The study of microhardness of powder metallurgy fabricated Fe-Cu alloy using vickers indenter

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Abstract

In the present study, micro hardness values of Iron-Copper based alloys with different compositions have been obtained by using Vickers indenter. The samples Fe-5Cu-1Sn-7.5BN (wt. %), Fe-5Cu-1.5Sn-5BN (wt. %) and Fe-5Cu-2.5Sn-2.5BN (wt. %) were prepared using Powder metallurgy technique. The elemental powder mixture was mixed for 2 hours, and compacted at a pressure of 500Mpa, and then was sintered in dry hydrogen atmosphere at a temperature of 900^{0}C for 50 minutes time. Vickers hardness values were obtained under the loads of 0.01 kg to 0.3 kg. The material with 2.5 wt. % of Sn exhibited the highest value of the hardness. The material with higher hardness shows better mechanical and tribological properties and can be used for various applications such as gears, bearings, connecting rods cams etc. Copyright © 2017 VBRI Press.

Keywords: Vickers hardness, micro indentation, powder metallurgy, sintering, iron-copper alloy.

Introduction

Change is perpetual. Since earlier times industries have always met a drastic change in which classical materials have been replaced by the latest and advanced ones to meet the demands of the current materialistic world whether in the field of aeronautics, nuclear science, terrestrial or maritime transportation, etc. Nowadays industries are based upon the substitution of classical materials with more advanced ones, whose properties maintain higher altitudes of success. The latest materials and advanced technologies fix up all the limitations faced in the usage of the traditional materials in respect of the limited strength and resistance values **[1]**.

Powder metallurgy, a beautiful alternative to produce metal products with advanced technologies from metal powders (sometimes mixed with non-metallic powders) by application of pressure and sintering. Powder metallurgy technique has become increasingly interesting for manufacturers of engineering parts due to its advantageous qualities which include high productivity, minimum consumption of raw materials and energy, high efficient use of the initial metals, near net shape character and unique capability of porous material production. Application of sintered parts is expanding in automobile and other engineering industries because of both economic and technical reasons. Machine elements which are complex in shape like gears, bearings, connecting rods, Cams, etc. can be economically manufactured through the powder metallurgy processing route **[2-3]**.

In recent years, iron-based sintered materials were considerably increased, due to low cost and availability of the iron powders as well as their higher strength. The mechanical properties of the parts are strongly related to the composition of the material. The material density plays an important role for exhibiting good load bearing capacity. Therefore, it is essential to know the actual loading conditions of the part and modify the alloying and the treatment conditions of the material on the basis of these conditions.

Sintered iron based materials were not developed till last decades because of their poor corrosion resistance. Considering the low cost and availability of iron powders, the more homogeneous structures obtained by sintering, the increased specific load-carrying capacities and sliding rates, the development of the Fe base sintered alloys for mechanical applications was continuously improved. Additions such as copper, graphite, manganese, lead, phosphorous, boron, and tin to iron have been attempted, but improvement in one property was offset by decrease in other property **[4-7]**. To overcome weaknesses in existing alloy systems and to meet the challenging nature of newer machines, it is important to develop a modified alloy system which can succeed in dealing with these deficiencies, either partially or fully.