissions from its manufacturing process. The excess of alternative fuels such as natural gas, biomass and wastes are suitable to act as substitute for cement clinker in cement making process. The three famous Supplementary Cementitious Materials (SCMs) that are using today in Malaysia are fly ash, blast furnace slag and silica fumes. In this research, two cement plants in Perak were selected to study how they used cement replacement materials to manufacture green cement that brings benefit to all of us. This research also aimed to assist in protecting the ecosystem of the world and at the same time reduce the impact of climate damage to the environment in the long run. This study also aimed to promote the concept of green cement in cement companies and construction users in Malaysia. A quantitative survey conducted by collecting respondents' answer for data analysis. The collected data is analysed by using quantitative methods.

Keywords: green cement; carbon dioxide emission

ABSTRAK

Simen adalah salah satu bahan utama yang digunakan dalam pembinaan dan pembinaan kejuruteraan awam. Industri simen menghadapi beberapa cabaran yang merangkumi rizab minyak fosil yang semakin berkurang, kebimbangan terhadap persekitaran alam sekitar terhadap pelepasan pelepasan karbon dioksida yang membawa kesan negatif kepada ekonomi dunia yang cedera. Proses pembuatan "Ordinary Portland Cement (OPC)" sangat intensif tenaga dengan pelepasan karbon dioksida semasa proses membuat klinker. Pengeluaran simen Hijau adalah salah satu kaedah untuk mengurangkan atau menghapuskan pelepasan CO2 dari proses pembuatannya. Lebihan bahan api alternatif seperti gas asli, biomas dan sisa sesuai untuk bertindak sebagai pengganti klinker simen dalam proses pembuatan simen. Sekarang, "Supplementary Cementitious Materials (SCMs)" yang terkenal untuk menggunakan di Malaysia adalah abu terbang, sanga letupan relau dan asap silika. Dalam kajian ini, dua loji simen telah dipilih di Perak untuk menyiasat bagaimana mereka menggunakan bahan pengganti simen untuk mengeluarkan simen hijau yang membawa manfaat kepada kita semua. Penyelidikan ini juga bertujuan membantu melindungi ekosistem dunia dan pada masa yang sama mengurangkan kesan kerosakan iklim kepada alam sekitar dalam jangka panjang. Kajian ini juga bertujuan untuk mempromosikan konsep simen hijau dalam syarikat simen Malaysia. Satu tinjauan kuantitatif yang dijalankan untuk mengumpul jawapan responden untuk analisis data. Kaedah kajian yang digunakan adalah kuantitatif.

Kata kunci: simen hijau; pelepasan karbon dioksida

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this era of globalization, Malaysia has a vision call for the nation to become an advanced economy in Year 2020. According to Unit (2015), the one of the challenges is to achieve a new environment in resilient, low-carbon emission, resource-efficient and socially-inclusive manner. The aim is to convert from the conventional and costly 'grow first, clean-up later' path to a more greener path that is "Green Growth" that will ensure that socioeconomic development is pursued more sustainably, beginning at the planning stage, and continuing throughout the implementation and evaluation stages (Unit, 2015).

In accordance to Kamar and Hamid (2011), the negative impact of built environment, the construction industry is a major demand of non-renewable resources and a massive producer of waste. The industry is responsible for approximately half of the total CO2 emissions. In addition, the building industry has exploited around 30-40% of natural resources (Kamar and Hamid, 2011). Other information available includes around 50% of energy used for heating and cooling in buildings, 40% of world consumption of materials converts to building environment, 40% of waste was sent to landfill and 12% of water consumption in building industry (Kamar and Hamid, 2011).

Rubenstein (2012) states the cement industry accounts for around 5% of global carbon dioxide (CO2) emissions. According to Rubenstein (2012), cement production is expected to grow at a steady rate of 2.5% annually. Based on the study, it is expected to rise from 2.55 billion tons in 2006 to 3.7- 4.4 billion tons by 2050. Cement manufacturing is noted to consume high energy and at the same time CO2 emissions intensive mainly due to the extreme heat required to produce it. Producing a ton of cement requires 4.7 million BTU of energy, equivalent to about 400 pounds of coal, and generates nearly a ton of CO2 (Rubenstein, 2012). Major emphasis should be given for its high emissions and critical impact to society as whole. In accordance to Rubenstein (2012), CO2 emission can be reduced by swapping over to alternative fuels such as natural gas, biomass and waste-derived fuels such as tires, sewage sludge and municipal solid wastes. These less carbon-intensive fuels could reduce overall cement emissions by 18-24% from 2006 levels by 2050 (Rubenstein, 2012).

1.2 Background of the study

Macfadyen (2006) was stated that the cement is a crystalline compound of calcium silicates and other calcium compounds having hydraulic properties. Cement cannot be used solely, but is used to mix with sand and limestone together to produce concrete (Macfadyen, 2006). The demand of cement is high because of the usage in construction area, the building of highways, residential and commercial buildings, tunnels and dams, production trends are some of the examples required the usage of cement. The constant demand for all of these structures, increasingly from the developing world, means that cement is the second most consumed commodity in the world after water (Francesca, 2010).

According to Rosenwald (2011), “You know, cement is everywhere” by Nikolaos Vlasopoulos, says while sitting in a brightly lit college conference room in a hulking seven-story building held up by the topic of conversation, “It’s

all around us". The new environmentally friendly formulation of green cement means the cement industry could change from being a "significant emitter to a significant absorber of CO2". Cement industries are continuously striving to achieve more efficient and environmentally-friendly production methods in cost-effective concepts for a more ecologically-friendly production of so-called 'green' cement (Shrivastava, Shrivastava and Ganguly, 2014). According to Fuentes (2015), green cement is classified as lower-carbon cements. This technology involves reducing the amount of clinker used to produce ordinary Portland cement. Since clinker is made with limestone and produced in kilns, less clinker means less emissions and less energy. The resulting material can be heated at lower temperatures than limestone (Fuentes, 2015). According to Fuentes (2015), the term "green cement" may sound like an oxymoron to some, but it's not. Many companies are hard at work reducing the environmental footprint of cement. From startups to the world's largest cement manufacturers, it appears everyone is on the bandwagon (Fuentes, 2015).

Rosenwald (2011) also states that big cement firms around the world were looking for new ways to make Portland cement more environmentally palatable. According to (Rosenwald, 2011), the producers added steel by-products, such as slag; coal residues, such as fly ash; and other materials, such as magnesium oxide, to bulk up the cement mixture, requiring less Portland cement. They experimented with mineral additives to reduce the temperatures needed to prepare the materials (Rosenwald, 2011).

Smithers (2012) expects the increase in green cement usage now to 2020 as landfill and waste disposal restrictions become more stringent and companies are forced to seek alternative methods of disposing of their process waste. In moving forwards to 2020, individual and commercial construction is more likely to buy green cement even if they are more expensive than traditional cement. They are keen to present themselves as environmentally responsible have the funds to purchase greener materials (Smithers, 2012). In addition, many governments now require a greater level of environmental awareness in projects they fund, leading to

more pressure on construction companies to buy green building materials including cement.

1.3 Problem Statement

Construction industry now concerns about CO2 emission and Energy Efficiency. According to Bakhtyar et al. (2017), cement production is a highly energy-intensive and carbon dioxide emission during the clinker-making process from the calcination process. Bakhtyar et al. (2017) also stated that the cement industry has always been among the greatest CO2 discharge sources with 900 kg CO2 released with each production ton of cement. Without considering the financial and technical benefits, Malaysia has yet to employ and use fully on its biogenic wastes, palms oil fuel ash, rice husk ash and saw dust ash. Till to date these wastes and ashes, are only used for landfill purposes. Hence, CO2 mitigation strategies can be applied on the extensive scale of the cement industry to a globally acceptable emission targets in each nation (Bakhtyar et al., 2017).

Besides that, cement is one of the key materials used in construction which is worth for this research. Basically, cement is an essential input into the production of concrete, an important building material for the construction industry such as residential and commercial buildings, tunnels and dams, highways and so on (Shrivastava, et al. 2014). Cement also plays a crucial role in economic development of the country.

Lastly, Malaysian Cement Industry still does not largely produce this green cement. Based on the reference in the individual cement websites, some already started with the production of eco-friendly cements which they have received certifications either from Singapore Environment Council's Green Label and SIRIM QAS International Eco-Label. Two of the largest cement plants, LafargeHolcim and YTL Cement have been producing these innovative and eco-friendly cements since 2010 that claimed that these cements are technological

breakthroughs in reducing the CO2 footprint in cement applications. Other cement producers such as Cement Industries of Malaysia Berhad, Hume Cement Sdn. Bhd. and Tasek Corporation Bhd have jumped into the bandwagon in producing similar grades of green cements.

1.4 Research Questions

The research questions are show below:

i. What are the criteria of green cement to produce in the Malaysian Cement industry?
ii. What are the factors that affect the green cement production in Malaysian Cement industry?
iii. What is the innovative suggestion in process of green cement production that could sustain cement industry?

1.5 Research Objectives

The objectives of this research are to find out the evidence of green cement technology for Malaysian Cement Industry. This research also aims to finding out the possibility of green cement production in Malaysia. By studying the complete activities of the management of construction industry, this research will be beneficial to the society, environment and the producer.

i. To investigate the criteria of the green cement production in the Malaysian cement industry.

ii. To examine the factors of green cement production in Malaysia.

iii. To propose the innovative suggestion to sustain process of green cement production that could sustain cement industry.