ABSTRACT

The research study envisages to optimize the surface roughness of the workpiece, tool life and metal removal rate in hot turning on AISI 316 stainless steel by carrying out wide range of experiments. AISI 316 stainless steel has been chosen as workpiece material since it is considered to be difficult to machine.

Tigham first innovated the process of hot machining in 1889 and since then it has created much interest among various investigators. In early stages, materials difficult to machine under normal conditions such as Stainless steel, Inconel and Navy grade v, Nickel-Chromium steel have been hot machined.

The production of exotic and smart materials has become highly indispensatile for aerospace, nuclear and defence sector. The machining of these materials has posed a great challenge in industries. It requires a cutting tool of high strength, which is very costly, and sometimes it is even impracticable. Non-conventional machining process, another viable method, is restricted to small-scale removal of material. For bulk removal of material, the growing interest for hot machining process is common in manufacturing industries. In hot turning method, workpiece is softened by heating and thereby the shear strength is reduced which makes machining easy.

The research is carried out in different phases as detailed below:

During the **first phase** of this study a genuine attempt had been made to survey the numerous literatures in hot machining and also in hard turning to predict the optimized machining parameters.
In the second phase, the behaviour of machining parameter on hard turning of AISI 316 stainless steel by tungsten carbide (WC) inserts to predict the surface roughness, cutting forces and tool wear of WC inserts were experimented and analyzed by analysis of variance (ANOVA) technique. Optimum cutting parameters for each performance measures were obtained; also the relationship between the cutting parameters and the performance measures were determined using the multiple linear regressions.

In the third phase, a newly developed mathematical modeling for process parameters on hard turning of AISI 316 stainless steel by tungsten carbide (WC) inserts using regression analysis and ANOVA theory were used to predict the surface roughness (Ra) of the machined part and tool wear (VB) of the inserts.

In the fourth phase, an experimental study had been carried on hot turning process. The workpiece namely AISI 316 stainless steel was heated by LPG flame to get 200\(^0\) C, 400\(^0\) C and 600\(^0\) C and the same was machined at different cutting speeds, feed rate and depth of cut to evaluate the surface roughness by Artificial Neural Network (ANN) and Response Surface Method (RSM). The experimental validation was carried out.

The fifth phase, dealt with the effect of cutting speed, feed rate, depth of cut and workpiece temperature on surface roughness, tool life and metal removal rate. These output values have been optimized by conducting a multi response analysis by using Taguchi and Grey analysis.
The present research is envisaged to study the following aspects:

- Identification of cutting parameters in hard turning of AISI 316 stainless steel to estimate the surface roughness and tool wear.

- To establish a mathematical model to predict the surface roughness and tool wear in hard turning of AISI 316 stainless steel with respect to varying machining parameters.

- Evaluation of surface roughness in hot turning of AISI 316 stainless steel by using Artificial Neural Network (ANN) and Response Surface Method (RSM).

- To optimize the process parameters on tool wear of WC inserts in hot turning of AISI 316 Stainless steel.

- Multi response optimization of machining parameters in hot turning using Grey analysis and to establish the optimum level of cutting parameters while hot turning of AISI 316 stainless steel.