International Journal of Research

International Journal of Research (IJR)

e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015
Available at http://internationaljournalofresearch.org

Improvement in Surface Quality with Different Material as Solid Lubricant in Turning on AISI 4340 Steel

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ABSTRACT

This report is mainly based on analysis of the use of different solid lubricant in place of liquid lubricant and improves the surface quality in turning in hardened steel surface. In this we include the testing of boric acid as a solid lubricant and to find how it is more effective and improves the surface quality in turning.This includes the short description of present, past, and future of improvement of surface quality in turning process. With the use of solid lubricant as boric acid and considering various parameters is been performed and result is obtained analyzing quality with the results of UNlubricated turned surface. We want to improve surface quality with different materials as solid lubricant for example Graphite, Boric acid in turning in AISI 4340 steel.

KEY WORDS: Boric Acid; D.C. Motor; AISI 4340 steel etc

1. INTRODUCTION

Reduction of environmental pollution has been the main concern in the present day manufacturing industry. Increasing pollution-preventing initiatives globally and consumer focus on environmentally conscious products has put increased pressure on industries to minimize the use of cutting fluids. It is reported that cutting fluids can pose serious problems, the major ones being those related to preservation of the environment, workers' health, etc. However, the use of lubricant cannot be swayed away in view of the high temperatures and forces generated during machining. The heat generated in machining adversely affects the quality of the products. As an alternative to the conventional cutting fluids, researchers experimented with biodegradable and cryogenic coolants, in order to reduce the heat generated in machining zone by reducing the coefficient of friction and tool wear. The effectiveness of cryogenic coolant seemed to increase at higher feeds. It reduced the magnitude of tensile residual stress for all materials, although to varying degrees, under all feed levels. This was attributed to the efficient cooling action, better modes of chip formation, less specific energy and finally, lower grinding zone temperature [1]**.**The concept of minimum quantity lubrication (MQL) was also employed as an alternative approach. A study has been carried out in the area of eco-friendly sustainable manufacturing using clean machining processes utilizing minimum quantity of lubricant such as MoS2 powder and grease based graphite mixed with water and SAE 20 oil in various proportions instead of flooding coolant. Advances in modern tri-biology have identified several solid lubricants, which are promising for sustaining and providing lubricant over a wide range of temperatures. Most of these lubricants, which include graphite, molybdenum disulphide, tungsten disulphide and calcium fluoride, belong to a special class of materials known as lamellar solids. Researchers investigated the use of graphite as a lubricating medium while grinding Sic to reduce the heat generated in the grinding zone. The tangential force component and hence, the specific energy requirement is found to be considerably reduced using graphite as a solid lubricant. The effective role of graphite as lubricant was evident from the overall improvement in the process. Researchers investigated the possibility of using graphite as a lubricating medium to reduce the heat generated in the grinding zone in surface applications. [5]

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1.1. BORIC ACID

In the present work, Boric Acid is used as solid lubricant during turning of AISI 4340 steel using HSS and carbide cutting tools. Boric Acid (H3BO3) is one of the most popular solid lubricant sand has excellent lubrication properties without calling for expensive disposal techniques.

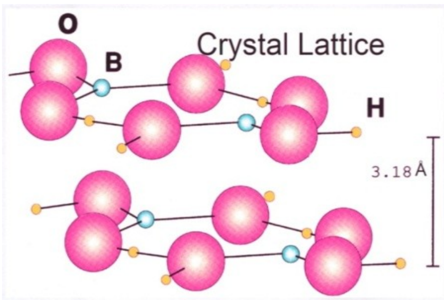
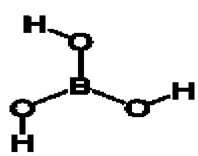


Fig 1.1 Crystal structure of Boric Acid

The most important characteristics of boric acid for use as a lubricant are that it is readily available and environmentally safe. The Environmental Protection Agency has established that boric acid is benign and the Clean Water Act doesnot classify it as a pollutant. Several studies related to the lubrication properties of boric acid are carried out over the past several decades.

1.1.1 Preparation of Boric Acid:

Boric acid may be prepared by reacting borax (sodium tetraboratedecahydrate) with



a mineral acid, such as hydrochloric acid:

$Na_2B_4O_7 \cdot 10H_2O + 2\ HCl \rightarrow 4\ B(OH)_3$ [or H_3BO_3] + $2\ NaCl + 5\ H_2O$

It is also formed as a by product of hydrolysis of boron trihalides and diborane:

$B_2H_6 + 6\ H_2O \rightarrow 2\ B(OH)_3 + 6\ H_2$

$BX_3 + 3\ H_2O \rightarrow B(OH)_3 + 3\ HX$ (X = Cl, Br, I)

1.1.2 Structure of Boric Acid:

Fig 1.2 Structure of Boric Acid

1.1.3 Properties of Boric Acid:

Boric acid is soluble in boiling water. When heated above 170 °C, it dehydrates, forming metaboric acid (HBO_2):

$$H_3BO_3 \rightarrow HBO_2 + H_2O$$

Metaboric acid is a white, cubic crystalline solid and is only slightly soluble in water. Metaboric acid melts at about 236 °C, and when heated above about 300 °C further dehydrates, forming tetraboricacid or pyroboricacid ($H_2B_4O_7$):

$$4\ HBO_2 \rightarrow H_2B_4O_7 + H_2O$$

The term boric acid may sometimes refer to any of these compounds. Further heating leads to boron trioxide.

$$H_2B_4O_7 \rightarrow 2\ B_2O_3 + H_2O$$

Boric acid does not dissociate in aqueous solution as a Bronsted acid, but is a Lewis acid which interacts with water molecules to form the tetra hydroxyl borate ion, as confirmed by Raman spectroscopy:

$B(OH)_3 + H_2O \rightleftharpoons B(OH)^-_4 + H^+$ (K_a =5.8x10^{-10} mol/l; pK_a = 9.24)

Polyborate anions are formed at pH 7–10 if the boron concentration is higher than about 0.025 mol/L. The best known of these is the tetra-borate ion, found in the mineral borax:

$4B(OH)^-_4 + 2H^+ \rightleftharpoons B_4O^{2-}_7 + 9\ H_2O$

Boric acid makes an important contribution to the absorption of low frequency sound in seawater.

1.2. TOOL USED (PLATINUM COATED CARBIDE TOOL)

Platinum (Pt) is a malleable, silvery white, noble metal widely but sparingly distributed over the Earth's crust. It is found mainly as the isotopes with atomic weights of 194, 195 and 196, with a Maximum oxidation state of +6, the oxidation states of +2 and +4 being the most stable. While the metal does not corrode in air at any temperature, it can be affected by halogens, cyanides, Sulfur, molten sulfur compounds, heavy metals and hydroxides.The chemistry of platinum compounds is dominated by the coordination complexes, hexachloroplatinic acid, potassium and ammonium tetrachloroplatinate, potassium, and sodium and ammonium hexachloroplatinate.[12]

1.2.1 Cutting Tool Properties

The cutting tool should have the following characteristics.

• High hardness
• High hardness temperature, hot hardness
• Resistance to abrasion, wear, chipping of the cutting edge.
• High toughness (impact strength)
• Strength to resist bulk deformation
• Good chemical stability

• Adequate thermal properties
• High elastic modulus (stiffness)

2. LITERATURE REVIEW

Mr.Nageswararaodamera, Mr.Vamis Krishna pasam accomplished a comparative performance analysis of the solid lubricant application with dry and wet machining process. Variation in cutting force, tool wear, tool temperature and surface roughness are studied under different machining condition. The result indicates that there is considerable improvement in the machining performance with Boric Acid assisted machining compared to dry and wet machining.[1]. Mr. L. B. Abhang, Mr. M. Hameedullah experimented on the optimal machining parameters for continuous profile machining are determined with respect to the minimum production time, subject to a set of practical constraints, cutting force, power and dimensional accuracy and surface finish. In this context, using minimum quantity of lubrication of Boric Acid mixed with base oil SAE 40 has proved to be a feasible alternative to conventional cutting fluid. In this context, 10% Boric Acid by weight mixed with base oil SAE 40 is used as a MQL in turning process. Variation in cutting force, cutting temperature, chip thickness, and surface roughness are studied under different machining condition.[2]. The low-friction characteristics of most dry lubricants are attributed to a layered structure on the molecular level with weak bonding between layers. Such layers are able to slide relative to each other with minimal applied force, thus giving them their low friction properties. However, a layered crystal structure alone is not necessarily sufficient for lubrication. In fact, there are also some solids with non-lamellar structures that function well as dry lubricants in some applications. These include certain soft metals (In, Pb, Ag, Sn), poly tetra fluro-ethylene, some solid oxides, rare-earth fluorides, and even diamond.[4]. S.M.Ali, and N.R.Dhar performed a project on tool wear and surface roughness prediction using a artificial neural network in turning steel under minimum quantity lubrication. Which deals with developing an artificial neural network model as a function of cutting parameter in turning steel under minimum quantity lubrication? A feed forward back propagation network with twenty five hidden neurons has been selected as optimum network.[5]. Mr. UmeshKhandey concluded that Quality and productivity play significant role in today's manufacturing market. From customers' viewpoint quality is very important because the extent of quality of the procured item (or product) influences the degree of satisfaction of the consumers during usage of the procured goods. Therefore, every manufacturing or production unit should concern about the quality of the product. Apart from quality, there exists another criterion, called productivity which is directly related to the profit level and also goodwill of the organization. The principal component, imposing highest accountability proportion, it has been treated as single objective function for optimization (multi-response performance index). Finally Taguchi method has been adapted to solve this optimization problem. The aforesaid methodology has been found fruitful in the cases where simultaneous optimization of huge number of responses is required [10]. Mr D. G. Thakur, B. Ramamoorthy, and L. Vijayaraghavan accomplished a project in which super alloy inconel 718 are regarded as extremely difficult-to-cut materials, and widely applied in modern industry because of their superior mechanical properties like heat and corrosion resistance. During machining these alloys, tool wears progress rapidly, because of high cutting temperature and strong adhesion between the tool and work material resulting from their low thermal conductivity and high reactivity. For this purpose a large amount of cutting fluid is flushed into the cutting zone to facilitate heat transfer from the cutting zone. But the cutting fluids have many detrimental effects. In the present paper an attempt has been made to show the effect of minimum quantity lubrication and optimization of its parameters as an alternative to the use of abundant cutting fluid for machining super alloy Inconel 718[11].

2.1 PROBLEM FORMULATION: NEED AND SIGNIFICANCE OF PROPOSED RESEARCH WORK

In metal cutting industry the use of coolant has become more problematic in terms of both employee health and environmental pollution. It is said that the use of coolant forms approximately 8-16% of the total production costs. Conventional cutting fluid is an environmental contaminant and the government has strict regulations limiting the dumping of cutting fluid water. Although the cutting fluid can be recycled, recycling services in the United State charge twice the purchasing price for disposal and the cost is four times as Mush in Europe. Conventional coolant also posses a health threat to the worker. Long term exposure to cutting fluid can cause dermatitis, a generic medical term that describes skin disorders ranging from an ugly rash to malignant cancer. In addition to environmental and health concerns, the metal cutting industry continues to investigate ways to achieve longer tool life, higher cutting speed, better work surface quality, less built up edge, easier chip breaking, lower production cost, overall quality and productivity. Although dry machining eliminates the use of cutting fluid, it negatively affects too life. In most cases, however, a lubricant free machining operation is acceptable only when it is possible to guarantee that the part quality and machining times will surpass or be equal to those achieved in flood coolant machining. To identify ways to simultaneously improve machining Technology and address environmental and health risks requires a technological innovation.[1]**.** As we know that Boric Acid (H3BO3) is one of the most popular solid lubricants and has excellent lubrication properties without calling for expensive disposal techniques. The most important characteristics of Boric Acid for use as a lubricant are that it is readily available in cheap and environmentally safe. Several studies related to the lubrication properties of Boric Acid are carried out over the past several decades. These works have primarily focused on the performance of Boric Acid in high temperature applications. The studies indicated that Boric Acid is unique layered inter-crystalline structure makes it a very promising solid lubricant material because of its relatively high load carrying capacity and low steady state friction coefficient (0.02). Another study focused on the use of Boric Acid as a lubricant in metal cutting process such as forming and drilling. In metal forming applications it is shown that the Boric Acid provided very low friction between an Aluminium work piece and a steel forming tool.[14]

Now we suggest that:-

1. Due to the use of solid lubricant uniform distribution of the lubricant is major problem on the work piece.
2. As the lubricant is in solid state instead of working as a good friction reluctant it is unable to absorb the heat produce during the turning process.
3. Boric Acid is hazardous to health a long term exposure to it can cause several problems.

3. EXPERIMENTAL SETUP

Number of variables affects the machining performance, the important parameters being the cutting conditions, tool geometry and type of lubricant. In this study lubricating condition is selected for experimental condition. Experiments are conducted under dry, wet and solid lubricant conditions to study the cutting forces, tool wear, tool temperature and surface roughness in turning. The experimental details are presented in Table 1. The experimental study was conducted using a NH-22 HMT lathe machine. A new experimental set-up was designed and developed for the supply of fine solid lubricant powder (Boric Acid) at the desired flow rate.

3.1 PREPARATION OF EXPERIMENTAL SETUP

For the preparation of experimental setup of uniform flow of solid lubricant (Boric acid), we have used following components which are listed below-

D.C. Motor(12 volt), Screw conveyor, Bevel hypoid gear, Wood of Teak, Nozzle, Adapter, Iron L-Bow, Hollow iron pipe, Ball bearing.

3.1.1 D.C. Motor (12 volt)

A **DC motor** is an electric motor that runs on direct current (DC) electricity. The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary magnets (permanent or electromagnets), and rotating electrical magnets.In any electric motor, operation is based on simple electro-magnetism. As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion. Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization,

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while green represents a magnet or winding with a "South" polarization).

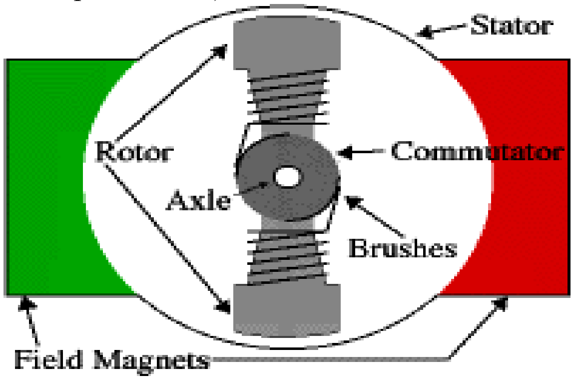

Fig 3.1 D.C. Motor

3.1.2 Screw Conveyor:

A screw conveyor or auger conveyor is a mechanism that uses a rotating helical screw blade, called a "flighting", usually within a tube, to move liquid or granular materials. They are used in many bulk handling industries. Screw conveyors in modern industry are often used horizontally or at a slight incline as an efficient way to move semi-solid materials, including food waste, wood chips, aggregates, cereal grains, animal feed, boiler ash, meat and bone meal, municipal solid waste, and many others. The first type of screw conveyor was the archimedian screw, used since ancient times to pump irrigation water. They usually consist of a trough or tube containing either a spiral blade coiled around a shaft, driven at one end and held at the other, or a shaft less spiral, driven at one end and free at the other. The rate of volume transfer is proportional to the rotation rate of the shaft. In industrial control applications the device is often used as a variable rate feeder by varying the rotation rate of the shaft to deliver a measured rate or quantity of material into a process. Screw conveyors can be operated with the flow of material inclined upward. When space allows, this is a very economical method of elevating and conveying. As the angle of inclination increases, the capacity of a given unit rapidly decreases. The rotating part of the conveyor is sometimes called simply an auger.

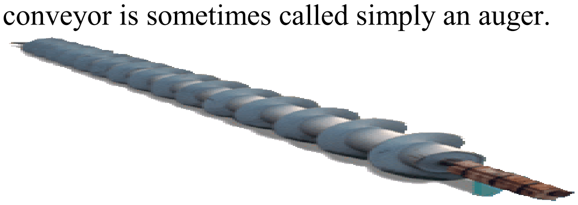

Fig 3.2 Screw Conveyor

3.1.3 Bevel Hypoid Gear:

A spiral bevel gear is a bevel gear with helical teeth. The main application of this is in a vehicle differential, where the direction of drive from the drive shaft must be turned 90 degrees to drive the wheels. The helical design produces less vibration and noise than conventional straight-cut or spur-cut gear with straight teeth. A hypoid is a type of spiral bevel gear whose axis does not intersect with the axis of the meshing gear. The shape of a hypoid gear is a revolved hyperboloid (that is, the pitch surface of the hypoid gear is a hyperbolic surface), whereas the shape of a spiral bevel gear is normally conical. The hypoid gear places the pinion off-axis to the crown wheel (ring gear) which allows the pinion to be larger in diameter and have more contact area. In hypoid gear design, the pinion and gear are practically always of opposite hand, and the spiral angle of the pinion is usually larger than that of the gear. The hypoid pinion is then larger in diameter than an equivalent bevel pinion.

Fig 3.3 Bevel Hypoid Gear

3.1.4 Wood of Teak:

Teak is found in tropical areas of the world. Thailand, Burma and India are just three countries. Teak is a natural wood, ideal for outside furniture. It contains natural oils that protect it against wet and cold weather. It can also be treated with teak oil giving it more protection against the elements. We have selected the wood of teak because the surface finish of this wood is much better than the other woods.

4. METHODOLOGY

4.1 SURFACE ROUGHNESS MEASUREMENT

The challenge of modern machining industries is mainly focused on the achievement of high quality, in terms of work piece dimensional accuracy, high surface finish, high production rate, less tool wear on the cutting tools, economy of machining in terms of cost saving and increase the performance of the

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e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015
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product with reduced environmental impact. Roughness of the machined surface is an important quality measure in metal cutting, and it is important to monitor and control during the machining operation. If the surface becomes too rough, the cutting tool has to be changed. There are several measurements that describe the roughness of a machined surface. One of the most common is the arithmetic average (AA) value usually known as Ra. So it is needed to measure the surface roughness.Inspection and assessment of surface roughness of machined work pieces can be carried out by means of different measurement techniques. These methods can be ranked into the following classes:

1. Direct measurement methods.
2. Comparison based techniques.
3. Non contact methods.
4. On-process measurement.

4.1.1 Direct measurement methods:

Direct methods assess surface finish by means of stylus type devices. Measurements are obtained using a stylus drawn along the surface to be measured. The stylus motion perpendicular to the surface is registered. This registered profile is then used to calculate the roughness parameters. This method requires interruption of the machine process, and the sharp diamond stylus can make micro-scratches on surfaces.

Stylus equipment*:*

- Basically, this technique uses a stylus that tracks small changes in surface height, and a skid that follows large changes in surface height. The use of the two together reduces the effects of non-flat surfaces on the surface roughness measurement.
- The actual apparatus uses the apparatus hooked to other instrumentation. The induction coils drive amplifiers, and other signal conditioning hardware.
- The paper chart that is recorded is magnified in height by 100000: 1, and in length by 82: 1 to make the scale suitable to the human eye.
- The datum that the stylus position should be compared to can be one of three,
  - Skid - can be used for regular frequency roughness.
  - Shoe - can be used for irregular frequency roughness.
  - Independent - can use an optical flat.

4.1.2 Comparison based techniques

Comparison techniques use specimens of surface roughness produced by the same process, material and machining parameters as the surface to be compared. Visual and tactile sensors are used to compare a specimen with a surface of known surface finish. Because of the subjective judgment involved, this method is useful for surface roughness Rq>1.6 micron.

4.1.3 Non contact methods:

There have been some works done to attempt to measure surface roughness using non contact technique. Here is an electronic speckle correlation method given as an example. When coherent light illuminates a rough surface, the diffracted waves from each point of the surface mutually interfere to form a pattern which appears as a grain pattern of bright and dark regions. The spatial statistical properties of this speckle image can be related to 39 the surface characteristics. The degree of correlation of two speckle patterns produced from the same surface by two different illumination beams can be used as a roughness parameter.

4.2. MACHINING OF HARD MATERIAL (AISI 4340 STEEL):

The present work deals with the turning of hard material such as AISI 4340 steel. It is an important engineering material employed in manufacturing of components in auto and aerospace industries. Since the present trend in the manufacturing industry is high speed dry machining, it was applied to evaluate the performance of coated tools in typical manufacturing processes.

4.3 WORK MATERIAL:

Solid bar of AISI 4340 steel with 33 mm diameter, 160mm long and of 45 HRC was used as work piece.

Fig 4.6 AISI 4340 steel bar before finishing

The chemical composition of AISI 4340 steel in percentage by weight:

C	Si	Mn	P	S	Cr	Ni	Mo	Fe
0.382	0.228	0.609	0.026	0.022	0.995	1.514	0.226	95.998

4.4 CUTTING TOOLS

We have used Platinum coated carbide tool manufactured by Sandvik.

Cutting Tool	Platinum coated Carbide- ISO US735 (ISO specification),
Tool Holder	PSDNN2525M 12(ISO specification)

4.4.1. EXPERIMENTAL CONDITION

Cutting tests were carried out on a Centre lathe machine under dry conditions.

Specification of the Lathe machine:		
Manufactured by	:	NANDA, Delhi
Power of the motor	:	2 HP
Centre height	:	11 inch
Length	:	72inch (6 ft)
Length of cross slide	:	14 inch
Range of spindle speed	:	28-500 rpm.

Turning experiments were carried out at three different spindle speeds which were 100 ,125,155,185 and 200 rpm and Feed rates were 1.55,1.45,1.37,1.31,1.27 ,mm/rev (*f*) and the approach angle(A*p)* were 55^o,65^o,75^o,85^o respectively throughout the experiments. The dry cutting conditions were kept constant for coated tools tested throughout the experiment.

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5. RESULT AND DISSCUSSION

5.1 MEASUREMENT OF SURFACE ROUGHNESS AT DIFFERENT SPINDLE SPEED, FEED RATE AND APPROACH ANGLE:

5.1.1 At approach angle 2^o

spindle speed(rpm)	feed rate(mm/rev)	run 1	run2	run3	run4	run5	run6
90	0.22	5.3	6.1	6.7	6.9	7.1	8.1
100	0.20	4.2	4.6	5.6	5.6	5.8	6.3
110	0.18	3.8	4.8	4.8	5.1	5.5	5.7
120	0.16	3.0	3.1	3.3	3.3	3.8	4.1
130	0.15	3.1	3.0	3.2	2.9	3.8	3.9

Table 5.1 At Approach Angle2^0

International Journal of Research

International Journal of Research (IJR)

e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015

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5.1.2 At Approach Angle 1.5^o

spindle speed(rpm)	feed rate(mm/rev)	run 1	run2	run3	run4	run5	run6
90	0.22	5.2	7.2	7.4	8.2	8.5	8.6
100	0.20	3.8	5.6	7.9	8.0	8.2	9.0
110	0.18	3.9	5.1	5.6	7.9	8.0	8.2
120	0.16	1.5	3.3	3.5	4.6	4.8	5.1
130	0.15	2.6	3.3	3.6	3.7	3.7	3.9

Table 5.2 at Approach Angle 1.5

5.1.3 At Approach Angle 1.0^o

spindle speed(rpm)	feed rate(mm/rev)	run 1	run2	run3	run4	run5	run6
90	0.22	3.9	4.1	6.7	6.8	7.6	8.6
100	0.20	3.7	3.9	4.1	6.4	6.4	7.6
110	0.18	3.8	4.8	4.8	5.0	5.2	5.7
120	0.16	1.6	3.4	3.8	4.7	4.9	5.1
130	0.15	2.4	3.1	3.2	3.4	3.6	3.9

Table 5.3 at approach angle $1.^o$

5.1.4 At Approach Angle 0.5^o

spindle speed(rpm)	feed rate(mm/rev)	run 1	run2	run3	run4	run5	run6
90	0.22	3.6	4.5	4.5	4.9	5.6	5.8
100	0.20	1.9	3.5	3.7	4.3	4.5	4.8
110	0.18	2.1	2.1	3.3	3.3	3.5	3.8
120	0.16	1.7	2.1	2.2	2.2	3.1	3.2
130	0.15	1.4	1.6	2.0	2.1	2.1	2.3

Table 5.4 at approach angle $0.5.^o$

5.2 MEAN VALUE OF SURFACE ROUGHNESS

S.NO.	Speed (rpm) *S*	Feed Rate (mm/rev) *F*	Surface Roughness -Ra (micron) Approach Angle - ap (degree)			
			0.5^o	1.0^0	1.5^0	2.0^0
1.	90	0.22	4.913	5.421	7.521	6.722
2.	100	0.20	3.721	5.312	6.812	5.353
3.	110	0.18	2.913	4.712	6.453	4.954
4.	120	0.16	2.732	4.252	3.814	3.433
5.	130	0.15	2.323	3.231	3.413	3.321

e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015
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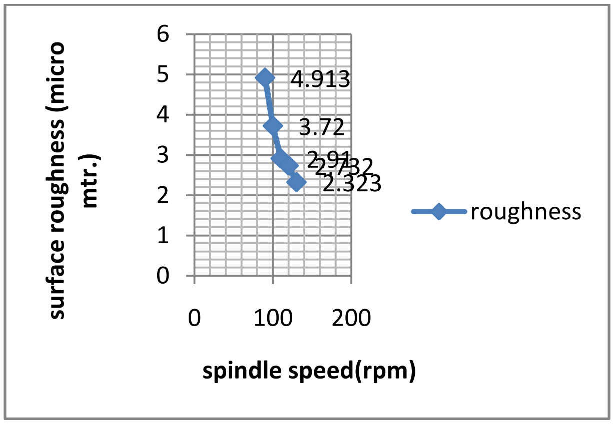
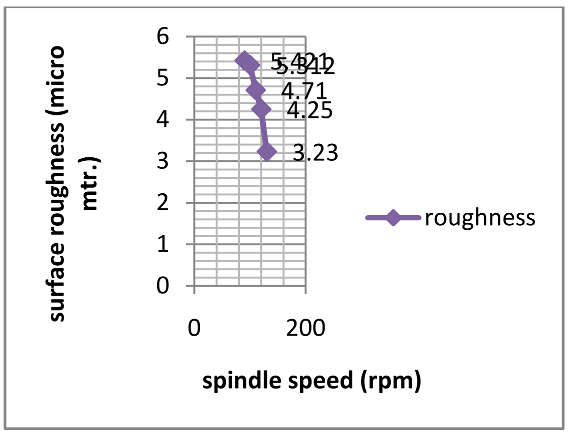
5.3 GRAPHICAL REPRESENTATION OF RESULT

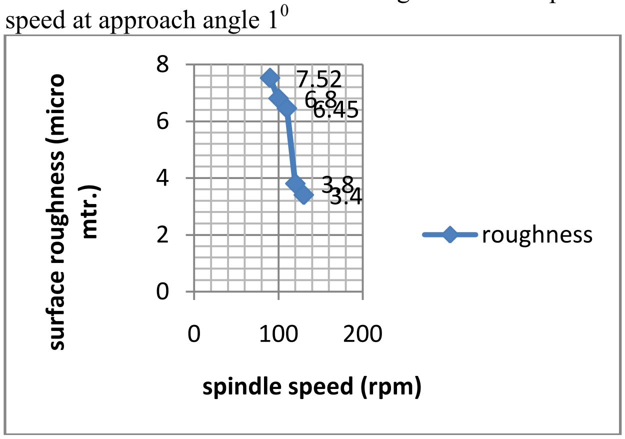
5.3.1 Variation with Spindle Speed:



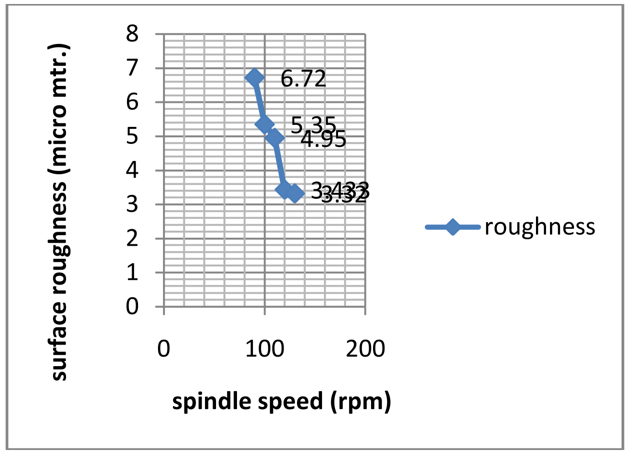
GRAPH 1:Variation of surface roughness with spindle speed at approach angle 0.5^0



GRAPH 2:Variation of surface roughness with spindle speed at approach angle 1^0

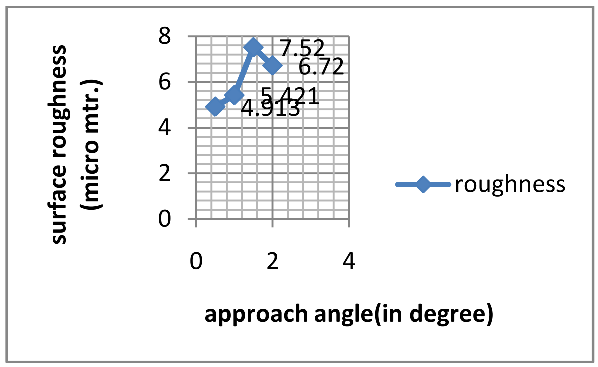


GRAPH 3:Variation of surface roughness with spindle speed at approach angle 1.5^0

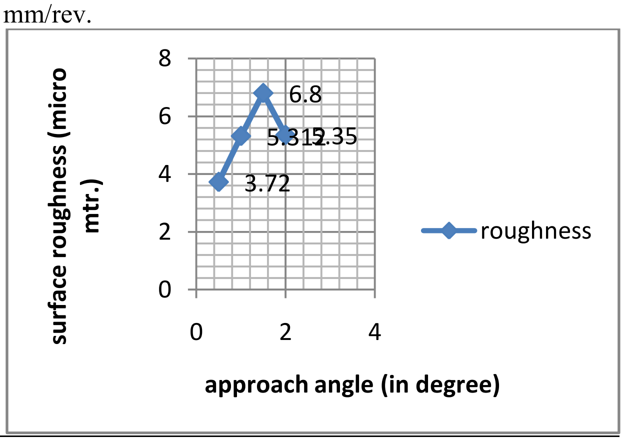


GRAPH 4:Variation of surface roughness with spindle speed at approach angle 2^0

5.3.2 Variation of Surface Roughness with Different Approach Angle

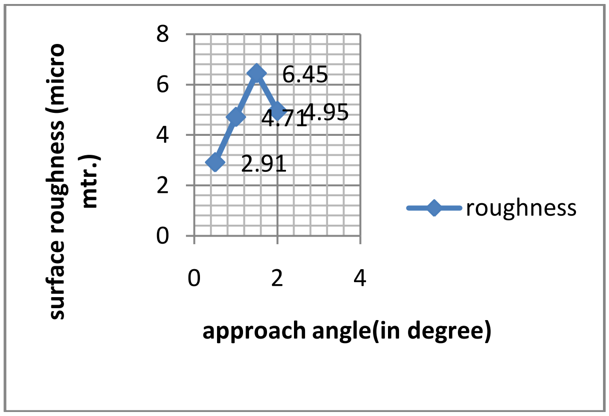


GRAPH 5:Variation of surface roughness with Approach Angle at spindle speed 90 rpm and Feed Rate 0.22 mm/rev.

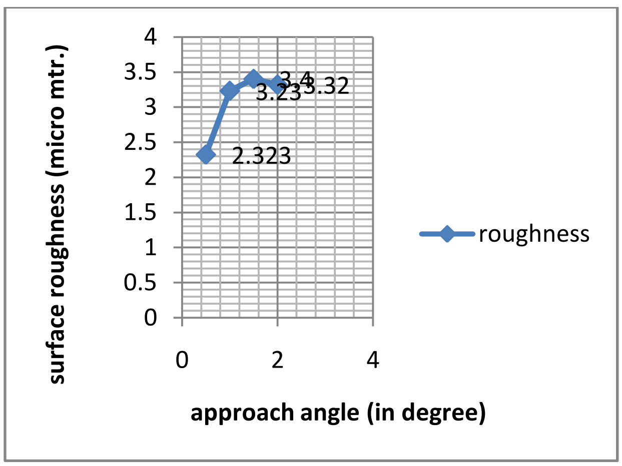


International Journal of Research
International Journal of Research (IJR)
e-ISSN: 2348-6848, p- ISSN: 2348-795X Volume 2, Issue 06, June 2015
Available at http://internationaljournalofresearch.org

GRAPH 6:Variation of surface roughness with Approach Angle at spindle speed 100 rpm and Feed Rate 0.2 mm/rev.



GRAPH 7:Variation of surface roughness with Approach Angle at spindle speed 110 rpm and Feed Rate 0.18 mm/rev.



GRAPH 8:Variation of surface roughness with Approach Angle at spindle speed 130 rpm and Feed Rate 0.15 mm/rev.

6. CONCLUSION AND FUTURE SCOPE

Graphical representation of surface roughness with spindle speed and approach angle is been done in above graphs. During the turning operation on AISI4340 Steel using platinum coated carbide tool we have taken three parameters approach angle, spindle speed and feed rate. The results show a wholesome variation in surface quality with respect to parameters considered. From the observation of graph1, graph2, graph3 and graph4 we concluded that surface quality is improving as we increase the spindle speed, in all the graphs optimum value of surface roughness is obtained at the maximum speed of 130 and least quality of surface roughness is at the low spindle speed of 90. From the observation of graph5, graph6, graph7 and graph8 we concluded that surface quality is degrading with the increase in approach angle the optimum value of surface quality is at the lowest approach angle that is at 0.5^0 and minimum quality of surface roughness is at 2^0 .With the increase in feed rate the surface roughness is getting decreased.

ACKNOWLEDGEMENT

I would like to thank God for not letting me down at the time of crisis and showing me the silver lining in the dark clouds and I wish to express my science profound gratitude to Dr.A.P.S GAURHead Of Department in Mechanical Engineering Department in BUNDELKHAND UNIVERSITY, JHANSI, whose supervision & guidance in this investigation has been carried out, without whose guidance and constant supervision. It is not possible for me to complete this research paper successfully.

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