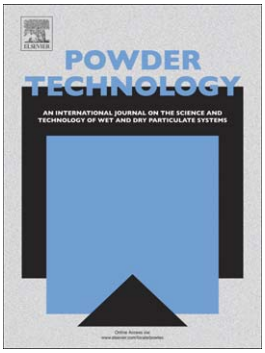

Waste steel scrap to nanostructured powder and superior compact through powder metallurgy: Powder generation, processing and characterization

P. Verma, R. Saha, D. Chaira

PII: S0032-5910(17)30940-3
DOI: doi:10.1016/j.powtec.2017.11.061
Reference: PTEC 12980

To appear in: *Powder Technology*

Received date: 14 July 2017
Revised date: 22 November 2017
Accepted date: 26 November 2017

Please cite this article as: P. Verma, R. Saha, D. Chaira, Waste steel scrap to nanostructured powder and superior compact through powder metallurgy: Powder generation, processing and characterization, *Powder Technology* (2017), doi:10.1016/j.powtec.2017.11.061

Waste steel scrap to nanostructured powder and superior compact through powder metallurgy: powder generation, processing and characterization

P. Verma, R. Saha[⊥], D. Chaira[ϒ]

Department of Metallurgical and Materials Engineering
National Institute of Technology Rourkela, India
[⊥]Product Development Research, R&D,Tata Steel, Jamshedpur-831007, India
[ϒ]Corresponding author:
E-mail: chaira.debasis@gmail.com, Phone: +91-661-2462561
Fax: + 91-661-2472926

Abstract

The present paper reports fabrication of superior steel compact using nanostructured steel powder generated from industrial steel scrap. Extra low carbon and low carbon steel powders with size of submicron were generated from industrial waste by planetary milling for 5 hours. The milled powders are characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and transmission electron microscopy (TEM) and hardness. Finest particles are obtained after 3 hours of milling in both cases. In case of extra-low carbon steel, cold welding and agglomeration is observed after 5 hours of milling. However, in case of low carbon steel, no such phenomenon is visible after 5 hours of milling. The effect of ball to powder weight ratio (BPR) is studied using BPR of 12:1 and 6:1 for low carbon steel chips by milling for 3 hours. A higher yield of 94.29 % is obtained when milling conducted at BPR 12:1 than 86.94 % yield at BPR 6:1 after milling low carbon steel for 3 hours. Lower average particle size of 5-10 μm is obtained when milling is carried out at BPR 12:1 than 15-20 μm at BPR 6:1. In case of low carbon steel, % yield increases from 94.29 % to 99.14% as milling time increases from 3 to 5 hours. Yttria free and 1 wt. % yttria dispersed both extra-low carbon and low carbon steel powders are cold compacted and conventionally sintered at 1100 °C for 1 hour. Significant improvement in the hardness was achieved through addition of small amount of yttria with both the steel powder generated from the steel scrap.

Key words: Steel scrap; planetary milling; powder metallurgy; microstructure; hardness