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CHAPTER1 INTRODUCTION 1.1 Generation of heat in metal cutting In the metal cutting process, the tool performs the cutting action by overcoming the shear strength of the work piece material. This generates a large amount of heat in the work piece resulting in a highly localized thermo-mechanically coupled deformation in the shear zone.

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During machining, heat is generated at the i) Primary deformation zone due to shear and plastic deformation, ii)

Chip-tool interface due to secondary deformation and sliding, iii) Work-tool interface due to rubbing.

All such heat sources produce the maximum temperature at the chip-tool interface. The portion of heat generated at the chip-tool interface which flows into the tool, causes very high temperatures at the cutting edge. Fig 1.1 and fig 1.2 shows the heat generation zones in the metal cutting process.

Fig 1.1 Heat generation zones.

μ=coefficient of friction , Ø=shear angle

Fig 1.2 heating zones. 1.2 Effect of temperature on cutting tool The possible detrimental effects of high cutting temperatures on cutting tool are Rapid tool wear which reduces tool life • Rapid tool wear which reduces tool life • Plastic deformation of the cutting edges if the tool material is not enough hot-hard and hot-strong. • Thermal flaking and fracturing of the cutting edges due to thermal shocks. • Built up edge formation 1.3 Effect of temperature on job • . Dimensional inaccuracy of the job due to thermal distortions and expansion and contraction during and after machining. • Surface damage by oxidation ,rapid corrosion,burning etc. • Inducing of tensile residual stresses and micro cracks at the surface,sub-surfaces 1.4 Cooling techniques for reduction of cutting temperatures Various factors affecting cutting temperatures are 1)Work piece and tool material. 2) Cutting conditions. 3) Cutting fluid . 4) Tool geometry. To reduce

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cutting temperatures many researchers have attempted several cooling techniques to cool the machining zone.

Fig 1.3 Various cooling techniques.

1.5Conventional cooling The general method of controlling high cutting zone temperature is by employing flood cooling by soluble oil. Conventional cooling is not that effective, as the bulk chip-tool contact under high cutting velocity and feed prevents the fluid from entering the chip-tool interface.The chip-tool interface penetration can be achieved by the high-pressure jet of soluble oil, and this could reduce the cutting temperature and improve the

tool life to some extent. The

application of conventional cutting fluids creates several techno environmental problems

such as: •

Environmental pollution due to chemical dissociation of the cutting fluid at high cutting temperature. •

Biological (dermatological) problems to operators coming inphysical contact with cutting fluid. • Water pollution and soil contamination during disposal. •

Requirement of extra floor space and additional systems for pumping, storage, filtration, recycling, chilling, etc. Conventional coolants are the major source of pollution from the machining industry, and their disposal cost is also increasing due to strict environmental regulations. Therefore, handling and disposal of cutting fluids must follow rigid rules of environmental protection.

1.6

Dry machining/near-dry machining

Dry machining refers to the use of a lubrication system that uses compressed air instead of a traditional coolant or oil cooling system. The air-oil mixture can reach the machined material through a small nozzle.Dry and near-dry techniques have been developed for sustainability interventions in machining. These techniques not only take care of sustainability and make the machining green, but also improve productivity and surface quality. 1.7 Surface texturing of cutting tools

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Various studies showed that textured cutting tools improved the tribological properties and reduced cutting forces, temperature, and tool wear. Surface texturing can be seen as a futuristic design to improve the performance of the cutting tool and to increase productivity.

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Manufacturing industries drives constantly for productivity improvements and cost saving.

With advancement in

technology, manufacturing industry is developing new techniques to attain more sustainability while machining. Recent research in metal cutting shows that by application of controlled surface texture over rake face and flank face of cutting tool has potential to reduce cutting forces, cutting temperature, friction co-efficeint, and tool wear.Also surface textures has ability to enhance tribological performance of sliding surface. 1.8

CNC CNC means Computer Numerical Control. This means a computer converts the design produced by Computer Aided Design software (CAD), into numbers. The numbers can be considered to be the coordinates of a graph and they control the movement of the cutter.Computer numerical control (CNC) is a method for automating control of machine tools through the use of software embedded in a microcomputer attached to the tool.Milling machines, lathes, routers, grinders and lasers are common machine tools whose operations can be automated with CNC.

Fig 1.4 CNC machine.

CNC machining is a manufacturing process in which pre-programmed computer software dictates the movement of factory tools and machinery. The process can be used to control a range of complex machinery, from grinders and lathes to mills and routers. 1.9Measurement of surface rougness Measurement of surface roughness is done on the work piece after the job is completed by using talysurf surface roughness measuring instrument

Talysurf is used to measure the surface roughness by using an electronic principle, this surface meter consist of stylus and skid type instrument used for measuring the surface of the give product.

Fig 1.7 working of talysurf instrument

This type of talysurf surface meter contains an Electronic means which is exact and high accurate than different types of surface meter.The measuring head consist of sharply pointed diamond stylus on it. in talysurf surface meter stylus has a very small radius of 0.002 mm tip and with the help of motor present in it helps to move the skid on the surface. In this instrument, the stylus point out's the profile of the surface and any deflections of a stylus is converted into electric current to identify the measurements of the object.It consist of stamping above the armature which consist of coils on both the sides of stamping, this coils helps to forms an oscillator. In this surface meter the armature present on the stamping is in fixed position when this fixed armature causes any vibrations of stylus it produces an air gap by this the current passing from a coil get changed due to this changes in the amplitude of current the output gets to demodulate due to this discontinuous current passing the measurement of surface is given by an electronic system present in it.

1.10 Tools Tool is an instrument used to do some operations by manually or with machines likes CNC. Types of tools:

Fig 1.8 single point and multipoint tools 1. Single point cutting tool. The tool which is having only one edge (or) side to cut the material surface. EX: Shaping tool, Turning tool, Slotting tool. 2. Multipoint cutting tool. The tool which is having more than one edge to cut the surface of the material. EX: Milling, Drilling and Grinding tool.

In the experiment we have used the tool material as Tungsten carbide (WC). Tungsten carbide is a compound made from rare tungsten metal and equal number of carbon atoms. Tungsten carbide is harder material than the precious materials like Gold and Platinum. It is high density and have high melting point of 2600 °C. It has high hardness and thermal conductivity. High quality Tungsten carbide mixed with nickel binder is chemically inert and will not oxidize with oxygen (O2).

Fig 1.9Textured Tungsten carbide tool Tungsten carbide PROPERTIES: 1. Density : 11900 kg/m3 2. Young's modulus : 534Gpa 3. Poission ratio : 0.22 4. Thermal conductivity : 50 W/m°C. 5. Specific heat : 400 J/kg°C. 1.12 Tools used in lathe: 1. Turning tool. a. Rough turning tool. b. Finish turning tool. 2. Chamfering tool. 3. Thread cutting tool. 4. Internal thread cutting tool. 5. Facing tool. 6. Grooving tool. 7. Forming tool. 8. Boring tool. 9. Parting-off tool. 10. Counter boring tool. 11. Under cutting tool.

1.12 TURNING: Turning is a machining process in which a cutting tool, typically a non-rotary tool bit. TYPES OF TURNING: 1. Roughing, or rough turning. 2. Parting aluminium. 3. Finish turning. 4. Turning. 5. Facing. 6. External grooving. 7. Face grooving. 8. Knurling. CNC TURNING: A good CNC lathe with the right cutting tool can also achieve a surface Ra of 0.4. Although equal in absolute value to that of milling, the surface texture will nonetheless have a different pattern of more closely spaced scratches, which will give it the appearance of being much "smoother". This is very important to consider when specifying an Ra value – every process has its own special mark that it leaves on the work piece, and they can look and feel very different. 1.13

CUTTING TOOL:

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A cutting tool is any tool that is used to remove metal from the work piece by means of deformation.

Formulas used to calculate the turning operations. CUTTING SPEED: The speed at which the metal is removed by the tool from the work piece. Cutting speed=π*d*s/1000 (m/min) Where d=diameter of the work in mm. n= r.p.m of the work.

FEED: The feeds of the cutting tool in the lathe work are the distance the tool advances for each revolution of the work. Feed is expressed in mm/revolution. Feed rate α 1/Cutting speed. Feed rate α Surface roughness. Feed depends upon the factors such as size, shape, strength and method of holding the component. Depth of cut: The depth of cut is the perpendicular distance measured from the machined surface to depth of cut = d1-d2 Where d1=diameter of the work piece before machining. . d2= diameter of the machined surface. Ratio of the depth of cut to the fees varies from 10:1 Machine time:The machining time in the lathe work can be calculated for a particular operation if the speed of the job, feed and length of the job is known. If "S" is the feed of the job per revolution expressed in mm per revolution and "L" the length of the job in mm, then a number of revolutions of the job required for a complete cut will be L/S (min) the uncut surface of the work piece. The depth of cut is as follows: D

1.14Average cutting speed expressed in m. per minute for different operations in a lathe using a H.S.S tool: MATEIAL TURNING CAST IRON 15-19 MILD STEEL 25-31 BRASS 60-90 ALLUMINIUM 120 1.15 CUTTING SPEED, SPEED AND DEPTH OF CUT FOR DIFFERENT MATERIALS: MATERIAL H.S.S STELLITE CEMENTED CARBIDE FEED RATE (mm/rev) Depth of cut (mm) CAST IRON 15-19 30 63 0.2 to 0.8 0.5 to 1 for finishing operation MILD STEEL 25-31 55 810 0.2 to 0.8 2 to 5 for roughing operation BRASS 60-90 120 180 0.2 to 0.8 ALLUMINIUM 120 300 360 0.2 to 0.8

1.16LASER TEXTURE MACHINE:

The machine used to make textures on the tool. The rays coming from the laser with intensity will fall on the tool and then textures are formed on the tool. By this the tool will attain the strength more than the un-textured tool. It resists against the tool wearing.

Fig 1.12 Laser texture machine. 1.19 TYPES OF LASERS: 1. Helium Neon Laser. 2. Argon, Krypton, and Xenon Ion Lasers. 3. Carbon Dioxide Laser. 4. NDYAG Laser Systems. 5. Excimer Lasers. 6. Semiconductor Diode Lasers.

Chapter-2 Literature review Machinability of 17-4 PH SS material lacks low productivity due to the poor surface quality as well as the formation of more built-up-edge (BUE) on the tool. This results in increase of the number of cutting tools required lead high manufacturing cost. Metal cutting industries are looking for higher production rate while machining 17-4 PH SS material due to the wide range of applications like aerospace, automotive and medical industries for severe chemical environments. Especially aerospace industry pay much attention in the usage of this material in different aerospace components as well as aircraft fittings. Aerospace components include bushings, shafts and cryogenic vessels (Xavior and Adithan, 2009). But higher cutting temperature at the machining zone is the main obstruction for the performance improvement while turning of 17-4 PH SS due to its gratifying properties like low thermal conductivity and high strength. One way of reducing the machining zone temperature is the application of conventional coolants. In the present scenario,metal cutting industries started the shift from usage of conventional coolants to surface textured tool due to the beneficial effect from the health and environmental point of view. In the recent times, researchers carried out the experimental study on various difficult to cut materials with different textured tools. Liu et al. (Liu et al., 2017) made different surface textured designs (parallel to cutting edge, perpendicular to cutting edge and 45o inclined to cutting edge) on the flank face of the tungsten carbide tool and studied its effect on tool wear and surface roughness during dry turning of green alumina ceramics. Experimental results reveal that surface texture parallel to the main cutting edge has significantly reduced the tool wear when compared to other designs as well as nontextured tools due to the more storage of alumina chip powder in the textured groves. Also, it has been found that surface textured tools have shown an insignificant effect on surface roughness compared to nontextured tools. Sugihara et al. (Sugihara, Nishimoto and Enomoto, 2017) compared the tool wear of polycrystalline cubic boron nitride (CBN) with and without surface texture on the flank face of the tool while high speed machining of Inconel 718 alloy under without coolant condition. In their study, different micro groove designs like grooves parallel to the cutting edge, grooves orthogonal to the cutting edge and grooves orthogonal to the cutting edge set back from cutting edge have been made on the flank face of the tool. From experimental result, they found that surface textured tools significantly reduced the tool wear over the nontextured tools because of effective control of wear mechanisms namely cutting edge chipping and adhesion wear. They claimed that machining of Inconel 718 material with CBN tool having grooves orthogonal to the cutting edge set back from cutting edge is a promising technique to improve the turning performance. Feng et al. (Materials et al., 2017) performed experiments on a dry cutting of 45 steel material and evaluated the turning machinability indices in term of tool wear, cutting force and cutting temperature with different textured and nontextured tool designs. Texture designs considered in their work are longitudinal and transverse directions to the chip flow. Graphite grains were utilized into the textured grooves while carrying out experimentation. Experimental results revealed that greater performance was found with transverse texture designs over other texture design. Also, carried out finite element modeling simulation and found accurate results when compared to the experimental results. Kumar and Patel (Kumar and Patel, 2018) observed enhanced machining performance with the inclined surface textures on the rake face of the Al2O3/TiCN composite ceramic cutting tools over surface textures with parallel and perpendicular to the chip flow direction during dry turning of AISI 52100 steel material. The explanation given to these beneficial results are due to the reduction of friction which is resulting from more chip curling effect. Su et al. (Su et al., 2017) observed superior tribological properties with surface texture on the rake face of the PVD tool parallel to the cutting edge over nontextured tools during dry cutting of Ti6Al4V titanium alloy. The reason given to obtain the superior result is

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due to the significant reduction in tool-chip contact length.

Orra and Choudhury (Orra and Choudhury, 2018) experimental study have been carried out to compare the turning performance during machining of AISI 4340 steel material using fabricated tools having horizontal, vertical and elliptical shape microtextures on the rake face with and without MoS2 solid lubricants and nontextured tools. They achieved superior results in terms of cutting force, cutting temperature, tool wear and friction coefficient with textured tools over nontextured tools. Also, it was found that vertically textured tools give paramount performance over the other texture tools. Thomas and Kalaichelvan (Thomas and Kalaichelvan, 2018) found a significant reduction in cutting temperature, surface roughness, cutting force with dimples

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on the rake face of the tool over nondimple tools during turning of mild steel (EN3B) and aluminum (AA 6351).

Also, observed favorable chip formation with tools having dimples. Few researchers made comparative studies with different surface texture design tools while machining of various difficult to cut materials and found beneficial results with all designs of textured tools over the nontextured tools. They also carried out simulation studies with different textured tools and results were compared with experimental results [9–11]. Literature study revealed that turning process performance significantly vary depends on the type of surface texture design tool. Few works of literature are available with textured tools impregnated with and without solid lubricants during machining of a different kind of difficult to cut materials. In the present study, a novel approach is suggested. As discussed in the literature, 17-4 PH SS material has many industrial applications even in the severe chemical environments due to their superior chemical as well as mechanical properties. Hence, to enhance the machinabilty of 17-4 PH SS, the proposed new approach consists of supply of coolant using conventional method on the rake face of the tool having different surface textured designs during turning of 17-4 PH SS and results were compared with dry cutting cooling environment respectively. Objective of the present work To compare the tool wear and surface roughness using a developed texture tool under dry and conventional cooling

Chapter 3 EXPERIMENTAL PROCEDURE 3.1 TOOL MATERIAL (TUNGSTEN CARBIDE) Tungsten carbide (chemical formula: WC) is a chemical compound (specifically, a carbide) containing equal parts of tungsten and carbon atoms. In its most basic form, tungsten carbide is a fine gray powder, but it can be pressed and formed into shapes through a process called sintering for use in industrial machinery, cutting tools, abrasives, armor-piercing rounds, other tools and instruments, and jewelry. 3.2WORK PIECE MATERIAL (17-4PH SS) 17-4 PH Stainless Steel is a martensitic precipitation-hardening stainless steel that provides an outstanding combination of high strength, good corrosion resistance, good mechanical properties at temperatures up to 600 °F (316 °C), good toughness in both base metal and welds, and short-time, low-temperature heat. 3.3 LASER CUTTING PROCEDURE Laser cutting is a technology that uses a laser to slice materials. While typically used for industrial manufacturing applications, it is also starting to be used by schools, small businesses, and hobbyists. Laser cutting works by directing the output of a high-power laser most commonly through optics. The laser optics and CNC (computer numerical control) are used to direct the material or the laser beam generated. A commercial laser for cutting materials involved a motion control system to follow a CNC or G-code of the pattern to be cut onto the material. The focused laser beam is directed at the material, which then either melts, burns, vaporizes away, or is blown away by a jet of gas,[1] leaving an edge with a high-quality surface finish. Industrial laser cutters are used to cut flat-sheet material as well as structural and piping materials.

Fig 3.1 Laser cutting machine. 3.4 CNC TURNING OPERATION PROCEDURE

Fig 3.2 CNC machine. 3.5 FEED RATE

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The phrase speeds and feeds or feeds and speeds refers to two separate velocities in machine tool practice, cutting speed and feed rate. They are often considered as a pair because of their combined effect on the cutting process.

Each, however, can also be considered and analyzed in its own right

Fig 3.3 Feed rate.

3.6 CUTTING SPEED

Cutting speed is defined as the speed

at which the work moves with respect to the tool (usually measured in feet per minute). Feed rate is defined as the distance the tool travels during one revolution of the part. Cutting speed and feed determines the surface finish, power requirements, and material removal rate.

Fig 3.4 Cutting speed.

3.7DEPTH OF CUT Depth of cut is the thickness of metal that is removed during machining. The perpendicular distance measured between the machined surface and the uncut surface of the workpiece is taken.

Fig 3.5 Optical microscope. 1. Connect your light microscope to an outlet. 2. Rotate the revolving nosepiece to the lowest power objective lens. 3. Place a glass cover or coverslip over your specimen. 4. Mount your specimen onto the stage using its metal clips. 5. Rotate the focus knob/coarse adjustment knob until the objective lens hovers over the slide. 3.9 TALYSURF EXPERIMENTAL PROCEDURE . TAYLOR-HOBSON TALYSURF: This instrument uses electronics for magnification of the stylus movement and for analysis of the profile. ... When the stylus changes its position, the air gap is varied and the current flowing through the armature coils are modulated. This is fed to the amplifier and further recorded for analysis.

Fig 3.6 Talysurf instrument. 1. Connect Ac adopter to the measuring instrument & Switch on the power supply 2. Attach the drive detector unit & connect to all the cable connection as shown when mounting the detector to the drive unit, take care not to apply excessive force to the drive unit. 3. Adjust or modify the measurement condition such as sample length, number samples, Standard required for the measuremen 4. Calibrate the instrument using standard calibration piece 5. Carefully place the detector on the work piece. Care should be taken to see that work piece & detector are aligned properly 6. Press the start button to measure the work piece & result are displaced on the console

CHAPTER 4 Results and discussion: 4.1 Effects of textures on tool rake wear:

Fig 4.1 Rake wear at cutting velocity 100m/min at a)conventional cooling and b)dry cutting. From the previous reasearch and experiments it is proven that if the cutting speed increases then automatically cutting temperatures also increases which resulted in tool wear. From the above fig 4.1 it is clearly observe that at less cutting speed rake wear is less compared to high cutting speed.And rake wear is less in conventional cooling compared to dry cutting. The below fig 4.2(a) shows conventional cutting and fig 4.3(b) shows dry cutting are experimental proofs for the rake wear at various cutting speeds. Usage of coolant and hybride textures on tools surface reduces the tool wear to maximum extent. When compared to dry cutting ,in conventional cutting rake wear is reduced 10-14%. When the coolant is supplied on to

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the rake face the texture surface supplies it towards machining zone and contribute to reduce heat and chip contact length resulting in low temperatures thus low tool wear.

The linear grooves and circular holes stores the coolant and serves continuously towards the machine zone which results in low rake wear.

Fig :4.2 Tool rake wear observed

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at

cutting velocity of 100

m/min,

feed rate of 0.15mm/rev

and depth of

cut of 0.2 mm (

a) Conventional cooling (b) Dry cutting.

Figure :4.3 Tool rake wear observed

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at

cutting velocity of 60

m/min,

feed rate of 0.15 mm/rev

and depth of

cut of 0.2 mm (

a) Conventional cooling (b) Dry cutting. In the above figures white color region represents the tool wear and BUE(Build up edge) represents the sticked workpiece material due to high temperature and high speed is shown in fig4.2(b) affected the texture design.In conventional cooling contact between chip and rakeface is less due to force pumpimg of coolant which thrown away the chip from workpiece ,where as in dry cutting contact between chip and rakeface is high which makes more wear on rake face.Lack of coolant supply the edge is chipping out in dry cutting and it affected the texture desing on rake face is shown in fig4.3(b) and this effect is less on fig4.3(a) due to the usage of coolant.

4.2Effects of textures on tool Flank wear:

4.4 Rake wear at cutting velocity 100m/min at a)conventional cooling and b)drycutting. From the above fig4.21 it is clearly observed that at less cutting speed flankwear is less compared to high cutting speed.And flankwear is less in conventional cooling compared to dry cutting. The below figure 4.5(a),4.5(b) shows conventional cutting and 4.6(a),4.6(b) shows dry cutting are experimental proofs for the flank wear at various cutting speeds. Usage of coolant and hybride textures on tools surface reduces the tool wear to maximum extent. When compared to dry cutting ,in conventional cutting flank wear is reduced 8-16%.

Figure :4.5

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Tool flank wear observed

at

cutting velocity of 100

m/min,

feed rate of 0.15 mm/rev

and depth of

cut of 0.2 mm (

a) Conventional cooling (b) Dry cutting.

Figure :4.6

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Tool flank wear observed

at

cutting velocity of 60

m/min,

feed rate of 0.15 mm/rev

and depth of

cut of 0.2 mm (

a) Conventional cooling (b) Dry cutting. In the above figures white color region represents the flank wear and BUE(Build up edge) represents the sticked workpiece material due to high temperature and high speed is shown in fig4.5(b),4.6(b) affected the texture design.In conventional cooling contact between chip and flank face is less due to force pumpimg of coolant which thrown away the chip from workpiece ,where as in dry cutting contact between chip and flank is high which makes more wear on flank face.Lack of coolant supply the edge is chipping out in dry cutting and it affected the texture desing on flank face is shown in fig4.5 (b),4.6(b) and this effect is less on fig4.5(a),4.6(b) due to the usage of coolant.

4.3 Surface Roughness:

4.7 Cutting speed vs surface roughness (Ra, Rq and Rz values). Where Ra is Average roughness Rq is Root mean square roughness Rz is Average maximum height roughness From the above figure 4.7 it is clearly observed that surface roughness is less in conventional cutting compared to dry cutting and surface roughness increases as cutting speed increases. At 60 m/min cutting speed: surface roughness in conventional cutting is reduced to 35-40% compared to dry cutting.At 100 m/min cutting speed: surface roughness in conventional cutting is reduced to 25-30% compared to dry cutting.From the figure it is clearly observed that, As the cutting speed increases surface roughness also increases.

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CHAPTER 5 CONCLUSIONS From the observed results following conclusions were drawn. 1) Experimental results showed that

conventional cutting is more efficient when compared to dry cutting. 2) Textured tools increases the turning performance when compared to un textured tools.

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Future scope:Further studies can be carried out with varying hybrid texture tool designs to evaluate its performance while turning of 17-

PH-stainless steel. conventional cooling cutting conditions respectively during machining of 17-4 PH SS material.

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During machining, heat is generated at the i) Primary deformation zone due to shear and plastic deformation, ii) Chip-tool interface due to secondary deformation and sliding, iii) Work-tool interface due to rubbing. All such heat sources produce the maximum temperature at the chip-tool interface. The portion of heat generated at the chip-tool interface which flows into the tool, causes very high temperatures at the cutting edge. Fig 1.1 and fig 1.2 shows the heat generation zones in the metal cutting process. Fig 1.1 Heat generation zones.	During machining, heat is generated at the i) primary deformation zone due to shear and plastic deformation, ii) chip-tool interface due to secondary deformation and sliding, and iii) work-tool interface due to rubbing. All such heat sources produce the maximum temperature at the chip-tool interface. The portion of heat generated at the chip-tool interface which flows into the tool, causes very high temperatures at the cutting edge. Figure 1.1 shows the heat generation zones in the metal cutting process. Figure 1.11 Regions of heat generation zones

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cutting temperatures many researchers have attempted several cooling techniques to cool the machining zone.

Fig 1.3 Various cooling techniques.

1.5Conventional cooling The general method of controlling high cutting zone temperature is by employing flood cooling by soluble oil. Conventional cooling is not that effective, as the bulk chip-tool contact under high cutting velocity and feed prevents the fluid from entering the chip-tool interface.The chip-tool interface penetration can be achieved by the high-pressure jet of soluble oil, and this could reduce the cutting temperature and improve the

tool life to some extent. The

application of conventional cutting fluids creates several techno environmental problems

such as: •

Environmental pollution due to chemical dissociation of the cutting fluid at high cutting temperature. •

Biological (dermatological) problems to operators coming inphysical contact with cutting fluid. • Water pollution and soil contamination during disposal. •

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CUTTING TEMPERATURES Many researchers have attempted several cooling techniques to cool the machining zone temperatures as shown in Figure 1.2.

Figure 1. 2 Different cooling techniques to reduce heat generation in metal cutting. 1.4.1 Conventional cooling In industry, the general method of controlling high cutting zone temperature is by employing flood cooling by soluble oil. Conventional cooling is not that effective, as the bulk chip-tool contact under high cutting velocity and feed prevents the fluid from entering the chip-tool interface, where the temperature is maximum (Shaw, 1984). The chip-tool interface penetration can be achieved by the high-pressure jet of soluble oil, and this could reduce the cutting temperature and improve the tool life to some extent. The application of conventional cutting fluids creates several techno-environmental problems such as: 1. Environmental pollution due to chemical dissociation/break up of the cutting fluid at high cutting temperature. 2. Biological (dermatological) problems to operators coming inphysical contact with cutting fluid. 3. Water pollution and soil contamination during disposal. 4. Requirement of extra floor space and additional systems for pumping, storage, filtration, recycling, chilling, etc. Conventional coolants are the major source of pollution from the machining industry, and their

Requirement of extra floor space and additional systems for pumping, storage, filtration, recycling, chilling, etc. Conventional coolants are the major source of pollution from the machining industry, and their disposal cost is also increasing due to strict environmental regulations. Therefore, handling and disposal of cutting fluids must follow rigid rules of environmental protection.

1.6

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6 100%

due to the significant reduction in tool-chip contact length.

6: M.GURU PRASAD-M.TECH-MECH-EVALUATION OF HYBRID TEXTURE TOOL PERFORMANCE IN TURNING OF INCONEL718 MATERIAL-A COMPARATIVE STUDY-31-05-19.docx 100%

due to the significant reduction in tool -chip contact length.

7 60%

on the rake face of the tool over nondimple tools during turning of mild steel (EN3B) and aluminum (AA 6351).

7: M.GURU PRASAD-M.TECH-MECH-EVALUATION OF HYBRID TEXTURE TOOL PERFORMANCE IN TURNING OF INCONEL718 MATERIAL-A COMPARATIVE STUDY-31-05-19.docx 60%

on the rake face of the single point HSS tool and carried out machinability studies during dry turning of mild steel (EN3B) and aluminum (AA 6351)

9 62%	9: M.GURU PRASAD-M.TECH-MECH-EVALUATION OF HYBRID TEXTURE TOOL PERFORMANCE IN TURNING OF INCONEL718 MATERIAL-A COMPARATIVE STUDY-31-05-19.docx 62%
the rake face the texture surface supplies it towards machining zone and contribute to reduce heat and chip contact length resulting in low temperatures thus low tool wear.	the rake face of the tool, texture surface serves in stock up coolant, supplies to the machining zone incessantly and contribute to reduce heat and tool-chip contact length at the machining zone resulting in low cutting zone temperatures thus low tool wear.

14 100%	14: M.GURU PRASAD-M.TECH-MECH-EVALUATION OF HYBRID TEXTURE TOOL PERFORMANCE IN TURNING OF INCONEL718 MATERIAL-A COMPARATIVE STUDY-31-05-19.docx 100%
CHAPTER 5 CONCLUSIONS From the observed results following conclusions were drawn. 1) Experimental results showed that	CHAPTER-5 CONCLUSIONS From the observed results following conclusions were drawn. • Experimental results showed that

15 100%	15: M.GURU PRASAD-M.TECH-MECH-EVALUATION OF HYBRID TEXTURE TOOL PERFORMANCE IN TURNING OF INCONEL718 MATERIAL-A COMPARATIVE STUDY-31-05-19.docx 100%
Future scope:Further studies can be carried out with varying hybrid texture tool designs to evaluate its performance while turning of 17-	Future scope: Further studies can be carried out with varying hybrid texture tool designs to evaluate its performance while turning of

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8 81%

The phrase speeds and feeds or feeds and speeds refers to two separate velocities in machine tool practice, cutting speed and feed rate. They are often considered as a pair because of their combined effect on the cutting process.

Each, however, can also be considered and analyzed in its own right

Fig 3.3 Feed rate.

3.6 CUTTING SPEED

Cutting speed is defined as the speed

8: https://en.wikipedia.org/wiki/Speeds_and_feeds 81%

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Cutting speed (also called surface speed or simply speed) is the speed

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4 89%

Manufacturing industries drives constantly for productivity improvements and cost saving.

With advancement in

technology, manufacturing industry is developing new techniques to attain more sustainability while machining. Recent research in metal cutting shows that by application of controlled surface texture over rake face and flank face of cutting tool has potential to reduce cutting forces, cutting temperature, friction co-efficeint, and tool wear.Also surface textures has ability to enhance tribological performance of sliding surface. 1.8

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Various studies showed that textured cutting tools improved the tribological properties and reduced cutting forces, temperature, and tool wear. Surface texturing can be seen as a futuristic design to improve the performance of the cutting tool and to increase productivity.

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5 82%	5: https://enacademic.com/dic.nsf/enwiki/1626520 82%
A cutting tool is any tool that is used to remove metal from the work piece by means of deformation.	a cutting tool, is any tool that is used to remove metal from the workpiece by means of shear deformation.

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10 97%	10: bbd646a1-17c9-442a-b5c8-4b8a21c834e6 97%
at cutting velocity of 100 m/min, feed rate of 0.15mm/rev and depth of cut of 0.2 mm (	at the cutting velocity of 33.75 m/min, feed rate of 0.143 mm/rev and depth of cut of 1 mm

11 97%	11: bbd646a1-17c9-442a-b5c8-4b8a21c834e6 97%
at cutting velocity of 60 m/min, feed rate of 0.15 mm/rev and depth of cut of 0.2 mm (	at the cutting velocity of 33.75 m/min, feed rate of 0.143 mm/rev and depth of cut of 1 mm

12 85%

Tool flank wear observed

at

cutting velocity of 100

m/min,

feed rate of 0.15 mm/rev

and depth of

cut of 0.2 mm (

12: bbd646a1-17c9-442a-b5c8-4b8a21c834e6 85%

tool flank wear at cutting velocity 188.4 m/min, feed rate of 0.143 mm/rev and depth of cut of 1 mm

13 85%

Tool flank wear observed

at

cutting velocity of 60

m/min,

feed rate of 0.15 mm/rev

and depth of

13: bbd646a1-17c9-442a-b5c8-4b8a21c834e6 85%

tool flank wear at cutting velocity 188.4 m/min, feed rate of 0.143 mm/rev and depth of cut of 1 mm cut of 0.2 mm (