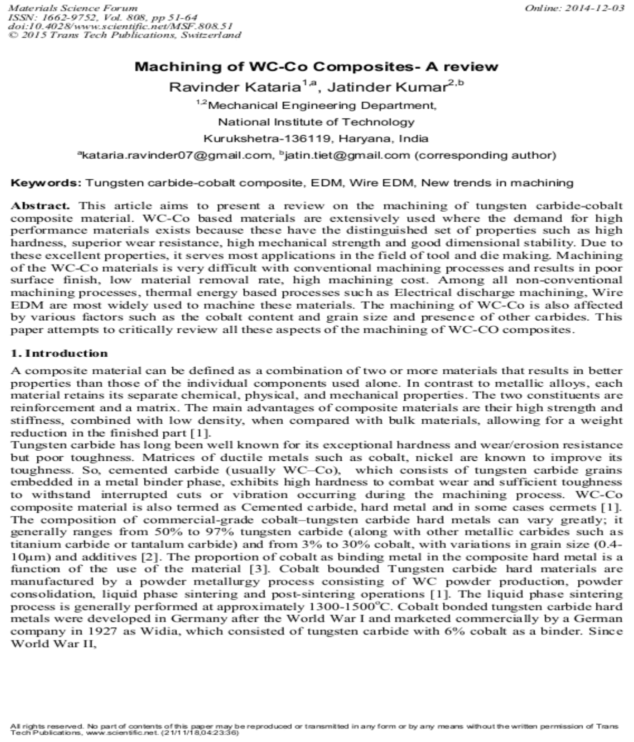
Cemented Tungsten Carbides: Production, Properties and Testing (Materials Science and Process Techno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Machining of WC-Co Composites- A review

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Abstract. This article aims to present a review on the machining of tungsten carbide-cobalt composite material. WC-Co based materials are extensively used where the demand for high performance materials exists because these have the distinguished set of properties such as high hardness, superior wear resistance, high mechanical strength and good dimensional stability. Due to these excellent properties, it serves most applications in the field of tool and die making. Machining of the WC-Co materials is very difficult with conventional machining processes and results in poor surface finish, low material removal rate, high machining cost. Among all non-conventional machining processes, thermal energy based processes such as Electrical discharge machining, Wire EDM are most widely used to machine these materials. The machining of WC-Co is also affected by various factors such as the cobalt content and grain size and presence of other carbides. This paper attempts to critically review all these aspects of the machining of WC-CO composites.

1. Introduction

A composite material can be defined as a combination of two or more materials that results in better properties than those of the individual components used alone. In contrast to metallic alloys, each material retains its separate chemical, physical, and mechanical properties. The two constituents are reinforcement and a matrix. The main advantages of composite materials are their high strength and stiffness, combined with low density, when compared with bulk materials, allowing for a weight reduction in the finished part [1].

Tungsten carbide has long been well known for its exceptional hardness and wear/erosion resistance but poor toughness. Matrices of ductile metals such as cobalt, nickel are known to improve its toughness. So, cemented carbide (usually WC–Co), which consists of tungsten carbide grains embedded in a metal binder phase, exhibits high hardness to combat wear and sufficient toughness to withstand interrupted cuts or vibration occurring during the machining process. WC-Co composite material is also termed as Cemented carbide, hard metal and in some cases cermets [1]. The composition of commercial-grade cobalt–tungsten carbide hard metals can vary greatly; it generally ranges from 50% to 97% tungsten carbide (along with other metallic carbides such as titanium carbide or tantalum carbide) and from 3% to 30% cobalt, with variations in grain size (0.4-10μm) and additives [2]. The proportion of cobalt as binding metal in the composite hard metal is a function of the use of the material [3]. Cobalt bounded Tungsten carbide hard materials are manufactured by a powder metallurgy process consisting of WC powder production, powder consolidation, liquid phase sintering and post-sintering operations [1]. The liquid phase sintering process is generally performed at approximately 1300-1500°C. Cobalt bonded tungsten carbide hard metals were developed in Germany after the World War I and marketed commercially by a German company in 1927 as Widia, which consisted of tungsten carbide with 6% cobalt as a binder. Since World War II,

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