Chapter 1

Introduction

Recently composites were used for orthopaedic surgery in several applications and dental restorations. Bone has been regarded as a composite two-phase structure consisting of components with different mechanical properties. A necessary prerequisite for an implant material is that it should be biocompatible and withstand the repetitive physiological load environment; moreover, their properties can be strengthened in preferential directions according to the loading situation. Among the composite materials, the hydroxyapatite reinforced polyethylene offers significant potential advantages to match their properties with those of bone.

Bonfield, *et al.* (1980) established a continuing search for this material. The mechanical properties were a crucial factor for the composite. At higher filler loading, there is generally a trade-off in terms of adverse effect on mechanical properties such as elongation, strength and toughness, etc. Piecuch *et al.* (1984) suggested that calcined bone ash was also non-toxic substance and when its pores were penetrated by connective tissue and bone, the resulting tissue-implant combination gains a significant amount of strength.

Moreover, the adhesion between polymer and filler is another factor affecting the strength of a particulate composite(Kenyon and Duffey, 1967). The early work on the degree of dispersion was considered in both polyethylene and polypropylene filled with mineral by using scanning

electron microscope (SEM) and transmitted-light microscope (TLM) techniques (Ess, J.W. *et al.*, 1984). The SEM provides a qualitative view of the effects of adhesion in composites (James and Hatsuo, 1989).

The purpose of this study is to investigate the influence of filler concentration on the mechanical properties of calcined bone ash reinforced polyethylene composite. The validity of the available theoretical models for particulate fillers has been checked at higher filler loading against the experimental data for predictive purposes. The strain rate dependence of the tensile stiffness has also been evaluated. Density measurement was used to imply the calcined bone ash content. The failure mechanisms and dispersion of filler will be discussed by SEM. The correlation between microhardness and Young's modulus for composites was also investigated for comparison purposes.

However, these studies have considered a single species and so the magnitude of the observed variables lie within a very narrow range. Within this range there is large scatter of the data which may mask some trends.