

Effect of Machining Parameters on Surface Roughness with Turning Process- Literature Review

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Abstract

The aim is to study the machining parameters and effect of them on surface roughness. A good number of published papers have been studied and a literature review has been presented to identify and mention the gap for further research

Keywords

Speed,
Feed,
Depth of Cut,
Nose Radius,
Surface Roughness,
Turning

1. Introduction

Surface condition is being determined by several factors:

- Cutting parameters (cutting speed, feed)
- Tool geometry (angle and sharpness of the cutting edge, corner radius, etc)
- The material the cutting tool is made from the rigidity of the assembly and of the machine,
- The forming of chips, cutting forces, etc.

The process of production of large number of items requires removing the excess material from the raw material. The activity involves large number of machine as well as human parameters which makes it complex phenomenon. The production activity determines the overall cost of the basic product. In the age of competition the cost has to be minimal. To achieve this, production activity needs to be optimized in terms of cost/time. The cost/time of production depends upon human parameters such as competency level and wages whereas the machine parameters are speed, feed, depth of cut and the number of passes. These parameters apart from the production rate, influence quality of finished product during a machining operation. To study the influence of various parameters involved one needs to find out from the available data, the practice involved and the shortcomings if any and the possible remedial measures.

2. Literature Review

In this paper the Literature Review has been presented in a tabular form. A number of published papers related to the machining area have been studied. Nearly 60 papers related to study of machining parameters have been separated for further consideration of detailed study. Machining parameters such as speed, feed, depth of cut,

nose radius and rake angle have been studied in detail along with their effect on surface roughness.

Many researchers have considered only Speed, feed and Depth of cut as input parameters. The review table given below explains the details of parameters considered in earlier studies by various researchers. Y represents the consideration of the parameter and X represents parameter not in consideration. Wherever the parametric values are available, they have been mentioned respectively in the table given below.

Table: 1. Published work on the study of Effect Machining parameters on Surface Roughness

Serial No	Author	Spindle Speed (rpm) / Cutting Speed (m/min)	Feed (m/m/rev)	Depth of Cut (m)	Nose Radius (m)	Rake Angle (Degrees)
1	[1978]Sundaram	Y	Y	Y	X	X
2	[1981]Sundaram and Lambert	Y	Y	Y	X	X
3	[1996]D. Gillibrand et al.	150, 200, 250	0.99, 0.12, 2,	0.8	X	X

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			020	1.00		
21	[2007]J. Paulo Davima et al.	71, 141, 283	0.16, 0.25	0.5, 0.75, 1.0	X	X
22	[2008]K. Palanikumar et al.	100, 200, 400	0.05, 0.1, 0.2	X	X	X
23	[2008]Y. Sahin and A.R. Motorcu	103, 138, 173, 208, 243	0.10, 0.13, 0.16, 0.19, 0.20, 0.23, 0.28	0.41, 0.54, 0.67, 0.80, 0.93	X	X
24	[2008]Y. Sahin and A.R. Motorcu	103, 138, 173, 208, 243	0.10, 0.13, 0.16, 0.19, 0.20, 0.23, 0.28	0.41, 0.54, 0.67, 0.80, 0.93	X	X
25	[2008]K. Palanikumar et al.	100, 200, 400	0.05, 0.1, 0.2	X	X	X
26	[2009]Ali Riza MOTORCU	306, 408, 510, 612, 714	0.14, 0.20, 0.25, 0.31, 0.36, 0.5	0.4, 0.57, 0.71, 0.85, 0.99	X	X
27	[2009]Dejan Tanikic	80, 140	0.09, 0.07, 0.1	0.5, 0.2	X	X

	et al.		0.32			
			1			
28	[2009]Karin Kandana nond	5000, 8000	0.00, 0.02, 0.00, 0.008	0.1, 0.2	X	X
29	[2010]D. Philip Selvaraj and P. Chandramohan	80, 100, 120	0.08, 0.10, 0.12	0.4, 0.6, 0.8	X	X
30	[2010]H. Yanda et al.	220, 300, 360	0.2, 0.3, 0.5	2	X	X
31	[2011]Adeel H. Suhail et al.	950, 1150, 1400	0.5, 0.75, 1	0.5, 0.75, 1	X	X
32	[2011]Hardeep Singh et al.	1000, 1260, 1600, 2000	0.05, 0.1, 0.2, 0.3	0.5, 1, 1.5, 2	X	X
33	[2011]M. Ramalinga Reddy et al.	X	0.10, 0.16, 0.28, 0.3, 0.31, 0.39	0.8	X	X
34	[2011]Suleiman Abdulka reem et al.	1000, 1500, 2000	0.5, 0.8, 1.0	X	X	X
35	[2011]Praveen Pandey and V.K. Gupta	158, 480	0.15	0.5, 1	X	X
36	[2012]R. Karuppa samy et	1000, 1750, 2500	0.1, 0.2, 0.3	0.5, 1.0, 1.5	0.4, 0.8	X

	al.				1.2	
37	[2012]M . Kaladhar et al.	150, 170, 190, 210	0.25 , 0.20 , 0.25 , 0.30	0.5, 1.0, 1.5, 2.0	0.4 , 0.8	X
38	[2012]M . Venkata Ramana et al.	63, 79, 99	0.20 6, 0.27 4, 0.34 3	0.6, 1.0	X	X
39	[2012]M anish Kumar Yadav et al.	180, 280	0.07 1, 0.14	0.8, 1.4	X	X
40	[2012]R ahul Davis	780, 1560, 2340	1.21 , 1.81 , 3.63	0.5, 1.0, 1.5	X	X
41	[2012]R odrigues L.L.R et al.	228, 360, 450	0.11 , 0.18 , 0.75	0.25 , 0.50 , 0.75	X	X
42	[2012]S. S. K. Deepak	105, 115, 125, 135, 145, 155, 165, 175, 185, 195	0.02 , 0.04 , 0.06 , 0.08 , 0.10 , 0.12 , 0.14 , 0.16 , 0.18 , 0.20	X	X	X

43	[2012]S. S. K. Deepak	Y	Y	Y	X	X
44	[2012]Y ansong Guoa et al.	140, 340	0.05 , 0.1	1	X	X
45	[2013]A dnan Jameel and Mohama d Minhat et al.	Y	Y	Y	X	X
46	[2013]Ja khale Prashant P and Jadhav B. R.	100, 125, 150	0.24 , 0.26 , 0.28	1, 2, 3	X	X
47	[2013]R aman Kumar et al.	1500, 1600, 1700	0.08 , 0.1, 0.12	0.6, 0.8, 1	0.4 , 0.8 , 1.2	X
48	[2013]S udhansu Ranjan Das et al.	60, 90, 120, 150	0.05 , 0.1, 0.15 , 0.2	0.2, 0.3, 0.4, 0.5	X	X

3. Conclusions

- From the published work, it is clear that most of the earlier research work used speed, feed and depth of cut as input parameters for studying the surface roughness.
- Some of them have considered nose radius as one of the parameter.
- The published work is silent on simultaneous effect of tool geometry and material properties on surface roughness.

References

[1] Adeel H. Suhail, N. Ismail, S. V. Wong, N. A. Abdul Jalil, Optimization of Cutting Parameters Based on Surface Roughness and Assistance of Workpiece Surface Temperature in Turning Process, American J. of Engineering and Applied Sciences 3(1): 102-108, 2010

[2] Adnan Jameel, Mohamad Minhat, Md. Nizam, Using Genetic Algorithm to Optimize Machining Parameters

- in Turning Operation : A Review, International Journal of Scientific and Research Publications, 3(5), 2013
- [3] Ali Riza MOTORCU, Surface Roughness Evaluation When Machining Carbon Steel With Ceramic Cutting Tools, Uludağ Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi, Cilt 14, Sayı 1, 2009
- [4] Anselmo Eduardo Diniz , Adilson Jose´ de Oliveira, Optimizing the use of dry cutting in rough turning steel operations, International Journal of Machine Tools & Manufacture 44 (2004) 1061–1067
- [5] B. Y. Leea, Y.S. Tarngb, H.R. Liic, An investigation of modeling of the machining database in turning operations, Journal of Materials Processing Technology 105 (2000) 1±6
- [6] C. H. Che Haron , A. Ginting, J.H. Goh, Wear of coated and uncoated carbides in turning tool steel, Journal of Materials Processing Technology 116 (2001) 49–54
- [7] C. Y. Niana, W.H. Yangb, Y.S. Tarngb, Optimization of turning operations with multiple performance characteristics, Journal of Materials Processing Technology 95 (1999) 90-96
- [8] C. Y. H. Lim , S.C. Lim, K.S. Lee, The performance of TiN-coated high speed steel tool inserts in turning, Tribology International 32 (1999) 393–398
- [9] D. Gillibrand, M. Sarwar, C.T. Pierce, The economic benefit of finish turning with coated carbide, Surface and Coatings Technology 86-87, 1996
- [10] D. Philip Selvaraj, P. Chandramohan, Optimization of Surface Roughness of AISI 304 Austenitic Stainless Steel In Dry Turning Operation Using Taguchi Design Method, Journal of Engineering Science and Technology, 5(3), 2010, 293 - 301
- [11] Dejan Tanikic, Miodrag Manic, Goran Radenkovic, Dragan Mancic, Metal cutting process parameters modeling: an artificial intelligence approach, Journal of Scientific & Industrial Research, 68, 2009, 530-539
- [12] H. Yanda, J.A. Ghani, M. N. A. M. Rodzi, K. Othman and C.H.C. Haron, Optimization of Material Removal Rate, Surface Roughness and Tool Life On Conventional Dry Turning Of FCD 700, International Journal of Mechanical and Materials Engineering (IJMME), 5(2), 2010, 182-190
- [13] Hardeep Singh, Rajesh Khanna, M. P. Garg, Effect of Cutting Parameters on MRR and Surface Roughness in Turning EN-8, International Journal of Current Engineering and Technology, 1(1), 2011
- [14] Hari Singh and Pradeep Kumar, Mathematical models of tool life and surface roughness for turning operation through response surface technology, Journal of Scientific & Industrial Research, 66, 2007, 220-226
- [15] I. A. Choudhury, M.A. El-Baradie, Tool-life prediction model by design of experiments for turning high strength steel (290 BHN), Journal of Materials Processing Technology 77 (1998) 319–326
- [16] J. Paulo Davima, V.N. Gaitondeb, S.R. Karnikc, Investigations into the effect of cutting conditions on surface roughness in turning of free machining steel by ANN models, journal of materials processing technology, 2007
- [17] J. Wang, The effect of the multi-layer surface coating of carbide inserts on the cutting forces in turning operations, Journal of Materials Processing Technology 97 (2000) 114±119
- [18] Jakhale Prashant P, Jadhav B. R., Optimization of Surface Roughness of Alloy Steel by Changing Operational Parameters And Insert Geometry in the Turning Process., International Journal of Advanced Engineering Research and Studies, 2013/17-21
- [19] K. Palanikumara, F. Matab, J. Paulo Davimc, Analysis of surface roughness parameters in turning of FRP tubes by PCD tool, journal of materials processing technology, 2008
- [20] Karin Kandananond, The Determination of Empirical Model for Surface Roughness in Turning Process Using Design of Experiment, WSEAS Transactions on Systems, 10(8), 2009
- [21] M. Cemal Cakir, Yahya Isik, Detecting tool breakage in turning AISI 1050 steel using coated and uncoated cutting tools, Journal of Materials Processing Technology 159 (2005) 191–198
- [22] M. Kaladhar, K. V. Subbaiah, Ch. Srinivasa Rao and K. Narayana Rao, Application of Taguchi approach and Utility Concept in solving the Multi-objective Problem when turning AISI 202 Austenitic Stainless Steel, Journal of Engineering Science and Technology Review 4 (1) (2011) 55-61
- [23] M. Kaladhar, K. Venkata Subbaiah, Ch. Srinivasa Rao, Determination of Optimum Process Parameters during turning of AISI 304 Austenitic Stainless Steels using Taguchi method and ANOVA, International Journal of Lean Thinking, 3(1), 2012
- [24] M. Venkata Ramana, A. Venkata Vishnu, G. Krishna Mohan Rao and D. Hanumantha Rao, Experimental Investigations, Optimization Of Process Parameters And Mathematical Modeling In Turning Of Titanium Alloy Under Different Lubricant Conditions, IOSR Journal of Engineering (IOSRJEN), 2(1), 2012, 086-101
- [25] M. Ramalinga Reddy, P. Ravi Kumar, G. Krishna Mohana Rao, Effect Of Feed Rate On The Generation Of Surface Roughness In Turning, International Journal of Engineering Science and Technology (IJEST), 3(11), 2011
- [26] B. Malakooti, V. Raman, An interactive multi-objective artificial neural network approach for machine setup optimization., Journal of Intelligent Manufacturing, 11, 2000, 41-50.
- [27] Manish Kr. Yadav, P. K. Sinha, Gopal P. Sinha, Development of Techniques Using Design of Experiments for Acquiring Appropriate Surface Finish by Multi Tool Machining, VSRD- International Journal of Mechanical, Auto. & Prod. Engg, 2(4), 2012, 140-150
- [28] R. A. Patil, V. D. Shinde, H. V. Shete, S. P. Nevagi, Effect of High Pressure Coolant on Surface Finish In Turning Operation, International Journal of Innovative Research in Science, Engineering and Technology, 2(7), 2013
- [29] N. R. Dhar , S. Paulb, A. B. Chattopadhyay, The influence of cryogenic cooling on tool wear, dimensional accuracy and surface finish in turning AISI 1040 and E4340C steels, Wear 249 (2002) 932–942

- [30] P. G. Benardos, G.-C. Vosniakos, Predicting surface roughness in machining: a review, *International Journal of Machine Tools & Manufacture* 43(2003) 833–844
- [31] S. K. Pal, Chakraborty, Surface roughness prediction in turning using artificial neural network, Springer-Verlag London Limited, 2005
- [32] K. Palanikumar, R Karthikeyan, Assessment of factors influencing surface roughness on the machining of Al/SiC particulate composites, *Journal of Materials and Design*, 28, 2007, 1584-1591
- [33] Praveen Pandey, V.K. Gupta, Duplex machining: an innovative approach for better dimensional accuracy and surface finish, *Int. J. Machining and Machinability of Materials*, 101/2, 2011
- [34] S. Purushothaman, Srinivasa, A back propagation algorithm applied to tool wear monitoring, *Int. J. Mach Tools Manufact.* 34.5, 1994, 625
- [35] Q. Meng, J. A. Arsecularatne, P. Mathew, Calculation of optimum cutting conditions for turning operations using a machining theory, *International Journal of Machine Tools & Manufacture* 40 (2000) 1709–1733
- [36] R. Karuppusamy, A. K. Shaik Dawood, G. Karuppusami, Reducing the Surface Roughness of Pneumatic Cylinder Piston Rod in Turning Process Using Genetic Algorithm, *IRACST – Engineering Science and Technology: An International Journal (ESTIJ)*, 2250-3498, 2(4), 2012
- [37] R. T. Coelho, L.R. Silva, A. Braghini, Jr., A.A. Bezerra, Some effects of cutting edge preparation and geometric modifications when turning INCONEL 718TM at high cutting speeds, *Journal of Materials Processing Technology* 148 (2004) 147–153
- [38] Rahul Davis, A Parametric Design Study of Surface Roughness In Dry Turning Operation of EN24 Steel, *International Journal of Mechanical Engineering and Technology*, 3(2), 2012
- [39] Raman Kumar, Raman Kumar, Jaspreet Singh Rai and Navneet Singh Virk, Analysis The Effects Of Process Parameters In En24 Alloy Steel During CNC Turning By Using MADM, *International Journal of Innovative Research in Science, Engineering and Technology*, 2(7), 2013
- [40] L. L. R. Rodrigues, A. N. Kantharaj, B. Kantharaj, Freitas W. R. C. and Murthy B.R.N., Effect of Cutting Parameters on Surface Roughness and Cutting Force in Turning Mild Steel, *Research Journal of Recent Sciences*, 1(10), 19-26, 2012
- [41] Ruey-Jing Liana, Bai-Fu Linb, Jyun-Han Huangb, A grey prediction fuzzy controller for constant cutting force in turning, *International Journal of Machine Tools & Manufacture* 45 (2005) 1047–1056
- [42] S. S. K. Deepak, A Geometric Programming Based Model for Cost Minimization of Turning Process with Experimental Validation, *International Journal of Engineering Sciences & Emerging Technologies*, 2012, 3(1), 81-89
- [43] S. S. K. Deepak, Cutting Speed and Feed Rate Optimization for Minimizing Production Time of Turning Process, *International Journal of Modern Engineering Research (IJMER)*, 2(5), 2012, 3398-3401
- [44] S. V. Bhaskara Reddy , M. S. Shunmugam , T. T. Narendran ,Optimal sub-division of the depth of cut to achieve minimum production cost in multi-pass turning using a genetic algorithm, *Journal of Materials Processing Technology* 79 (1998) 101–108
- [45] Safeen Y. Kassab, Younis K. Khoshnaw, The Effect of Cutting Tool Vibration on Surface Roughness of Work piece in Dry Turning Operation, *Eng. & Technology*, 25(7), 2007
- [46] Sahin, Yusuf and Motorcu A.Riza, Surface Roughness Prediction Model in Machining of Carbon Steel by PVD Coated Cutting Tools, *American Journal of Applied Sciences*, 1, 2004, 12-17
- [47] Sudhansu Ranjan Das, Amaresh Kumar, and Debabrata Dhupal, Effect of Machining Parameters on Surface Roughness in Machining of Hardened AISI 4340 Steel Using Coated Carbide Inserts, *International Journal of Innovation and Applied Studies*, 2(4), 2013, 445-453
- [48] Suleiman Abdulkareem, Usman Jibrin Rumah and Apasi Adaokoma, Optimizing Machining Parameters during Turning Process, *International Journal of Integrated Engineering*, 3(1), 2011, 23-27
- [49] R. M. Sundaram, B. K. Lambert, Mathematical models to predict surface finish in fine turning of steel: Part I and Part II, *International Journal of Production Research*, 19(5):1981, 557-564.
- [50] R. M. Sundaram, B. K. Lambert, Surface roughness variability of ANSI 4140 steel in fine turning using carbide tools, *International Journal of Production Research*, 17(3):1979, 249-258
- [51] W. H. Yang, Y. S. Targ ,Design optimization of cutting parameters for turning operations based on the Taguchi method, *Journal of Materials Processing Technology* 84 (1998) 122–129
- [52] Y. Sahin, A. R. Motorcu ,Surface roughness model in machining hardened steel with cubic boron nitride cutting tool, *International Journal of Refractory Metals & Hard Materials* 26 (2008) 84–90
- [53] Yansong Guoa, Jef Loendersb, Joost Duflooua, Bert Lauwersa, Optimization of energy consumption and surface quality in finish turning, Available online at www.sciencedirect.com, *Procedia CIRP* 1 (2012) 551–556