WEAR BEHAVIOUR OF HYDROXYAPATITE – TZP COMPOSITE

A Thesis Submitted
In Partial Fulfillment of the Requirement
For the degree of
BACHELOR OF TECHNOLOGY

By
SATISH FRANKLIN TIRKEY
ROLL 10608015

TO THE
DEPARTMENT OF CERAMIC ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA
MAY 2010

CERTIFICATE

This is certified that the work contained in the project entitled "WEAR BEHAVIOUR OF HYDROXYAPATITE – ZIRCONIA COMPOSITE" by Satish Franklin Tirkey (Roll 10608015) in partial fulfillment of the requirements of the award of Bachelor of Technology Degree in Ceramic Engineering at the National Institute of Technology, Rourkela is an authentic work carried out by her under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other university / institute for the award of any Degree or Diploma.

S.BHATTACHARYYA

PROFESSOR

Department of Ceramic Engineering

National Institute of Technology

Rourkela-769008

ACKNOWLEDGEMENT

I express my sincere thanks to Prof S. Bhattacharyya, Department of Ceramic Engineering, N I T Rourkela, for his guidance in the completion of this project work. My heartfelt thanks to all the faculty members for their suggestions during this project work. My sincere thanks to Mr Yougojoti Nayak and other research scholars for the help and cooperation extended to me. And finally, my hearty thanks to all my friends who have constantly helped me.

Satish Franklin Tirkey

10608015

LIST OF TABLES:

CONTENTS

ABSTRACT

The present work deals with the study of wear behaviour of HA- TZP composites by reciprocatory wear tester. The wear increased with an increase in the load and the Coefficient of Friction was higher for HA- 10 wt% TZP composite in comparison to HA- 2 wt% TZP composite.

CHAPTER 1 ~ INTRODUCTION

Hydroxyapatite (HA) with the stoichiometric chemical formula $Ca_{10}(PO_4)_6(OH)_2$, is a well known bio-ceramic material having excellent biocompatibility with the human body. HA has been used as powder, bulk material as well as coatings in different types of implants[1]. HA is used both in the dense and porous form. The porous HA is preferred because it leads to better osteoconduction and osseous regeneration but it cannot be used as load bearing component because of the poor load bearing capacity Dense HA on the other hand has higher strength but its bioactivity is less and limited only to the surface [2].. Dense HA can be used in some load bearing components of the body like femoral head, knee joints etc which also experiences friction and wear. Due to this reason, there has been research on the improvement of mechanical properties , particularly the wear behavior of HA. One method of increasing the mechanical properties of HA is to make a composite. HA – TZP is one such composite which have been tried for increasing the strength of HA [3]. This study therefore plans to study the wear behavior of some HA_TZP composite.

CHAPTER 2~ EXPERIMENTAL WORK

STUDY OF WEAR BEHAVIOUR IN RECIPROCATORY WEAR TESTER

The wear behavior was tested in a reciprocatory wear testing machine (Model TR-285, Ducom, Bangalore) by the pin on disk method [4]. The HA- TZP composites was made into a pin (bar size (30 x 5 x 5 mm^3) and it was reciprocated against a High Density Polyethylene (HDPE) plate (35 x 20 mm^2). The wear behavior was tested under two different loading conditions, viz 500 gm load and 1000 gm load. The wear behavior was studied till 1850 reciprocation cycles. The parameters that were calculated are Coefficient of Friction (COF) and total wear (gm).

CHAPTER 3 ~ RESULTS AND DISCUSSIONS

Table 3.1 Total Wear of HA – TZP composite

Sample Identification	Load (gmf)	Initial Wear (gm)	Final wear (gm)	Actual Wear (gm)
HA- 2 wt% TZP	500	0	0.4964	0.4964
HA- 2 wt% TZP	1000	0	11.19	11.19
HA- 10 wt% TZP	500	4	27.10	23.10
HA- 10 wt% TZP	1000	3	15.23	12.23

Table 3.2 Coefficient of Friction (COF) of HA – TZP composite

Sample Identification	Load (gmf)	Initial COF	Final COF
HA- 2 wt% TZP	500	0.351	0.309
HA- 2 wt% TZP	1000	0.333	0.328
HA- 10 wt% TZP	500	0.53	0.48
HA- 10 wt% TZP	1000	0.43	0.416

Table 3.1 shows that the wear of HA- 2 wt% TZP composite is lower than HA- 10 wt% TZP composite. This is probably due to higher sintered density (0.99 of TD) of the former composite with respect to the latter one (0.90 TD).

Table 3.2 shows that the COF increases both with increasing load as well as on increasing the TZP amount. This is due to the higher hardness of TZP particles which are pulled out during the polishing of the samples thereby creating craters which increases the COF.

.

CHAPTER 4~ CONCLUSION

The wear behaviour of HA –TZP composite was studied by reciprocatory wear tester. The wear increases with load as well as on increasing the TZP content.

REFERENCES

1. Hench LL, Wilson J. An introduction to bioceramics. London: World Scientifc, 1993. p. 8, 165, 170, 331, 335.
2. Samar J. Kalita, Abhilasha Bhardwaj, Himesh A. Bhatt. Nanocrystalline calcium phosphate ceramics in biomedical engineering. Materials Science and Engineering C 27 (2007) 441–449
3. Nayak Y, Rana RP, Pratihar SK, Bhattacharyya S. Pressureless sintering of dense hydroxyapatite-zirconia composites. J Mater Sci: Mater Med. 2008; 19: 2437-2444.