CRACK BEHAVIOR OF HEAT TREATED SINTERED STEEL UNDER CYCLIC LOADING

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ABSTRACT

Fatigue crack nucleation and initiation at particles or defects in materials have been the interest of many researchers over the past years. This is because the understanding of theses phenomena would provide a better understanding of production of new fatigue resistance materials. In this study a test was developed to evaluate the fatigue properties and to observe fatigue crack nucleation and initiation in sintered steel. The fatigue test was carried out on polished specimens which was based on plate bending gives balanced biaxial tension. The experimental results shows that there were mixed mode of crack nucleation and initiation such that most cracks initiated at the interface of particles and matrix especially at high stress values. Cracks were also observed to initiate at voids and beneath the surface. Quenched specimens which were tempered between temperature range of 300^0C and 600^0C shows similar crack initiation mechanisms. The significant difference between as-received and tempered specimens was that the number of cycles to fail due to differences in material hardness and internal defects. The results of the experimentation are discussed in the light of possible micro crack toughening at the crack tip and the presence of residual stresses due to temperature changes. It is believed that some effects of residual stresses at the surface and beneath play a role in the nucleation of crack in sintered steel.

CHAPTER 1

INTRODUCTION

In the last few years, sintered steel has been developed for mass-production for engineering applications that are subjected to large mechanical stresses. It is therefore, necessary to determine the static and dynamic properties of this material. Numerous works have been conducted to understand the properties of crack growth both at sharp notch and notch root specimen. According to the literature review, the behavior have been observed in the relation to fatigue crack growth and crack length have been well understood but limited literature could be found on crack nucleation and short crack mechanisms.

1.1 Historical Perspectives

Metal fatigue has been studied for the past 150 years. Form 1850 to 1875, experiments were conducted to establish a safe alternating stress below which failure would not occur. Nearly 100 years of research has been performed to establish the effect of many variables on the influence of the long life fatigue strength of metal. Many significant contributions were made during the 1960's. Irwin *et al.* (1970) and others pioneered the development of fracture mechanics as a practical engineering tool. Ewing and Humphrey did the first work on fatigue crack initiation around 1900 to 1910. They prepared a specimen and examined the surface grains with an optical microscope during the course of a fatigue test. They observed formation of slip lines across grains and broadening into bands and eventualy developed cracks in the broadened bonds. Then in the 1950's, the concept of a two-