AN INVESTIGATION OF CUTTING FORCE DURING TURNING INCONEL 718 SUPERALLOY

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ABSTRACT

Inconel 718 is a nickel-based alloy designed for very high yield strength. The alloy is used in jet engine and parts like bolts, fasteners, pump shafts, valves etc. The machining of Inconel 718 is difficult due to extreme toughness and work hardness of alloy. This paper discusses the effect of cutting parameters like cutting speed, feed and depth of cut on cutting force. The study on cutting force helps to predict the tool life of the cutting insert.

Keywords: cutting force, machining, super alloy

1. Introduction

Inconel 718 is a nickel based super alloy widely used in aerospace, automobile sectors due to high corrosion resistance and gives excellent yield strength at elevated temperature. During turning the tool life is greatly affected due to combination of properties like toughness, high temperature strength, hardness and chemical wear resistance. [1] The very high cutting force gives rise to work hardening, surface tearing and distortion in machined components due to induced stresses. [2]. Due to continuous work hardening it is difficult to machine Inconel using conventional machining processes and also plastically deforms the tool and workpiece surface. [3] Stress relieving of Inconel before machining will increase the tool life by minimizing the wear and tear of cutting tool. [4] This paper discuss the effect of cutting parameters like cutting speed, feed and depth of cut on cutting force during machining Inconel 718.

2. Experimental Procedure

The experiment was carried out in a high speed conventional lathe. SNMG120408 cutting tool was used to perform turning operation. During turning the cutting force was measured using Kistler dynamometer. The piezoelectric force sensors in the dynamometer produce an electric charge which varies with the applied load on the sensor. The charge amplifier converts the electric charge

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into a proportional voltage. With the help of Dynoware software the signals were analyzed and the cutting forces are recorded in Newton.

Table 1 Nominal chemical composition of Inconel 718

Element	Ni	Cr	Nb	Al	Ti	Fe and others
Wt.%	54.5	17.5	5.01	0.71	0.95	Balance

3. Result and Discussion

The cutting force recorded for various feed rate is shown in figure 1. Cutting force influences the machinability of workmaterial and chip formation. A constant depth of cut of 0.5 mm was maintained during the experimentation. From figure 1 it is observed that cutting force increases as the feed rate increases and also it is seen that cutting force decreases with increase in cutting speed. As the cutting speed increases the temperature increases in the cutting zone, the increase in temperature soften the workmaterial and reduce the cutting force during machining

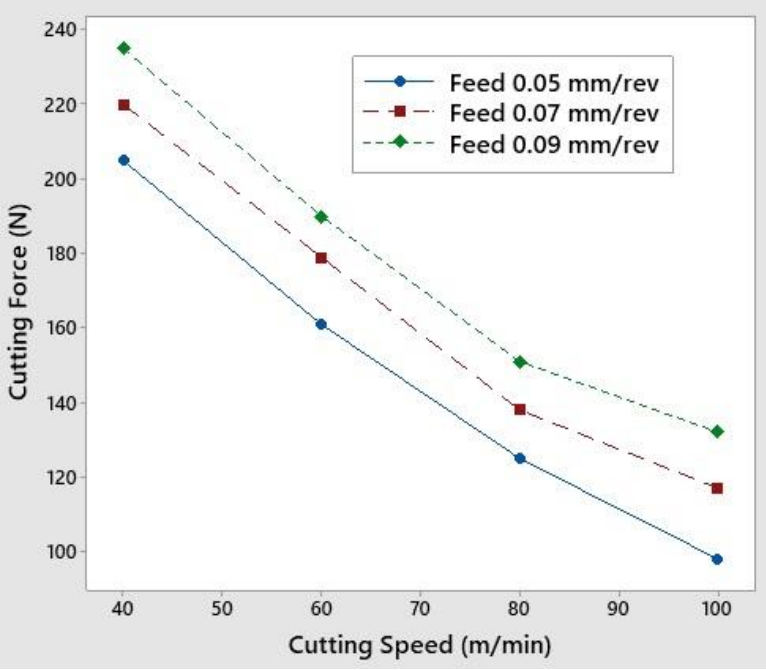

Figure 1 Graph showing cutting force for varying cutting speed and feed rate

The cutting force also drops due to decrease in chip tool contact as the cutting speed increases. This occurs due to the fact that average coefficient of friction at the tool face decreases with decreasing contact length. Increasing feed rate increases the contact length thereby increases the cutting force and flank wear.

4. Conclusion

The effect of cutting parameters like cutting speed, feed and depth of cut on cutting force during turning Inconel 718 was studied. It is observed that the cutting force increases as the feed rate increases. When the cutting speed increases the cutting force decreases due to softening of the workmaterial in the cutting zone.

5. Reference

[1] D. G. Thakur, B. Ramamoorthy & L. Vijayaraghavan (2009) A Study on the Parameters in High-Speed Turning of Superalloy Inconel 718, Materials and Manufacturing Processes, 24:4, 497-503,

[2] M. Rahman, W.K.H. Seah, T.T. Teo, The machinability of inconel 718, Journal of Materials Processing Technology, Volume 63, Issues 1–3, 1997, Pages 199-204,

[3] Asit Kumar Parida, Kalipada Maity, Comparison the machinability of Inconel 718, Inconel 625 and Monel 400 in hot turning operation, Engineering Science and Technology, an International Journal, Volume 21, Issue 3, 2018, Pages 364-370,

[4] Soumikh Roy, Ramanuj Kumar, Anurag, Amlana Panda, Rabin Kumar Das, A Brief Review on Machining of Inconel 718, Materials Today: Proceedings, Volume 5, Issue 9, Part 3, 2018, Pages 18664-18673