

Investigation of The Chip Formed as a Result of Machining of GGG50 Casting Material by Turning Method

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Abstract – In this study, the relationship between the chips formed during the machining of GGG50 material by turning method in different parameters was investigated. GGG50 material is spheroidal graphite cast iron, which can melt at low temperatures and has high wear resistance. Silicon, which is present at the rate of 2-4% in cast iron, causes the carbon to be found in the form of graphite leaflets, which facilitates the machinability of the material. Chips reflect the machining properties of the material in the manufacturing industry and are also responsible for removing heat from the cutting zone. It also plays an important role in measuring the machining capabilities and strengths of cutting tools. In the experiments, three main factors affecting the state of the chips in the turning process were discussed. These are cutting speed, depth of cut and feed rate. As a result of the study, the most important parameter affecting the chips in the turning of the GGG50 material in terms of thickness was determined as the cutting speed. The results of these experiments are expected to guide future studies in the manufacturing sector.

Keywords – Turning, Cast Iron, GGG50, Chip Forming, Machinability.

I. INTRODUCTION

Cast iron, in its most general definition, is an iron-carbon alloy with a carbon content of more than 2% [1]. Crankshafts and differential boxes in the automotive industry due to their high wear resistance and high-pressure resistance properties in the industry; It has a very common usage area such as hydraulic presses and machine tools in the machinery industry. GGG50 material, which is one of the cast irons, has the property of spheroidal graphite with high wear resistance and high tensile strength capacity. Silicon, which is present at the rate of 2-4% in cast iron, causes the carbon to be found in the form of graphite leaflets, which facilitates the machinability of the material [2-5]. There are quite a variety of methods in the machining industry. The oldest and still used one of these methods is turning. The turning operation is performed with the advancement of the cutting tool on the workpiece rotating around its axis. The chips generated during the turning process, on the other

hand, reflect the machinability properties of the material in the manufacturing industry and are also responsible for removing heat from the cutting zone. They are also important factors in measuring the machining capabilities and strengths of cutting tools [6].

The chips generated during the process vary due to different parameters. The decisive ones among these parameters are cutting speed, depth of cut, insert radius and feed rate [7-9]. Taguchi method was used to determine the cutting parameters for the turning process of Binali et al.'s pre-hardened die steel nimax. As a result of the study, it was seen that the most important parameter in determining the chip shape was the cutting speed and the depth of cut and feed rate did not reveal much difference in chip shape [10]. In another work of Binali et al., color, length, helix etc. considers the mentioned points by evaluating the milling parameters under dry cutting conditions to compare chip properties. The evaluation was carried out by examining the

microscopic images according to the chips obtained experimentally under two different levels of cutting speed, feed and cutting depth. They found that the depth of cut had no significant effect on chip shape, higher feed rate i.e. 0.3 mm/tooth was much better than the lower value and deeper at lower cutting speeds and in some threads at lower cutting speeds [4]. The change caused by the mentioned cutting parameters on the material or in the process environment is also an important issue in machining in order to ensure the continuity of the process [11, 12]. The effect of machining parameters on vibration, sound intensity and surface roughness was focused in the study of Şahinoğlu et al. In the study, GGG50 was subjected to casting material processing experiments. Machining experiments were performed with turning method at 4 different cutting speeds (50-125 m/min), four different feed (0.1-0.4 mm/min) and 4 different cutting depth (1-2.5 mm) made of dry cutting conditions without using coolant. As a result, it has been observed that as the feed increases, the vibration value, surface roughness value and sound intensity increase. It was observed that as the depth of cut increased, the vibration and sound intensity increased. The study of Şahinoğlu et al. revealed the effects of different cutting parameters affecting the chips on the working environment and the surface roughness of the GGG50 material [3].

As can be seen, in previous studies, chip analysis was performed for different materials and the parameters were evaluated. The main purpose of this study is to show the parameters according to which the chips formed in the use of GGG50 material in the industry are shaped and it is expected to contribute to future studies.

II. MATERIALS AND METHOD

GGG50 material, which is from the cast material group, was used in the experiments. The chemical composition of the GGG50 material is given in Table 1. The dimensions of the GGG50 material used in the experiments are 30 mm in diameter and 100 mm in length and have a cylindrical geometry. The experiments were carried out with a cutting tool with TiC coated CCMT 09T308-304 code. The cutting tools were renewed at the end of each stage during the experiment. The tests were carried out considering the different cutting speeds, depths of cut and feed rates given in Table 2. The determined parameters were taken in accordance with previous

studies. The chips resulting from the tests were evaluated according to different cutting conditions.

Table 1. Chemical composition of GGG50 material.

Material	C	Mg	Mn	P	Si	S
GGG50	3.5-	0.06-	0.4	0.1	2-3	0.01
	3.8	0.12				

Table 2. Machining parameters.

Cutting Speed (m/min)	Feed Rate (mm/rev)	Cutting Depth (mm)
60-80-130	0.2-0.4-0.6	0.12-0.16-0.2

III. RESULTS

This study was primarily carried out by using the turning method, which is widely used in the manufacturing sector. In the experiments, it was preferred because the effect of the turning process in the manufacturing sector could not be underestimated. In the turning method, chips that occur during the process and which generally have a positive or negative effect on the machining, part, and tool have been examined. Inspection and classification of chips in shape, size should be done for the following reasons;

- i. Chips provide the removal of heat from the material surface during the process. These properties are very important in terms of the mechanical properties of the material used.
- ii. If the chips are not easily broken during the process and cannot be removed from the process area, they may hit the cutting tool or the workpiece and this may cause unwanted accidents.
- iii. The chips, which are naturally broken during the process, ensure that all the desired properties on the surface of the material are obtained in the same quality on all surfaces. These features include surface roughness, dimensional accuracy, etc. can be given as an example.
- iv. Understanding the shape of the removed chips adds quite different interpretations and direction to the machinability aspect in the manufacturing sector.

The chips forms obtained as a result of the experiments are given in Figure 1.

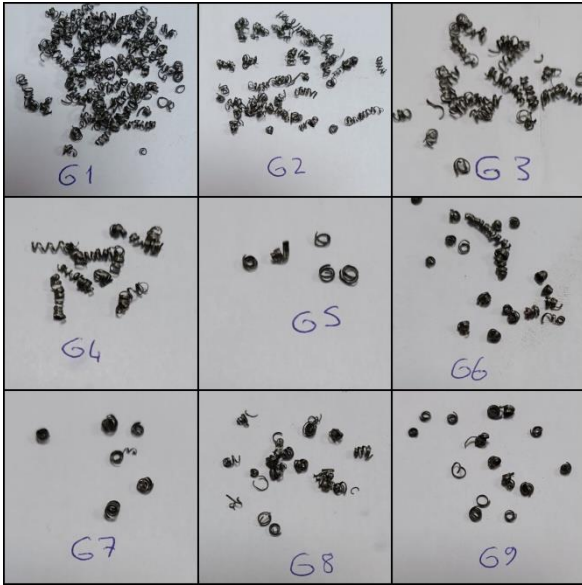


Fig 1. Chips collected after turning experiments.

In this study, the chips collected after turning operations under different conditions are shown in Figure 1. Experiments were not carried out using scanning electron microscopy (SEM) because the resulting chips were not very small in size and were visible to the naked eye. If a more detailed analysis is required, the SEM method can be used. In the experiments of G1, G6 and G8 chips shown in Figure 1, the cutting speed was kept constant at 60 and the feed rate was increased gradually. As a result, it was concluded that the feed rate is not very effective in chip thickness or shape. At another stage, in experiments where G2, G4, G9 chips were obtained, it was revealed that the thickness of the chips obtained was thinner than G1, G6, G8 chips when the feed rate was increased gradually and the cutting speed was increased to 80. Looking at the experiments from a different perspective, in the experiments in which G1, G2, G3 chips were obtained, the cutting speed was increased by keeping the feed rate constant and it was observed that the thickness of the chips became thinner at each stage. As the cutting speed decreases, irregular chip formation can be seen, and the chips are short or long. It has been observed that the depth of cut, which is another parameter, does not have a certain effect on chip size shapes. It has been revealed that in the same working environment and under the same conditions, the chip color is not much related to the determined parameters and does not show a change depending on them.

IV. CONCLUSION

In this research, the examination of the chips resulting from the turning process according to three different values of three different cutting parameters of the GGG50 material, which is from the cast iron material group, was taken into consideration and the following conclusions were drawn:

- The effect of feed rate, which is one of the test parameters, on the chip is less than the cutting speed.
- When the cutting speed is increased, the chip thickness decreases.
- Since the effect of depth of cut on chip shape and size cannot be observed clearly, the effect of depth of cut is less than cutting speed and feed rate.
- Experimental work can be extended under different cutting conditions.

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