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INVESTIGATION OF THE EFFECTS OF TOOL WEAR ON TEMPERATURE AND SURFACE ROUGHNESS VALUE IN THE DIN 1.2343 MATERIAL MACHINING

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ABSTRACT
Turning of materials above 45 HRC Hardness is defined as hard turning. After the workpiece material is hardened by heat treatment, abrasion resistance increases according to the place of use. But hardening materials are very difficult for machining. Hard turning is also a finish turning process. Therefore, it must have very good surface quality. Good surface quality and low tool wear are desirable during the hard turning. Thus, the reduces frictional losses. In this experimental study, the material of DIN 1.2343 is machined with a hard metal insert. Wear of the tools formed during machining; temperature, sound intensity and surface roughness values were investigated. Accordingly experimental result, the amount of wear increases, the sound intensity increases, the surface roughness value deteriorates and the temperature increases.

Keywords: DIN 1.2343, hard turning, tool wear,surface roughness

Introduction

The increasing world population has enabled more devices to take part in our lives. The use of more devices and machines resulted in more energy consumption. More energy is produced due to increased energy consumption. The majority of the energy produced is derived from fossil fuels. The combustion of fossil deposits causes the release of gases harmful to the environment. These harmful gases create a greenhouse gas effect and increase the temperature in the world. The increased temperature causes the glaciers to melt and increase the water level. With each passing day the habitats are reduced further. Only in the coastal areas of the sea and the ocean does not shrink living spaces. Temperature rise creates desertification. Desertified soils cannot be planted. It becomes unusable. Thus, living spaces are destroyed. Farmland is reduced. The quantity of food produced does not suffice. Instant floods with melting glaciers. Immediately, the need for fresh water becomes unmet. For these reasons, many studies are carried out on energy consumption [1–8].

Increased droughts cause the destruction of forests and the extinction of forests leads to higher drought and temperature increases.

The machines are being run more and more to meet increased production. Rather than running machines, it is a problem that they do not work efficiently. Machine life must be longer. A machine that is used for a short period of time consumes a lot of energy both in production and in use. Efficient use of energy resources is essential for a sustainable world. In this context, measures to increase the life of the machine, which is of great importance, should be taken. More efficient designs, lower material usage, more wear-resistant, friction-resistant machine parts will minimize energy waste in life. Because almost every material we see and use is obtained as a result of the processing of a machine. The production of this machine is a very important issue. This is because an efficient machine will consume less energy during its lifetime. The number of waste products will be reduced. It will reveal durable products. Therefore, manufacturing is of great importance in the industry. Quality and low energy consumption are the priority values to be considered in machine manufacturing which is the starting point of manufacturing. For a quality surface, low surface roughness values should be obtained[9–14].

Materials and Methods

In this experimental study, DIN 1.2343 hardened material was used. As a result of the vacuum hardening process, a hardness value of 50 HRC was obtained. The material is 50 mm in diameter and 250 mm in length. Since the material is long, it is machined between lathe and tailstock. 0.1 mm depth of cut was selected. Cutting speed 150 m / min. The feed rate was determined as 0.15 mm / rev. Since

hard turning is a finish turning process, it is aimed to obtain a good surface quality. For this, the cutting parameters were determined.

It is possible to process materials up to 55 HRC with carbide inserts. Therefore, in this experimental study, carbide insert with WNMG 080408 geometry of Taequtec was used. Experimental study was carried out on TTC 630 model CNC lathe of Taksan company. Machine power 20 KW. The speed is 4000 RPM.

Dino Capture optical microscope was used to monitor tool wear.
At the time of processing, LT pensampermeter was used to measure the current value. A phase value was measured. The voltage values are taken from the regulator. Total power consumption is calculated by multiplying the total time.

The surface roughness value was measured with the Mitutoyo SJ 201 roughness tester. Measurements were taken at 3 different points and the aricmetic mean was calculated. The sampling range was selected as 0.8.

Experiment results

Relationship between tool wear and temperature

Temperature values increase with increasing wear amount. Because as the tool wear increases, the amount of friction increases. The temperature increases with increasing friction. The increase in temperature causes expansion. the expansion causes a greater frictional force. therefore, sudden increases in temperature rise are observed after a while.

During each machining process, 3 passes are removed. 0.1 mm depth of chip is taken constant for each pass. Feed rate 0.15mm/rev. cutting speed 150 m/min. It was obtained. According to the images obtained from the thermal imager, the average temperature values increase to 150 C during the 1st Processing, 160 C during the 2nd Processing and 180 C during the 3rd machining.

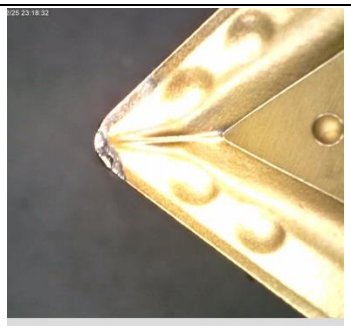
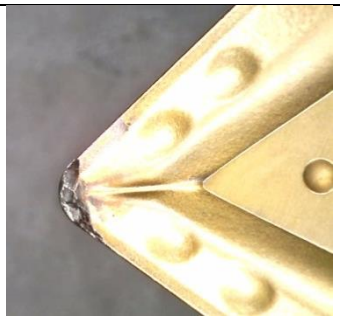
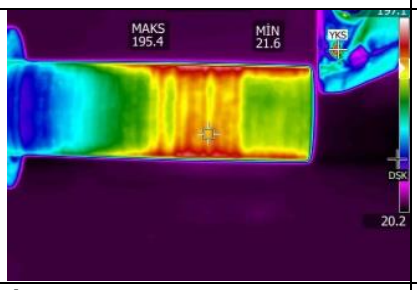
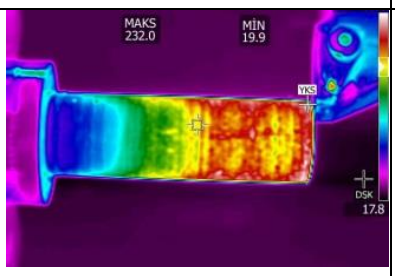
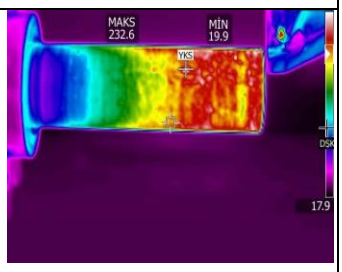
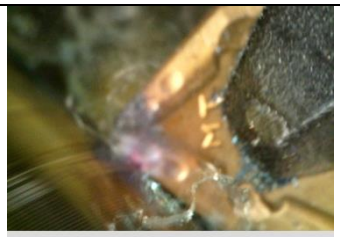
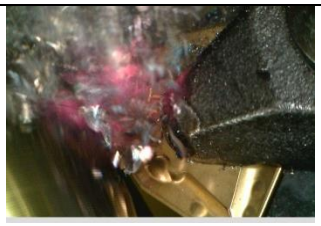
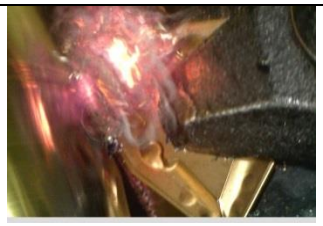
Test Time	10 (min)	20(min)	30(min)
Tool Wear			
	a	b	c
Temperature value			
	d	e	f
Machining moment			
	g	h	j

Figure 1. Relationship between tool wear and temperature

Tool wear causes temperature rise. At the same time, tool wear accelerates as temperature increases. Excessive temperature increase will damage the chemical structure of the material. Changing chemical and mechanical properties affects the performance of the machine part. Especially in heat treated workpieces, the increase in temperature decreases the hardness value. Reduces resistance to wear and friction. Increased temperature and friction cause an increase in energy loss.

The relationship between tool wear and current value

As tool wear increases, friction and temperature increase, so the current value increases. The machine tool is forced more. Chip removal becomes difficult. Power consumption increases. Depending on the power consumption, the amount of energy consumed on the machine tool increases. Microscope is used to investigate tool wear. Current value can be measured instantaneously. Therefore, it is of paramount importance to check the instantaneous current value in tool condition monitoring.

It is known that cutting forces increase as long as tool wear increases. Thus, a strong relationship can be established between the increase in shear forces and the current value.

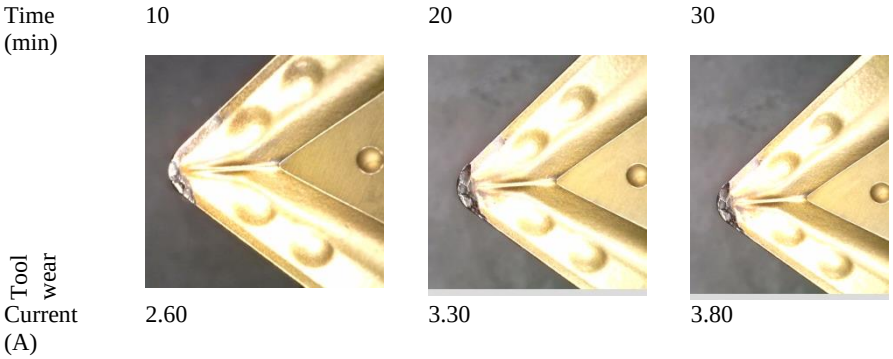


Figure 2. Relation between tool wear and instantaneous current value

Surface Roughness Value

Surface finish is especially important for finish turning operations. Because the regular work of the machine parts is ensured with good surface quality. The surface quality must be high to produce a low friction force. The surface roughness value increases with increasing tool wear. The increased amount of wear causes the tip radisun to grow after a while. increasing tip radisu has a positive effect on surface quality. However, the increasing amount of wear and vibrations cause deterioration of surface quality.

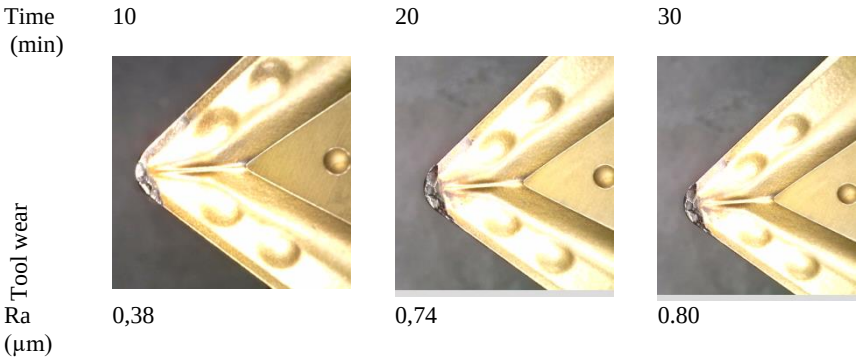


Figure 3. Relation between tool wear and surface roughness

In this experimental study, it was seen that carbide inserts can be removed for a long time in DIN 1.2343 material which is a hard material. The surface roughness values of less than 1.3 micrometer value indicates that the surface is close to the quality of grinding.

Results

As a result of these experimental studies;

It was observed that the temperature increased as the tool wear increased. It has been observed that the friction force increases with increasing wear amount and therefore the temperature values increase rapidly.

It has been seen that energy consumption on the machine tool increases due to tool wear. current values increase. The current value measured in single phase increased from 2.60 A to 3.80 A.

Surface roughness values are also increased due to tool wear. The surface roughness values are less than 1 micron despite the 30 minutes metal removal time. It has been found that carbide inserts can be used up to a certain hardness value as it provides good surface quality.

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