

UNIVERSITI TEKNOLOGI MARA

**INJECTION MOLDING OF HAP-ZIRCONIA
COMPOSITE USING PALM STEARIN BINDER SYSTEM**

MUHAMMAD FAIZI BIN IBRAHIM

Thesis submitted in fulfilment of the requirement for the degree of
Bachelor Eng. (Hons) Chemical

Faculty of Chemical Engineering

January 2019

ABSTRACT

The main objective of this paper is to analyze the ability of the feedstock HAp-ZrO₂ which has different composition with Palm Stearin (PS) based binder system. In this research, the feedstock was classified by different weight percentage composition which 90-10, 80-20 and 70-30 of the HAp-ZrO₂ with the same ratio 60% of their optimum powder loading to palm stearin. Thus, the performance of HAp-ZrO₂ composite powder is studied through the Thermogravimetric Analysis (TGA) which showing that palm stearin binder system completely being removed in the present of high temperature 5000C with heating rate of 10°C/min. While the analysis of Scanning Microscopy Electron (SEM) to identify their physical characterization of feedstock. The effect of Zirconia content in the composition can be investigated through rheological test using Rosand RH2000 capillary rheometer. During the rheological test, the feedstock containing the mixture and the binder carried out pseudoplastic behavior and viscosity. The binder in the feedstock gives exceptional properties to ensure the success of injection molding process

ACKNOWLEDGMENT

In the name of Allah, the Most Beneficent and the Most Merciful

First of all, thanks to Allah for giving me this opportunity to embark on my degree and completing this long and challenging journey successfully. Big thanks to Universiti Teknologi MARA for allowing and providing places for me to run my experiment and research.

My thanks and gratitude go to my supervisor, Dr. Istikamah Subuki. Thank you for all the guide, support, patience and ideas in assisting me with this project. I also would like to express my gratitude to the lab assistances in faculty of chemical engineering for guiding me regarding lab matters while doing this research. To the all staff of Faculty Chemical Engineering, UiTM Shah Alam for their assistance in the laboratory and Ms. Siti Aishah from SEM laboratory at Faculty of Applied Science, UiTM Shah Alam for allowing me to do analysis there. Not forgotten, my sincere appreciation goes to my colleagues for their kindness and support throughout this project.

Lastly, this hard work is dedicated to my beloved parents and family that are always there for me, prayers and never ending support.

TABLE OF CONTENTS

	Page
AUTHOR'S DECLARATION	i
SUPERVISOR'S CERTIFICATION	ii
COORDINATOR'S CERTIFICATION	iii
ABSTRACT	iv
ACKNOWLEDGMENT	v
TABLE OF CONTENT	vii
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF SYMBOLS	x
LIST OF ABBREVIATION	xi
 CHAPTER ONE: INTRODUCTION	
1.1 Research Background	1
1.2 Problem Statement	2
1.3 Research Objectives	2
1.4 Scope of the Research	3
 CHAPTER TWO: LITERATURE REVIEW	
2.1 Hydroxyapatite As Implant Material	4
2.2 Hap-Zirconia Composite	5
2.3 Hap Composition Of Zirconia In Hap	6
2.4 Injection Molding and Preparation of Feedstock	10
2.5 Binder System In Injection Molding	12
2.5.1 Mixing Method	12
2.6 Addition Of Hap Moulded Specimen	12
2.7 Debinding	12
2.7.1 Thermal Debinding	12

CHAPTER ONE

INTRODUCTION

1.1 RESEARCH BACKGROUND

Research and development on bioceramic give huge impact and contribution to the biomedical field. Biomaterials such hydroxyapatite can be used as bone implant or substitution because hydroxyapatite that generally make up to 69% of the weight of natural bone. It can be explain by comparing the Ca/P ratio in the molecular formula which is 1.67. Hydroxyapatite is suitable to be used as bone implant because it is the most stable type of calcium phosphate and has a hexagonal structure. The use of synthetic HA which are high quality and very expensive will be limit on their usage as the reuse of waste and recycling practice of waste were implemented as the source of calcium.(Silva, Quadros et al. 2008).

Nowadays, the use of HA which come from natural sources have been practices. HA comes from the waste such as animal and organic may raise the concern from people on the process and method involve to get the HA(Akindoyo, Beg et al. 2017). Chemical processes by using various reactants such as Ca(OH)_2 and H_3PO_4 or CaO and CaHPO_4 is able to produce synthetic HA. However this processes need to be discuss on impact on biologically processes and high cost. Thus, the solution to this problem have been identified such as microwave method in producing HA from eggshell.(Okada and Furuzono 2012).

Calcium act as element that frequently build up bones and teeth tissues in our body. Bones contain calcium which in the form of hydroxyapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$). Hydroxyapatite is different from others that contain the similarity composition of bones and has the biocompatibility which make it excellent substance to being use. Long period of time need to be taken by human body to enable the production of HA by human to recovered during bone injury.

Thus, medical field found that HA from other elements can be implemented to reduce the time and to rebuild the tissue more excellent.