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Wear Analysis of Aluminium Hybrid Metal Matrix Composites

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A B S T R A C T

Aluminum hybrid metal matrix composites (Al-HMMCs) are a class of materials that have gained significant attention due to their excellent mechanical and thermal properties. In this study, the hardness and wear resistance of Al-HMMCs were investigated using a variety of testing methods. The results showed that the hardness and wear resistance of Al-HMMCs were significantly higher than those of pure aluminium. The improved hardness and wear resistance were attributed to the presence of the hard reinforcement particles, which were dispersed throughout the matrix material. The results of this study demonstrate the potential of Al-HMMCs as a durable material for a wide range of applications, including structural components and wear-resistant coatings. To further evaluate the hardness and wear resistance of Al-HMMCs, a series of tests were conducted using both indentation and sliding wear methods. In the indentation tests, a diamond indenter was used to apply a load to the surface of the Al-HMMCs and the resulting indentation depth was measured. The results showed that the Al- HMMCs had a higher hardness than pure aluminium, with the hardness increasing as the volume fraction of the reinforcement particles increased In the sliding wear tests, a pin-on-disk setup was used to simulate sliding wear between the Al-HMMCs and a counterface material. The results showed that the Al- HMMCs had a significantly lower wear rate compared to pure aluminium, indicating improved wear resistance. This improved wear resistance was attributed to the hard and abrasive nature of the reinforcement particles, which prevented the formation of wear debris and reduced the wear rate the results of this study demonstrate that Al-HMMCs have excellent hardness and wear resistance properties, making them suitable for a variety of applications where these properties are important.

Keywords: AL-HMMC

Introduction

Aluminium hybrid metal matrix composites (Al-HMMCs) are a class of materials that have gained significant attention due to their excellent mechanical and thermal properties. In this study, the hardness and wear resistance of Al-HMMCs were investigated using a variety of testing methods. The results showed that the hardness and wear resistance of Al-HMMCs were significantly higher than those of pure aluminium. The improved hardness and wear resistance were attributed to the presence of the hard reinforcement particles, which were dispersed throughout the matrix material. The results of this study demonstrate the potential of Al-HMMCs as a durable material for a wide range of applications, including structural components and wear-resistant coatings. Evaluate the hardness and wear resistance of Al-HMMCs, a series of tests were conducted using both indentation and sliding wear methods. In the indentation tests, a diamond indenter was used to apply a load to the surface of the Al-HMMCs and the resulting indentation depth was measured. The results showed that the Al- HMMCs had a higher hardness than pure aluminium, with the hardness increasing as the volume fraction of the reinforcement particles increased. sliding wear tests, a pin-on-disk setup was used to simulate sliding wear between the Al-HMMCs and a counterface material. The results showed that the Al- HMMCs had a significantly lower wear rate compared to pure aluminium, indicating improved wear resistance. 1 The improved wear resistance was attributed to the hard and abrasive nature of the reinforcement particles, which prevented the formation of wear debris and reduced the wear rate. The results of this study demonstrate that Al-HMMCs have excellent hardness and wear resistance properties, making them suitable for a variety of applications where these properties are important. Potential applications include structural components, wear-resistant coatings, and cutting tools. Further research is needed to fully understand the mechanisms behind the improved hardness and wear resistance of Al-HMMCs and to optimize their composition and processing for specific applications. Series of tests were conducted using both indentation and sliding wear methods. In the indentation tests, a diamond indenter was used to apply a load to the surface of the Al-HMMCs for a wide range of applications, including structural components and wear-resistant coatings.

Literature Survey

[1] Ansar Kareem, For casting the Aluminum hybrid metal with reinforcement material increase mechanical and tribological properties. Aluminum were developed for enhanced material performance. Al 6061 is an aluminium alloy that has extensive applications due to its superior material characteristics.

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3. Experimentation

3.1 Project Work flow

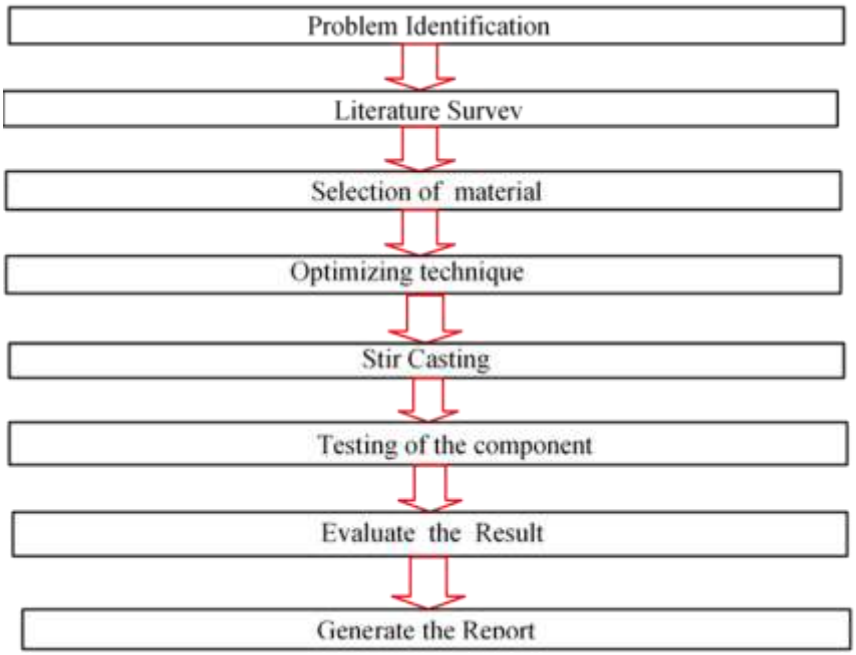

Fig. 1 – Project Work Flow

3.2 Stir Casting Machine

It is used to cast different composite materials using needed reinforcements to improve strength of the materials.

Fig. 2 – Stir Casting Machine

3.3 Rockwell Hardness Machine

It is used to calculate the hardness of the material by applying the constant load for the specimen of varying percentage of the composition.

Fig. 3 – Rockwell Hardness Machine

3.4 Wear Testing Machine

It is used to wear loss for particular load and certain load at particular speed to identify friction force and wear resistance.

Fig. 4 – Wear Testing Machine

4. Test Results

4.1 Hardness Testing Results

Table 1 – Hardness Testing Results

S.No	Material Wt Percent	Hardness(HRC)
1.	Al = 85% Tic = 10% Mos_2 = 5%	80
2.	Al = 85% Tic = 5% Mos_2 = 10%	67
3.	Al = 95% Tic = 2.5% Mos_2 = 2.5%	55
4.	Al = 86% Tic = 7% Mos_2 = 7%	72
5.	Al = 97% Tic = 1.5% Mos_2 = 1.5%	46
6.	Al = 80% Tic = 10% Mos_2 = 10%	78

4.2 Wear Test Table

Table 2 – Wear Test Table

S.No	Material Wt Percent	Hardness(HRC)
1.	Al = 85% Tic = 10% Mos_2 = 5%	168
2.	Al = 85% Tic = 5% Mos_2 = 10%	93

S.No	Material Wt Percent	Hardness(HRC)
3.	Al = 95% Tic = 2.5% Mos_2 = 2.5%	117
4.	Al = 86% Tic = 7% Mos_2 = 7%	159
5.	Al = 97% Tic = 1.5% Mos_2 = 1.5%	126
6.	Al = 80% Tic = 10% Mos_2 = 10%	105

Conclusion

In this project Aluminium hybrid metal matrix composite is casted it is used in the automobile industry to manufacture brake drum and disc drum in which aluminium hybrid metal matrix composite material is used because aluminium has good mechanical and chemical properties as well as life of the material is also so long compare to the other material. In these material also continuously usage of material leads to reduce the hardness and weariness of material drastically. To avoid the problem in order to increase the hardness and weariness of the material adding the reinforcement material such as Titanium carbide which provide higher hardness than other reinforcement and Molybdenum disulfide provide higher weariness comparative to other reinforcements and to identify the material which has higher hardness and weariness among the specimen and to apply that percentage material to manufacture brake drum and disc brake and increase the strength as well as life of the material also increases and casting the material by varying the percentage of the reinforcement material .

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