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INVESTIGATION ON FEED FORCE DURING TURNING OF ALUMINUM BAR BY USING DOUBLE POINT CUTTING TOOL

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Abstract

Time takes very important role in the field of Manufacturing. Taking less time for machining the workpiece without affecting the functional parameters is the attractive feature. Mechanism, Metal cutting tool take very important role in reducing the time for Machining. It is very clear in the case of Crank and Slotted link mechanism of shaper Machine, the time is reduced for return stroke (idle stroke) of the tool. So the total time for machining on the workpiece can be reduced. Here a specially designed tool takes less time for turning long workpiece. A special tool namely double point cutting tool takes lesser time than the time taken by the usual single point cutting for turning long workpiece. The specially designed HSS double point cutting tool is made to have double cutting points with height difference of 0.5mm and distance difference of 6 mm. Turning is carried out with depth of cut as 0.5mm by the first point and as well as by second point of the double point cutting tool. Investigation on feed force is made by using HSS double point cutting tool during turning of Aluminum Bar for different speed and feed rate and it is presented in this Research article.

Keywords: double point cutting tool, machining time, turning, feed force, Aluminum Bar, speed, feed rate

Introduction

Researchers' work is to develop and improve the existing system by way research. Research will not stop at one point and it goes on for further and further improvement. "Doing things in different way is better than doing different things ". Here this is the different way of doing the work from the existing method of turning by using a specially developed tool

which may be termed as double point cutting tool and to reduce the total turning time for long workpiece. Time is very important factor in the field of Manufacturing. Taking less time for machining the workpiece without affecting the functional parameters is the attractive feature. Mechanism, Metal cutting tool take very important role in reducing the time for Machining. It is very clear in the case of Crank and Slotted link mechanism of shaper Machine, the time is reduced for return (idle) stroke of the tool by the mechanism. So the total time for machining on the workpiece can be reduced. Here a specially designed tool takes less time for turning long workpiece. A special tool namely double point cutting tool takes lesser time than the time taken by the usual single point cutting for turning long workpiece. The specially designed HSS double point cutting tool is made to have double cutting points with height difference of 0.5mm and distance difference of 6 mm. Turning is carried out with depth of cut as 0.5mm by the first point and as well as by second point of the double point cutting tool.. So the double point cutting tool takes lesser time than the time taken by the usual single point cutting for turning long workpiece. Aluminum is used as workpiece material which is an attractive material in the field of Engineering. Because it is low weight material and has high strength, moreover it has high machinability and low cost, corrosion free material etc., Investigation on feed force is made for the new HSS double point cutting tool during turning of Aluminum Bar for different speed and feed rate.

Literature Review

Yong Huang et. al[(2)] stated that total cutting forces under hard turning conditions are the sum of forces due to chip formation and forces due to flank wear. Yadhav.J.S et. al[(14)] concluded that the feed rate has significant influence on the force. Hiren Gajera et. al[(16)] stated that both the cutting speed and the feed rate play equally important roles in the effect on the feed force. The depth of cut is not crucial. Mohd. Rafeeq et. al[(17)] concluded that optimal feed force is recorded at N=500 rpm ,f=0.12 mm/rev and DOC =1mm. Manjanatha.R et. al[(18)] concluded that the feed force obtained is 120 N corresponding to optimal process parameters for cutting speed (101.8 m/min), feed rate (0.125 mm/rev) and depth of cut (0.5 mm) . This is with respect to EN-19 steel as workpiece and coated carbide as tool material. All the feed force measurement research work is with respect to single point cutting tool. But S.Vanangamudi et. al[(19)] conducted and concluded their work on feed force by using HSS double point cutting tool during turning of Aluminum bar for various speed and feed rate that as the speed increases the feed force decreases on the first point and as well as on the second point of the double point cutting tool.

Materials, Machine and Instrument

Aluminum bar which has 50 mm as diameter and 300 mm as long is used as workpiece material. It is an attractive material in the field of Engineering. Because it is low weight material and has high strength, moreover it has high machinability and low cost etc., Turning operation is done on the Aluminum bar for various speed and feed by keeping 0.5 mm depth of cut as constant in the Precision Centre Lathe Machine. HSS material is used as tool for turning operation by grinding the same by tool and cutter grinding machine to have two cutting points one after another with height difference of 0.5 mm and distance between them is 6 mm. The feed force is being measured by employing the Kistler 9257B Piezo-electric Dynamometer with built-in multi channel Charge Amplifier and PC based data acquisition System.

Methodology

By using tool and cutter grinding machine the HSS tool bit is ground to have the required tool angles and geometry. The double point cutting tool is fixed properly in the four way tool post by referring the dead centre of the tailstock. The cutting points are set to coincide with the axis of the workpiece by keeping necessary metal strips under the tool as we do for fixing the single point cutting tool in the tool post. Aluminum bar is used as workpiece which has 50 mm as diameter and 300 mm as long. It is also fixed carefully in the self centering three jaw chuck by tightening the jaws gently and rigidly and other end of the long aluminum bar is supported by dead centre of the tailstock to avoid wobbling of long Aluminum workpiece during turning by using the HSS double point cutting tool. The Kistler 9257B Piezo-electric Dynamometer with built-in multi channel Charge Amplifier and PC based data acquisition System is employed for measuring the feed force during turning of Aluminum Bar by using the Double Point Cutting Tool. The different speed and feed are chosen for measuring the feed force when turning is being carried out on Aluminum bar.

Experimental Setup

Figure-1: HSS Double Point Cutting Tool has been fixed in the tool post for turning on Aluminum Bar.

The HSS Double Point Cutting Tool has been fixed in the tool post and Aluminum Bar workpiece has also been fixed in the three jaw chuck and the other end of the Aluminum bar is supported by the dead centre of the tailstock which is shown in the Figure : 1.

Figure-2: Double Point Cutting Tool does Turning on Aluminum bar.

HSS double point cutting tool is doing turning on Aluminum Bar which is shown in Figure :2. To check whether the HSS double point cutting tool is fixed in the tool post properly and whether the Aluminum bar is fixed rigidly in the three jaw chuck a trial run is made. After the trial run the different speed and feed are chosen for the turning operation on the Aluminum bar.

Figure-3: Experimental Set up.

Figure-3: shows the Kistler 925 7B Piezo-electric Dynamometer with built-in multi channel Charge Amplifier and PC based data acquisition System which is used for measuring the feed force during turning of Aluminum Bar by using the Double Point Cutting Tool.

Results and Discussion

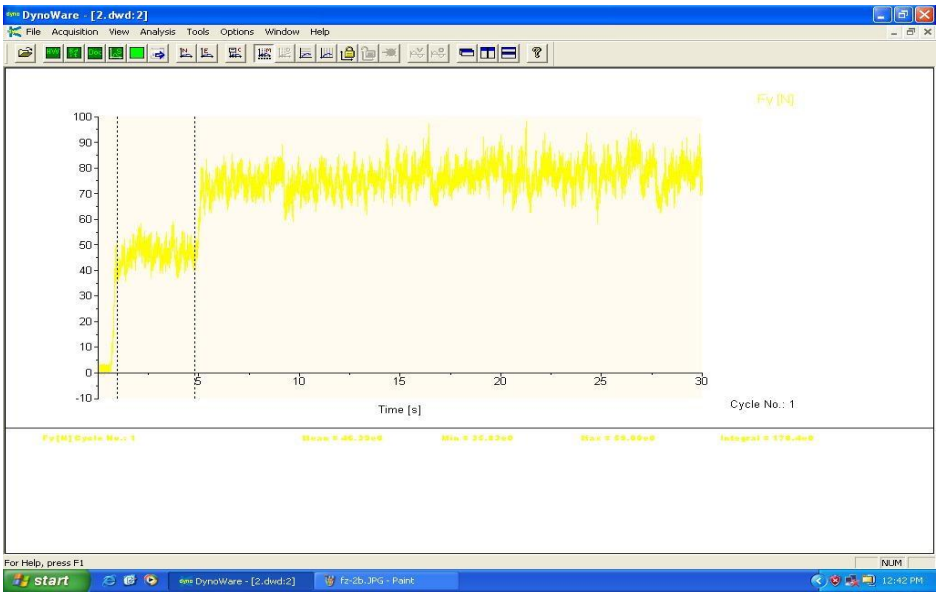

Figure-4: At First Point: Fy = 40.39 (N) at N = 325 rpm and f = 0.238 mm/rev.

Figure : 4 shows that the feed force (Fy) = 40.39 N has been recorded when turning is done on Aluminum bar by using the Double Point Cutting Tool at the speed of 325 rpm when feed is 0.238 mm/rev and depth of cut is 0.5 mm. This is the record for the first point of the double point cutting tool.

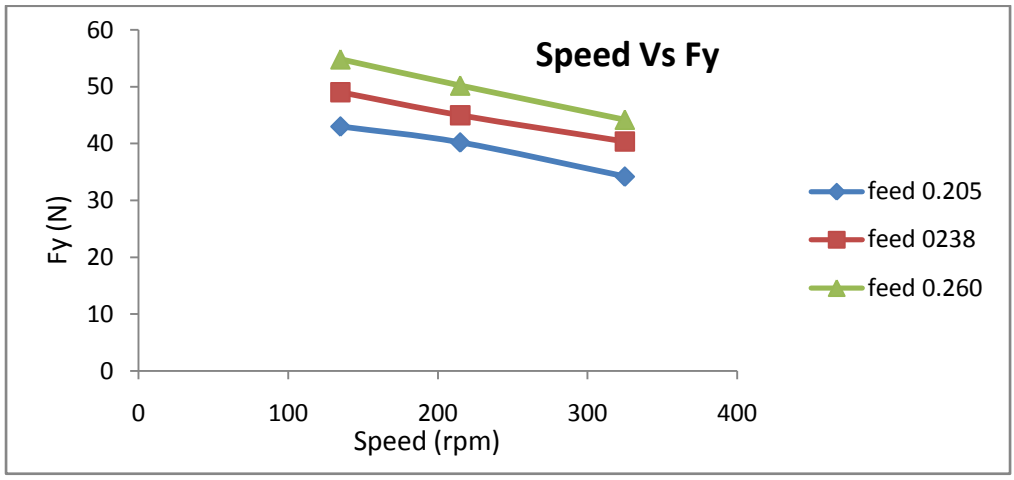

Figure-5: HSS Double Point Cutting Tool: First Point: Speed (rpm) Vs Fy (N).

The feed force is recorded as 43 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm . The feed force is recorded as 40.2 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm . The feed force is recorded as 34.2 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm. It is

observed that as the speed is increased the feed force decreases when feed and depth of cut are constants. Similarly the feed force is recorded as 49.05 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm . The feed force is recorded as 45 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm .The feed force is recorded as 40.39 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm . Here also it is observed that as the speed is increased the feed force decreases when feed and depth of cut are constants. Finally the feed force is recorded as 54.81 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm .The feed force is recorded as 50.2 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm . The feed force is recorded as 44.2 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm. On comparing the different speed by keeping the feed and depth of cut are constants it is stated that as the speed is increased the feed force decreases when turning is done by the first point of the double point cutting tool on Aluminum bar. Figure: 5 show the same.

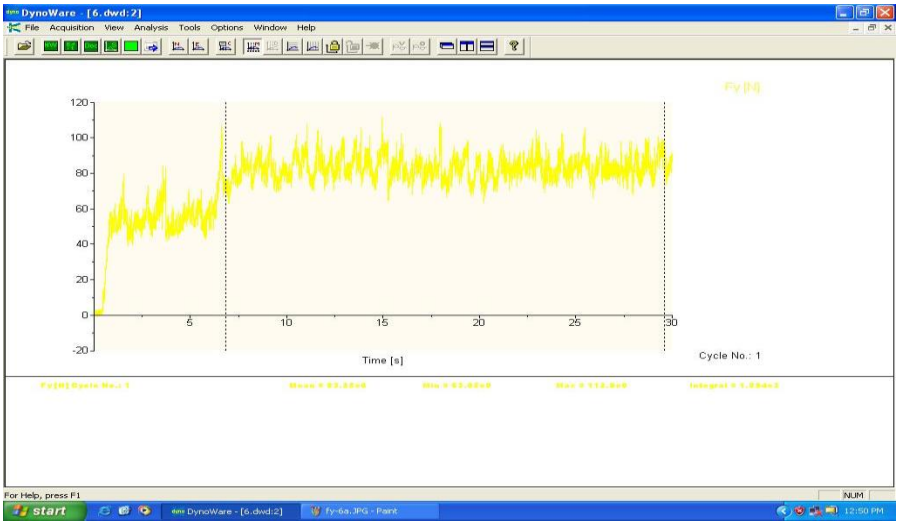

Figure-6: At Second Point: Fy = 83.25 (N) at N = 215 rpm and f = 0.260 mm/rev.

Figure : 6 shows that the feed force (Fy) = 83.25 N has been recorded when turning is done on Aluminum bar by using the Double Point Cutting Tool at the speed of 215 rpm when feed is 0.260 mm/rev and depth of cut is 0.5 mm. This is the record for the second point of the double point cutting tool.

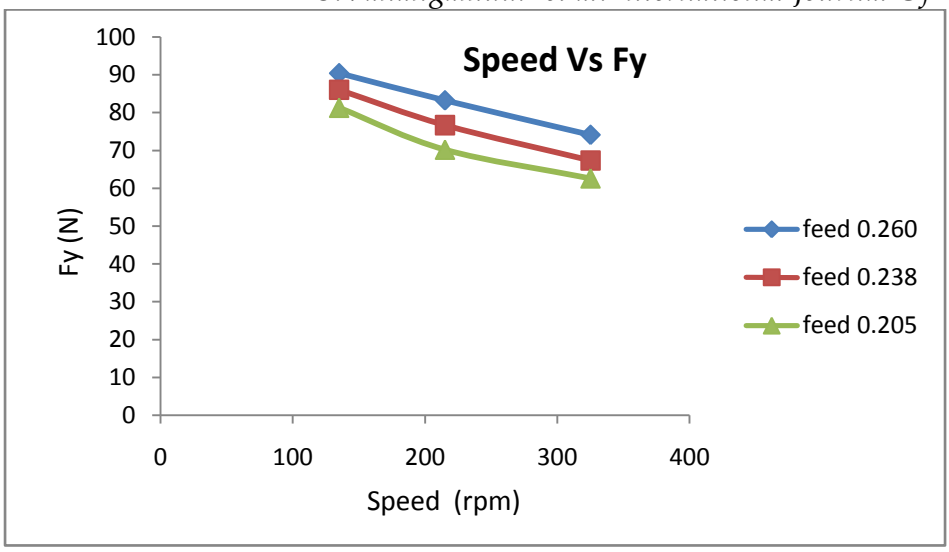

Figure-7: HSS Double Point Cutting Tool: Second Point: Speed (rpm) Vs Fy (N).

The feed force is recorded as 81.28 N when turning is being carried out on Aluminum bar by using the Double Point Cutting too at 135 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm . The feed force is recorded as 70.2 N when turning is being carried out on Aluminum bar by using the Double Point Cutting too at 215 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm . The feed force is recorded as 62.6 N when turning is being carried out on Aluminum bar by using the Double Point Cutting too at 325 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm . It is seen that as the speed is increase the feed force decreases when feed and depth of cut are constants. Similarly the feed force is recorded as 86.04 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm . The feed force is recorded as 76.7 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm .The feed force is recorded as 67.36 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm. Here also it is seen that as the speed is increased the feed force decreases when feed and depth of cut are constants. Finally the feed force is recorded as 90.42 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm .The feed force is recorded as 83.25 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm . The feed force is recorded as 74.15 N when turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.260 mm/rev feed

with depth of cut as 0.5mm . On comparing the different speed by keeping the feed and depth of cut are constants it is stated that as the speed is increased the feed force decreases when turning is done by the second point of the double point cutting tool on Aluminum bar. Figure: 7 shows the same.

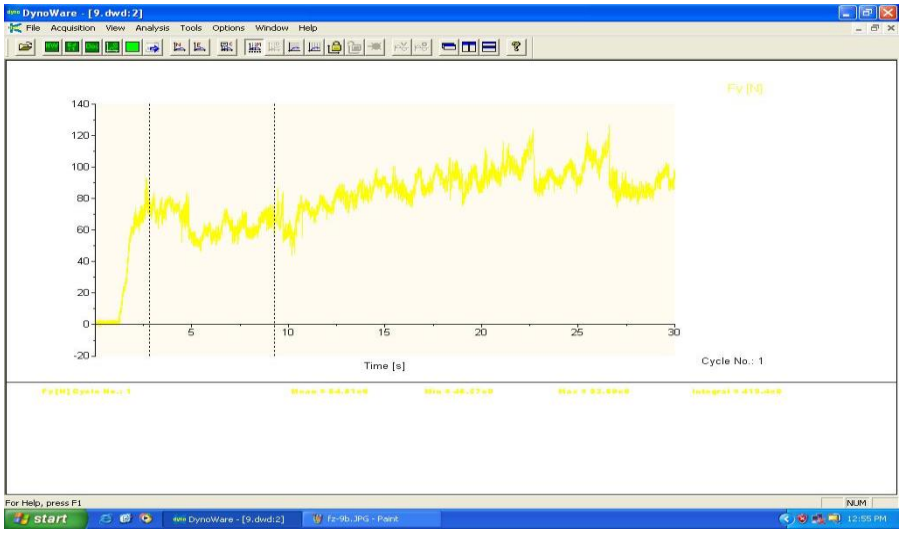

Figure-8: At First Point: Fy = 54.81 (N) at f = 0.260 mm/rev rpm and N = 135 rpm.

Figure : 8 shows that the feed force (Fy) = 54.81 N is recorded when turning is done on Aluminum bar by using the Double Point Cutting Tool at the feed of 0.260 mm/rev when the speed is 135 rpm and depth of cut is 0.5 mm. This is the record for the first point of the double point cutting tool.

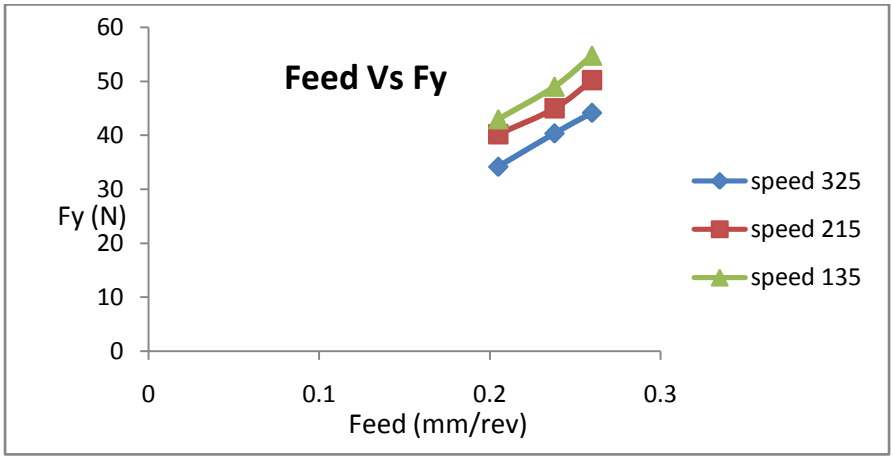

Figure-9: HSS Double Point cutting tool: First Point: Feed vs. Fy (N).

When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm , the feed force is recorded as 43 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm , the feed force is recorded as 49.05 N. When Turning is being carried out on Aluminum bar by using the Double

Point Cutting too at 135 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm , the feed force is recorded as 54.81 N. It is noted that as the feed rate is increased the feed force also increases when speed and depth of cut are constants. Similarly When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm , the feed force is recorded as 40.2 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting too at 215 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 45 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting to at 215 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 50.2 N. Here also It is observe that as the feed rate is increased the feed force also increases when speed and depth of cut are constants. Finally When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 34.2 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 40.39 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 44.2 N. With respect to 325 rpm speed It is noted that as the feed rate increases the feed force also increases when speed and depth of cut are constants. When turning is done by the first point of the double point cutting tool on Aluminum bar for various feed by keeping the speed and depth of cut are constants it is stated that as the feed rate is increased the feed force also increases. Figure : 9 shows the same.

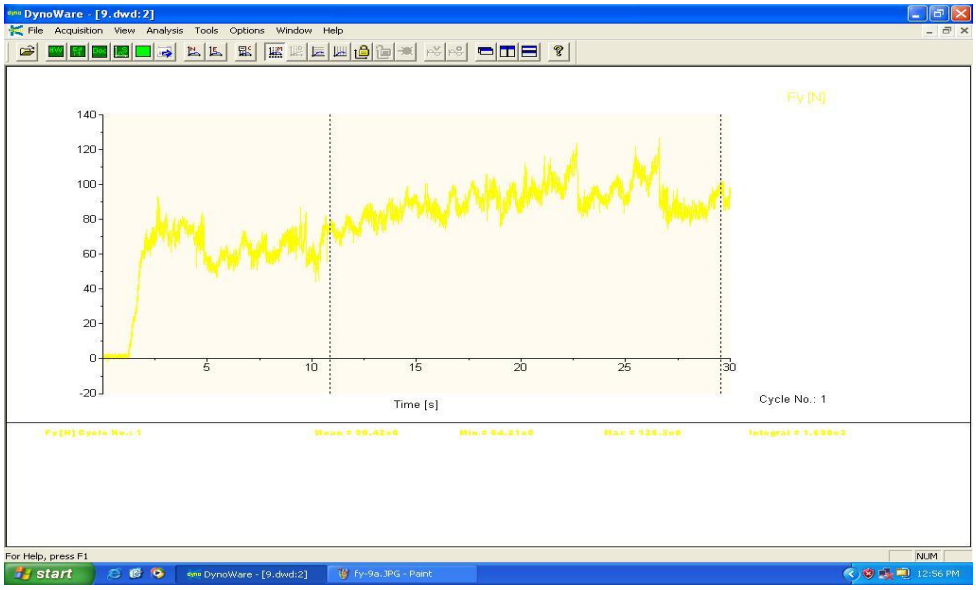

Figure 10: At Second Point: Fy = 90.42 (N) at f = 0.260 mm/rev rpm and N = 135 rpm.

Figure :10 shows that the feed force (Fy) = 90.42 N is recorded when turning is done on Aluminum bar by using the Double Point Cutting Tool at the feed of 0.260 mm/rev when the speed is 135 rpm and depth of cut is 0.5 mm. This is the record for the first point of the double point cutting tool.

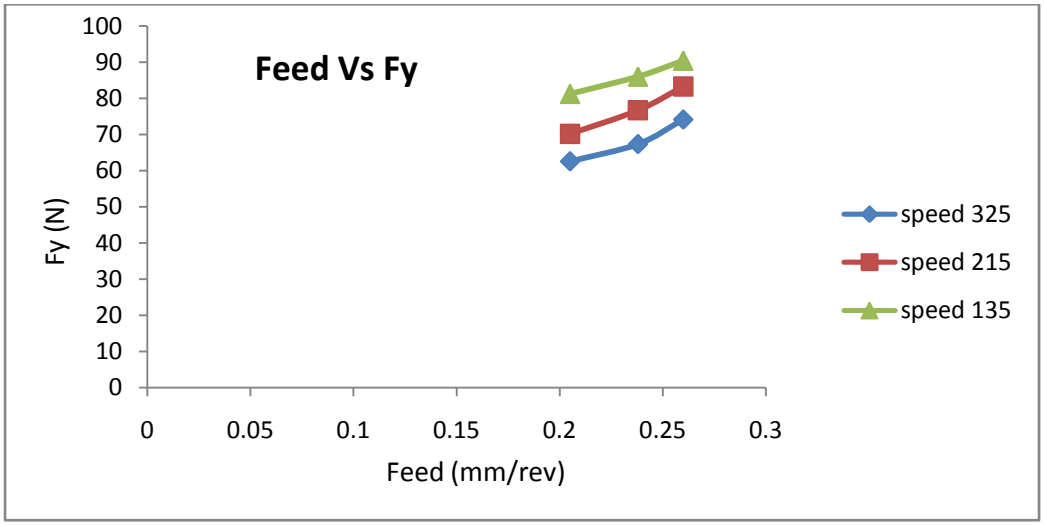

Figure 11: HSS Double Point cutting tool: Second Point: Feed vs. Fy (N).

When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm , the feed force is recorded as 81.28 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 86.04 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 135 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 90.42 N. It is observed that as the feed rate is increased the feed force also increases when speed and depth of cut are constants. Similarly When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm , the feed force is recorded as 70.2 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.238 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 76.7 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 215 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 83.25 N. Here also It is seen that as the feed rate is increased the feed force also increases when speed and depth of cut are constants. Finally When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.205 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 62.6 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.238 mm/rev

feed with depth of cut as 0.5mm, the feed force is recorded as 67.36 N. When Turning is being carried out on Aluminum bar by using the Double Point Cutting tool at 325 rpm speed and 0.260 mm/rev feed with depth of cut as 0.5mm, the feed force is recorded as 74.15 N. With respect to 325 rpm speed It is also observed that as the feed rate is increased the feed force also increases when speed and depth of cut are constants. When turning is done by the second point of the double point cutting tool on Aluminum bar for various feed by keeping the speed and depth of cut are constants it is stated that as the feed rate is increased the feed force also increases. Figure : 11 shows the same.

Conclusion

The implementation of the HSS double point cutting tool is more efficient and reliable which minimizes the total turning time effectively when compared to the single point cutting tool for turning Aluminum bar for different speed and feed rate. As the result it has been summarized as the speed is increased there is significant decrease in the feed force at first and second point of the HSS double point cutting tool when feed and depth of cut are constants. It is also concluded that as the feed rate is increased feed force also increases little bit at first and second point of the double point cutting tool when speed and depth of cut are constants.

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