Processing of Metallic Filters by Powder Metallurgy Technique

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Abstract

Metal filters are available in a wide range of materials including copper, nickel, bronze, stainless steel and "Monel", and are widely used for the filtration of fuel oils, chemical solutions and emulsions. They are also efficient in separating liquids of varying surface tension. The unreliability of the ceramic filter elements in demonstration trials and the high capital cost of these systems have hindered their application and are factors restricting the uptake of gasification power plants in general. The successful development of a durable metallic filter system for the gasification and purification would be a major step towards its implementation. Metallic filter elements have potential applications in all systems and in other industries requiring hot gas cleaning.

Metallic filter media provides a number of significant advantages over ceramics as, Lower pressure drop - leading to a reduced filtration area and hence reduced capital cost, excellent cleanability, more predictable durability and reliability and simpler installation and handling requirements

Various application for metallic filters are covered including, petrochemical, agricultural fluid and gas transfer. Many of these are designed for safety applications such as those required in hydraulic lines typically fluid control and cleaning .

In this work, nickel coated iron oxide (Fe_2O_3) pellets of different particle sizes ranging between 500~900 μm were prepared using chemical reduction method. Hypophosphite bath in alkaline tartarate was used as a chemical coating bath for Fe_2O_3 particles with Ni, then sintered at 1000 ^{0}C in a reducing atmosphere for a 60 min. to produce metallic filters having a composition of Fe70wt%-Ni 30wt% in the shape of cylindrical candles as illustrated in Figure (1).

Extensive metallographic studies using optical and scanning electron microscopy were carried out. It was found that, the coating layer of the nickel on the iron oxide powder is about 250 μm thick. Sintering of the coated powder takes place by neck growth formation between the coated pellets as shown in Figure (1). The magnetic properties of the iron oxide pellets , the Ni coated ones and the related sintered Fe-Ni filters were measured by vibrating sample magnetometer (VSM).The results indicate that the reduced Fe_2O_3 to Fe has saturation induction (B_s) value of 1.47 emu/g which form a solid solution Fe-Ni with the Ni layer having a B_s value 129.6 emu/g and coercive force (H_c) value of 16.5 Oe. The porosity values, as determined by Poresizer apparatus, were between 27.5 % and 41.5 % corresponding to 5.5 g/cm^3 and 3.1 g/cm^3 density respectively.

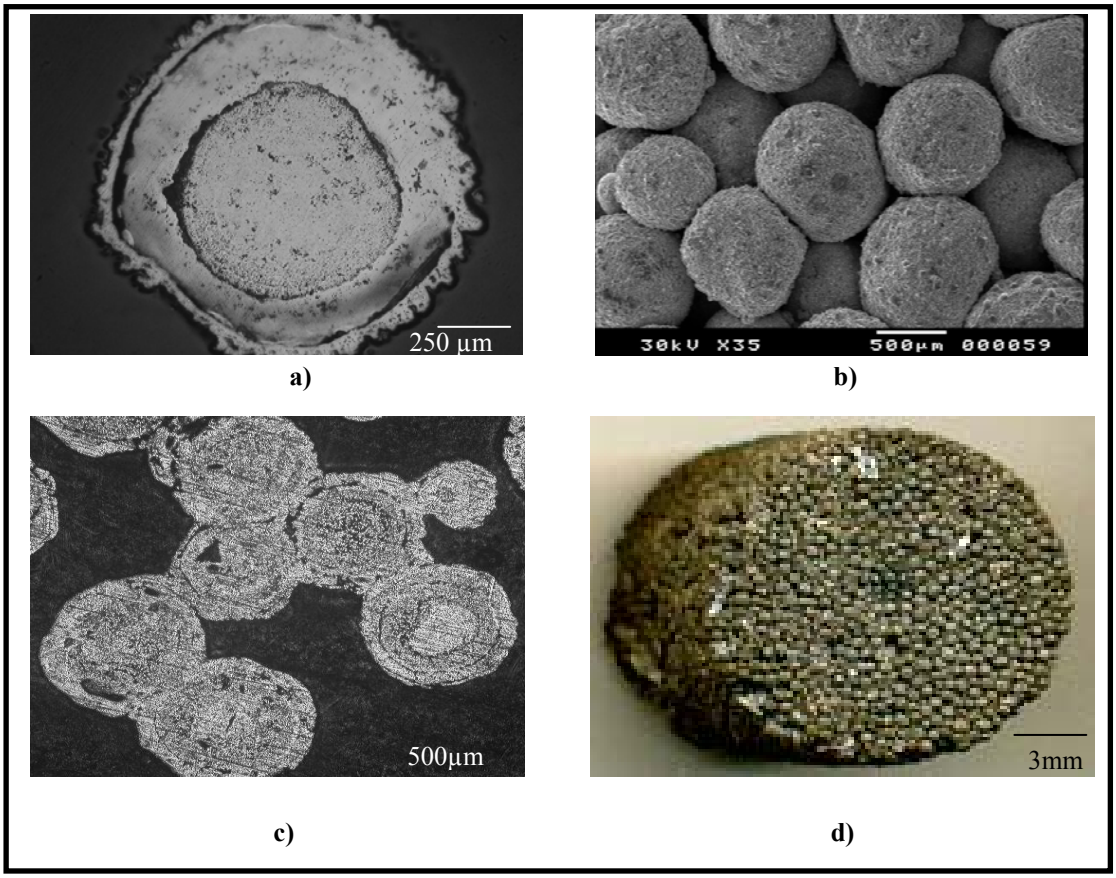

Fig. 1. The microscopic graphs of the prepared metallic filters where a) an optical micrograph for the coated iron oxide bellets by Ni metal, b) SEM micrograph for the prepared sintered Ni, c) an optical micrograph for the cross section area of the prepared sintered Ni filter and d) a stereograph for the prepared cylindrical candle.