UNIVERSITI TEKNOLOGI MARA

EXPANDABLE POLYSTYRENE (EPS) FOAM FILLED EPOXY COMPOSITE

RABIATUL MANISAH BINTI MOHAMED

Thesis submitted in fulfillment of the requirements
for the degree of
Master of Science

Faculty of Applied Sciences

May 2008

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledge as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditions above, I voluntarily waive the right of conferment of my degree and agree to be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

Name of Candidate	:	Rabiatul Manisah Binti Mohamed
Candidate's ID No.	:	2004188350
Programme	:	AS780
Faculty	:	Faculty of Applied Sciences
Thesis Title	:	Expandable Polystyrene (EPS) Foam Filled Epoxy Composite

Signature of Candidate .....

Date ...9/6/08.....

ABSTRACT

In product packaging, the role of expanded polystyrene (EPS) is important for the protection of fragile goods, preventing them from shock and vibration. The EPS is also known as thermal insulator and lightweight but it is non-biodegradable. Increased demands in packaging lead to an increase in the volume and quantity of the waste in landfills. Some efforts have been made to recycle them to ease the problem. This study aims to recycle the EPS solid waste as fillers in epoxy matrix. Studies on the physical, mechanical and thermal conductivity of formed composites were conducted. The EPS waste was crushed and the EPS/Epoxy composite was prepared at ranges of composition from 20% to 80% (by Volume %) using compression moulding. It was found that the composite density decreased with an increase in filler loading from 1.136 to 0.468 g/cm^3. The reduction was due to the lightweight of EPS since the combination of EPS and the Epoxy matrix resulted in air being incorporated in the composite. It also showed that the higher filler loading gave higher water absorption. More voids introduced in the composite with higher filler percentages encouraged the water absorption. For the mechanical properties, the tensile strength (15.52 to 1.30 MPa), strain (2.69 to 0.76 %) and Young's modulus (1201.22 to 307.31 MPa) was found to decrease upon increase in filler content. Similar trend was also obtained for flexural strength (33.61 to 4.06 MPa) and flexural modulus (1074.20 to 466.14 MPa). These results were explained from the SEM micrographs which showed that the wall of EPS cellular structures did not collapse during fabrication. The gas phase which encapsulated through out the composite acted as voids. The micrographs also revealed good adhesion between the EPS and Epoxy matrix. Despite the good adhesion, the EPS/Epoxy composite strength did not improve due to the effect of the air which filled the foam cellular structures. The thermal conductivity (0.1333 to 0.056 W/mK) was also found to be reduced for all filler content with increase in the heat supplied. However, the influence was small compared to the significant reduction in the thermal conductivity upon increase in the filler content. As the EPS content increased, the quantity of air trapped in the cellular structure also increased, making it more difficult to transfer heat, thus lowering the thermal conductivity. From the study, the EPS waste can be recycled through EPS/Epoxy composites and could be used as heat insulation material for dwelling.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

Plastics have played an important role in our life over the past few decades and are in high demand today. They have many practical uses which contribute to the comfort of modern society and consequently are indispensable in our daily lives. Plastic materials possess several versatile characteristics such as lightness, sturdiness as well as low cost. Massively produced and widely applied, they are used for building materials, consumer products, transportation, packaging and many more.

Improvements in the quality of plastics have been extensively researched. The bulk properties of a polymer can be altered considerably and as such widely differing products can be created. The development of plastics with the aim of imparting specific desirable properties is achieved through a blend of polymers, addition of additives and fillers and also through fabrication of composite material. Global research into improving the quality of plastics will not only be beneficial for future application but also come out with material that last for a long time. This is where plastics appear less attractive to the environment. It succeeds in improving the material properties but not environmental-wise. Once they are disposed, plastics will not readily degrade and thus will increase the amount of waste.

There is increased awareness of environmental issues nowadays. The disposal of plastic waste poses serious problems because most plastics are non-biodegradable. Plastic waste can be managed through various methods including landfill, incineration and recycling.