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Investigation of Chip and Surface Roughness when Milling AISI304 Stainless Steel

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Abstract. Stainless steel was used for many engineering applications. The optimum parameters needs to be identify to save the cutting tool usage and increase productivity. The purpose of this study is to develop the surface roughness mathematical model for AISI 304 stainless steel when milling using TiN (CVD) carbide tool. The milling process was done under various cutting condition which is cutting speed (1500, 2000 and 2500 rpm), feed rate (0.02, 0.03 and 0.04 mm/tooth) and axial depth (0.1, 0.2 and 0.3 mm). The first order model and quadratic model have been developed using Response Surface Method (RSM) with confident level 95%. The prediction models were comparing with the actual experimental results. It is found that quadratic model much fit the experimental result compare to linear model. In general, the results obtained from the mathematical models were in good agreement with those obtained from the machining experiments. Besides that, it is shown that the influence of cutting speed and feed rate are much higher on surface roughness compare to depth of cut. The optimum cutting speed, feed rate and axial depth is 2500 rpm, 0.0212 mm/tooth and 0.3mm respectively. Besides that, continues chip is produced at cutting speed 2500 rpm meanwhile discontinues chip produced at cutting speed 1500 rpm.

Introduction

Stainless steel AISI 304 is categorized of very high corrosion resistance metal. This metal has a wide range of excellent mechanical properties which couldn't find in any other alloy. Stainless steel AISI 304 is categorized has austenite stainless steel. Besides that, stainless steel AISI 304 is a material which is very difficult to machine [1]. Therefore, the machining of stainless steel accompanied with very high machining cost due to the difficulties. Poor surface integrity and very less tool life are among the common difficulties of these materials. In the modern industries, the machining is mainly focused on surface quality of product in term of surface roughness, dimensional tolerance and also high rate of tool life. Surface roughness is one of the complicated parameter in end milling which the process dependent on several factors such as spindle speed, feed rate and depth of cut [1]. Besides that, there some uncontrolled factor (tool geometry and workpiece material) that also influenced the surface roughness on product. Most of the industries are using 'try and error' method to find the perfect cutting parameter to find the finest surface roughness in their product [2]. However, this is not an efficient method to find the optimum cutting parameter in machining because this process can be very time consuming

Surface finish influences not only the dimensional accuracy of machined part, but also the mechanical property of the part, especially the fatigue strength. The surface finish describes the geometrical feature of surface which in turn determines the fatigue life and corrosion life [3] [4]. Recent investigation performed by Alauddin, El Baradie [5]has revealed that when the cutting speed is increased, productivity can be maximised and, meanwhile, surface quality can be improved. According to Hasegawa, Seireg [6], surface finish can be characterised by various parameters such as average roughness (Ra), smoothening depth (Rp), root mean square (Rq) and maximum peak-to-valley height (Rt). The present study uses average roughness (Ra) for the characterisation of