

LUBRICATION EFFECT ON LABORATORY SCALE WHEEL-RAIL CONTACT

T. Lesage^{a*}, A. Saulot^b, J. Chalon^a, A. Ferrieux^b, L. Lafarge^b, S. Guidoum^c

*thibault.lesage@railenium.eu

^a Institut de Recherche Technologique RAILENIUM, F-59300, Famars, France,

^b INSA Lyon, CNRS, LAMCOS, UMR5259, 69621 Villeurbanne, France,

^c SNCF Réseau, Railway Division, 75010 Paris, France

KEYWORDS

Experiments in tribology, Rolling contact fatigue, Fluid lubrication, wheel-rail contact

ABSTRACT

Wheel/rail contact in the railways industry is of major importance for train circulation and maintenance. However, due to the diversity of railroad rolling stock, track geometry and accessing difficulties of remote positions, these contact conditions strongly vary, making systematic understanding of the influence of each isolated parameter problematic. Thus, models and testing benches have been developed over the years to further improve traffic and maintenance operations. Among the existing testing benches, most are either full-scale, such as the Grenoble's Wheel [1] or the Railway Noise Test Rig (RNTR) [2], or overly simplified, such as pin-on-disk tests for example [3]. Full-scale test benches are representative of actual contact conditions but expensive, time consuming and often limited in testing conditions. Conversely, simplified tests are cheaper, faster, but representativity of such tests often is uncertain.

The test bench used during this work lies between these two extremums and replicates a wheel/rail contact study at 1/10th scale, following a mechanical similarity law. This test bench was initially designed at Université Gustave Eiffel by H. Chollet and further improved at LaMCoS. Rail is designed as circular to allow a continuous contact and lower the bench dimensions. It results in a compact test bench (Figure 1), named TriboRail, with high adaptability in terms of contact conditions. TriboRail accurately represents wheel/rail contact at reduced scale in straight lines and curves, in dry as well as lubricated condition.

This work focuses on the impact of lubrication on wheel/rail contact in curvy solicitation, including both wear and Rolling Contact Fatigue (RCF) resistance. Contact conditions are monotonic, hereby maximizing its criticality towards RCF. Simulating a tight curve of 500 m radius, the evolution of friction coefficient, wheel and rail profile, crack initiation and lubrication pollution and repartition are followed. The benefits of lubrication in terms of service life, RCF resistance and wear

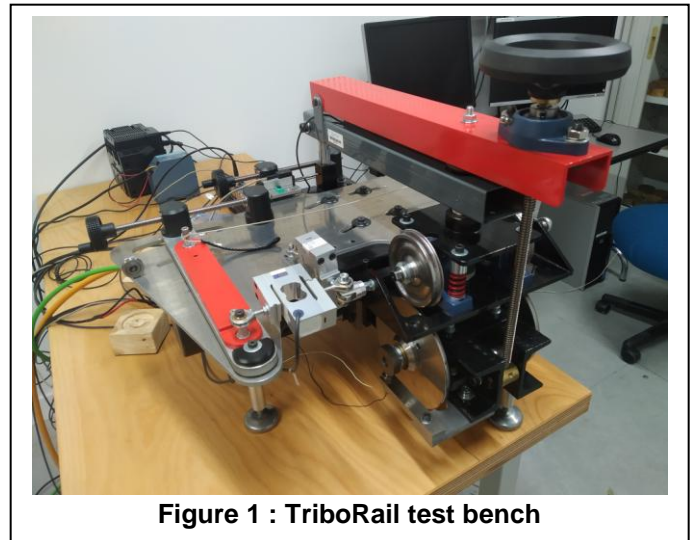


Figure 1 : TriboRail test bench

resistance are emphasized.

ACKNOWLEDGMENTS

The authors would like to gratefully thank Dr. H. Chollet, Université Gustave Eiffel - GRETTIA for initial test bench conception.

REFERENCES

- [1] H. Chollet, Etude en similitude mecanique des efforts tangents au contact roue-rail, These de doctorat, Paris 6, 1991. <https://www.theses.fr/1991PA066069> (accessed February 6, 2024).
- [2] C.F. Hartung, T. Vernersson, A full-scale test rig for railway rolling noise: simulation and measurement of dynamic wheelset-track interaction, *J. Sound Vib.* 267 (2003) 549–563. [https://doi.org/10.1016/S0022-460X\(03\)00723-5](https://doi.org/10.1016/S0022-460X(03)00723-5).
- [3] D.H. Mesa G., I.A. Vázquez-Chacón, M.A. Gómez-Guarneros, P. Sanchez-Tizapantzi, E.A. Gallardo-Hernández, A pin-on-disk wear map of rail and wheel materials from different standards, *Mater. Lett.* 307 (2022) 131021. <https://doi.org/10.1016/j.matlet.2021.131021>.