Experimental Evaluation On Broadband Noise And Vibration Reduction Performance Of A Novel Rail Particle Damper Through An In-Situ Test

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The wheel/rail interaction generates broadband noise and vibration in the railway, affecting the environment and residents and inducing rail corrugation, structural fatigue, and component looseness in rail tracks. Rail dampers are suitable and efficient measures to deal with these undesirable phenomena. Rail dampers have been widely adopted worldwide and obtained convincing effects through in-situ comparative measurements. This research exploits a novel rail damper utilizing particle damping, a simple yet effective vibration mitigation strategy. A noise-sensitive section of an operating urban metro line is selected to evaluate the noise and vibration reduction performance of this novel rail particle damper (RPD). The rolling noise and vibration level of the rail during the train passing with 70 km/hr operating speed were measured under two conditions: with and without RPDs mounted on the rail track. The RPDs were installed over a 40 m long rail track. Two damper installation configurations were adopted, i.e., full-installation and half-installation. For noise evaluation, one microphone was set by the side of the rail track, and a microphone array was installed 7.5 m away from the central line of the rail track. The track decay rate (TDR) test, which reflects the attenuation of waves along the rails, was conducted. The dynamic test was performed to investigate the effectiveness of RPDs on real operating conditions. and acceleration responses of rails were measured. The in-situ test results show that the RPDs increase the TDR in a wide frequency range and effectively control the broadband noise and vibration in railways.