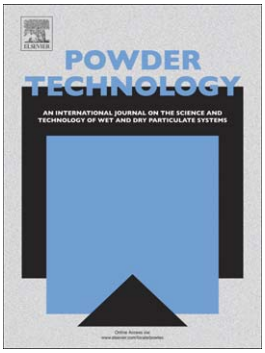

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Energy and material efficiency of steel powder metallurgy

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Abstract

Concern about global warming motivates the reduction of greenhouse gas emissions from manufacturing but as yet the environmental impact of the whole powder metallurgy production chain has not been assessed. This paper therefore traces the flow of energy and material through the major powder metallurgy processes from liquid steel to final products and assesses the efficiency of both energy and material use. The results show that there is significant opportunity for reducing energy and material requirements in delivering products. Specific opportunities such as avoiding lasers in additive manufacturing or minimizing heat losses in powder sintering are proposed and evaluated.

Keywords: powder metallurgy, steel, efficiency.

1 Introduction

Powder metallurgy processes provide opportunities that are not available when using material in the conventional form: melting is not required in order to form complex components and the rapid solidification typical of powder production allows for use of highly alloyed compositions. Concern about global warming has led to agreement on national and international targets to reduce greenhouse gas (GHG) emissions [1]. Industry is responsible for 35% of all energy/process emissions [2, p. 13]. Emissions from steel powder metallurgy are currently only a small portion of industrial emissions but may become more significant with the rapid growth of processes such as metal additive manufacturing. Wohlers and Associates [3, p. 123], for example, reported that material sales increased

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