# ABSTRACT

Hard turning is a process which eliminates the requirements of grinding operation. A proper hard turning process gives surface finish Ra 0.4 to 0.8 micrometer, roundness about 2-5 micrometer and diameter tolerance +/-3-7 micrometer. Hard turning can be performed in the same Lathe where soft turning is done. Minimum hardness of the hard turning materials is 47 HRC but regularly hard turning is done on the material having hardness 60 HRC and higher. The materials which requires hard turning are tool steel, case-hardened steel, bearing steel, Inconel, Hastealloy, stellite and other exotic materials. The length to diameter ratio (L/D) for unsupported work piece should not be more than 4:1 even after tailstock support, chatter would be induced due to high cutting pressure. The degree of hard turning accuracy is measured by the degree of machine rigidity. The system rigidity is more required for hard turning than the machine rigidity.

If rigidity of system is to be maximized then overhangs, extensions of tools, extensions of parts should be minimized and shims and spacers should be eliminated. The purpose is to keep everything as close to turret or spindle as possible. The main challenge in hard turning is whether coolant will be used or not. In most cases, hard turning will be performed dry.

Hard Turning is one of the most important machining operations in industries. The process of hard turning is influenced by many factors such as the cutting velocity, feed rate, depth of cut, geometry of cutting tool cutting conditions, etc. The finished product with desired attributes of size, shape and surface roughness are functions of these input parameters. Properties such as wear resistance, fatigue strength, coefficient of friction, lubrication, wear rate and corrosion resistance of the machined parts are greatly influenced by surface roughness. In many manufacturing processes, engineering judgment is still relied upon to optimize the multi-response problem. Therefore multi response

optimization is used in this study for optimization problem and also to find the appropriate level of input characteristics.

There are two main practical problems that engineers face in a manufacturing process. The first is to determine the values of the process parameters like cutting velocity, feed rate and depth of cut that will yield the desired product quality (meet technical specifications) and the second is to maximize manufacturing system performance using the available resources. The decisions made by manufacturing engineers are based not only on their experience and expertise but also on data collection regarding the phenomena that take place during hard turning processing. In the machining field, many of these phenomena are highly complex and interact with a large number of factors, thus preventing high process performance from being attained. To overcome these problems, the researchers propose models which try to simulate the conditions during machining and establish cause and effect relationships between various factors and desired product characteristics. Surface roughness is a widely used index of product quality and in most cases a technical requirement for mechanical products. Achieving the desired surface quality is of great importance for the functional behaviour of a part. On the other hand, the process dependent nature of the surface roughness formation mechanism along with the numerous uncontrollable factors that influence pertinent phenomena, make almost impossible a straightforward solution. Optimal surface roughness is necessary because of improvement of corrosion resistance, tribology attributes and aesthetic appearance. Exceedingly low surface roughness involves additional expenses in production. Therefore, selection of optimal cutting parameters is necessary in order to achieve optimal values of surface roughness.

Oil hardening non shrinking steel which is economical and ependable for gauging, cutting, blanking and stamping dies, Punches, Rotary shear blades, Thread cutting tools, Milling cutters, Reamers, Broaches,

Chasers tools as well as can be relied for hardness and good cutting performance.

The objective of this research work is to evaluate the optimal setting of cutting parameters that cutting velocity (V), depth of cut (d) and feed (f) of the tool to have a minimum surface roughness(R). In this research, work hard turning of Oil Hardened Non Shrinking (OHNS) steel work piece and Ti [C, N] mixed alumina based ceramic cutting tool (SNGN 12 07 12 T02520 650) is performed. The range of cutting parameters are cutting speed (141, 188,264,377,471 m/min), feed rate (0.038, 0.078, 0.108, 0.15, 0.2 mm/rev) and depth of cut (0.05, 0.1, 0.15, 0.2, 0.25 mm).

This study highlights the use of Taguchi design of experiment to optimize the multi response in turning operation. For this purpose Taguchi design of experiment was carried out to collect the data for surface roughness and various cutting forces. The results indicate the optimum values of the input factors and the results are conformed by a confirmatory test. This is validated by the Artificial Neural Network and Response Surface Method.

A tested ANN model which gives easy, quick and precise parameters setting data for hard turning process of OHNS is obtained. This can be used as a reliable computer aided tool in predicting parameters which aids the machinist in the shop floor.