Optimization of machining parameter of horizontal honing machine using ANOVA

M.Muthu mani [1] P.Vijayakumar[2] TTM.Kannan[3] R.Elangovan [4]

[1] Department of Mechanical Engineering, PRIST deemed to be University, Thanjavur-613 403

[2 3] Associate professor, Department of Mechanical Engineering, PRIST deemed to be University, Thanjavur-613 403

[4]Professor, Department of Mechanical Engineering, Mookambigai College of Engineering,

Pudukkottai-622502, India

Abstract

Honing machine is that produce the various parts with high degree of accuracy. The specific applications such aeronautical parts and medical equipments need micron level accuracy and close tolerance. In this work, development of proto type horizontal honing machine and conduct machining performance. The spindle speed, feed and depth of cut are input parameters of honing process and Surface roughness is response parameter. The experiment is designed by L_{16} orthogonal array and machining process parameters of analyzed by Anova

Keywords: Honing machine, Process parameters, surface roughness, Anova.

I-Introduction

Honing is an abrasive machining process that produces a precision surface on a metal workpiece by scrubbing an abrasive stone against it along a controlled path. Honing is primarily used to improve the geometric form of a surface, but may also improve the surface texture. Typical applications are the finishing of cylinders for internal combustion engines, air bearing spindles and gears. There are many types of hones, but all consist of one or more abrasive stones that are held under pressure against the surface they are working on.[1] Investigated on the effects of different process parameters, such as number of trials, concentration of abrasive, abrasive mesh size and media flow speed, on material removal and surface finish are studied. The dominant process parameter found is concentration of abrasive, followed by abrasive mesh size, number of cycles, and media flow speed [2,3] Investigated on the surface finishing of die steel with the use of abrasive flow machining against the traditional grinding process. Results showed that as the abrasive loading increases, the improvement in surface roughness increases. Based upon the experimental data of the effects of AFM process parameters, e.g., abrasive mesh size, number of finishing cycles, extrusion pressure, percentage of abrasive concentration, and media viscosity grade, on performance characteristics But at the high percentage (above 78%) of abrasive loading, the flow becomes difficult as well as carrier acts as inefficient binder for abrasives. Similarly as hardness of work piece increases, the number of cycles to achieve better Surface roughness also increases.[4,5]The change in surface roughness, Δ Ra increases with the increase in length of the work-piece and decreases with the increase in cross section of the work-piece. It can also be seen that work piece having single vent for media outflow have higher material removal and more improvement in surface roughness and the performance measures decrease with increase in the number of vents for media outflow.

II-Experimental Details

The experiment is designed by Taguchi design of experiment using L 16 orthogonal array which provide 4 levers and 3 factors (Table1) Spindle speed, feed and depth of cut are the process parameters and input to horizontal honing machine (fig 1) and machined surface is measured by HMT surface roughness tester.

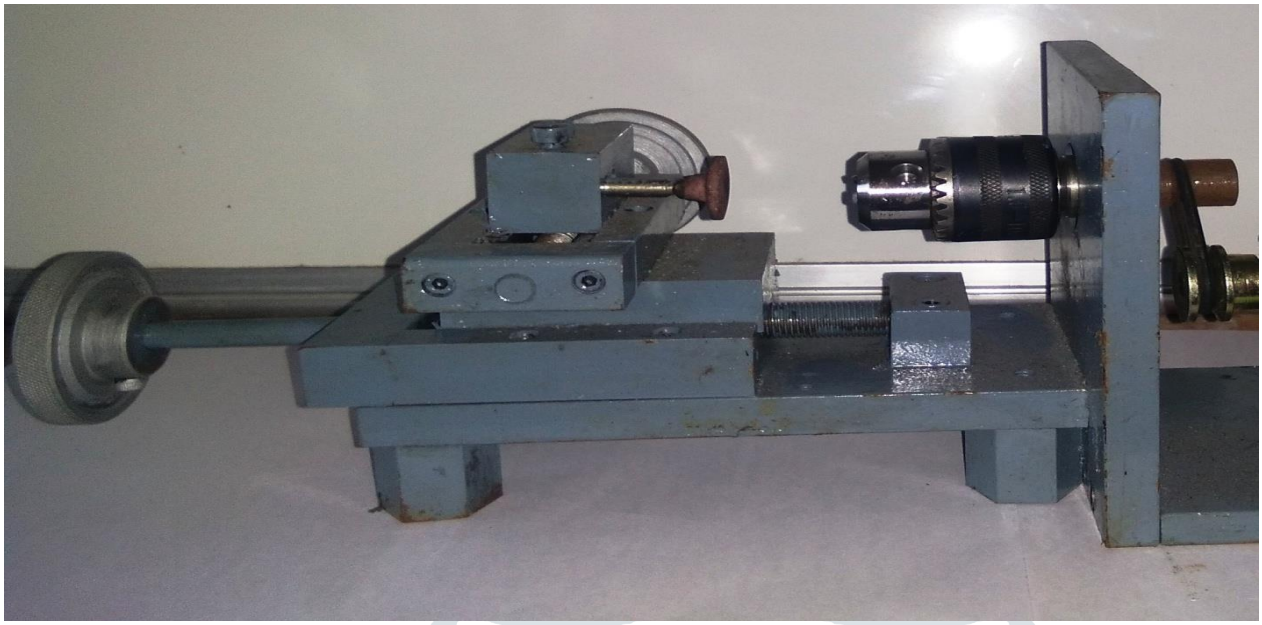

Fig 1 Horizontal honing machine

Table 1 Levels and Parameters of Horizontal honing machine

Levels	Spindle speed (Rpm)	Feed rate (mm/rev)	Depth of cut (mm)
1	900	0.010	0.5
2	1200	0.015	0.7
3	1500	0.018	0.9
4	1800	0.020	0.1

III-Result and discussion

Table 2 Honing machine process parameters of surface roughness

Spindle Speed	Feed Rate	Depth of cut	Surface Roughness	SN ratio
1	1	1	0.75	2.49
1	2	2	0.86	1.31
1	3	3	0.97	0.26
1	4	4	0.42	7.53
2	1	2	0.63	4.01
2	2	1	0.73	2.73
2	3	4	0.67	3.47
2	4	3	0.64	3.87
3	1	3	0.72	2.85
3	2	4	0.82	1.72
3	3	1	0.92	0.81
3	4	2	0.53	5.51
4	1	4	0.74	2.61
4	2	3	0.68	3.34
4	3	2	0.77	2.27
4	4	1	0.76	2.38

Table 2 shows that corresponding 16 experiment specimens is tabulated in Table 2.The smaller is the best concept is adopted in this work. The optimum process parameters of horizontal honing machine are 900 rpm of spindle speed, 0.02 mm / rev of feed rate and 0.1 mm depth of cut is best process parameter to achieve good and reasonable surface roughness.

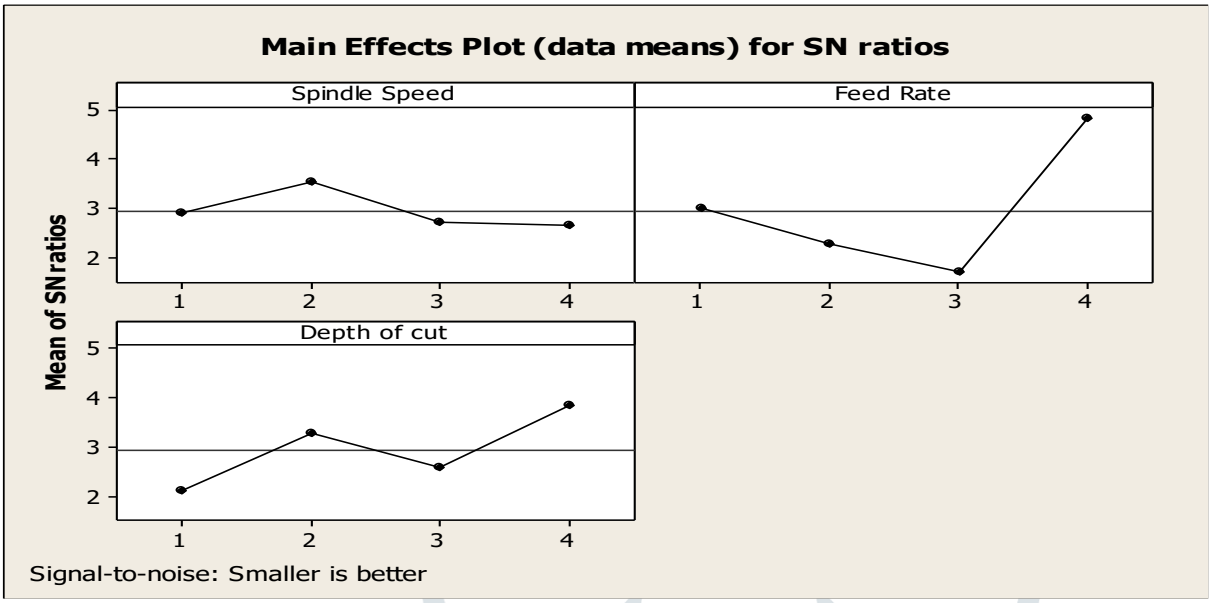

Fig 2 Main effect plot for surface roughness by SN Ratio

Table 3 Analysis of Variance for surface roughness

Source	DOF	Seq SS	Adj SS	Adj MS	F	P
Spindle speed	3	0.01795	0.01795	0.00598	0.39	0.768
Feed rate	3	0.12965	0.12965	0.04322	2.79	0.132
Depth of cut	3	0.03730	0.03730	0.01243	0.80	0.537
Error	6	0.09310	0.09310	0.015552	--	-
Total	15	0.27800	-	-	-	-

Table 3 shows that Analysis of variance, Mention the feed rate is a dominating parameter for achieving smaller surface roughness indicated by higher value of F value. It also confirms that 95 % of confidential level.

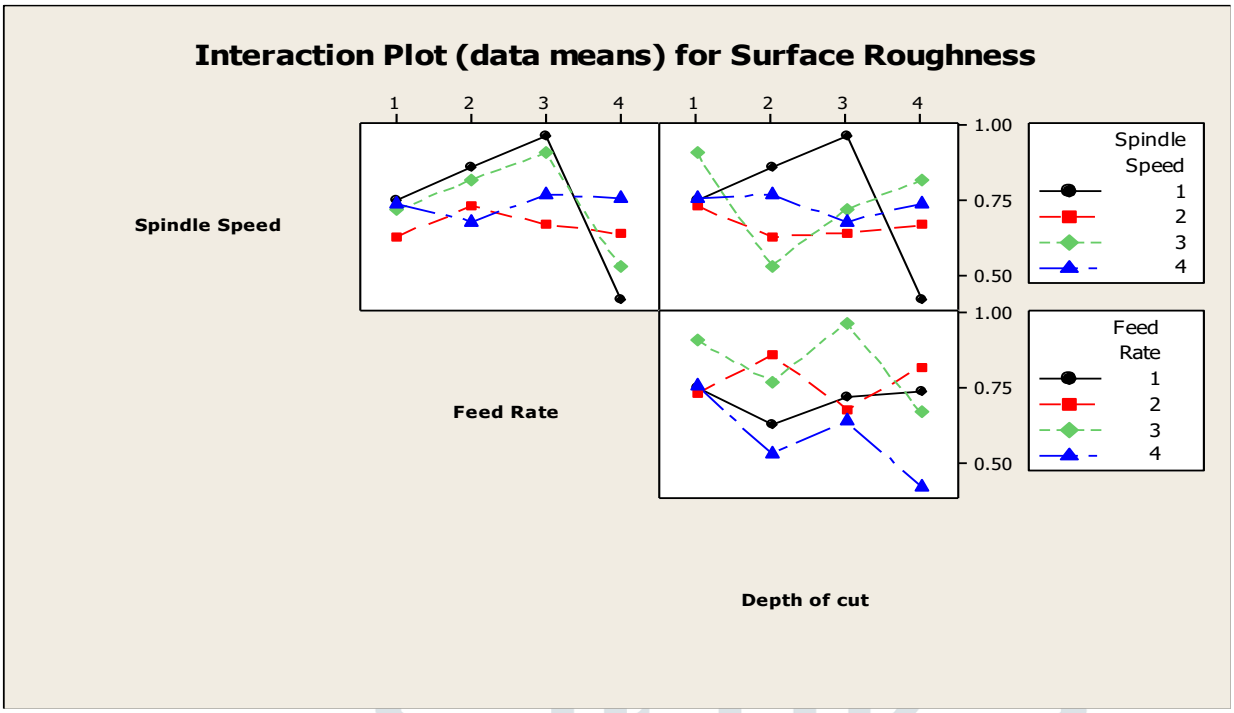

Fig 3 Interaction Plot for surface roughness

Figure 3 represent interaction plot for surface roughness of horizontal honing machine. All input parameters such that Spindle speed, Feed rate and Depth of cut are dependant parameters and significant to obtain better surface roughness using horizontal honing machine.

IV- Conclusion

- The portable mini honing machine has been fabricated successfully as per design of machine element procedure. The mini honing machine is suitable for super finishing process of small size internal bore, cylinder and bush components.
- Portable, compact size and lower power consumption are the special features of micro machine. The mini honing machine saves energy, power, space and material.
- Spindle speed, feed and depth of cut are the dependable parameters of for achieving better surface roughness in horizontal honing machine. Feed rate is a dominant parameter for obtain good surface roughness and also indicate 95% of confident level in Analysis of variance. Optimum parameter of horizontal honing machine for producing better surface roughness from Signal to Noise ratio.
- It can bring remarkable benefits such as low thermal distortion, high spindle speed, low inertial force, light weight and portable. It may implement in micro factory concept and lead to sustainable manufacturing system in 2020.

References

[1]. Jain V K and Adsul S G "Experimental investigations into abrasive flow machining (AFM)", International Journal of Machine Tools& Manufacture 40 (2000),pp 1003–1021.

[2]. Kursad Gov, Omer Eyercioglu and Mehmed Veysel Cakir "Hardness Effects on Abrasive Flow Machining"Journal of Mechanical Engineering 59 (2013)10, pp 626-631.

[3]. Harlal Singh Mali and Alakesh Manna "Simulation of surface generated during abrasive flow finishing of Al/SiCp-MMC using neural networks" Int Adv Manuf Technol (2012), pp 1263–1268.

[4]. Rajendra K. Jain and Jain V K "Stochastic simulation of active grain density in abrasive flow machining" Journal of Materials Processing Technology 152 (2004), pp 17– 22.

[5]. Sandeep Chouhan and Sushil Mittal "Abrasive Flow Machining: Major Research Areas &Analysis" International journal of research in aeronautical and mechanical engineering, Vol 2 Issue 1

(Jan 2014), pp 77- 83.

[6]. Jain V K, Rajani Kumar, Dixit P M and Ajay Sidpara "Investigations into abrasive flow finishing of complex workpieces using FEM" Wear 267 (2009), pp 71–80.

[7]. Mamilla Ravi Sankar, Jain V K and Ramkumar J "Experimental investigations into rotating workpiece abrasive flow finishing" Wear 267 (2009),pp 43–51.

[8]. Raju H P , Narayanasamy K , Srinivasa Y G and Krishnamurthy R "Characteristics of extrude honed SG iron internal primitives" Journal of Materials Processing Technology 166 (2005), pp 455–464.

[9]. Kenda J, Pusavec F, Kermouche G and Kopac J "Surface Integrity in Abrasive Flow Machining of Hardened Tool Steel AISI D2" Procedia Engineering 19 (2011), pp 172 – 177.

[10]. RaviSankar M, Jain V K, Ramkumar J and Joshi Y M "Rheological characterization of styrene-butadiene based medium and its finishing performance using rotational abrasive flow finishing process" International Journal of Machine Tools & Manufacture 51 (2011), pp 947–957