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DRY SLIDING BEHAVIOUR OF POWDER METALLURGY PROCESSED MAGNESIUM MATRIX HYBRID COMPOSITES

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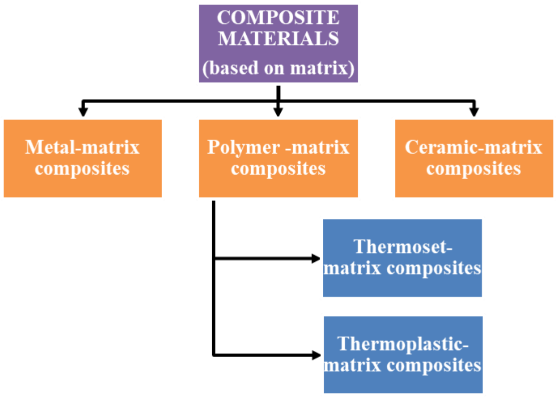
ABSTRACT

Lightweight metal matrix composites have the potential to be used as replacements for steel and cast irons components. Magnesium alloys, the lightest among structural materials, have become attractive material for applications in automotive and aerospace industries. Addition of hard and soft reinforcement particles into magnesium improves the properties of magnesium.

In this work Mg – B_4C – Gr hybrid composites has been developed by powder metallurgy route. The hybrid composite displays increase in hardness when compared to base material, which is attributed to the presence of hard B_4C particles and a slight decrease in hardness is noted for the hybrid composite when compared to Mg– B_4C composite which may be due to the presence of graphite particles. The tri-biological properties of these composite materials were investigated by pin-on-disc wear test apparatus under dry sliding condition. The wear resistance of the developed hybrid composites improves significantly when compared to that of the monolithic magnesium.

INTRODUCTION

Conventional monolithic materials have limitations in achieving good combination of strength, stiffness, toughness and density. To overcome these shortcomings and to meet the ever increasing demand of modern day technology, composites are most promising materials of recent interest. Metal Matrix Composites (MMCs) possess significantly improved properties including high specific strength, specific modulus, damping capacity and good wear resistance compared to unreinforced alloys. There has been an increasing interest in composites containing low density and low cost reinforcements. Among various discontinuous disperse solids used, fly ash is one of the most in expensive and low density reinforcement available in large quantities as solid waste by-product during combustion of coal in thermal power plants. Hence, composites with fly ash as reinforcement are likely to overcome the cost barrier for wide spread applications in automotive and small engine applications



ENVIRONMENTAL IMPACTS

As more than 97% of the starting materials reach the finished product, powder metallurgy is a process that conserves both energy and materials. Powder Metallurgy (P/M) is closely connected with technologies that determine its relationship to environmental protection. If P/M is limited to the
production of metal or metal-like powders, it would be just a part of metallurgy

and could not be a progressive, technologically, and economically attractive method combined with metallurgy, materials science, and metalworking. Reducing elimination or at least minimization of machining of the end product leads to economic advantages. Elimination of scrap losses, which directly reflects on environmental protection, is another privilege of the P/M method, providing many possibilities to create waste-free and environmentally friendly process.

LITERATURE SURVEY

Magnesium alloys, the lightest among structural materials, have become attractive material for applications in automotive, aerospace, audio and electronic industries Mordike, Ebert et al . The studies by Liu et al. show that the monolithic counterpart is compared to, particulate reinforced magnesium matrix composites; it possesses with higher strength and improved mechanical and tribological properties. Selvakumar, et al. have reported that the reinforcing of metal matrix with hard ceramic particles can increase both the hardness and strength levels, resulting in improved wear resistance of the material.

PROJECT IDENTIFICATION

One way to improve the properties of conventional metallic materials is to reinforce them judiciously keeping the end application in mind. Magnesium is always at the centre of attention due to its intrinsic characteristics such as low-density, high specific modulus and strength which have been significantly improved with the use of discontinuous reinforcement. Mutual interactive influences of the intrinsic properties of reinforcement and matrix and the size, volume fraction and distribution of the reinforcement phase contributes to the improvements in properties of reinforced materials such as metal matrix composites (MMCs). Metal matrix composites (MMCs) have been developed to respond the demand for lighter materials with high specific strength, stiffness and wear resistance.

MATERIALS

Commercially available Mg powder (99.8% pure and 60 μm average particle size) is used as the matrix material. B_4C powder with mean particle size of 220 mesh is used as hard reinforcements and graphite powder (98% pure and mean particle size of 60 mesh) is used as soft reinforcement are used in this study. The density of magnesium, B_4C and graphite powders are

1.73 g/cm^3, 2.52 g/cm^3 and 2.27 g/cm^{3}respectively.

METHODS

Micro-particles are very economical because of their low prices and easy dispersion during fabrication. The micron-particle reinforced Mg matrix composites own the potential commercial use for its relatively low cost and good mechanical properties. Micron- particle reinforced metal matrix material is usually produced by powder metallurgy, high-energy ball milling, sputtering and stir casting etc., Among the various methods, powder metallurgy method used in the fabrication of this composite. In manufacturing metal matrix composites, the dispersion of the reinforcement particles is a challenge. Powder metallurgy overcomes the negative effects of liquid state processing methods such as stir casting.

POWDER METALLURGY

Powder Metallurgy (P/M) is sometimes the only manufacturing method which can be used for some materials such as porous materials, composite materials, refractory metals and special high duty alloys. The P/M processes employed to produce components from such materials include loose powder sintering, liquid phase sintering, cold and hot isostatic pressing and other special techniques. Less obvious applications of P/M involve common materials since these can also be processed by casting, metal forming, and machining. The P/M method competes with other methods on the basis of cost which can be lower for high volume production of complicated components. In most cases such components are manufactured using a classical P/M route which involves compaction of the metal powder followed by sintering. In powder metallurgy, the reinforcement is homogeneously dispersed in the matrix for the fabrication of composites.

BLENDING

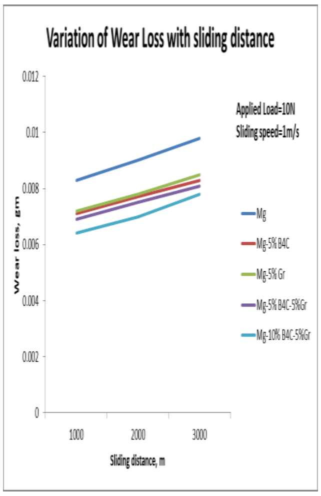
The end properties of composite materials are critically governed by selection of type of reinforcement and its compatibility with metallic matrix during materials processing. Although the use of reinforcement leads to an improvement in strength characteristics of magnesium, the intrinsic .

COMPACTING

The blended powders were subjected to cold compaction in the hydraulic press as shown in the figure 3.4 into cylindrical size of diameter 12mm with a height of 15mm at a pressure of 550 MPa.

SINTERING

The green compacted specimen taken out from the die is subjected to sintering process. Sintering was done in a controlled atmosphere tubular furnace at the temperature of 520°C for a dwell time of 1 h and allowed to get cooled in the furnace itself. The ends of the sintered composite specimens were successively polished with the silicon carbide abrasive papers with a grit of 600, 800 and 1000 respectively for a mirror-like surface finish.



CONCLUSION

Metal matrix composites with high specific stiffness and strength could be used in applications in which saving weight is an important factor. Concerns about power saving and environmental issues have encouraged efforts to increase applications of lightweight materials, especially in automobiles. In recent decades, Mg and its alloys find applications in automobile and aerospace industries because of their low density and high specific strength. Even though these alloys have an attractive range of mechanical properties, relatively lower strength at both ambient and elevated temperatures, poor resistance to wear and corrosion are the serious impediment against wider applications. In order to exploit the potential of magnesium, it is necessary to improve their mechanical strength, such as hardness and wear resistance which are usually incorporated with ceramic elements in the form of fibers/particulates, so as to make magnesium metal matrix composites, MMCs.

REFERENCES

1. Mordike, B. L. and Ebert, T. 2001, —Magnesium: properties – applications – potential, Materials Science and Engineering: A, 302(1), pp 37–45.
2. Ye, H. Z. and Liu, X. Y. 2004, —Review of recent studies in magnesium matrix composites, Journal of Materials Science, 39(20), pp 6153–6171.
3. Selvakumar, N. and Narayanasamy, R. 2005, —Deformation behavior of cold upset forming of sintered Al–Fe composite preforms, Journal of Engineering Materials and Technology, 127(2), pp 251–256.
4. I. Topcu, H.O. Gulsoy, N. Kadioglu, A.N. Gulluoglu 2009, —Processing and mechanical properties of B4C reinforced Al matrix composites, Journal of Alloys and Compounds, 482, pp 516–521.