

Impact of Cooling Time on the Structure and Tribological Properties of Metal Matrix Composite Castings

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ABSTRACT

The article presents the influence of cooling time on the structure of metal matrix composites (MMC) castings. The examination covered two types of composites manufactured by mechanical mixing. Composite reinforcement consisted of SiC particles, and the matrix consisted of AlSi9 alloy in the first case and AlSi11 in the second. Comparison covered samples cooled in sand moulds and gravity dies by presenting their cooling curves and their abrasive resistance.

KEY WORDS: metal matrix composites, casting, cooling curves.

INTRODUCTION

In recent years, metal and non-metal composites have been rapidly developing as construction materials of various applications in different industries.

One of major composite advantages is the possibility of obtaining desired usable properties. This involves, among others, the use of relevant fabrication methods. Composites with hard particles reinforcement (SiC, Al₂O₃, and BC) are frequently used as elements comprising tribological pairs [4-5]. Methods used to test their wear enable assessing relative resilience of the materials. Tribological phenomena depend mainly on the status of surface layers at interfaces between interacting elements of machines [3-4]. For this reason, it is important to examine the impact of the composite structure, which comprises at least two different materials [9], on the wear and tear. The wear and tear of such elements involves a number of processes that accompany friction and apply to the surface layer and change in mass, surface geometry, and shape. The objective of the paper is to present findings of the research focusing on resistance to wear and tear of composites which structures were determined by different cooling conditions (sand mould and gravity die).

1. METHODOLOGY

The examination covered MMCs fabricated using mechanical mixing. It is an intermediary method also known as ex-situ [2,3]. The method involves introducing reinforcement particles (or fibers) to liquid metal (alloy) and their mechanical spreading in the matrix as shown in Fig. 1 (suspension composites) [9].

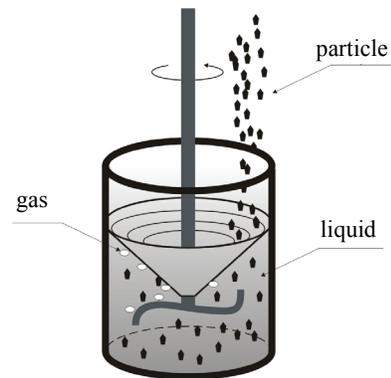


Fig. 1. Fabrication of composites using mechanical mixing [3]

The research covered two types of materials which differed as regards their matrix:

- composite of AlSi11 matrix and 15% SiC particle reinforcement. The material was fabricated in the Chair of Metal Alloy and Composites Technologies at the Silesian University of Technology in Katowice, Poland,
- composite of AlSi9 matrix and 15% SiC particle reinforcement fabricated by ALCAN Canada.

The composite input was prepared by cutting pig sows. It was then melted in a graphite crucible, moulds were filled and temperature changes registered during liquid metal cooling, solidification and cooling of casting. Trial castings were made of each of the materials.