UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE INFLUENCE OF BENTONITE ON GLASS WASTE FILLED SPENT BLEACHING EARTH (SBE) COMPOSITE.

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Engineering Materials) (Hons.)

by

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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TAJUK: The influence of bentonite on glass waste filled spent bleaching earth (SBE) composite

SESI PENGAJIAN: 2013/14 Semester 2

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I hereby declare this report entitled **THE INFLUENCE OF BENTONITE ON GLASS WASTE FILLED SPENT BLEACHING EARTH (SBE) COMPOSITE** is the result of my own research except as cited in the references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Engineering Materials) (Hons.). The member of the supervisory is as follows:

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Dr. Zurina Binti Shamsudin

(Project Supervisor)

ABSTRAK

Tujuan utama projek ini adalah untuk menganalisa kesan yang dipengaruhi oleh bentonite apabila digabungkan bersama lebihan peluntur bumi (SBE). Objektif utama projek ini adalah untuk mengenalpasti komposisi yang paling sesuai untuk kaca komposit dan untuk menilai sifat-sifat termo-fizikalnya. Selain itu, objektif lain adalah untuk mengkategorikan mikrostruktur dan fasa di dalam kaca komposit ini. Kaca komposit digunakan kerana kobinasi di antara kaca soda kapur (SLG), kaca borosilikat (BSG) bersama sisa semulajadi (SBE) dan kelebihan kaca ini ada ia sangat bergantung kepada mikrostruktur dan fasanya. Bahan-bahan yang digunakan dalam projek ini adalah SLG, BSG, SBE dan bentonite yang mana ia digunakan sebagai pengikat. Nisbah peratus berat untuk SLG dan BSG telah ditetapkan kepada 65% bagi kombinasi kedua-dua gelas. Serbuk kaca ini telah disumbangkan oleh Pusat Penyelidikan Mineral (PPM) dalam saiz 75μm dan kemudian ditapis ke saiz 45μm di UTeM. Nisbah peratus berat bentonite adalah 0wt%, 2wt%, 5wt%, 10wt%, 15wt% dan 20wt%; dibakar pada suhu 750°C dan 850°C dengan kadar pemanasan 2°C/minit. Nisbah lebihan sampel adalah SBE. Sampel telah dibentuk menggunakan kaedah tekanan kering ekapaksi. Beberapa ujian telah dilakukan seperti ujian fizikal (pemerhatian mata, ketumpatan dan penyerapan air), ujian mekanikal (kekerasan mikro) dan ujian mikrostruktur (imbasan mikroskop elektron (SEM), tenaga serakan sinar-x spektroskopi (EDX) dan pembelauan sinar-x (XRD). Selepas pembakaran,hasil sampel adalah kasar. Walau bagaimanapun, selepas dikurangkan kandungan peratusan bentonite kepada 0 dan 2wt%, rupa permukaan telah menjadi lebih baik. 10% kandungan bentonite mempunyai kekerasan yang paling tinggi sebanyak 230kg/mm², yang mana sangat rendah dan hanya boleh digunakan untuk kegunaan yang lembut seperti alat hiasan dalaman rumah dan aksesori wanita. Kesimpulannya gabungan di antara komposisi ini tidak sesuai untuk digabungkan bersama BSG kerana ia cenderung menyebabkan sampel menjadi lembut.

ABSTRACT

The aim of this project is to investigate the influence of bentonite on spent bleaching earth (SBE) composite. The objectives of this project are to determine the suitable batch for glass composites and to evaluate the thermo-physical properties. Other than that, the objective of this project is to characterize the microstructure and the phases on the glass composites. Glass composites are used due to the combination of soda-lime glass (SLG) and borosilicate glass (BSG) powders with natural waste spent bleaching earth (SBE) and the specialty of it, is depending on the microstructure and its phases. The materials used in this project are SLG, BSG, SBE and bentonite which acting as the filler. The weight percent ratio for SLG and BSG have been fixed to 65% for the combinations of both glasses. The glass powders were supplied by Pusat Penyelidikan Mineral (PPM) in 75μm and were further sieved to 45μm in ceramic laboratory. The bentonite weight percent has been distinguished to 0wt%, 2wt%, 5wt%, 10wt%, 15wt% and 20wt%; sintered at 750°C and 850°C with the heating rate of 2°C/minute. The rest of the weight percent is SBE. The samples were pressed using the uniaxial dry pressing method. A few testing have been done like physical testing (optical observation, density and water absorption), mechanical testing (microhardness) and microstructure analysis (scanning electron microscope-SEM, energy dispersive X-ray spectroscopy-EDX and X-ray diffraction-XRD). The samples were rough after the sintering process. However, after reducing the bentonite weight percent ratio to 0 and 2wt%, the surface appearance has improved. 10% of bentonite have the highest hardness was 230kg/mm², which is very low and only can be used for simple soft application like indoor home decoration and jewelry. BSG is not suitable to be mixed in this composition because it caused the samples to be soft.

DEDICATION

For my supportive family, lecturer, friends, UTeM, Pusat Penyelidikan Mineral, and especially for my religion, race and country.

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Bismillahirrahmanirrahim, in the name of Allah, the most gracious and most merciful. First of all I would like to thank to Allah for his blessing to complete PSM I and PSM II successfully. I would like to express my gratitude to those who gave me the possibility to complete this PSM report. I am also grateful to Dr Zurina Binti Shamsudin for showing me the road and helped me to get me started on the path to this final year project. Her enthusiasm, encouragement and faith in me throughout have been extremely helpful. She was also available for my questions and she was positive and gave generously of her time and vast knowledge. She always knew where to look for the answers to obstacles while leading me to the right source, theory and perspective.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

ASTM	-	American Standard Testing Material
B	-	Bentonite
BSG	-	Borosilicate glass
CaO	-	Calcium Oxide
$CaAl_2Si_2O_8$	-	Anorhite
EDX	-	Energy Dispersion X-ray Spectroscopy
ISO	-	International Organization for Standardization
K	-	Kelvin
$KAl_2(Si_3Al)O_{10}(OH,F)_2$	-	Muscovite
LOI	-	Loss on ignition
mg	-	Mili gram
MPa	-	Mega Pascal
Na_2O	-	Natrium Oxide
$NaAlSiO_4$	-	Carnegeite
PPM	-	Pusat Penyelidikan Mineral

SBE	-	Spent Bleaching Earth
SEM	-	Scanning Electron Microscopy
SiO2	-	Silicon Oxide, Coesite, Cristobalite
SLG	-	Soda-lime glass
XRD	-	X-ray Diffraction
Wt. %	-	Weight percentage
μm	-	Micron meter
°C	-	Degree Celsius

CHAPTER 1

INTRODUCTION

This chapter explains about the introduction of the product, covering the introduction, problem statement, objectives, scope and the conclusion. Other than that, the structure of the full report will be discussed in this chapter.

1.1. Background

Glass waste is unique, beauty and function-ability of glass composites has drawn interest from many researches and manufacturer due to its special mechanical and physical properties. It has attracted Stoneville to do research on it based on its uniqueness. Stoneville is a company that produces products using waste glasses. The products are usually beautiful, innovative, can be applied in many applications and eco-friendly properties. Other than that, Stoneville is a well-known company for glass tile production, which is made of waste glasses (Stoneville, 2012).

The aim of this project is to turn the waste into a beneficial product. Waste is used as the main materials in this project. The purposes of using waste are to be environmentally friendly and to save the cost of manufacturing a new product. Other than that, the usage of raw materials such as silica can be reduced slowly.

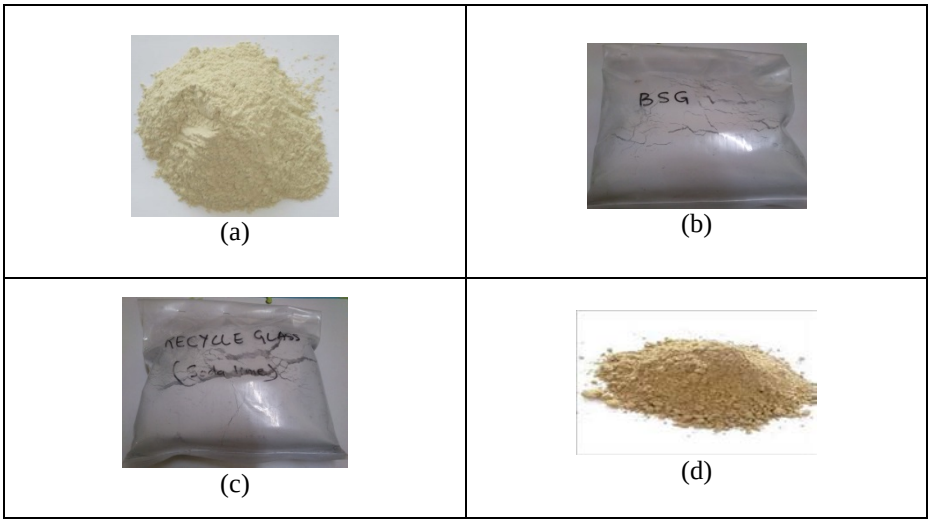
There are several types of glasses, mainly are Borosilicate glass (BSG) and Soda-Lime glass (SLG). Borosilicate glass waste comes from jars, glass kettle, mugs, cookware and many more. Soda-lime comes from drinking glasses, bottles, wares and others. Both the waste glasses are commonly used in production of tiles, slabs, dental composites cookware and kitchen appliances. It is used for that application because it has low water absorption (0.2%), low potential for scratches and can be repaired if scratched. Other than that, the cost of producing a new glass product by using raw materials are increasing. Furthermore, the source of raw materials is decreasing (J Dent Res, 1999; Condon, 1991).

Recycled Eco Glass compares favorably with that of other types of materials made of recycled glass that are cheaper. Other benefits of this material include stain resistance, hardness and color depth that creates a three dimensional effect (Stoneville, 2012).

The waste term also implied to natural resources. In Malaysia, there are a several types of natural sources. Some of the natural waste in Malaysia are jute, kenaf, palm oil waste and others. All the natural waste is safe to be used and not hazardous because it does not contain any chemical composition (Smith and Sch Affer et al., 1999, pp. 761-763).

A recent study by Huda, 2012 reported that spent bleach earth (SBE) powder has improved the hardness. However the studies only limited to the hardness measurement based on the formulation between SBE and glass waste (SLG). Moreover, all compounding needs a filler or also known as binder to increase and improve the properties and to give a stronger bonding to the compounding.

The most important of the appearance of the ceramic product also need to be highlighted. It has been reported, that additional filler such as Bentonite has shown an improvement in the color appearance. Bentonite has been used as a binder in this project. Based on previous studies by Liyana (2013) on BSG and SLG composite, the ideal addition of Bentonite is between 5 to 10% of the formulation. If the temperature is too high, the sample revealed burnt and changed in shape. Less Bentonite adding shows changes color into more whiter. With the increasing of Bentonite, the color turned to brownish but less change in shape has been observed.The results have proven that 10% of Bentonite have improved the mechanical properties. The hardness shows approximately 400 HV and ultimate tensile strength measured by flexural test approximately 35 MPa. Figure 1.1 shows the type of glass waste and filler.



(a) (b) (c) (d)

Figure 1.1: Type of materials used in this project a) Bentonite powder, b) Borosilicate glass (BSG), c) Soda-lime glass (SLG) and d) Spent Bleaching Earth (SBE) (Vasundhara Industries, 2011; Cargo Handbook.Com, 2013).