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MRR and MT PARAMETER ANALYSIS in FACE MILLING of ALUMINIUM ALLOY

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Abstract - ***Process modeling and optimization are two important issues in product manufacturing. Selecting the optimum cutting parameters, such as depth of cut, feed rate and spindle speed, is a very important issue for any machining process. In shop practice, the cutting parameters are selected from specialized manual or machining databases, but the range provided in these sources are actually initial values and are not optimal values. The optimization of the processing parameters not only increases the utility for the processing economy, but also the product quality to a large extent. Al 7075 aluminum alloy of 7000 series aluminum alloys can be used in a variety of applications. The lightness and hardness characteristics of grade 7075 are highly appreciated by manufacturers and end users. This article shows an analysis and a comparative study of the contribution of processing parameters, i.e. MMR and MT, towards quality characteristics through the use of experimental design techniques.***

***Index Terms* - Aluminium 7075 alloy, Material Removal Rate, Machining Time.**

I. INTRODUCTION

The main objective of this work is the study of MRR, MT and surface roughness in the 7075 aluminum alloy face and an analysis of the MRR, MT parameters and surface roughness in the 7075 aluminum alloy face using the special innovative method. As a solid, machinable aluminum alloy, it is used exceptionally in automotive, aviation and aviation companies. Deeply focused on parts such as gears, combine parts, auxiliary segments and is removed from the included 7075 aluminum alloy. In this research work, the optimization of the machining parameters of surface roughness, material removal costs and processing times of the newly developed 7075 aluminum alloy will be performed using a general steel faceplate (coromill 390 cutter) using the Taguchi and Minitab method Software.

In this era of mass production, material removal rate (MRR) is a primary concern in CNC machine manufacturing as well. The main goal of today's modern manufacturing industries is to produce high quality, low cost products in a short time. To improve quality and reduce costs, the material removal rate must be optimal. In processing precise dimensions are required but with good product quality. The manufacturing process involves many factors that influence the process directly or indirectly. The research study aims to analyze the MRR by taking into account the feed, depth of cut and spindle speed of 6063 aluminum using the Taguchi method. An orthogonal matrix L9 is used to perform the various experimental studies that analyze the MMR and the analysis of the surface roughness and the signal / noise ratio (S / N ratio) [10].

Using S / N analysis, the best possible machining parameters are obtained from test drives. The analysis software or that can be used are the Taguchi method, regression analysis and statistical analysis tools, etc. Among this Taguchi method, the use of Minitab is a very popular tool or method. The orthogonal matrix L9 was used for the material considered in this exam to direct the analysis.

II. LITRETURE REVIEW

S.T. Warghat, Dr.T.R.Deshmukh [01], during the machining operation it is essential to have a correct selection of the machining parameters. The current machining parameters are selected primarily based on the previous job experience of the process planner or the rule of thumb or the machining data manual. All of these techniques take time and are boring. It is necessary to develop a model that can find the optimal machining parameters for the surface finish required in the machining. In this work the effect of the machining parameters is studied to obtain the optimal machining parameters for the final milling operations. Many researchers have used various techniques such as the Taguchi method, the genetic algorithm, the neural network, the ANOVA.

Ashutosh Satpathy, Sudhansu Sekhar Singh [02], the goal of this work is to know the optimal set of values to optimize machining time using Taguchi's robust design method considering the control factors (spindle speed, feed and depth of cut) with three levels for the Al-7075. Based on MMC.

Satish Kumar, Arun Kumar Gupta, Pankaj Chandna [03], in this article, optimization of unit time and material removal rate (MRR) are the most frequently considered goals. A higher MRR can be achieved at the expense of surface quality and tool life. Therefore, to maintain tool life and surface finish inspection interval, the feed rate and speed are kept at a moderate level.

S. Sakthivelu, T. Anandaraj, M. Selwin [04], in this research, an experimental investigation of the machining characteristics of 7075 T6 aluminum alloy was conducted on a CNC milling machine with a high-speed steel (HSS) cutting tool. The purpose of this article is focused on the analysis of the optimal cutting conditions to obtain the minimum surface roughness and the maximum material removal rate in CNC milling of 7075T6 aluminum alloy with the Taguchi method. Alagarsamy. S. V, Raveendran. P, Arockia Vincent Sagayaraj.S, Tamil Vendan.S [05], explain optimization of machining parameters for turning of aluminium alloy 7075 using Taguchi method

This paper R.N.Nimase1, Dr. P. M. Khodke [06], recognizing the need to reduce costs and improve quality and productivity, companies have embarked on total quality management. It is an innovative method that requires management commitment, employee participation and the use of statistical tools. Dr. Taguchi's method, which uses the Design of Experiments (DOE), is one of TQM's most important statistical tools for designing high-quality, low-cost systems. Taguchi's methods provide an economical, efficient and systematic way to optimize projects in terms of performance, quality and cost. This method has been used successfully in the design of reliable, high quality and low cost products in industries such as automotive, aerospace and consumer electronics.

In this paper J.A.Ghani et al. [07], applied Taguchi's optimization methodology to optimize cutting parameters in final milling when machining AISI H13 hardened steel with a P10 TiN coated carbide insert under semi-finished finishing and high speed cutting conditions. The milling parameters evaluated are the cutting speed, the feed rate and the depth of cut. An orthogonal matrix, a signal-to-noise ratio (S / N), and a Pareto analysis of variance (ANOVA) are used to analyze the effect of these grinding parameters. Analysis of the result shows that the optimal combination for resulting low cutting force and good surface finish are high cutting speed, low feed rate and low depth of cut. Other significant effects such as the interaction between the grinding parameters are also investigated. The table represents the range of the input factor with respect to the S / N ratio. The table represents that the depth of cut is the most significant influencing parameter with respect to the feed and spindle speed over time. From the histogram above, he plotted that the processing time fluctuates with respect to the input factor. The graph below shows that when the depth of cut is constant but the spindle speed and feed rate increase, the machining time value decreases.

Surasit Rawangwong, Jaknarin Chatthong, R. Burapa and W. Boonchouytan, [08], the purpose of this research was to investigate the effect of main factors of the surface roughness in aluminum 7075-T6 face milling. The results of the research could be applied in the manufacture of automotive components and mold industry. The study was conducted by using computer numerical controlled milling machine with 63 millimeter diameters fine type carbide tool with twin cutting edge. The controlled factors were the speed, feed rate and the depth of cut which the bite cutter was not over 1 mm.

Caroline J.E. Andrewes, Hsi-Yung Fenga, W.M. Lau [09], explain the main properties that make aluminum a precious material are lightness, strength, recyclability, corrosion resistance, durability, ductility, formability and conductivity. Thanks to this unique combination of properties, the variety of applications for aluminum continues to increase. It is essential in our daily life. We cannot fly; ride a show cars or fast ferry without it. We cannot get heat and light into our homes and offices without it. We depend on it to preserve our food; our medicine and to provide electronic components for our computers. Physically, chemically and mechanically, aluminum is a metal like steel, brass, copper, zinc, lead or titanium. It can be melted, shaped and worked in the same way as these metals and conducts electric current. Indeed, equipment and manufacturing methods are often used for steel. Aluminum alloys are chosen for design experimentation for their properties, characteristics and composition and aluminum alloys are designated by LM for their most favorable property, which is their light weight. Here L means light weight and M means metals. Turning and milling are one of the most important manufacturing processes in metal removal. Black metal cutting is defined as the removal of metal chips from a workpiece to obtain a finished product with the desired characteristics of size, shape and surface roughness during final milling. The challenge that engineers face is finding the optimal parameters for the preferred output and maximizing the output using available resources. In general, the selection of suitable machining parameters is difficult and largely depends on the experience of the operators and the machining parameters provided by the machine tool manufacturer for the target material.

III. Machining Process & Experimental Setup

The research aims at optimizing MRR during face milling and MT during face milling under different conditions. Then the wear equation will be found out for all the materials experimented under various conditions. The methodology used is the Taguchi’s method for design of experimentation using orthogonal array.

IV. Work Piece Material

The experiment is performed on Al-Alloy (Al 7075) plate (100*100*10 mm) which contains 0.5% of silicon sufficient enough to give corrosion resistance property and good ductility. Face milling cutter under study: It is made up of general steel/cast iron. It is named as coromill face milling cutter shown in fig, 1.

Fig. 1 machining cutter under study

Contents of Aluminium 7075 alloy is as shown in table 4.1.as below.

Table 4.1: Contents of Work piece Material

Contents	Percentage (%)Composition
Copper	1.2-2
Magnesium	2.1-2.9
Silicon	0.5max
Iron	0.5max
Manganese	0.3 max
Nickel	5.1-6.1
Zinc	0.18-2
Lead	0.1 max
Tin	0.2 max
Titanium	1.2-2
Aluminium	Remainder

The CNC cutters under consideration use turning cutters to shave, cut or cut segments of a part. The innovation of the CNC allows for much more remarkable precision in machining than when the task is done manually. The CNC machining machine can be modified to fluctuate in and out, the cutting edge and direction. A 3-pivot machine works along the horizontal X and Y axes, as well as the vertical Z axis. A 4-pivot machine incorporates a rotation measure to its direct capability, allowing it to cut along a curve.The cutting tool for the milling operation is a HSS flat nose end mill, an opening angle of 0 was used for the experiment. The different sets of dry milling experiments are performed using a HYTECH CNC milling machine. The machined surface is measured in 2 different positions and the average values are taken using a Talysurf XR20 surface texture measuring instrument, which has a needle tip with an accuracy of 0.005 μm and a resolution of 0.05 μm and a maximum measurement of 300 μm.

V. Results of Experiments

The Taguchi method uses a loss function to determine quality characteristics. The values of the loss function are also converted into a "S/N" "η" signal-to-noise ratio. The term "signal" represents the desirable (average) value for the output characteristic and the term "noise" represents the undesirable value for the output characteristic. In general, there are three categories of performance characteristics in S/N analysis; namely, lower is better, rated better, and higher better. The S/N ratio for each level of process parameters is calculated based on the S / N analysis. The optimal level of process parameters is the level with the highest S / N ratio. Table 4.2 shows S/N ratio values of MRR & MT.

Table- 4.2: Result for MRR & Machining Time

Trial No	Average MRR DURING FACE MILLING	SN Ratio
1	6333	75.0910
2	11800	78.5353
3	86355	76.8787
4	12000	79.6666

Trial No	Average MT DURING FACE MILLING	SN Ratio
1	0.1100	20.0061
2	0.0750	23.1111
3	0.0803	20.1320
4	0.06980	23.0020

III. CONCLUSION

The aim of this study was to produce maximum material removal rate and minimum machining time in turning operation. Larger is better quality characteristic is used for material removal rate as larger MRR values represent better. Smaller is better quality characteristic is used for machining time as smaller machining time values represent better or improved productivity.

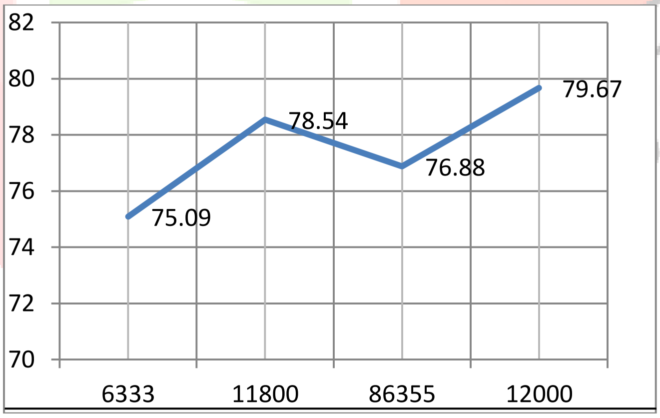

Fig.2 Graph for MRR vs S/N ratio

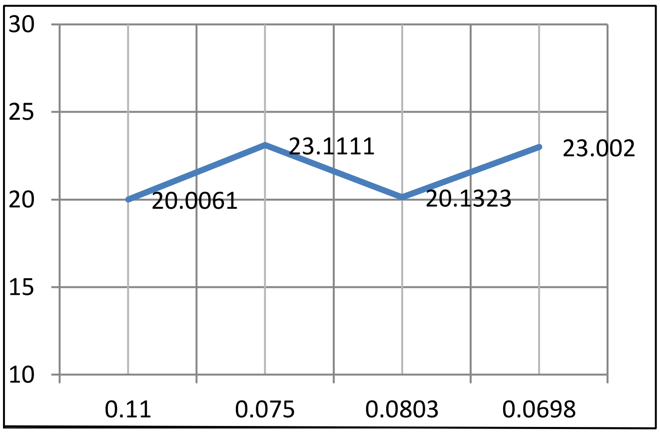

Fig.3 Graph for MT vs S/N ratio

From results fig,2 and fig3 we can say that for better MRR value, S/N should be large and for proper MT value, S/N ratio should small.

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