

THE EFFECT OF USAGE AND PAD MATERIAL ON THE TRIBOLOGICAL CIRCUIT AND WEAR DYNAMICS IN FRICTION BRAKING

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ABSTRACT

Railway braking systems are vital components of train operation, ensuring safe and efficient deceleration. In underground railway enclosures, several studies have shown that the concentration of particles is a significant concern. These studies have revealed that the source of particle emissions is closely linked to brake wear [1]. During braking events, the high dissipation of energy at the contact point results in significant frictional heat and wear processes on both brake pads and discs, leading to the generation of particles and gases. These generated particles are employed by the contact to form a third-body layer, while a portion of the material is expelled from the tribological circuit, referred to as the wear flow [2]. To effectively reduce wear and particle emissions, it is important to explore the factors contributing to their formation, particularly their relationship with the tribological circuit and thermomechanical loadings at the contact interface.

This study investigates the performance of an organic matrix composite pad in conjunction with lamellar graphite cast iron brake discs as the base material. Specifically, two variations of the base pad with identical formulations but differing fabrication techniques, resulting in distinct rigidity levels, are examined. The primary objective is to assess the influence of pad material and braking conditions on wear and the generation of particulate matter emissions during frictional braking. The selection of this material couple is motivated by its prevalent use in railway braking applications. Experimental tests are conducted using a dedicated laboratory tribometer to simulate braking conditions. Additionally, two distinct scenarios of railway metro braking are modeled and analyzed to comprehensively characterize the effects of usage.

Highly instrumented tests were conducted to comprehensively analyze wear processes, tribological circuit dynamics, and the kinematic accommodation of the disc-lining contact. Key indicators related to these aspects were carefully evaluated to characterize and quantify wear phenomena alongside the history of contact solicitation. Utilizing an optical high-speed camera, the evolution of the disc friction track's morphology was observed. Additionally, temperature measurements supplemented by infrared thermography enabled the characterization of thermal localizations and load-bearing areas in the contact over time. Displacement sensors on the pad support were employed to track the evolution of thickness loss, providing insights into wear progression. Furthermore, post-mortem analyses of the friction surfaces were carried out using scanning electron microscopy and energy dispersive spectroscopy to evaluate the surface morphologies and chemical compositions.

This oral communication will explore the effect of operating conditions and materials on wear during braking. Detailed experimental results from these tests will be presented and thoroughly discussed, revealing how different factors impact wear dynamics in braking systems.

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