Oxidation Behavior of Hardmetal Scrap

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1. Introduction

Hardmetal is widely used for a various applications such as machining, cutting, drilling, and wear and corrosion resistive coating that has a very high cost. There is little research on the recycling for used cemented carbide.

Recently, a new recycling technology of hardmetal scrap was proposed by direct oxidation and carburization. It will be able to get effectively the fine hardmetal powder from the bulk scrap. Oxidation was very important for the new recycling process of hardmetal scrap. In this study, the effect of the oxidation temperature and oxidizing atmosphere on the hardmetal scrap was investigated in the view on the recycling of the hardmetal scrap.

2. Experimental detail

The shape change of the hardmetal scrap during oxidation was observed using three kinds of K-grade hardmetal scrap bulks : circumferences, 8footnotes and plate shapes. TGA analysis was carried out for knowing the effect of the oxidation condition on the oxidation of the K, P-grade hardmetal scrap.

The oxidation test from the prescribed is at below 1000℃ of the heating rate for 5℃/min. and the weight change measured for 12 hours. At that time, the oxidizing atmosphere were in air, and in 100%O_2. The gas flow rate is 20cc/min with all conditions. The oxidized bodies were analyzed by XRD and SEM for microstructure and phase.

3. Results and discussion

The oxidation progress was dramatically increased when the temperature near 700℃. An early stage of oxidation, it occurred on the surface like general metal oxidation. The swelling of oxide layers and cracks on the K, P-grade hardmetal scrap were not related to their shapes. In the first stage the direction of the crack was progressed from the edge of the surface of the scrap to the inside. The shape of the broken of the oxide layer depend on the raw hardmetal scrap form. According to the TGA analysis results that the weight gain was saturated. The general average weight gain fraction of the K-grade hardmetal scrap was 120%. The K and P-grade hardmetal scrap were oxidized better in 100%O_2 atmosphere than air atmosphere. The hardmetal scrap must exposed in a high O_2 concentration oxidizing atmosphere for efficiently advances a complete oxidation at in a short time. After oxidation, If the sample was completed change to oxide, there are no WC and Co x-ray diffraction peak on the oxide. The created phase of oxidized K-grade hardmetal scrap were $CoWO_4$ and WO_3 that are not related to oxidation temperature or oxidation atmosphere. The grain size of the oxide powder is more effectively in oxidation temperature than in oxidation atmosphere.

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