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Effect of process parameters on surface roughness during CNC turning

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Abstract
In order to produce any product with desired quality by machining, proper selection of process parameter is essential. The objective of our project is to investigate the effect of process parameters in turning of SS202-Austenitic stainless steels in a CNC lathe by using coated carbide tool. The parameters namely the spindle speed, feed rate and depth of cut are varied to study their effect on surface roughness. The experiments are conducted using one factor at a time approach. The six SS202 used for turning. This investigation reveals that the surface roughness is directly influenced by the Spindle speed, feed rate and depth of cut. It is observed that the surface roughness increases with increased feed rate and is higher at depth of cut and vice versa for all feed rates.

Keywords: Cnc turning, SS202, Surface roughness

Introduction
In metal cutting and manufacturing industries, surface finish of a product is very crucial in determining the quality. Good surface finish not only assures quality, but also reduces manufacturing cost [6]. Surface finish is important in terms of tolerances, it reduces assembly time and avoids the need for secondary operation, thus reduces operation time and leads to overall cost reduction. Besides, good-quality turned surface is significant in improving fatigue strength, corrosion resistance, and creep life [8, 9]. Due to the increasing demand of higher precision components for its functional aspect, surface roughness of a machined part plays an important role in the modern manufacturing process.
Turning is a machining operation, which is carried out on lathe. The quality of the surface plays a very important role [11] in the performance of turning as a good quality turned surface significantly improves fatigue strength, corrosion resistance, or creep life.
Surface roughness also affects several functional attributes of parts, such as contact causing surface friction, wearing, light reflection, heat transmission, ability of distributing and holding a lubricant, load bearing capacity, coating or resisting fatigue. Therefore, the desired surface finish is usually specified and the appropriate processes are selected to reach the required quality [1]. Surface roughness plays an important role in affecting friction, wear and lubrication of contacting bodies [2]. Surface roughness is one of the parameters that greatly influence the friction under certain running conditions [3]. Surface roughness of the contacting surfaces influences the frictional properties of those surfaces during the forming processes [4, 7, 10, 12]. It is clear now that surface roughness geometry strongly influences the manner in which the contacting surfaces are interacting. Furthermore, it is well known that the final geometry of surface roughness is influenced by various machining conditions such as spindle speed, feed rate and depth of cut [5].

Experimental Details
To turn stainless steel 202 material in CNC FANUC control lathe machine, for that we are using coated carbide cutting tool in the inserted type tool holder. The spindle speeds were constant 1500 rpm and the feed rates were 0.003, 0.0035, 0.004, 0.0045, 0.005 and 0.006 mm per revolution. and depth of cut were 0.1,.15,0.2,0.25,0.3 and 0.4 [13,14].The spindle speeds, feed rates and depth of cut were selected from the standard tables given for the safe operation of the materials to avoid excessive tool wear and tool failure. The surface roughness of all the six sample pieces were measured using a surface roughness tester, it is capable of evaluating surface texture with a variety of parameters according to various national and international standards. The measurement results are displayed

digitally/graphically on the touch panel, and output to the built-in printer. The stylus of the detector unit traces the minute irregularities of the workpiece surface. Surface roughness is determined from the vertical stylus displacement produced during the detector traversing over the surface irregularities. The Arithmetic Mean Deviation of the profile, surface roughness average (Ra) of the each sample piece is noted down as a surface roughness measure. Six samples of the surface roughness profile generated by the surface roughness tester value given below.

Table 2.1: Standard Input parameters and their range in stainless steel.

S. No	Name of Parameter	Symbol	Range
1	Spindle Speed	N	500-1500 rpm
2	Feed rate	F	0.003-0.006 mm/rev
3	Depth of Cut	D_{cut}	0.1-1 mm

The experiments are conducted using One-factor-at-a-Time-Approach in which, one input parameter is kept constant and all other parameters are varied.

Table 2.2: Experimental input parameters and R_a values

Sample no	Spindle Speed (N) rpm	Feed rate (F) mm/rev	Depth of Cut (D_{cut}) mm	surface roughness average (Ra) value µm
S1	1500	0.003	0.1	0.60
S2	1500	0.0035	0.15	1.82
S3	1500	0.004	0.2	2.39
S4	1500	0.0045	0.25	3.84
S5	1500	0.005	0.3	4.92
S6	1500	0.006	0.4	5.62

3.1: Photography of SS202 in turning

3.1.1: Raw material

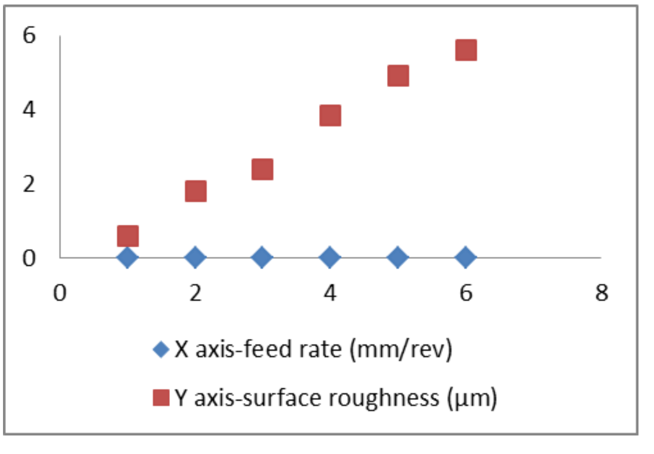
3.1.2: Machining

3.1.3: Testing SS202

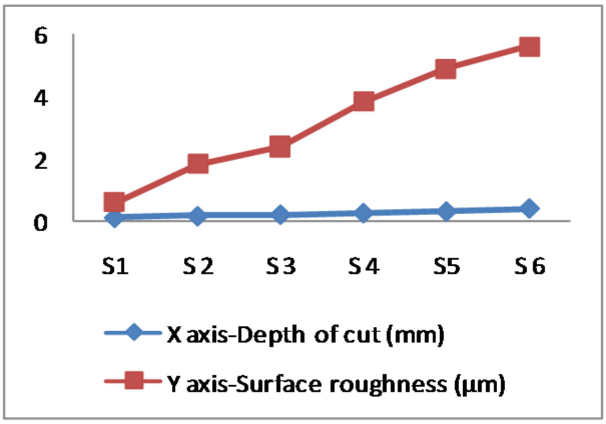
3.1.4: Finished SS202

Results and Discussion

The graph 4. 1 to 4.2 indicate the feed rate, depth of cut v_s surface roughness to get the better surface roughness values for SS202, when minimize the values of feed rate and depth of cut is plotted on the graphs.



Graph 4.1: Feed Rate V_s Surface Roughness



Graph 4.2: Depth of Cut V_s Surface Roughness

Conclusion

From these experiments of effect of spindle speed, feed rate and depth of cut on surface roughness of SS202 it may be concluded that the better surface finish may be achieved by turning SS202 at low feed rate(0.003mm/rev)), depth of cut(0.1mm) and spindle speeds(1500rpm). The outlying points in the Graph: 4.1 to Graph: 4. 2.

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