Optimization Of Machining Parameters Of CNC Lathe In Turning Using RSM

[1]Ashok Bharii, [2]Dr. Deo Raj Tiwari

[1]M.tech Student, [2]Associate Professor
[1]Mechanical Engineering
[1]IIMT College of Engineering , Greater Noida, India

Abstract : **Metal matrix composites (MMCs) constitute an important class of design and are weight- efficient structural materials that are encouraging every field of engineering applications. There has been an increasing interest in composites containing low density and low cost reinforcements. Among various discontinuously dispersed solids used, Alumina is one of the most inexpensive and low density reinforcement available in large quantities as solid waste by- product during combustion of coal in thermal power plants. Hence, composites with Alumina as reinforcement are likely to overcome the cost barrier for wide spread applications in automotive and small engine applications. To produce Al matrix cast particle composites, wet ability of the ceramic particles by liquid Al is essential. To improve wet ability, elements such as Alumina are added into Al melt to incorporate the ceramic particles. The present work has been focused on the utilization of abundant available industrial waste. Alumina in useful manner by dispersing it into Alumina matrix to produced composites by mechanical stir casting. Wide size range (0.1- 100µm) Alumina particles were used. The mechanical properties such as hardness and tensile strength, Toughness, and microstructure have been investigated.**

IndexTerms **- Metal matrix composites, Alumina, utilization, industrial waste, reinforcement etc.**

I. INTRODUCTION

materials and technology that reflect human ability and understanding. Many times scales begins with the stone age, which led to the Bronze, Iron, Steel, Aluminium and Alloy ages as improvements in refining, smelting took place and science made all these possible to move towards finding more advance materials possible. Composite materials are emerging mainly in response to extraordinary demands from technology due to fast advancing activities in aircrafts, aerospace and automotive industries. These materials have low specific gravity that makes their properties particularly superior in strength and modulus to many conventional engineering materials such as metals. As a result of intensive studies into the fundamental nature of materials and better understanding of their structure property relationship, it has become possible to develop new composite materials with improved physical and mechanical properties.The recognition of the potential weight savings that can be achieved by using the advanced composites, which in turn means reduced cost and greater efficiency, was responsible for this growth in the technology of reinforcements, matrices and fabrication of composites.

1.1 COMPOSITES

A typical composite material is a system of materials composing of two or more materials (mixed and bonded) on a macroscopic scale. Generally, a composite material is composed of reinforcement (fibers, particles, flakes, and/or fillers) embedded in a matrix (polymers, metals, or ceramics). The matrix holds the reinforcement to form the desired shape while the reinforcement improves the overall mechanical properties of the matrix. When designed properly, the new combined material exhibits better strength than would each individual material. Composites consist of one or more discontinuous phases embedded in a continuous phase. The discontinuous phase is usually hard and stronger than the continuous phase and is called the 'reinforcement' or 'reinforcing material', whereas the continuous phase is termed as the ' matrix'.Properties of composites are strongly dependent on the properties of their constituent materials, their distribution and the interaction among them.

1.2 CLASSIFICATION OF COMPOSITE MATERIALS

(a) The three broad classifications of composites are on the basis of reinforcement:

(i) Particle reinforced composite: It consists of the composite material in which the filler materials are roughly round. An example of this type of composite would be the un-reinforced concrete where the cement is the matrix and the sand serves as the filler.

(ii) Fiber -reinforced composites : It is of two types short and long fiber composite .in short fiber composite , l /d ratio greater than one .Short fiber composites are generally taken to l /d of ~100 while long fiber type would have l /d ~ infinite . Fiber glass filler for boat panel is an example of short fiber composite. Carbon fibers, aramid fibers are some of the filler materials used in the long fiber composite.

(iii) Laminated composite: It is the type of the composite material in form of sheet instead of round particles or fibers .Formica countertop is a good example of this type of composite the matrix material is the phenolic type thermo set polymer. The filler could be any material from craft paper Formica) to canvas (canvas phenolic) to glass (glass filled phenolic).

(b) On the basis of Matrix composite can be classified in the following groups:

(i) Polymer-matrix composites (PMC) The most common matrix materials for composites are polymeric. Polyester and vinyl esters are the most widely used and least expensive polymer resins. These matrix materials are basically used for fiber glass reinforced composites. For mutations of a large number resin provide a wide range of properties for these materials .The epoxies are more expensive and in addition to wide range of ranging commercials applications also find use in PMCs for aerospace applications. The main disadvantages of PMCs are their low working temperature high coefficients of thermal expansion and hence dimensional instability and sensitivity to radiation and moisture.

(ii) Metal-matrix composites (MMCs) The matrix in these composites is a ductile metals .Due to their properties such as low density, high stiffness, and low coefficient of thermal expansion, high thermal conductivity, high strength and high wear resistance MMC have application in the automotive aviation space precision industry, defense, energy, and electronics work. Metal matrix composites are much more expensive those PMCs and, therefore, their use is somewhat restricted are low compared with metals and ceramics. Popular reinforcement materials for these composites are silicon carbide and alumina particles, while aluminium titanium and magnesium are the most common matrix materials.

(iii) Ceramic-matrix composites (CMCs) One of the main objectives in producing CMCs is to increase the toughness. Ceramics materials are inherent resistant to oxidation and distortion at elevated temperatures; were it not for their disposition to brittle fracture, some of these materials would be idea candidates for use in higher temperature and serve-stress applications, specifically for components in automobile an air craft gas turbine engines .The developments of CMCs has lagged behind mostly for main reason behind itis the most processing route involve higher temperature and only employed with high temperature reinforcements.

II. MATERIAL USED

2.1 Matrix Material

Most of the automobile parts, aerospace structures and its allied infrastructure are made of aluminum alloy. In this context considering Al 6082 which was used for making pressure vessel cylinders is now testing for aircraft structures. Al 6082 has high corrosion resistance and can be seen in forms of extruded rod bar and wire and extruded shapes. It is easily machine-able and can have a wide variety of surface finishes. It also has good electrical and thermal conductivities and is highly reflective to heat and light. Due to the superior corrosion resistance, Al 6082 offers extremely low maintenance. Al 6082 is only one-third the weight of cast iron, with about 75% of comparable tensile strength. . In this investigation the tensile strength on circular rod specimen of Al 6082 is finding out by applying the loads on universal testing machine with various dimensions. The experimental results were found satisfactory to propose the alternative alloy for aircraft structures.

2.2 Composition Of Matrix Material (Al6082)

Aluminum	Copper	Magnesium	Silicon	Iron	Manganese	Others
95.2- 98.5	0.1%	0.4-1.2%	0.6-1.3%	0.6%	0.4-1.0%	0.3%

III EXPERIMENTAL WORK

.

The work materials used in the present work are aluminium alloy 6082 and aluminium oxide (Al_2O_3 as reinforcement). These materials are chosen due to their easily mixable property and gives good mechanical properties. First of all the aluminium alloy (Al6082) is heated

Fig. Lathe machine

up to its melting temperature in a electric furnace and then aluminium oxide is heated and mixed slowly in molten aluminium alloy with the help of stirrer. The mixer is left for cool down in the crucible in which it was melted and mixed. There are six samples in different ratios which are prepared for testing mechanical properties and choosing the best. The ratios are shown below in the Table.

Table 3.1 Composition selection

Material	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**	**Sample 5**	**Sample 6**
Aluminium alloy (AA6082)	97.5%	95.0%	92.5%	90.%	87.5%	85%
Aluminium oxide (Al_2O_3)	2.5%	5%	7.5%	10%	12.5%	15%

Figure 3.1 Sample of aluminium + Al_2 O_3 2.5 and 5% Alumina in Aluminium

Figure 3.2 Sample of aluminium + Al_2 O_3 7.5 and 10% Alumina in Aluminium

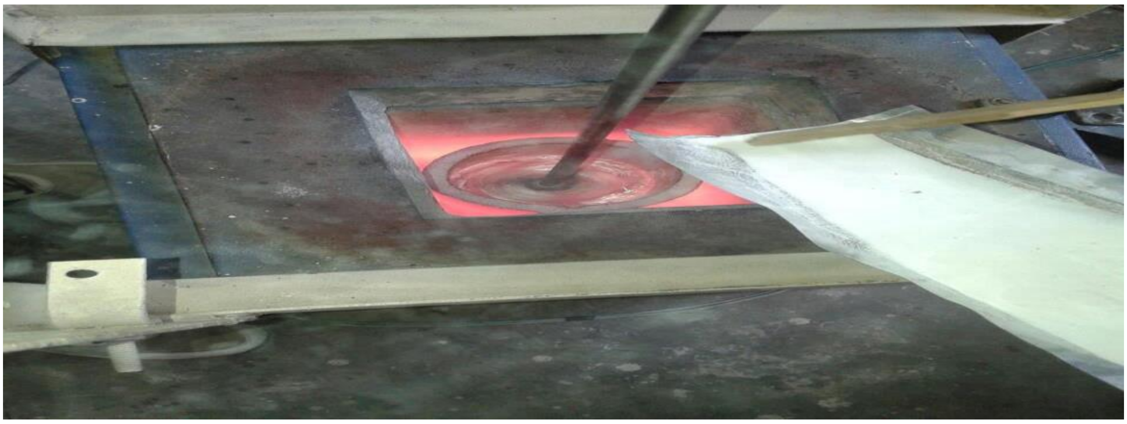

Figure 3.3 Preparation of sample by mechanical stir casting

3.1 OPTIMIZATION TECHNIQUE

Optimization is a process of arranging different input variables to get the best output. In this project optimizing the four parameters like feed rate, Depth of cut, speed and tool nose radius, and study the behavior of these parameters on dimensional deviation.

3.2 RESPONSE SURFACE METHODOLOGY

Response surface methodology (RSM) is a collection of mathematical and statistical techniques for empirical model building. By careful design of experiments the objective is to optimize a response (output variable) which is influenced by several independent variables (input variables). An experiment is a series of tests, called runs, in which changes are made in the input variables in order to identify the reasons for changes in the output response. Originally, RSM was developed to model experiments responses (Box and Draper in 1987) and then migrated into the modeling of experiments. In physical experiments, inaccuracy can be due ,for example, to measurement errors while, in computer experiments, numerical noise is a result of incomplete convergence of iterative processes, round -off errors or the discrete representation of continuous physical phenomena. In RSM the errors are assumed to be random. The most extensive applications of RSM are in the particular situations where several input variables potentially influence some performance measures or quality characteristics are called the response. The input variables are sometime called independent variables, and they are subjected to the control of the engineer or scientists. The field of response surface methodology consists of the experimental strategy for exploring the space of the process or independent variables, empirical statistical modelling to develop an appropriate approximating relationship between the yield and the process variables , and optimization methods for finding the values of the process variables that produce desirable values of the response. In this report i concentrate on the statistical modeling to develop an appropriate approximating model between the response y and independent variables $E_{1,}$ E2. En. In general the relationship is

$$Y = f(E1,E2,E3) + e$$

Where the form of the true response function f is unknown and perhaps very complicated, and E is a term that represents other sources of variability not accounted for in f .Usually E includes effects such as measurement error on the response, background noise, the effect of other variables, and so on. Usually E is treated as a statistical error, often assuming it to have a normal distribution with mean zero and variance, then Because the form of true response function f is unknown, we must approximate it.

$$E(y) = E\,[f\,(E1, E2, E3) + E\,(e) = f\,(E1, E2, E3)$$

IV. RESULT AND DISCUSSION

4.1Analysis Of Microstructure

The microstructures of the MMC samples are seen using metallurgical microscope. When describing the structure of a material, we make a clear distinction between its crystal structure and its microstructure. The term ‘crystal structure’ is used to describe the average positions of atoms within the unit cell, and is completely specified by the lattice type and the fractional coordinates of the atoms. The term ‘microstructure’ in metal matrix composites is used to describe the appearance of the reinforcement material. A reasonable working definition of microstructure is “The arrangement of phases and defects within a material.”

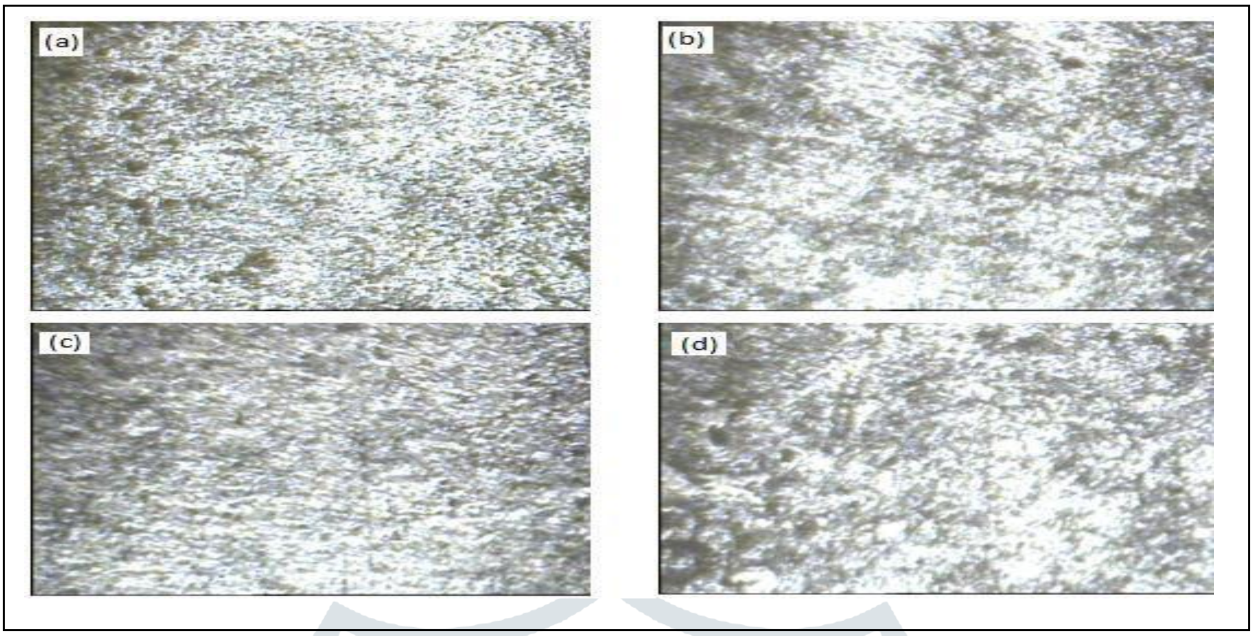

Figure 5.1 Microstructure of different samples

(a) 2.5% reinforcement, (b) 5% reinforcement, (c) 7.5% reinforcement, (d) 10% reinforcement

4.2 ANALYSIS OF TENSILE STRENGTH

The tensile testing of MMC is carried out on Tensometer machine. Tensometer is a device used to evaluate the tensile properties of materials such as their Young's modulus and tensile strength. It is usually a universal testing machine loaded with a sample between two grips that are either adjusted manually or automatically to apply force to the specimen. The machine works either by driving a screw or by hydraulic ram. Testing is done by clamping the specimen in the jaws of the Tensometer

Fig. 4.2. Tensile Testing on Tensometer

Table 5.1 Tensile Test Results

Samples (of Al_2O_3)	Ultimate strength(N)	ongation (mm)	ak load (N)	Break Elongation (mm)	True UTS (N/ sq mm)	Area (sq. mm)
2.5%	699.8	0.53	148.3	0.63	26	28.386
5.0%	637.5	0.5	205.9	0.67	22.9	28.186
7.5%	1398.1	2.16	1008.3	2.50	62.2	26.123
10%	441.3	0.38	304	0.54	15.8	28.286
12.5%	342	0.32	298	0.48	14.9	26.282
15 %	308	0.30	282.2	0.39	14.5	25.832

V.CONCLUSION

The following conclusions can be drawn from analysis;

1.Within the investigated range of process parameters, lower speed (100 m/ min), lower feed (0.15 mm/rev.) and lower depth of cut (0.20 mm) and rake angle (-9 .00) are preferred for low dimensional deviation of machined A6064/7.5% Al_2O_3 metal matrix composite.

2.Within the process parameters range; dimensional deviation of machined A6064/7.5%Al_2O_3 metal matrix composite decreases, by increasing the speed, feed rate and depth of cut and increases by increasing rake angle.

3.Mechanical properties are improved by adding the reinforcement material Alumina at 7.5% in Al6064.

4.The value of dimensional deviation is 2.5933

REFERENCE

[1] Y. Iwai , T. Honda , T. Miyajima ,Y. Iwasaki and M.K. Surap “Dry sliding wear behavior of Al_2O_3 fiber reinforced aluminum composites” Composites Science and Technology 60 (2000) .

[2] C.G. Kang, N.H. Kim and B.M. Kim “The effect of die shape on the hot extrudability and Mechanical properties of 6061 Al/Al2O3 composites” Journal of Materials Processing Technology 100 (2000).

[3] B. Venkataraman , G. Sundararajan “Correlation between the characteristics of the mechanically mixed layer and wear behaviour of aluminium, Al-7075 alloy and Al-MMCs” Wear 245 (2000) 22–38.

[4] O. Yılmaza and S. Buytoz “Abrasive wear of Al2O3-reinforced aluminium-based MMCs” Composites Science and Technology61 (2001) 2381–2392.

[5] Y. Sahina,, M. Kok and H. Celik “Tool wear and surface roughness of Al2O3 particle- reinforcedaluminium alloy composites” Journal of Materials Processing Technology 128 (2002) 280– 291.

BIOGRAPHIES

Mr. Ashok Bharii completed his B.Tech in Mechanical Engineering From Galgotia’s College of Engineering & Technology Greater Noida in 2013. Now pursuing His Master Degree From IIMT College of Engineering Greater Noida .