ABSTRACT

The important goal in the modern industries is to manufacture the products with lower cost and high quality in short span of time. There are two main practical problems that engineers face in manufacturing process. The first one is to determine the values of process parameters that will yield desired product quality (meet technical specification) and the second one is to maximize the manufacturing system performance using the available resources.

The metal cutting industries in developed countries continue to suffer from major drawback of not running of machine tools at their optimum cutting conditions. The operating conditions of machine should be chosen solely on the basis of hand book values or worker experience. The quality of design can be improved by improving quality and productivity in manufacturing activities.

In the present work a set of experiments are conducted on the work piece AISI 4340 with CVD and PVD cutting tools to evaluate the effect of machining parameters namely speed, feed, and depth of cut.

The conventional treatment of manufacturing processes mainly emphasizes the operational procedures. This study, on the other hand seeks to highlight the basic scientific principles of how things are made. Such an approach would hopefully make the author appreciate the reasons why things are made the way they are and the possibilities of improving the given methods.
Material properties play a key role in manufacturing process. In most cases large scale of removal of metal is not possible either for geometric reasons or for the size involved. This process is termed as machining and is perhaps the most versatile manufacturing processes. The body which removes excess material through a direct mechanical contact is called the cutting tool and the machine which provides the necessary relative motions between the work and tool is commonly known as the machine tool. Since the removal of metal takes place only in the form of small chips, the machining of finite area requires a continuous feeding of the uncut portion at the suitable rate.

In this present work, laboratory experiments were conducted on the work-piece AISI 4340 with Physical vapour deposit (PVD) and Chemical vapour deposit (CVD) tools by orthogonal experiment and Taguchi design of experiments. The data thus generated in the experiments were used to determine the most influence parameters such as surface roughness and metal removal rate (MRR) and Power consumption using ANOVA and regression. Further the same data used to train and validated by ANN models. ANN models are developed which can compare the predicted and experimental values. Also, to evaluate the optimal cutting conditions of Genetic Algorithm (GA) is adapted. The multi-object of GA consists of Minimization of surface roughness, Power Consumption and Maximization of MRR. The each objective is assigned with weights and performance of each objective is
evaluated. The effectiveness of the AISI 4340 material with tool PVD and CVD interactions have been analyzed in the development of predicted models. The optimal cutting conditions for different weights is again analyzed by testing in ANN simulated model and again experiments were conducted for validation. From the analysis of ANOVA the most influenced parameters is identified. The experiments were tested for ANN for development simulated modeling. Also to get optimal cutting conditions for the same parameters as mentioned above by using GA tool multi objective optimization. The optimized parameters are again tested in ANN simulated model. Based on the results of various case studies, the proposed models can be used in predicting the surface roughness, PC and MRR for better productivity.

For the turning operations on AISI 4340 in addition to the above parameters one more parameter is introduced i.e., strength ratio of work material to tool material. It is necessary to follow suitable optimization method which can be found out by choosing optimal values of cutting parameters for minimizing surface roughness, power consumption and maximizing material removal rate.

Based on literature review it is observed that there is a void in research area regarding the influences of the Hardness Ratio between the tool and work piece. Hence the author has chosen these particular parameters in the present thesis.