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# "A STUDY ON OPTIMIZATION OF PROCESS PARAMETERS IN TURNING OPERATION CARRIED OUT BY COATED INSERT"

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## ABSTRACT

***The machining processes model is commonly used by manufacturing industries in order to produce precision component and very intricate products in a short time. These machining processes model include large number of process parameters which may affect the quality and cost of the components. Optimum machining parameters Selection in such machining processes is very significant to satisfy all the contradictory objectives of the process. There are two ways to select the optimal cutting parameters for a given financial objective. The primary one is apprehensive with the need of a machine expert that manually chooses the machining parameters on the basis of its own skill and by means of a proper machining handbook. That way creates many worries and drawbacks in terms of efficiency of solutions and cost / time requirements. As a substitute to the above mentioned approach, many research efforts have been done to state a pervasive mathematical model of a turning process that, in practice, mentions a set of cutting constraints to be handled. Machining optimization problems become delicate whenever a given objective function must be optimized in accordance to a large number of constraints. Good surface finish not only ensures quality, but also brings down the manufacturing cost. Surface finish is an essential parameter with respect to tolerances; it brings down the assembly time and eliminates the need for secondary operation, thus minimizes the operating time and paves way to overall reduction in cost. Due to improvement in the machining processes, a special concentration has been given on the life of a tool. To achieve that, the best way is to coat the tool with PVD and CVD techniques. By doing so an optimized machining condition under coated tool can be obtained to improvise the output parameters like tool life, surface finish etc.***

***Keyword:*** *Optimization, Turning, Inserts, coating, PVD, CVD, surface roughness*

## I. INTRODUCTION

High strength work materials have tremendous applications in the field of aerospace, nuclear, biomedical, automotive, etc. It is a challenging task to machine these high strength materials. Although there have been many methods evolved to machine such materials, such techniques are expensive and costly cutting tools are required to machine those materials. Hot machining is a process in which work piece has to be heated below recrystallization temperature but in some cases it has been also heated above recrystallization temperature. High Manganese steel and other high wear resistance alloys which are widely used for various applications are having high strain hardening property. The hot machining operation is based on the softening phenomenon at the vicinity of shear zone (deformation zone). Softening of workpiece at the deformation zone makes the material ductile (reduces shear strength) which helps to reduce cutting force and increment in surface integrity. Heating gas flame used for operation should be in a constant manner, which

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delivers same temperature throughout the workpiece material. Heating can be done prior or at the time of machining. The blowpipe direction should be opposite to tool holder for better heating. There are many controlling factors such as workpiece temperature, cutting speed, feed rate, depth of cut, nose radius, cutting time, etc. which contribute on the performance characteristics. The problem arises may be due to the use of incorrect levels of control parameters such as feed, depth of cut and cutting velocity, etc. Tool life and power consumption have much contribution in cost of manufacturing. Surface finish is the most desired characteristic for good performance of product. Chip reduction coefficient is also an effective measure which evaluates the machinability. The appropriate selection of machining parameters has to be made to achieve the above machinability criteria.

## II. LITERATURE SURVEY

**(Alexandre et al., 2013)** Precipitation hardenable martensitic stainless steel 15-5PH has incredible advantages in aerospace industries (particularly in actuator parts for modern aircrafts), nuclear industries, chemical, petrochemical, gears, pumps, food processing, paper and general metalworking industries

**(Ashok Kumar et al., 2013)**. These materials provide an outstanding mechanical properties, high strength and hardness, good corrosive resistance, weldability, low distortion. Precipitate hardened stainless steels exhibit high strengths at temperatures up to 315oC like other martensitic stainless steels

**(Ozler and Tosun 2002)** The hardness of 15-5PH stainless steel is 40 HRC and it is also one of the difficult to cut materials. The main aim of machining is to produce the parts most economically. An unsuitable decision causes expensive production cost and decreases the machining quality.

**(Lei et al., 2001)** The materials having mechanical properties like high strength and hardness, good corrosive resistance, weldability, low distortion, which are frequently used in aerospace and nuclear industries, are generally difficult to cut materials. Conventional machining of these materials have problems like low speeds, feeds, poor surface finish, high tool wear, less tool life low production, in another aspect unconventional machining is often employed for machining of these materials. But, the unconventional machining of these materials involves a high capital cost and offers a low material removal rate (MRR). To overcome these problems hot machining is one of the most potential techniques developed to machine difficult to cut materials.

In hot machining a part or whole workpiece is heated before or during machining Heating of the material makes high hardness of the material become soft, resulting in improvedmachinability, high production rate, low power consumption from all these advantages hot machining is extremely used full to machine hard to cut materials like ceramics

**(Ozler et al., 2001)**. Many researchers have used different heating techniques like laser heating,
plasma heating, induction heating, electrical heating and they were proved that these heating techniques are expensive. Several researchers reported that there is an improvement in both surface finish and tool life in hot machining
(Akasawa et al., 1987, Ueharaet al 1986., Hinds et al 1980, Raghuram et al., 1979, Chen et al., 1973, Pal et al., 1969). In hot machining it was observed that the cutting mechanism of the ceramics changes from brittle fracture type to plastic deformation type

**(Ueharaet al., 1986)**. Hinds et al. (1980) suggested that the shape of the heat source and positioning of the torch also affects overall efficiency. Materials of different hardness's were machined using different grades of carbide tools, over a range of cutting speeds and heating current.

**(Chen et al. 1973)** and Uehara et al (1983) improved the cutting performance by the using coated carbide tools in electric hot machining, suggesting new possibilities in the field of the machining of low machinability metals.

**(Raghuram et al. 1979)** tool life is observed to increase if a magnetic field is applied during machining.

Thandra et al. (2010) they conducted experiments in both conventional and hot machining and they observed that hot machining was effective in bringing down the cutting forces, surface roughness and flank wear by about 34%.

Tosun et al. (2004) heated high manganese steel with liquid petroleum gas flame and showed that cutting speed and feed rate were the dominant variables on multiple cutting performance characteristics like tool life and surface roughness.

**(Akasawa et al., 1987)**. The cooling method of the cutting tool is very effective for reducing the tool wear in the hot machining process .

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Kitagawa et al., 1990). In plasma hot machining cutting forces is decreasing by machining high hardness materials (Hot machining is mainly used in turning. But some researchers used it for shaping and milling also

**(Pal et al., 1971)**. Based on the literature review, research work carried on hot machining on difficult to cut materials is to improve the machinability such as cutting forces, surface roughness and tool wear.

**(Kitagawa et al., 1990; Uehara et al.,1983)** After an extensive research and survey of existing heating techniques. it has been concluded that the oxy-acetylene heating setup will be in expensive compared to others techniques.

**(Varun Shekhar et. al 2016 )**A significant amount work has been conducted for determine the effect of hot machining on hard materials by changing different parameters during machining. Numerous attempts have been made to approach this problem with experimental analysis. Here the work piece heated with oxyacetylene flame that reduce the hardness of material as material become soft and then machined under different parameters that is cutting speed, feed rate, depth of cut, and work piece temperature on a conventional lathe. The effect of cutting speed, feed rate, depth of cut, and the work piece temperature on surface roughness, tool life and cutting force have been optimized by conducting experiments. From experiments the optimum level of cutting parameters has been identified. Experiment results revel that feed rate and cutting speed are dominant variable on the performance and can further improve the hot turning process. Here statistics analysis is done by using Taguchi methods. As Taguchi designs provide a powerful and efficient method for designing products that operate consistently and optimally over variety of condition. The primary aim is to find factor settings that minimize response variation while adjusting the process on target. A process is designed with the aim of produce more consistent output. A process designed with this aim will produce more consistent performance regardless of the environment in which it is used. Taguchi method advocates the use of orthogonal array designs to assign the factors chosen for the experiment. The most commonly used orthogonal array designs are L8, L16, L9 (That means eight experimental trials), L16 and L18. But we are using L9 for our experiment purpose. The power of Taguchi method is that it integrates statistical methods into engineering process. Finally this paper is going to give graphical relationship of different parameters of machining such as feed rate, cutting speed and depth of cut with respect to force and surface roughness. Effect of temperature which is playing important role for machining is also discussed in this paper.

**(S. Sowjanya et. al. 2015 )**The heat generated at the tool-chip interface dissipates the heat into the tool, which causes the rise in temperature at the tool tip during the metal cutting process. The temperature rise in cutting tool tends to soften it and causes loss of tool material in the cutting edge leading to its failure. Objective: To determine the temperature distribution along the tool tip for different cutting parameters like feed rate, cutting speed and depth of cuts. Method: In this study, tool chip interface temperature was determined in cutting of mild steel workpiece with HSS as the cutting tool. The effects of different parameters like cutting speed, feed rate and depth of cut are taken into account so as to predict their effects on tool life are studied both in experimental and numerical analysis. Finding: In present work the tool life of HSS tool is evaluated at different cutting parameters during turning process. It has been found that the tool life is decreases with feed rate and cutting speed. The optimal process parameters found in turning process are high cutting speed, low depth of cut and lower feed rate. Conclusion: The results have shown that change in cutting speed and feed rate has the maximum effect on cutting temperature than depth of cut.

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