Study of Different Parameters in CNC Milling Machine Using Composite Material as a Cutting Tool

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Abstract:
End milling process is very important machining operation, which is used in most of the production and manufacturing industries. This milling operation is capable of producing fine and typical geometrical surfaces with predefined dimension accuracy and surface finish. However, the use of CNC milling machine increases the flexibility along with the versatility in end milling machining operation. There is a requirement of making connection between productivity and quality and required to achieve both with an economic method. This study is based on CNC milling machine optimization process, operation parameters and to receive higher tool life and batter surface finish with the minimum effort. In this analysis finished surface of work material has been taken as quality attributes and the machine tool life is performance index which is directly related to productivity. Analysis has been performed to optimize productivity and quality to the expected level with the analysis of tool life and the surface finish index. In this analysis Nickel Titanium composite is used for the machine tool material for solving the optimization of multi objective problem. Depending on priority weights of each property i.e. performance and quality attributes needed to estimate from the entropy measurement technique.

Keywords: CNC end milling process, surface finish, machine tool life, entropy measurement technique.

I. INTRODUCTION

Composites are newly engineered materials which has greater strength and performance compared to the parent materials. Composite are of many types here mainly the metal matrix composite (MMCs) is used which consists of at least two or more than two constituent parts, of which one constituent part being metal and the other parts must be different from the first metal or another material, for hard materials workpiece ceramic is used. When the composite is prepared by at least three or more than three materials, it is called hybrid metal matrix composite. Hybrid MMCs are formed by arranging a reinforcing material into a metal matrix. It is obtained by typical research and trials in Toyota Motor Inc. in the early1980s. The metal matrix materials are generally the lighter weight metals such as aluminum, titanium and magnesium. In this Method the reinforcements do not always provide satisfactory structural task that is reinforcing of the composite material, but it also transfers the properties of material. This new material has exceptional properties such as lighter weight, higher strength and wears resistance and much better quality than the parental materials. Due to such exceptional properties improves the ability of material to operate at very high pressure and temperature, hybrid MMCs are formed with super-alloys such as ceramics, plastics and different non ferrous metal parts used in many automobile application and also in aircraft.

The Conventional milling cutter or machining tool materials such as high-speed steel become outdated which cannot be used for machining of hybrid MMCs because of it undergoes rapid wear and surface abrasion. The Carbide tools exert significant levels of tool abrasion and wear after a short period of machining. In previous researches it has been concluded that polycrystalline diamond (PCD) tools are the single tool material which is able to provide effective tool life in machining the hybrid MMCs, it is harder than SiC and Al2O3 and saturated chemical bonding which does not react with the workpiece material. The tool wears rate and surface roughness were measured by different experiment and results were analyzed for machining of hybrid MMCs and to study the influence of different factors in tool life.

The metal matrix composite is able to work with the standard metal working process such as rolling, forging or extrusion and by using traditional techniques, but for the milling and finishing process necessarily performed by using of polycrystalline diamond (PCD) machine tool. Alumina and silicon carbide are used as the reinforcing materials between this three hybrid MMC forming by solid, liquid and vapor state methods. The composite formed in liquid method by using stir casting technique, in which reinforcements were stirred into the molten metal and is allowed to solidify.

II. MAIN OBJECTIVE OF RESEARCH WORK

The main objective of this research work is to study the composite materials and its mechanical properties so that it can work for a cutting tool in a CNC milling machine with better tool life and performance using entropy measurement techniques, also studied failure of tool and analysis of tool life during milling operation and machining process by the composite tool material and their cutting parameters depth of cut, surface roughness. Composite materials can use for cutting tool because of their exceptional mechanical properties and also the characteristics that reduces the unwanted effects for machining different work materials. Composite materials have wider engineering applications so that this technology is now used for aircraft, automobile bodies, building structures etc.

III. PREVIOUS WORK

Amit Joshi et al. (2012) had presumed process parameters like depth of cut, spindle speed, feed rate to investigate to expose their Impact on surface finish using Nickel titanium Methodology. They had taken L9 orthogonal array to perform experiments. They found the optimal setting for selected process parameters and optimal value of surface roughness.
finish was obtained at first level of factor A, third level of factor B and second level of factor C. From the ANOVA analysis they were found that feed rate is the most dominating factor for surface finish.

Anish Nair et al. (2013) had studied effect of different process parameters on surface roughness on Brass material on CNC milling machine with TiN coated carbide insert tool. They analyzed the results using Nickel titanium method. PCA has been used to eliminate correlation among the responses and to convert the correlated responses into independent quality indexes; so as to meet the basic requirement of Nickel titanium method. They found for multi optimization that best combination of the cutting parameters was the set with Depth = 0.25mm, Speed = 2100 rpm, Feed = 550mm/min.

IV. METHODOLOGY

Machine Tool life depends on various factors i.e. cutting force, rake angle, feed rate, working temperature etc. The failure of milling machine tool at the process because of different working conditions which is brittle fracture, built-up edge, softening of tool tip and sudden change in mechanical or shock loading, gradually increasing wear in working piece etc. The development of stresses into the work material because of resistance to the raising temperature and rate of strain make happen to rounding off the principle cutting edge because of insufficient strength of the principle cutting edge. The contact areas were flank expands its forcing to the effluent too much amount of material past the flank surface. Whereas, if the ratio of the hardness and chip material of the tool is moderated for raising cutting temperature and for the rate of strain, this type of failure is not usual and “form stability” will be achieve.

The Brittle fracture failures are to extreme pressure and sudden load or such shock loads are present in quick freezing action of the cutting, intermittent cuttings, cutting under chatter or vibrating condition, etc. whereas, such avoidable factors are brittle fractures by proper selection of cutting conditions depth of cut, feed, etc. and also with increasing in wedge angle of the machine tool or by strengthening the edge of cutting with a land, etc. in general conditions of cutting, when form stability of the principle cutting edges have been achieved or brittle fracture failure is restricted, machine cutting tools failure by process of wear still continue to fail because of interaction between the tool and chip or between the tool and work piece.

After all the cutting process has progressed for required time, tool wear comes into action in two different types of regions on machine cutting tool. The wear of tool will takes place on the flank of the cutting tool below the principle cutting edge forming place a wear land enlarging approximately parallel to principle cutting edge. The wear of tool will also develop on the tool face forming a typical cavity called as ‘crater’ which starts at a particular distance from the principle cutting edge. For economy conditions in metal are associated with an increase in rate of production, with a satisfactory dimensional accuracy and surface finish. The required life of the milling tool is reduced by wear, distortion and built-up edge. Hence, productivity of the material is directly affected or reduced by the wear of milling tools. The research of most important concern of ability to being machined is to investigate the required mechanism of tool wear through which tool life is governed.

V. EXPERIMENTAL WORK

Fig. 1 - Figure shows the design of cutting tool taken for analysis.

Fig. 2 – Stress generated in cutting tool in different load condition

Fig. 3 – Pressure distribution in cutting tool higher pressure exerted at the surface of the tool.

Fig. 3 – Graph indicates iteration of force on the cutting tool with load condition.

VI. RESULT AND CONCLUSION

As there are a number of basic process Parameters which affect the surface roughness and tool life of the end milling tool of a CNC milling machine.
According to this work conditions and experiment through the ANSYS over composite material there are mainly three cutting parameters named cutting speed, depth of cut, feed may be selected and optimize these three parameters using ANASY Nickel Titanium Materials. In this case the Experimental results demonstrate that the cutting force and cutting speed is the main parameters that Influence the surface roughness and also the tool life of end mill cutters of a CNC milling machine. The tool life can be improved in an appreciable level through ANASY Nickel Titanium method approach instead of using other Engineering method. The confirmation experiments were conducted to verify optimal cutting parameters.

VII. REQUIRED WORKS

The future works that can be extended through this work as wear in the machining tool are unidirectional and the volume of wear (in terms of a unit quantity) cannot be calculated with the general method is needed to calculate with different method. In addition to damping in milling is also required to reduce at an acceptable level this can be calculated by oscilloscope, dynamometer and analyzer. Cutting force of milling machine can also be calculated by Dynamometer during any experiments which have reasonable effects on wear calculation.

By testing other matrix material suitable for structures or for the working milling tool material according to requirement of design present work can be use in various composite milling tool problems. Software’s are used in this project report to determine different condition may be fixed in it to achieve different composite machine tool material. For different types of the metal matrix or hybrid composites this project report can be used to explore data.

VIII. REFERENCES


