Material Science Research India Vol. **7**(2), 491-493 (2010)

Analysis of aluminium matrix composite using oxidised copper

K. RAJI[1] and S. ALFRED CECIL RAJ[2]

[1]Department of Physics, Holy Cross College (Auto), Tiruchirappalli (India).
[2]Department of Physics, St. Joseph's College (Auto), Tiruchirappalli (India).
Email: rajdavey59@yahoo.co.in

(Received: July 20, 2010; Accepted: September 07, 2010)

ABSTRACT

This paper gives a vivid picture about Aluminium matrix composite. P/M aluminium and aluminium matrix composites offer lower density, improved strength, stiffness, and wear resistance. The materials are produced from both blended elemental powders and pre alloyed powders with additives by a range of processing routes such as sintering, compression and annealing. The purpose of the investigation is to study the characteristics of selected Al-Cu composition. Because aluminium is silvery –white in colour and extensively used where a light non corrosive metal is desired as an aircraft and automobile components where the saving of weight is an added advantage and moreover Aluminium finds its widest use when alloyed with small amount of other metals.

Key words: Green density, compacting, ejection, porosity.

INTRODUCTION

The traditional powder metallurgy has seen tremendous developments over the years since the major industrial scale applications initiated with the production of self –lubricant bearings and cemented carbides. The continuous and sustaining research and development over the years have contributed several innovations in this process. The trends in globalization, world trade and industrial acquisition and alliance have their own impact on P/M industry. Automotive industry is the major customer of P/M accounting for about 60 to 80 percent of its total production.

EXPERIMENTAL

Evaluation of grain size

In order to evaluate the grain size of the particle, sieve analysis method [1] is used. This method is used to separate different grain size particles and also to determine the grain size of the Al-Cu composite where 9% copper in weight proportion is added to aluminium.The sieve shaker consists of standard set of sieves, having apertures of different sizes arranged one over the other in decreasing order with coarsest sieve on the top. The powder composition collected is weighed and placed on the top sieve and the sieve shaker is shaken for 30 minutes. The grain size distribution of Cu is shown in the form of histogram in Fig. 1.

Preparation of compacts

The experimental set up for preparation of compacts consisting dies, punch, lower punch support and ejection block. Lower punch support is placed at the bottom of the die to support the loose powder poured in the cylinder. Molybdenum die sulphide is used for die wall lubrication in order to get the finished compact [2] from the die wall easily. Ejection block is used to eject the finished component from the die wall without any damage. A universal testing machine is used for compaction of the AL - CU composition by single action die compaction.

Characteristics of compacts

Nearly 15 compacts are prepared for the test. The green compact obtained is weighed using a common balance. Length and diameter of the green compact is measured with a micrometer. Green density [3] is calculated using the equation G = 4W / (II d_g^2 l_g) and it is tabulated. The parameters like apparent density, theoretical density, true porosity and hardness are calculated and recorded calculated using the equation (1) and the values are tabulated in Table 1.

Percentage of True porosity [4]=1-(Green Density / True Density) ...(1)

RESULTS

1. The green density is increasing with increase in compacting pressure [5] and increase in Particle size (Fig. 2)
2. The Porosity is decreasing [6] with increase in compacting pressure (Fig. 2)
3. Ejection load and green hardness are increasing [7] with the increase in compacting Pressure (Fig. 2)

Table: 1 Characteristic of 3% Cu in Al Matrix

Serial Order	Al-Cu Composition %	Theoretical density Gm /Cc	Apparent density Gm / CC	Green density Tons / m³	Pressure at compaction Tons	True porosity %	Hardness Tons / mm²
1	3	2.755	0.84608	49464.89	10.2	77.85	0.05271
2	5	2.786	0.81752	19949.797	5	28.57	0.0271
3	7	2.818	0.8816	14503.102	3.5	48.54	0.0190
4	9	2.850	0.87192	25846.089	5.8	10.71	0.03150

After determining the green density of each compact its true porosity in percentage is calculated using the equation (1) and the values are tabulated in Table: 1

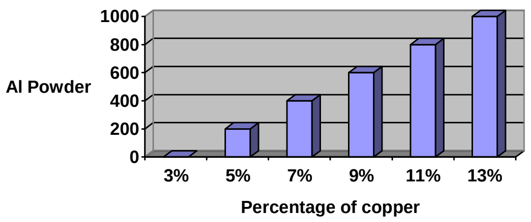

Fig. 1: Grain distribution of copper

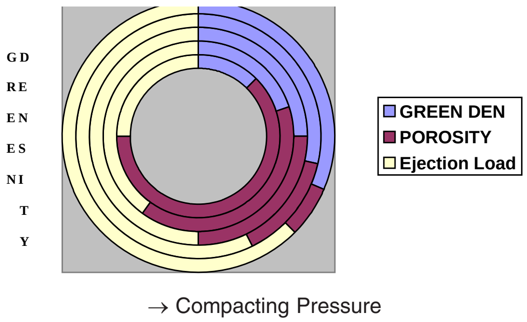

Fig. 2: The general dependence of green density on several important factors is shown

DISCUSSION

The most common internal defect is porosity. This generally arises from shrinkage during solidification and in this case the order of porosity is minimized. The metal powders obtained in a suitable degree of fineness and purity is also the main cause for the best result. The metal powder composite is subjected to a sufficient pressure in a suitable mould to cause cohesion to occur between the particles and there by increasing the density of the compact. The increase in the hardness of the composite may be giving the ability to resist being permanently deformed when a load is applied.

CONCLUSION

It is understood that, the greater the hardness, the greater is the resistance towards deformation because it consists of the fine dispersion of Alumina [8] (Al_2O_3) particles into a polycrystalline aluminum matrix. The presence of this second phase gives it interesting mechanical properties. The present investigation showed that it is possible to make powder metallurgy components from different composition of Al -Cu. While growth is expected to accelerate, it is important to track of changes in automotive industry as they are the major users of structural PM parts.

ACKNOWLEDGEMENTS

The author thanks the UGC funding agency and Professors of Holy Cross College and St. Joseph's College.

REFERENCES

1. Lin CB , Chang,R.J.,Weng,W.P. , A study on process and tribological behaviour of Al alloy/ Gr (p) composite, *Wear.* **217:** 167-174 (1998).
2. Lepper K., James M., Chashechkina., J.,Rigney, D.A., Sliding behaviour of selected aluminium alloys, *Wear.* **203**: 46-56 (1997).
3. Pathak, J. P., Torabian, H., Tiwari, S. N., Anti seizure and antifriction characteristics of Al-Si-Ph alloys, *Wear* **202**: 134-141 (1997).
4. G.S. Upadhyaya, Sintered Metallic and Ceramic Materials, J.Wiley, New York, NY, 21 (1999).
5. Yihr A.A, Chung D.D.L, Titanium di boride Copper matrix composites, *Journal of Material Science*, **32**: 1703-1709 (1997).
6. V. Sivaraj, Engineering Metallurgy VK Publishers, Bangalore, India, 62 (1980)
7. W.J Dawson, Hydrothermal Synthesis of Advanced Ceramic Powders Am. *Cream. Soc. Bull*., **67**(10): 1673-1678 1998.
8. R.M.Anklekar, K. Bauer, D.K. Agrawal and R.Roy, Improved mechanical properties and Microstructures development of microwave Sintered copper and nickel steel PM parts, *Powder Metallurgy.* 48(1) (2005).