http://dx.doi.org/10.21611/qirt.2017.063

NONDESTRUCTIVE EVALUATION OF RAILWAY COMPONENTS USING INFRARED THERMOGRAPHY TECHNIQUE

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ABSTRACT

Infrared thermography (IRT) is one of advanced nondestructive evaluation techniques based on the detection of infrared radiation using an infrared camera. Especially, IR thermography provides a quick, full-field and real-time inspection as well as a non-contact mode. Using those advantages, it is possible to perform thermographic analysis in the fields of railway applications such as brake disc, abnormal heating detection of components, mechanical testing monitoring, etc. In this investigation, current research activities in railway materials/components with IR thermography was introduced. For example, the electrical units of diesel electric locomotives were characterized for deterioration evaluation using infrared thermography technique. The high-speed infrared camera was used to measure surface temperature changes during tensile testing of railway steels. The damage evolution due to generation of hot spots on railway brake shoe or disc was successfully monitored using a high-speed IR camera. In this paper, the useful applications of IR thermography in railway areas was introduced and recent research results was also presented.

KEYWORDS: Infrared thermography, Railway applications, Railway brake disc, Temperature monitoring, Nondestructive inspection

1. INTRODUCTION

Infrared thermography is an advanced NDE technique based on the detection of infrared radiation. Especially, infrared thermography provides a quick, full-field and real-time inspection as well as a non-contact mode. Also, lock-in thermography is an active technique in which the sample is subjected to modulated heating, and it is based on thermal waves generated inside a specimen and detected remotely by an IR camera. In order to encourage wide application of infrared thermography technique, it is required to develop the detection technique for in-service or manufacturing defects in railway components, such as bogie materials, wheelset materials, brake disc, etc.

2. RESULTS AND DISCUSSION

2.1 TEMPERATURE MONITORING OF RAILWAY MATERIALS DURING TENSILE TESTING

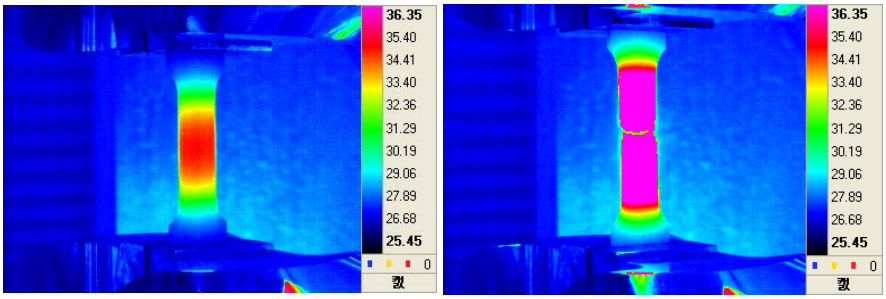

Fig. 1 The entire thermographic images of axle material in diesel electric locomotive during tensile testing.

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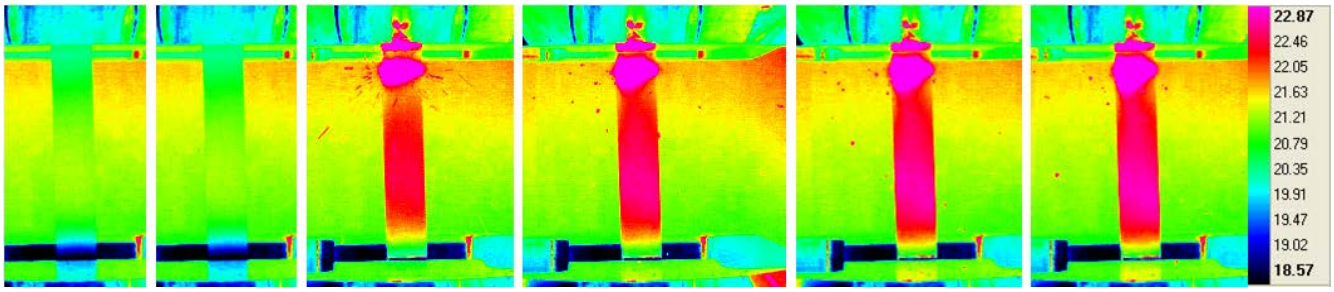

Fig. 2 The infrared thermographic images during tensile testing at every 0.01 second before and after final failure

2.2 THERMOGRAPHIC INSPECTION OF ELECTRICAL UNITS IN RAILWAY SYSTEM

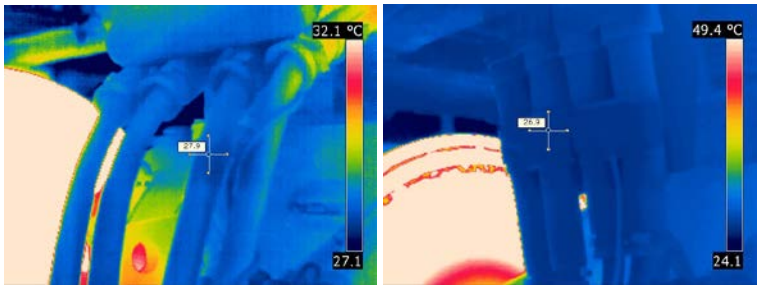

Fig. 3 Thermographic inspection of high-voltage cables in traction motors

3. CONCLUSIONS

The current research leads the following summaries. In order to encourage wide application of infrared thermography, the current applications in railway area were introduced. The tensile fracture behavior of axle and wheel materials in electric and diesel electric locomotives was investigated with the aid of infrared thermography NDE technique. The temperature evolution during brake operation in brake disc was introduced, and a high-speed infrared camera was used to measure the surface temperature of brake disc as well as for in-situ monitoring of hot spot evolution. The infrared lock-in thermography provided a qualitative nondestructive tool for the integrity evaluation of railway bogies. It was found that the infrared thermography technique could be reliable method to analyze deformation and/or failure interpretation through the monitoring of temperature in railway components.

ACKNOWLEDGMENT

This research was supported by a grant from R&D Program of the Korea Railroad Research Institute, Republic of Korea.

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