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INVESTIGATION OF MATERIAL PROPERTY CHANGES OF DISCS DURING BRAKING ON HOT SPOTS AND HOT BANDS GENERATION

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Introduction

A braking systems during friction interaction convert mechanical energy into heat energy. The corresponding heating is a major design parameter as it influences the tribological and mechanical performances (wear of the materials, friction performances, risks of cracks, vibrations, etc.) [1]. During breaking process in such breaking systems, different locations of thermal overheating areas of material of friction pair may occur, usually named as hot spots or hot bands. These spot and bands are characterized by very high temperature gradients. This brake systems exposed to thermoelastic instabilities show a characteristic temperature distribution on break disc surface that can lead to local material change[2,3]. The interaction of thermal energy and thermal expansion of the material of the friction braking effect on the local increase in temperature leading to a dominant impact frictional forces in this area. Often destabilization of the braking process is a consequence of such a rise in temperature. The difficulty of understanding and modeling all of these phenomena still remains due to the complex interactions of thermal, mechanical, and tribological effects. Experimental investigation is still nowadays a major instrument for detecting and understanding the physical effects. In this presentation, we propose to consider an example of two frictional system made from two materials leading to various types of hot spotting: the disk braking system.

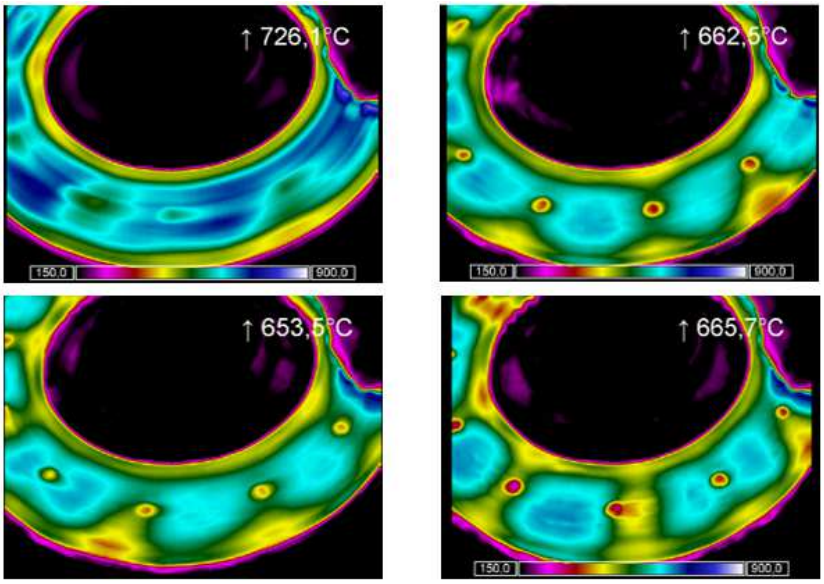

Fig. 1. The temperature distribution in the disc in its final stages braking from a speed of 385 km/h

Considered the research problem

In paper are presented results of investigation performed on a certified inertia test stand at Railway Institute in Warsaw. The test stand enables investigations of actual brake systems of rail vehicles (including pad and disc brakes) in the scale 1:1. Details of structure the test stands described in the paper [4]. In these experiments, railway brake discs made of steel and cast iron were used. During the study the hardness and roughness of the friction surfaces of the

brake discs before and after tests of breaking were analyzed. The obtained results of the hot spot and hot band occurring on the brake disks surfaces after the braking process with change of material property were correlated. Temperatures using a thermocouple and a thermal and fast imager were monitored (Fig.1 and Fig 2).

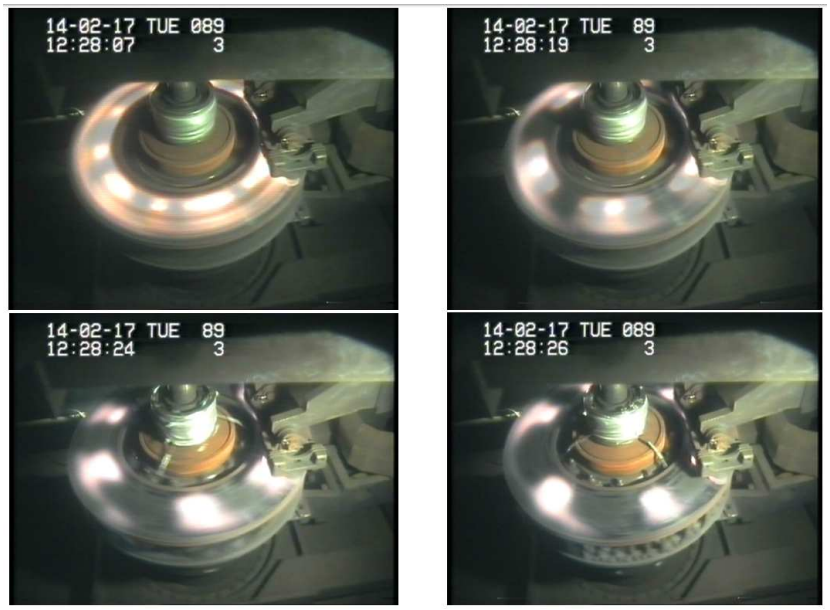

Fig. 2. The temperature distribution in the steel disc during braking from a speed of 425 km/h

Summary

Shown in the presentation of the results of tests and analyzes the formation of the hot bands and the hot spots on the brake discs used in high-speed railway vehicles, provided information on the temperature distribution on the surface. Measurements of the hardness of the hot bands and surface roughness of brake discs showed the effects of such phenomena on the change on the structure of the cast iron and steel discs materials. The increase the hardness of these hot areas on the discs surface of may result in an increase maintenance costs. The costs caused by for a more frequent lathing of the brake discs can occur. These changes also influences to reduce the coefficient of friction in the friction pair.

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