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PAPER

Influence of cenosphere reinforcement on microstructure, microhardness, and corrosion behavior of Al5052 alloy matrix composite produced by compo casting method

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Abstract

The study investigates AA5052alloy matrix composite (MMC) with varying cenosphere particle percentages. Compo-casting integrated cenosphere fly ash particles (2, 4 and 6) wt% into the alloy, improving distribution and wettability. Microhardness increased with higher reinforcement, peaking at 87 Hv with 6% addition. Corrosion resistance in 3.5 wt% NaCl solution showed improved values compared to the base alloy with lowest corrosion rate of 0.144 mmpy for the composite with 6% reinforcement. The study highlights importance of cenosphere reinforcement in enhancing microstructure, hardness, and corrosion resistance in AA5052 MMCs.

1. Introduction

Aluminum and its alloys exhibit effective resistance to corrosion in moderately hostile environments. However, organic coatings are often used to guarantee long-term protection. Because of its effectiveness and convenience of use, chromate conversion coating is currently one of the agents used most frequently to improve adhesion to aluminum and its alloys [1–8]. Environmental regulations have prompted numerous surface providers to create new technologies based on eco-friendly procedures recently [6]. Aluminum 5052 (AA5052) alloys are used in the production of chemical barrels as well as vehicle bodies. AA5052 is a non-heat-treatable grade of Al alloy that is mostly made of magnesium and chromium as alloying components. This alloy is becoming more and more popular as a material for automobiles. Its expanded use is a result of the transportation and industrial sectors' growing need for improved strength and corrosion resistant qualities [9–12]. Metal matrix composites (MMC's) have gained significant attention in recent years due to their superior mechanical properties and potential for various industrial applications [13–15]. Over the past decade, there has been a significant rise in the amount of research conducted in the area of aluminium matrix composites (AMMCs). These composite materials are being employed to substitute traditional metallic alloys, particularly in aerospace components such as wings and fuselage, as well as in automotive parts like brake discs, drums, and pistons, all while keeping production costs relatively low [16–19]. Faraji *et al* [20] explored the impact of SiC and TiB_2 on the corrosion of AA5052 alloy when utilized as reinforcement and reported that the corrosion rate of AA5052/SiC composites was lower than that of the unalloyed base material. In present study, AA5052 has been selected as the research study's matrix material for a number of important reasons. The study focuses on utilizing the widely recognized AA5052 aluminum alloy as a matrix material due to its excellent mechanical properties, corrosion resistance, and versatility in various applications. Chosen for its balance of strength and lightweight nature, AA5052 offers both low density and high tensile strength, making it ideal for structural purposes. Additionally, aluminum was selected for its affordability, abundance, and ease of processing compared to other metal matrix options. The objective is to develop metal matrix composites by incorporating varying concentrations of cenospheres into AA5052 using the compo casting technique. The resulting composite will then be analyzed to observe microstructural changes, assess microhardness characteristics, and evaluate corrosion behavior.