A New Improvement in the Machinability of P/M Steel Due to Retained Graphite Particles

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Abstract

The effect of graphite retained in the pore sites of sintered steels on machinability and the formation mechanism of graphite during sintering were investigated. Sintered steels containing retained graphite were obtained by sintering green compacts made from sulfur-containing iron powder with copper and graphite. Retained graphite in the pore sites of sintered steels in amounts of 0.1 to 0.3wt% resulted in 10 times longer drilling tool life and no significant impact on tensile strength. Inclusions of FeS on the surface of the iron powder reduced the diffusion rate of added graphite during sintering and graphite retained in sintered steels after sintering.

Introduction

The powder metallurgy process makes it possible to produce parts of complex shape with little or no machining. However, the impossibility of producing certain geometrical features, such as transverse holes, requires some machining, especially drilling. Improvement of the machinability of sintered steel is therefore important to increase productivity and reduce cost, because sintered steel has poor machinability due to its low thermal conductivity and interrupted cutting.(1)

The addition of 0.5% high purity MnS powder was effective in improving machinability and had little impact on sintered steel performance.(2) Sintered steel with an addition of 0.5 to 2 % lead required 25-50% less the drilling trust force. However, the addition of lead deteriorated the mechanical properties of the material.(3) A graphite of 0.5% content in wrought eutectoid steel reduced the principal cutting force by 25% during turning and acted as lubricant at the tool-workpiece interface.(4) On the other hand, little is known about the effects of graphite on the machinability of sintered steel.

For practical use, it is important to improve machinability without sacrificing mechanical properties. Therefore, a new iron powder was developed to improve the machinability of sintered steel while retaining the same tensile strength as conventional sintered steel.

The key concepts in this work are as follows.

1. Use of graphite in the sintered steel material to secure high thermal and good lubricant properties during machining.
2. Design of a suitable microstructure with sufficient graphite in the pore sites to improve machinability and sufficient combined carbon in the iron grains not to reduce tensile strength.
3. Prealloying of elements, especially sulfur, that are likely to segregate on the surface to retain graphite in the sintered steel after sintering.