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Details

Main Themes published in this Periodical:

Search Volume Or Title

<< < ... 33 34 35 36 37 ... > >>

Main Theme	Volumes
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Advances in Mechanics Engineering Edited by: Lawrence Lim	588-589
Civil Engineering and Materials Edited by: Catalina Spataru	587
Advanced Materials and Information Technology Processing II Edited by: Junqiao Xiong	586
Advances in Materials and Processing Edited by: B.S.S. Daniel and G.P. Chaudhari	585
Recent Trends in Advanced Materials Edited by: D. Rajan Babu	584
Advanced Composite Materials and Manufacturing Engineering Edited by: B. Xu and H.Y. Li	583
Frontiers of Materials, Chemical and Metallurgical Technologies Edited by: Jimmy (C.M.) Kao, Wen-Pei Sung and Ran Chen	581-582
Mechanical Properties and Structural Materials Edited by: Y.M. Song	580
Advanced Manufacturing Focusing on Multi-Disciplinary Technologies Edited by: Zone-Ching Lin, You-Min Huang, Chao-Chang Arthur Chen and Liang-Kuang Chen	579

Showing 341 to 350 of 640 Main Themes

<< < ... 33 34 35 36 37 ... > >>

LEMBAR PENGESAHAN

Judul : Characterization of Cutting Temperature and Ignition Phenomena of Magnesium Chip Using Infrared Imaging

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Characterization of Cutting Temperature and Ignition Phenomena of Magnesium Chip using Infrared Imaging

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Keywords: measurement temperature; optimum cutting; infrared imaging.

Abstract. In this paper, we report our experimentation about measurement temperature of ignition cuts and chip phenomenon using infrared imaging methods, to model and simulate machine rotary cutting tool system. Finally this research was obtained of the optimum conditions expected of cutting magnesium at high speed and without coolant.

Introduction

The tendency of increasing magnesium use as well mineral oil saving measures by reducing the weight of automotive parts. Therefore, treatment and processing of magnesium into a product/component has gained attention. However, increased productivity through increased cutting speed and feed are constrained by the nature itself machining magnesium ignition is on furious (600°C). All this to control the cutting temperature and improve the productivity of machining magnesium researchers [1] using a liquid coolant-based mineral oil. However, the use of cooling fluids will contaminate the environment through disposal of waste.

Therefore, this research has the virtue to develop a new method which cheap and environmentally friendly way to control the ignition so that productivity can be improved.

The Underlying Theory

High-speed machining with rotary cutting tool

One method to reduce cutting temperature and to increase the productivity of machining is to use a rotating cutting tool in cutting lathe machining process [2]. Figure 1 illustrates the principle of this machining process. As shown in the figure, in this cutting method, with a rotating cutting tool the cutting blade (cutting edge) will be cooled during the period without the deduction (non-cutting period) in a round chisel cut. It is expected that the temperature of cutting tool will cut down compared to a conventional lathe machining processes (cutting chisel silent). It is also hoped that the machining process with a rotating cutting tool can be used for cutting high speed (high speed cutting) for the material Magnesium (Magnesium Alloy) and the material is difficult to cut (difficult, to-cut materials) such as nickel alloys (nickel alloy), and Titanium (Titanium Alloy).

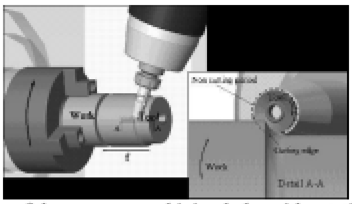


Fig 1 Illustration of the process machining lathe with rotating cutting tools

Cutting temperatures in machining processes with a rotating cutting tool

The heat generated by deformation during the machining process furious chisel spinning lathe with potentially generated from four heat source. The heat source consists of three zones of deformation close to the blade of a tool cutting edge as shown in Figure 2, which is usually referred to each of the main deformation zone (primary), second (secondary), and third (tertiary). In addition, another source of heat is due to heat accumulation in the cutting edge tool due to the rapid cooling period.

In the machining lathe with rotating cutting tool, a period non-cutting period becomes shorter with increasing speed rotary cutting tool, this means that a short cooling period chisel. Therefore at a certain speed limit, the temperature at the end of the chisel blade cooling period has not been cold enough when it went back into the cutting area so that the chisel blade temperature continues to rise due to heat accumulation.

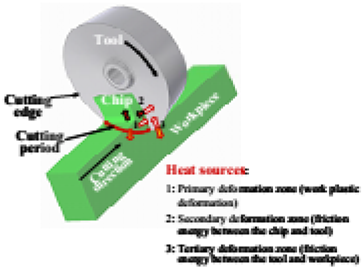


Fig. 2 Heat flow along machining lathe process using rotary cutting tool [2]

Infrared Imaging

Equipment used for the analysis of infrared imaging in general consists of two forms. Radiometry equipment first form is used for temperature measurement precision, and that the two so-called monitoring equipment, which is not designed for quantitative measurements but only for qualitative comparison. Monitoring only states that an object is warmer than the others, while radiometry states that an object (for example) 25.4 ° C warmer than the other with an accuracy of 2%.

The response is a standard video camera for visible light radiation from the visible object, while a special thermography unit response to infrared radiation from the object being observed. Therefore, the object was captured through the viewfinder is displayed in false colors to bring the temperature information.

Temperature is the measure of every object's thermal energy. The temperature measurement methods for objects are based on some temperature scales. Any object heat measurement is based on the thermal energy transferred from the object to the sensor, directly or indirectly via the infrared emission which is captured from a distance by special sensors. The data received from a non-contact temperature measurement appear as an image which represents the temperature distribution over the monitored object [3, 4, 5].

Naturally, infrared emission is related to the radiated heat transfer, which as an electromagnetic wave having wavelengths between the visible light and the microwave. Therefore, if we replace the thermal wave blocking hot mirror with a visual blocking filter, we expect to see the differences in the histogram patterns of the R, G, and B data which bear the information of the infrared image captured [6]. We also foresee high random noises due to low sensitivity of the RGB sensors in the IR range [7].

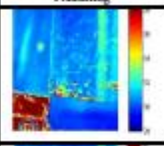
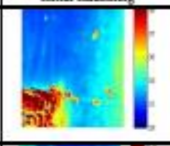
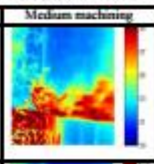
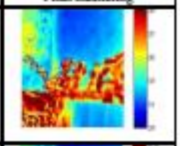
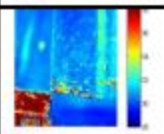
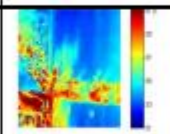
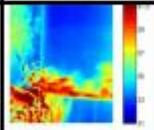
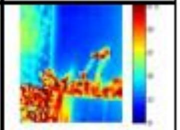
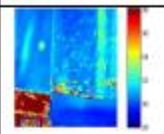
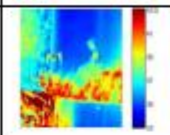
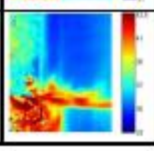
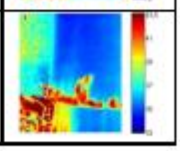
The Result of The Research

Colormapping of cutting tool and chip temperature conducted from the image that captured using infrared camera. For thermal image processing, the RGB image is converted into gray level image. Conversion to gray level intended to be seen the intensity level of the object based on the temperature. After a gray level image and look difference in the intensity, the next step is pseudocoloring. Pseudocoloring process aims to provide a color temperature of the object.

Table 1 shows temperature image on the cutting tool and workpiece with an infrared camera. By using a camera filter, it will be easier to distinguish objects that are rotating to dwelling. Color of the object becomes is more vague. With a faint object color image of the map the temperature of the object to look more spacious.

Then we could see from these images is the temperature in the cutting tool-workpiece color becomes flushed as indicated by the dashed line circle in Table 1. Means the area is a concentration increase in temperature.

Table 1 Image cutting temperature and chip captured by infrared camera with vary cutting condition

Cutting condition	Precutting	Initial machining	Medium machining	Final machining
v=150 m/min, f=0,05 mm/rev, d=0,25 mm				
v=270 m/min, f=0,05 mm/rev, d=0,25 mm				
v=410 m/min, f=0,05 mm/rev, d=0,25 mm				

From Table 1 it appears even more increasing temperature of thermal image based on increasing feed motion and depth of cut.

Conclusion

a. Infrared imaging can capture temperature image of machining magnesium, in spite of the temperature of infrared image must be converted by calibrated thermocouple temperature.
b. The increasing of the machining temperature due to cutting speed, feed and depth of cut motion can be seen from the image color change.

Suggestion

This research could be continuing with further research to get the model and simulation results of machining using rotary cutting tool system.

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