Tool characteristics for better performance in machining
ohns steel using coated tungsten carbide tool inserts

Shivakumara C. M1, Srikantappa. A. S2, Adaveesha. B3
1Cauvery institute of Technology, Mandya, Karnataka State, India
2Principal, Cauvery Institute of Technology, Mandya, Karnataka, India
3Visvesvaraya Technological University, Belagavi, Karnataka, India

Abstract— Turning Process is a significant machining process in which TiAlN covered tipped cutting tool inserts additions expel material from the outside of a pivoting round and hollow work piece. Machining of Oil Hardened Non Shrinking (OHNS) Steel is a challenge for production engineers in tool industry. In this examination paper, an investigation on turning OHNS Steel utilizing tungsten carbide instrument additions is made by shifting profundity of cut, feed rate and cutting rate each in turn and keeping other two consistent. The effect on process parameters like surface finish, material removal rate, tool wear, cutting force, thrust force and temperature distribution on tool tip are discussed.

1. Introduction
Makers center around the surface completion and item dimensional precision during the assembling. Early scientists have attempted to decrease wear pace of hardware by choosing Cutting Speed, profundity of cut and feed are the chosen information parameters for turning AISI 4140 STEEL and surface harshness is the yield reaction parameter [1].

Panda and Dutta, et al have contemplated on enhancement of feed power through setting of ideal estimation of procedure parameters in particular cutting pace, feed rate and profundity of cut in turning of EN-31 steel with TiN covered tungsten carbide embeds [4]. The creators have utilized Taguchi's parameter structure [3] and presumed that the impact of cutting rate and combine are critical parameters to limit device wear and harshness in turning AISI D3 utilizing TiAlN, covered carbide instruments [6-7]. The AlTiN-covered device demonstrated a self-versatile conduct to improves frictional conditions and, subsequently, wear opposition during machining [8]. Dr. Srikantappa.A.S has examined execution assessment of wire EDM process in cutting OHNS kick the bucket steel [9].

From the writing review it saw that much research work has not been done on turning of OHNS kick the bucket steel and advancement of machining conditions. In this present research work investigations have been completed with a target of deciding ideal machining conditions for turning OHNS pass on steel utilizing TiAlN covered tungsten carbide cutting instrument embeds.

The authors of this paper have made an attempt to determine the machining characteristics suitable to obtain required characteristics for OHNS (AISI-4140,E24,31 and AISI D3 ) steel. In modern industry multi point cutting tool inserts are widely used for machining operation in general and turning operation in particular. In this present research work Tungsten carbide tipped tool inserts were used for cutting work material.

2. Experimentation
Machining tests are performed under dry cutting conditions by shifting profundity of cut, cutting rate and feed rate on OHNS Steel utilizing tungsten carbide TiAlN covered tipped and jewel molded apparatus embeds. The impact of these parameters on surface unpleasantness of work material, apparatus wear, material expulsion and cutting power and temperature appropriation are broke down.

Figure 1 shows the experimental setup used to conduct machining tests on OHNS Steel using diamond shaped TiAlN coated tipped tool inserts. Lathe tool dynamometer with transducer setup for the measurement of Cutting force and thrust force thermocouple setup for temperature measurement attached to the tool tip is fitted on the lathe to conduct the turning experiments.
OHNS- Oil Hardened Non Shrinking Die Steel is used as the work material for conducting the turning experiments. We have used 32mm diameter 300mm length bars to conduct turning experiments under different machining conditions such as depth of cut, feed rate and cutting speed.

The analyses are led by differing the machining parameters, for example, speed, feed and profundity of cut for turning of OHNS bite the dust steel and the procedure parameter like material removal rate surface finish, tool wear, tool temperature are determined as follows.

- Forces acting on the cutting tool inserts are recorded with the help of lathe tool dynamometer.
- Surface finish is measured using Perthometer.
- Tool wear viz flank wear is measured using tool maker’s microscope.
- The material removal rate (MRR) is found out by dividing the weight of metal removed by machining time.
- Tool tip temperature is measured using thermocouple setup.

3. Results and Discussion

The experimental results obtained are plotted and analysed.

Machining processes generate a wide variety of irregularities on the surface of work piece. These irregularities are in the form of finely spaced marking (pattern) left by the cutting tool on the work piece surface. In simple words, the finish obtained on the work piece surface after machining is not perfectly smooth. The term surface finish, or texture or surface roughness is used to indicate the local deviations of a work surface from the perfectly flat ideal face. The Perhometer used to measure the surface finish of the work material after turning. The surface finish is measured in microns.

From Figure 2. gives the variety of surface completion with expanded profundity of cut for various feed rate conditions at the cutting velocity of 11.10m/min. surface completion is increments with increment inside and out of cut at higher feed rate. Surface unpleasantness is diminishes with increment inside and out of cut at lower feed rate. Surface unpleasantness is diminishes with increment inside and out of cut at moderate feed.

Figure 3 gives the variety of surface completion with expanded profundity of cut for various feed rate conditions at the cutting velocity of 15.58m/min. Surface unpleasantness is increments with increment top to bottom of cut at higher feed rate. Surface harshness is bit by bit increments with increment top to bottom of cut at lower feed rate. Surface unpleasantness is diminishes with increment inside and out of cut at moderate feed rate.

Figure 4 gives the variety of surface completion with expanded profundity of cut for various feed rate conditions at the cutting pace of 19.47m/min. Surface completion is diminishes with increment inside and out of cut at higher feed rate.
Surface unpleasantness is bit by bit diminishes with increment inside and out of cut at lower feed rate. Surface unpleasantness is increments with increments with increment inside and out of cut at moderate feed rate.

![Surface Roughness v/s Depth of Cut](image)

**Fig. 3.** Variation of surface roughness by varying depth of cut of cutting speed 15.58m/min.

Figure 5 gives the variety of material expulsion rate increment top to bottom of cut for various feed rate conditions at the cutting rate of 19.47m/min. Material evacuation rate is diminishes with increment top to bottom of cut at higher feed rate. Material evacuation rate is bit by bit diminishes with increment inside and out of at lower feed rate. Material evacuation rate is increments with increment inside and out of cut at moderate feed rate.

The material removal rate is estimated by account the heaviness of the work material when machining as for time. Gauging scale analyzes masses by adjusting the weight because of the mass of an article against the heaviness of at least one known masses.

The weight of the work piece is measured before the machining and after the machining, the weight is noted. Similarly, for different trails the weight is measured.

The increase in material removal affects on the surface obtained on the turned work surface and the flank wear of the coated tungsten carbide tipped tool insert used for turning OHNS Steel. In turning operation, the physical contact between the tool tip and the work piece causes friction and generation of temperature in the interface. This will effect on the properties of the work material and results in nonlinear behavior of the material in turning.

![Surface Roughness v/s Depth of Cut](image)

**Fig. 4.** Variation of material removal rate by varying depth of cut at speed of 19.47m/min.

Figure 6 gives the assortment of equipment wear by augmentation start to finish of cut for different feed rate conditions at the cutting pace of 11.10m/min. Instrument wear is decreases with augmentation through and through of cut at higher feed rate. Gadget wear is relentlessly reduces with augmentation through and through of cut at lower feed rate. Gadget wear is additions with augmentation through and through of cut at moderate feed rate.
Figure 7 gives the variety of hardware wear by increment inside and out of cut for various feed rate conditions at the cutting pace of 15.58m/min. Device wear diminishes with increment inside and out of cut at higher feed rate. Instrument wears increments with increment inside and out of cut at lower feed rate. Apparatus wears diminishes with increment top to bottom of cut at moderate feed rate.

In our trial we have utilized apparatus producer’s magnifying lens to gauge the flank wear of the covered Tungsten Carbide Tool embeds. The turning of the OHNS Work material prompts wear on flank side of covered tungsten carbide device embeds. So as to quantify the length of the flank wear the device creator's magnifying lens an adaptable instrument that measure by optical methods with no weight being included, along these lines valuable for estimation on little and fragile parts.
The resultant cutting power following up on the device tip might be settled into three parts, they are Feed power acting in even plane, yet toward the path inverse to the feed, at that point push power acting toward the path opposite to the produced surfaces, and primary power called cutting power acting toward the fundamental cutting movement. The biggest in size to the vertical power which in turning is around 2 or multiple times bigger than push power and from 4 to multiple times bigger than the feed power. The power following up on the chip in symmetrical cutting is shear power which follows up on shear plane. It is the protection from the shear of metal in shaping the chip, typical power is ordinary to the shear plane. This is the reinforcement power on the chip given by the work piece and Frictional obstruction of the instrument acting descending against the movement of the chip as it moves upwards along the apparatus power.

Figure 8 gives the variety of cutting power by increment top to bottom of cut for various feed rate conditions at the cutting velocity of 11.10m/min. Cutting power is step by step increments with expanding top to bottom of cut at higher feed rate. Cutting power step by step increments with expanding inside and out of cut at lower feed rate. Cutting power is increments with expanding top to bottom of cut at moderate feed rate.

Figure 9 gives the variety of cutting power by increment top to bottom of cut for various feed rate conditions at the cutting velocity of 19.47m/min. Cutting power is diminishes with increment top to bottom of cut at higher feed rate. Cutting power is diminishes with increment inside and out of cut at lower feed rate. Cutting power is increments with increment inside and out of cut at moderate feed rate.

Figure 10 gives the variety of Temperature by varying depth of cut at 11.10m/min.
The Tool-Work thermocouple was utilized to gauge the temperature at the cutting purpose of the apparatus. The goal of this test was to think about the temperature produced during machining at covered tungsten carbide cutting instrument. The machining tests were directed by fluctuating the cutting pace, profundity of cut and feed rate. In this test, turning addition and work piece were protected from the machine by utilizing holders.

Thermocouples are self-controlled and require no outside type of excitation. The primary restriction with thermocouples is exactness; framework blunders of short of what one degree Celsius (°c). The changing temperature of the instrument additions is perused by associating the thermocouple.

A digital thermocouple instrument is used to measure the tool tip temperature during turning operation. A wire from the instrument is connected to the tip of the coated Tungsten carbide tool insert. The temperature rises in the tool during turning operation is recorded for different machining conditions and analyzed.

Figure 10 gives the variety of temperature increment inside and out of cut for various feed rate conditions at the cutting rate of 11.10m/min. Temperature is increments with increment inside and out of cut at higher feed rate. Temperature is step by step increments with increment inside and out of cut at lower feed rate. Temperature is bit by bit diminishes with increment inside and out of cut at moderate feed rate.

Figure 11 gives the variety of temperature increment top to bottom of cut for various feed rate conditions at the cutting rate of 19.47m/min. Temperature diminishes with increment inside and out of cut. Temperature slowly diminishes with increment inside and out of cut at lower feed rate. Temperature is increments with increment top to bottom of cut at moderate feed rate.

4. Conclusion
- The accompanying ends are produced using the assessment of the exploratory outcomes.
- The surface completion improves with increment inside and out of cut and stays same at higher profundity of cut conditions. The surface completion quality will be great with increment in cutting pace.
- The material evacuation rate increments step by step at lower profundity of cut conditions yet increments quickly at higher profundity of cut conditions. The expansion in feed rate will expand the material expulsion rate.
- The temperature at the apparatus tip increments with increment top to bottom of cut and feed rate conditions. The pace of temperature raise is least at higher cutting pace conditions.
- The flank wear of the tungsten carbide tipped apparatus increments with increment inside and out of cut. The pace of flank wear will be lower at higher feed rate conditions. The device wear rate will be least at higher cutting pace condition.
- The cutting power applied on the device tip increments with increment top to bottom of cut. The pace of increment in cutting power increments with expanded feed rate at higher profundity of cut conditions.
- The push power increments with increment top to bottom of cut at lower cutting rate conditions however stays consistent at higher cutting rate conditions. The pace of push power increments with expanded feed rate.
- For better surface completion with higher material expulsion and lower apparatus wear the machining conditions can be gotten from the careful examination of the exploratory outcomes plotted.
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