Experimental verification of twin-disc test rig for wheel squeal noise research

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Recently, there has been a predominant effort to consider the radiated noise when controlling adhesion in wheel-rail contact. As research into this issue requires many repeatable experiments with controlled conditions that are difficult to achieve on a real track, so-called twin-discs test rigs are designed. A twin-disc which utilizes a dynamic model of the track-train interaction for a more realistic representation of the emitted noise was designed. This study deals with experimental verification of designed twin-disc test rig, which will consist in comparing the measured data with the results from the twin-disc with scaled contact and data from the real track.

The main parts of the designed test rig are a railway wheel with profile ORE S 1002 and a disc representing a rail. The suspension of the wheel and disc is modelled according to the real stiffness of the tram wheel suspension and to track stiffness, therefore, the contact conditions are close to the real track conditions. The second used test rig was a twin-disc with 66 mm diameter discs, which was designed primarily to study adhesion and wear in contact. All laboratory experiments were conducted under the following experimental conditions: contact pressure p_h = 0.8 GPa simulating the axle load of the light rail system, mean speed u_m = 1 m/s, AoA was set to 0-4 ° to simulate stages of a vehicle passing through a sharp curve. The measurements on the real track took place on the reversing loop. Noise measurements were performed in frequency range from 20 Hz to 18 kHz by sound level meter Brüel & Kjær 2270 both in laboratory and on a real track. The measured data were analyzed by STFT analysis.

Two main conclusions emerge from the measurement results. The noise measured on the real track is in the frequency band 500 Hz - 2 kHz. The data obtained from the designed test rig show that the frequency band of the noise is the same. This indicates that the noise on the designed test rig is probably generated by the same mechanism as the noise on the real track. The test rig should thus bring new knowledge in the field of wheel squeal noise research. The frequency band of the noise measured on twin-disc with scaled contact differs, which was expected with regard to the original purposes of the test rig. This test rig may not be suitable for research into the mechanism of squeal noise generation, but its advantages include the ability to control operating conditions. This can be used to compare the effect of different compositions of friction modifiers on noise depending on adhesion and wear.

Keywords: wheel-rail tribology, wheel-rail contact, twin-disc test rig, wheel squeal noise

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