ABSTRACT

Advancements in technology led to considerable constructive changes in manufacturing industries occurring across the globe. Technological change is a term which is used to describe the overall process of invention, innovation and diffusion of technology or processes. In reality, it is the invention of a technology or a process and the subsequent improvement in the know-how parameters and economic productivity diffuses throughout industry or society.

One of the most important commercial sectors in the world is manufacturing, the chief wealth-producing sector of an economy. Manufacturing industries use various technologies and methods, widely known as manufacturing processes. These processes can be broadly categorized into engineering, construction, electronics, chemical, energy, textile, food and beverage, metalworking, plastic and transport and telecommunication industries. Each of these industries are important for an economy as they employ a large share of the labour force and produce materials required by various sectors of strategic importance.

Product quality has always been one of the most important parameter in manufacturing operations. With present global economy and competition, continuous improvement in quality has become a major priority, particularly in major corporations of industrialized countries. Quality assurance is the total effort made by a manufacturer to ensure that its products conform to a detailed set of specifications and standards. These standards
cover several parameters such as dimensions, surface finish, tolerances, composition, color and other mechanical, physical and chemical properties. Quality assurance is the responsibility of everyone involved in design and manufacturing. Prevention of defects in products and on-line inspections are now major goals in all manufacturing processes. It is important to ensure that quality is built into a product and not merely checked after the product has been manufactured.

Manufacturing process is significantly altered by tool wear. Tool wear creates intricate issues that hinder attaining manufacturing automation. The other vital parameters determining tool life are dimensional accuracy and surface roughness of the workparts. In this research work, an attempt has been made to conduct machining studies on martensitic stainless steel AISI410 to analyze the effect of crater wear and surface roughness in TiN coated tungsten carbide (WC) tool. The crater wear and surface roughness values are initially recorded. The recorded data are used as input in the Analysis of Variance (ANOVA) plinth and are subsequently used for developing mathematical tool wear models using Multiple Regression Analysis (MRA). The results from ANOVA reveal that the cutting speed influences the surface roughness more significantly than feed rate and depth of cut. Further, it was observed that feed rate has a greater influence on crater wear when compared to the cutting speed. Consequently, the metallographic studies using Scanning Electron Microscope (SEM) have been conducted. Based on the study, the effects of crater wear on the TiN coated WC cutting tool have been plotted and analyzed.
The objective of this study is to investigate the optimization of hard finish turning operation parameters for martensitic stainless steel using ANOVA and Back Propagation Neural Network (BPNN). Experimental trials have been carried out based on an orthogonal array of Taguchi method. The recorded data are assessed and evaluated with ANOVA and Artificial Neural Network (ANN) techniques. A multilayer perception model has been constructed with back-propagation algorithm using the input parameters such as depth of cut, cutting speed and feed rate. The output parameters considered include crater wear and surface roughness of the machined component. Subsequent to experimental test, ANOVA and ANN models are employed to validate the results obtained and further, to predict the behavior of the system under conditions within the prevailing operating range.

In this investigation, tool crater wear and surface roughness have been taken as response (output) variables during hard finish turning process. The impact of input parameters, namely the cutting speed, feed rate, depth of cut, force ratio and type of coating on tool crater wear is evaluated using ANOVA, Response Surface Methodology (RSM) and BPNN models.

The interaction effects of the input parameters on crater wear and surface roughness have been plotted. This helps in quick selection of the machining parameters to achieve the desired quality of machining surface by controlling wear of the cutting tool. The predicted values of the crater wear and surface roughness using both the techniques are compared with the experimental values and its closeness with the experimental values has been determined.
This study attempts to provide an outlay of the essentialities of the modern manufacturing sector, which employs advanced characteristic features of DLC (Diamond-like carbon or amorphous carbon) and TiAlN (Titanium Aluminium Nitride) coatings for attaining stability and modernization. DLC and TiAlN are the thin films used on cutting tools to bring tangible benefits during chip removal processes by increasing crater wear resistance properties. These properties improve parallel with increased surface finish of the work material. Hard finish turning tests were conducted with TiAlN and DLC coated carbide tools as a cutting tool and martensitic stainless steel (AISI 410) as the work material. In order to reduce the number of experiments, TAGUCHI’S design of experiments were used to perform the machining tests. The results revealed that coated tools increase the wear resistance and surface finish when compared to the uncoated tool. An analysis of variance was performed and it was observed that the cutting speed has greater influence on surface roughness (74.51% contribution). Also, both the type of coating and feed rate seems to have a greater influence on tool wear (35.78% contribution). Microstructure studies were performed using SEM to analyze the effect of coated and uncoated cutting tools under different machining conditions.

In this study, finite element technique has been used to analyze the stability of machining process. The tool model is shaped in ANSYS software based on real dimensions. Modal analysis, harmonic and transient dynamic analysis have been performed. The vibration characteristics of tools with and without coating have been compared and evaluated.