Machining of EN31 Steel using CNC Vertical Milling Machine for different parameters: A Review

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Abstract

The purpose of this review paper is to obtain the most favorable set of machining variables used by the researchers for machining of the Steel on CNC milling machine using various methods/Technique. The S/N ratio and Analysis of Variance techniques have been applied by the researchers to verify the significant parameters. This literature review showed that feed and depth of cut were the most significant factors for the Tool Wear Rate. Depth of cut was the most significant factor for Material Removal Rate and Tool Wear Rate. Feed was the most significant factor for Surface Roughness. Spindle speed had little effect on Tool Wear Rate, Surface Roughness, and Material Removal Rate.

Keywords: CNC Machine, Taguchi, ANOVA

1. Introduction

CNC milling or computer numerical control milling is a machining process that rotates and controls the multi-point cutting tools through a computer and customizes the work piece to the desired shape. Using this process, we can do machining on wide range of materials, such as metals, plastic, glass, and wood. It can make more variety of products or parts in lesser time and most accurate compared to other processes. CNC milling is a mechanical machining process along with the combination of other machining processes like drilling and milling, i.e. material is removed from the work piece by the mechanical action of the cutting tool.
The basic production steps for the CNC milling are as mentioned below.

I Designing a CAD model
II Converting the CAD model into a CNC program
III Setting up the CNC milling machine
IV Executing the milling operation

The CNC milling process starts from the designing of a 2D or 3D CAD part design. The completed design is converted into a CNC machine program by using CAM software. After that file is exported to a CNC-compatible file format. CNC machine program governs the machine action and the movements of the tool across the workpiece. After that

workpiece is connected to the machine work surface vice or work holding device. Then milling tool is required to be connected to the machine spindle.

CNC milling is of two types i.e. horizontal or vertical CNC-enabled milling machines. The selection of horizontal or vertical CNC depends upon the specification and requirement of the milling applications along with rotating multipoint cutting tools such as mills and drills. When all the above work is finished then the machine is ready and the operator starts the program by using the machine interface which governs the machine to execute the milling operation

2. Literature Review

Year & Author	Aim of Research Work	Material	Input Parameters	Output Parameter	Technique Used	Result Observed
Deepak and Beedu (2017)	Optimized parameters of MRR And surface roughness	EN8	Cutting speed, Feed, & Depth of cut	Surface roughness, Material removal rate, & TWR	Taguchi, ANOVA	Depth of cut is the most important for MRR.
Kaladhar et al. [2] (2021)	Optimized Parameters for Austenitic Stainless-Steel AISI202.	Austenitic Stainless-Steel AISI202.	Cutting fluid flow rate Cutting speed, Feed	Surface roughness, Material removal rate	Taguchi, ANOVA	Feed & cutting speed are the most important variables for MRR
Campatelli et al.. (2020)	Optimized parameters of MRR And surface roughness	EN 24	Spindle speed, Feed & DOC	Surface roughness & Material removal rate	Taguchi, ANOVA	The most important parameter for MRR was speed. Feed was the most significant parameter for SR.
Vasudevan et al. (2019)	Multi Response optimization	Ti-6A-4V	Insert Type, Feed & DOC	Radial thrust force, Cutting power & Coefficient of friction	GRA, RSM	Feed & cutting speed are the most significant variables for MRR
Kulkarni et al. (2018)	Optimized parameters of CNC Milling Parameters	Aluminum 6062	Speed, feed & DOC	Surface roughness	Taguchi	The feed is the major influencing parameter among the three controllable factors
Jaiganesh et al. (2018)	Optimum parameters in CNC milling	Aluminum 6465	Spindle speed, feed, DOC & Coolant	Surface roughness	GRA, PCA	Feed is the most significant factor for Surface Roughness
Kumar et al. (2018)	Optimized parameters in CNC Milling	EN24	Lubrication, feed & spindle speed	SR & MRR	Taguchi	MRR increase with the increase in feed & SR decreases with the increase in DOC & speed
Lee et al. (2017)	Optimization of CNC milling	Al 7030	Cutting speed, feed & DOC	SR & MRR	RSM	Feed & cutting speed are the most important variables for MRR

Abdullah et al. (2017)	Optimized Parameters of CNC milling process	Aluminum alloy	Spindle speed, feed, DOC	Tool temperature, SR	ANOVA	The cutting speed was the major contributor to the surface roughness.
Anatony et al. (2016)	Optimization of machining parameters for milling operation	Carbon steel	Cutting speed, feed & DOC	SR & MRR	GRA	Feed is the most significant factor for Surface Roughness
Kumar et al. (2016)	Optimization of process parameters in CNC milling	Aluminum Alloy	Spindle speed, feed rate & DOC	SR, MRR	RSM & ANOVA	Spindle speed has little effect on Tool Wear Rate
Ahilan et al. (2015)	Optimization of Process Parameters on CNC lathe	Al-6085	Feed, speed & DOC	SR	Taguchi	Depth of Cut had minimum impact on Surface Roughness
Sunder et al.. (2015)	Multi-response optimization of MQL parameters	EN16	Cutting fluid, flow rate & cutting speed	TWR, SR	GRA	Feed is the most significant factor for Surface Roughness
Chaudhari et al. (2014)	Analysis of machining parameters in CNC milling	AISI 1060	Cutting speed, feed & DOC	SR, MRR	Taguchi & RSM	Spindle speed has little effect on Tool Wear Rate, Surface Roughness, and Material Removal Rate.
Raneen et al. (2013)	Prediction Model for CNC Milling	AISI318	Cutting speed, feed & DOC	SR & TWR	RSM	Feed & cutting speed are the most important variables for MRR,
Ramanathan et al. (2012)	Multi response optimization of CNC milling parameters	AISI 305	Cutting speed, feed & DOC	SR	Taguchi & RSM	Depth of cut is a significant factor for Material Removal Rate and Tool Wear Rate
Ramulu et al. (2011)	Multi-response optimization of machining parameters	EN24	Cutting speed, feed, DOC & work piece temperature	SR, MRR & Tool life	GRA	Feed & cutting speed are the most important variables for MRR
Kant et al. (2008)	Optimizing power consumption for CNC turned parts	Carbon steel	Cutting speed, feed, &DOC	Power Consumption, MRR	Taguchi & RSM	Spindle speed has little effect on Tool Wear Rate, Surface Roughness, and Material Removal Rate.

3. Conclusion

In this work, the researchers performed studies on process parameters such as depth of cut, environment, nose radius, spindle speed, feed, and the impact on power consumption, material removal rate, surface roughness, thrust force, and tool wear rate.

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