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SOME APPLICATIONS OF THERMOGRAPHY AS NON-DESTRUCTIVE EVALUATION OF THE PRODUCTION PROCESS

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ABSTRACT
Infrared Thermography it's a non-destructive testing technology that can be applied to determine the superficial temperature of the objects. Detectors collect infrared radiation to create a thermal image showing the superficial temperature distribution. Despite thermography's many potentials, it's applications in automotive and machine construction, has not been greatly studied yet. The paper presents an experimental approach for the analysis of the machines from a workshop using thermographic investigations. In most of the cases it is really expensive and can cause many problems when a machine stops because of a damaged part. With the use of thermography the damage can be predicted, it's growth can be monitories and maintenance can be programmed avoiding the unexpected shutdown of the machinery. Thermographyc images are accomplished with a Flir Thermacam E45 that converts infrared radiation into visual images. The images were taken in the laboratory of the Technical University of Cluj Napoca.
Key words: thermography, maintenance, production process

1. INTRODUCTION
Every corpse from our environment that has a temperature of over 0˚k (-273˚C) emits thermal energy under the form of infrared radiation (IR). Thermal vision infrared cameras measure this radiation using special sensors; it converts it and shows it as thermal images. Infrared thermography is a visualization technique of the temperature distribution at the surface of the corpse (invisible to human eye) and the measurement of the temperatures in any point of the image [1]. Thermography makes heat visible and measurable. Thermography is a modern technique, of high performance, which allows the visualization and generates thermal maps in real time (thermal images) of the biological or technical systems being under investigation. For the accomplishment of the thermal scanning activities special devices are used, named thermal cameras, which look and have the same dimensions as a normal video camera.

Thermography is a visualization method from the radiation point of view, radiation emitted by the objects that it's not detected by the human eye.[1,2] Thermography measures the thermal field by registering the infrared radiation and the visualization of the temperature distribution on the surfaces observed. This is a non-destructive, non-contact method used for detecting the faults during the production process, without the interruption of the technological process.

2. THERMAL CAMERAS

The necessity of generating thermal maps that can be interpreting in different domains of science conducted to an increase of the interest of the companies into developing special equipments witch will expand the human visual field and the infrared radiation domain [1]. So, thanks to new technologies, thermal cameras were manufactured, cameras that allow the visualization of the Infrared radiation, emitted or reflected by biological and technical systems, the final result being the visualization of the temperatures from the measured object. The structure of the used detectors for non-contact termography, thermovision works in the infrared range of the electromagnetic spectrum. In Figure no. 1 we can seen example of a Thermal camera, the Flir Thermacam E45 with a range between -20˚C to 250˚C (900˚C Optional), with a display of 50Hz, emissivity range from 0.1 to1.0. Precision of ±2˚C and ±2%, with a spectrum between 7.5 and 13 µm the reproduced image is jpeg format, 16k colors, 160x120 pixels[3]. IR camera construction is similar to a digital video camera. The main components are the lens that focuses IR [3] onto a detector, plus electronics and software for processing and displaying the signals and images. Instead of a charge coupled device that video and digital cameras still use, the IR camera detector is a focal plane array (FPA) of micrometer size pixels made of various materials sensitive to IR wavelengths[5].

Figure 1. Flir ThermaCam E45[3]

In most applications, the IR camera must view a radiating object through the atmosphere. Therefore, an overriding concern is matching the detector's response curve to what is called an atmospheric window [6]. This is the range of IR wavelengths that readily pass through the atmosphere with little attenuation. Essentially, there are two of these windows, one in the 2–5.6µm range, the short/medium wavelength (SW/MW) IR band, and one in the 8–14µm range, the long wavelength (LW) IR band.

3. APLICATIONS

Manufactured for industrial applications, these cameras can be indispensable also for the service and maintenance activities. Some examples of applications to understand the utilities of this instruments [4]:

a) Electrical engines (figure 2):

Hot spots can signal a problem of the involutions of an electrical engine. The insulation of the involutions can be affected by the high temperature even if it functions in this regime for a short period of time. An overheated engine indicates an inefficient operating, for example the cooling is not running properly or there are problems with the energy supply[5].

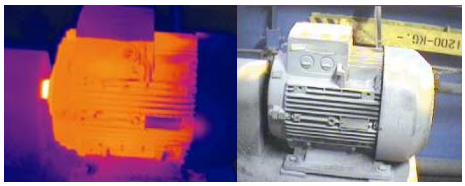

Figure 2. Thermography of electrical engines [3]

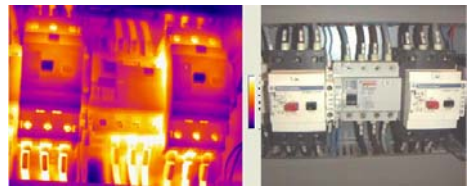

Figure 3. Thermography of panels fuses [3]

b) Panels fuses (figure 3):

Different temperatures between the phases indicate a problem with the connections or an unbalance. The functionality in these conditions implicates the decrease of the life of the entire system as well as significant costs for the replacement of the part.

c) Moving parts (figure 4):

The high temperature of a bearing can be caused by the low quality of the lubricant or the falls alignment between the engine and the pump. This problems conduct to the failure of the bearings or the overheating of the engine.

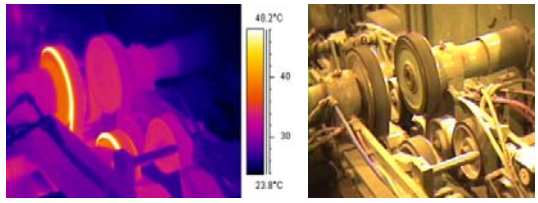

Figure 4 Thermography of moving parts [3]

3.1. Temperature measurements during the machining process

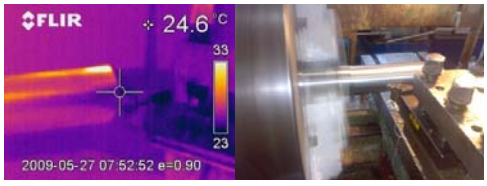

Figure 5. Thermography of the turning process

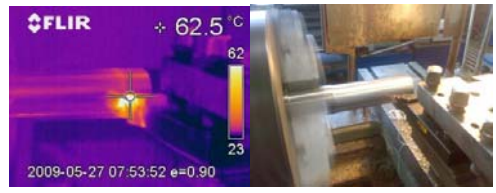

Figure 6. Thermography of the turning process

The measurements were taken at the laboratory of the Technical University of Cluj Napoca, on a normal turning machine, SNB400. The material used was OLC 45 and the thermal images were captured with the Flir Thermacam E45. We can see that the temperature starts at 24.6˚C with a feed of 0.1 mm/rot and reaches over 113˚C with a feed of 0.71 mm/rot. By analyzing the thermal images (figures 5, 6 and 8) we were able to determine the working temperatures as well as the overheating of the tool, which can mean that the tool is damaged and it can damage the quality surface of the processed part.

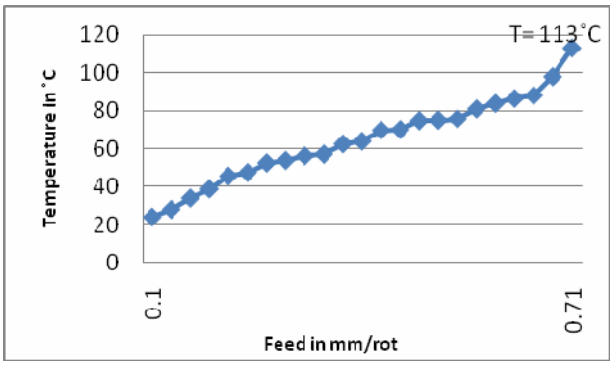

Figure 7.
Temperature growth in relation with the feed

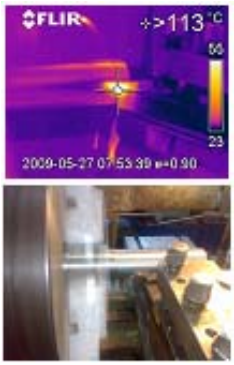

Figure 8.
Termography of the turning process

4. CONCLUSION

Thermography offers incredible solutions for a great number of applications: maintenance, constructions, transport medicine, research, surveillance, etc. [4] Thermography has many advantages:

- Allows temperature measurements from a distance without direct contact with the object.
- It's a nondestructive and non invasive method.
- The problems can be detected in an incipient stage, before any damage occurs.
- The investigation is made efficient and fast without being necessary to stop the production process.
- Thermo vision system provides an image that allows a quick and precise identification of the overheated points.
- The obtained images can be analyzed and downloaded on any PC.

Thermography is a nondestructive technical method extremely effective for the rapid localization and detection of the overheated points in a process [6]. In conclusion with the use of thermography we can observe the temperature growth in a process, and when they reached values are too high, can mean that the tool is damaged and the friction between the tool and the processed part is also high, and this will damage the obtained surface of the finished product. By monitoring the process with the help of thermography we can see after how much time the tool is damaged and stop it before the processed part is damaged.

5. REFERENCES

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