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Dynamic Compression Characterization of Vascomax® C250 Alloy

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Introduction

Vascomax steels are widely used in a variety of extreme environmental conditions because of their high strength, high fracture toughness, and stability over a range of temperatures. Typical applications for Vascomax C250 maraging steel alloy include rocket motor casings, landing gear, power shafts, and munitions. In such environments, these alloys experience high-rate impact loading. Mechanical properties at elevated loading rates must be investigated to build numerical models and simulations of such impact events.

Since Vascomax steels are typically employed as the bar material in Kolsky bar experiments [1, 2], the compressive properties have not been studied because it is difficult to measure the material properties of a sample made from the same material as the bar.

In this study, a Kolsky compression bar was used to characterize the stress-strain response of C250 maraging steel alloy over a range of strain rates from 1000 to 3000 s^{-1} to expand on an earlier study of the tensile properties at elevated strain rates [3]. In addition to strain rate effects, the effect of specimen hardness on strength at high strain rates is explored. Specially designed tungsten platens were used to conduct experiments on the high-strength steel alloys since the steel alloys were the same strength and hardness as that of the pressure bars.

Materials and Specimens

C250 Vascomax steel was subjected to compressive strain rates of 1000 to 3000 s^{-1}. The C250 steel specimens were hardened to Rockwell C (HRC) 48.

Impedance-matched tungsten platens were designed and manufactured so that the high-strength steel specimens did not damage the bars during the experiments.

Results and Discussion

Figure 1 shows the effect of strain rate the mechanical response of C250 steel with hardness of HRC48. The material exhibits a weak rate effect where the yield stress is increased from 2100 MPa to 2240 MPa. Since there is some variability in the failure strain, it is difficult to draw a conclusion about the effect of strain rate on the failure strain.

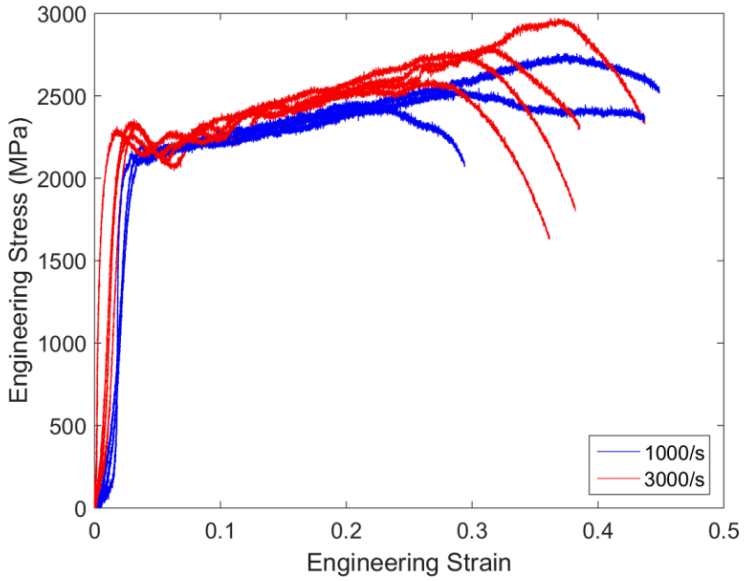

Fig. 1. Effect of strain rate on stress-strain response for C250 steel with hardness of RC48

Conclusion

High-strength Vascomax steel was investigated at elevated strain rates of 1000 and 3000 s^{-1}. Impedance-matched tungsten platens were designed and manufactured so that the high-strength steel specimens did not damage the bars during the experiments. The materials exhibited a weak rate effect on the yield stress.

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