ANALYSIS OF TOOL WEAR DURING DRY AND WET TURNING RESEARCH METHODOLOGY

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ABSTRACT

This thesis was proposed to study and analyze the surface properties of mild steel and tool life during dry, water, oil and mixture of oil and water cooling during turning on the lathe. The tool life and surface properties (surface roughness) of mild steel during turning with mixture of oil and water cooling found very good. In this process order to tackle a multi-objective optimization problem which seeks identification of the best process condition or parametric combination for the manufacturing processes, dry and wet turning, In the present experiment investigation on straight turning of mild-steel bar by using HSS tool. This experiment has aimed to evaluate best manufacturing process which could satisfy both productivity as well as quality with special focus on reduction of cutting tool wear. Because reduction in tool wear ensures increase in tool life. The experimental analysis showed that surface properties of mild steel improved when wet turning (mixture of oil and water) was carried out.

1. INTRODUCTION

Productivity and quality of machined parts are the main challenges of metal cutting industries. Turning is mostly used process among all the machining processes. The growing demands for high productivity and quality of turned parts in terms of surface finish and less time for machining need use of high cutting velocity [22].Manufacturing industries faces problems of dimensional inaccuracy, short tool life & surface quality problem during machining. There are several techniques which are used to improve surface quality & protect tool life by use of coolant or cutting fluid. Cutting fluids are used for improving surface finish & tool life [1]. All machining process depends on cutting tool. All demands in production like workpiece quality, dimensional accuracy & surface roughness mainly depends on cutting and coolant [12]. Among all steels Mild steel have special place in the manufacturing sector because of its mechanical properties like machinability, less cost and Ductility. Therefore it is mostly used as raw material in all the machining process [8].During turning operation material removed from work piece in the form of chips by the shear action of cutting tool. Heat generated due to rubbing of tool on work piece as well as shear action. Generated heat will distribute on work piece, tool and chip. This heat affects cutting process. So Temperature generated in cutting tool-chip interface is taken as one of the parameter to analyze the performance [2]. As depth of cut increases it increase cutting temperature as well as surface roughness and causes more tool wear [4].

2 METHODOLOGY

2.1 OBJECTIVE OF PRESENT WORK

The purpose of this research is to investigate the surface roughness in turning operation under different cooling conditions and at the same time calculating the weight of single point cutting tool by the high precision digital balance meter before and after machining. The material losses of single point cutting tool at different cooling conditions are nothing but the tool wear of the cutting tool as it loses its weight during operation.

2.2 MATERIAL SELECTION

2.2.1 Mild Steel

Mild Steel is a type of steel that contains only a small amount of carbon and other elements. It is softer and can be shaped more easily than higher carbon steels. It also bends a long way instead of breaking because it is ductile. It is used in nails and some types of wire; it can be used to make bottle openers, chairs, staplers, staples, railings and most common metal products. Its name comes from the fact it only has less carbon than steel. The proportions of manganese (1.65%), copper (0.6%) and silicon (0.6%) are approximately fixed, while the proportions of cobalt, chromium, niobium, molybdenum, titanium, nickel, tungsten, vanadium and zirconium are not fixed. A higher amount of carbon makes steels different from low carbon mild-type steels. A greater amount of carbon makes steel stronger, harder and very slightly stiffer than low carbon steel. However, the strength and hardness comes at the price of a decrease in the ductility of this alloy. Carbon atoms get trapped in the interstitial sites of the iron lattice and make it stronger. The calculated average industry grade mild steel density is 7.85 gm/cm3. Its Young's modulus, which is a measure of its stiffness, is around 210 GPa. Mild steel is the cheapest and most versatile form of steel and serves every application which requires a bulk amount of steel. Mild steel has a maximum limit of 0.2% carbon. The low amount of alloying elements also makes mild steel vulnerable to rust. Naturally, people prefer stainless steel over mild steel, when they want a rust free material. Mild steel is also used in construction as structural steel. It is also widely used in the car manufacturing industry. Mild steel is used in almost all forms of industrial applications and industrial manufacturing [19].

2.2.1.1 Specification of specimen:

- Percentage of Carbon = 0.05 – 0.15 %
- Density = 7.85 g/cm3
- Young’s Modulus = 210 GPa

2.2.1.2 Parameters of specimen:

Table 2.1 Parameters of specimen

Length of specimen	100 mm
Initial Diameter of specimen	40 mm
Diameter after machining	38 mm
Depth of cut	2 mm

2.2.2 Cutting Tool (High Speed Steel)

The term high speed steel was derived from the fact that it is capable of cutting metal at a much higher rate than carbon tool steel and continues to cut and retain its hardness even when the point of the tool is heated to a low red temperature. Tungsten is the major alloying element but it is also combined with molybdenum, vanadium and cobalt in varying amounts. Although replaced by cemented carbides for many applications it is still widely used for the manufacture of taps, dies, twist drills, reamers, saw blades and other cutting tools. In this paper mild steel is used as work piece and tool is a single point cutting tool made up of high speed steel and the turning operation is performed on a lathe machine having different lathe speed taken into account [19]. For this experiment we have used MIRANIDA S-400 tool (9.53*76.20 mm).

Fig 3.1 HSS Single Point Cutting Tool

2.3 EXPERIMENTAL PROCEDURE

Turning operation performed on lathe machine using mild steel as a work piece and high speed steel as cutting tool.

- Preparation of workpiece
- Turning is done at constant depth of cut, feed rate and cutting speed and varying cooling conditions.
- Surface roughness will Measure by Dial gauge.
- Calculates the weight of single point cutting tool by the high precision digital balance meter before and after turning
- Calculates the weight of workpiec by the high precision digital balance meter before and after turning.
- Results are evaluated after the plotting different graphs.
- Measuring chip thickness using vernier caliper.

3 RESULTS AND DISCUSSION

3.1 MATERIAL LOSS OF SINGLE POINT CUTTING TOOL AT DIFFERENT CUTTING PARAMETERS

According to table 4.1 Material Loss Of Single Point Cutting Tool At Different Cutting Parameters shows that maximum material remove from cutting tool in dry turning which is .026. It indicates that maximum tool life is in case of turning with mixture of oil and water cooling because in this turning process tool wear is less among all which is .001.

Table 3.1 Material Loss Of Single Point Cutting Tool At Different Cutting Parameters

S. No.	Dry	Water	Oil	Mixture of oil and water cooling
1	.026	.004	.002	.001

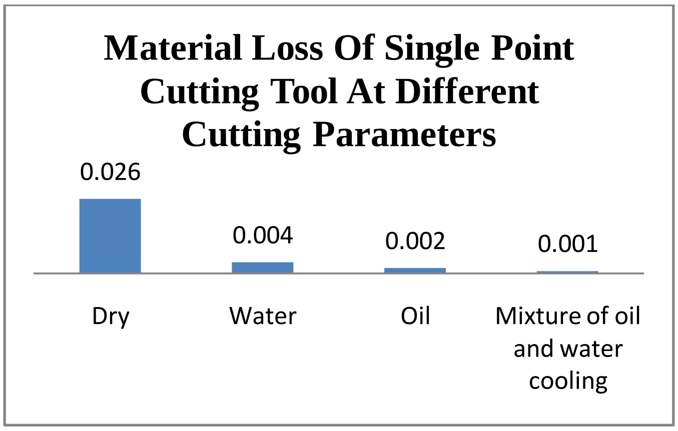

Fig 3.1 Material Loss Of Single Point Cutting Tool At Different Cutting Parameters

3.2 ANALYSIS OF SURFACE ROUGHNESS

These values (table 3.7) are taken from dial gauge (Aerospace made, 0-10 mm, .01 mm). In this experiment we found total 70 mm length by turning operation. The initial diameter of work piece is 38 mm and final diameter that we obtain from analysis is 30 mm. From this 70 mm length we take reading at every 2 mm distance with the help of dial gauge. To determine average surface roughness we use centre line average method.

Table 3.2 Average Surface Roughness Value For Different Cooling Parameter

S. No.	Dry	Water	Oil	Mixture Of Oil And Water Cooling
1	0.021142857	0.062	0.015714286	0.012857143

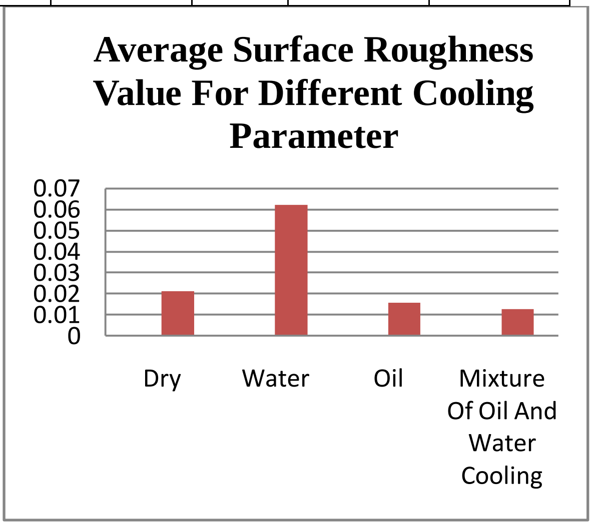

Fig 3.2 Average Surface Roughness Value For Different Cooling Parameter

From table 3.2 we got lowest average surface roughness value of turning with mixture of oil and water cooling which shows higher surface finish.

CONCLUSION

This thesis was proposed to study and analyze the surface properties of mild steel and tool life during dry, water, oil and mixture of oil and water cooling during turning on the lathe. The tool life and surface properties (surface roughness) of mild steel during turning with mixture of oil and water cooling found very good. The following conclusions could be made on the basis of experiment this work provides us information about the effect of cooling on surface finish and tool life. Various cutting parameters like speed, feed rate and depth of cut are constant for every experiment. The selection of cutting fluids (mixture of oil and water) for turning processes generally provides various benefits such as longer tool life, higher surface finish quality and better dimensional accuracy.

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