

Formation process, key influencing factors, and countermeasures of high-order polygonal wear of locomotive wheels

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Background

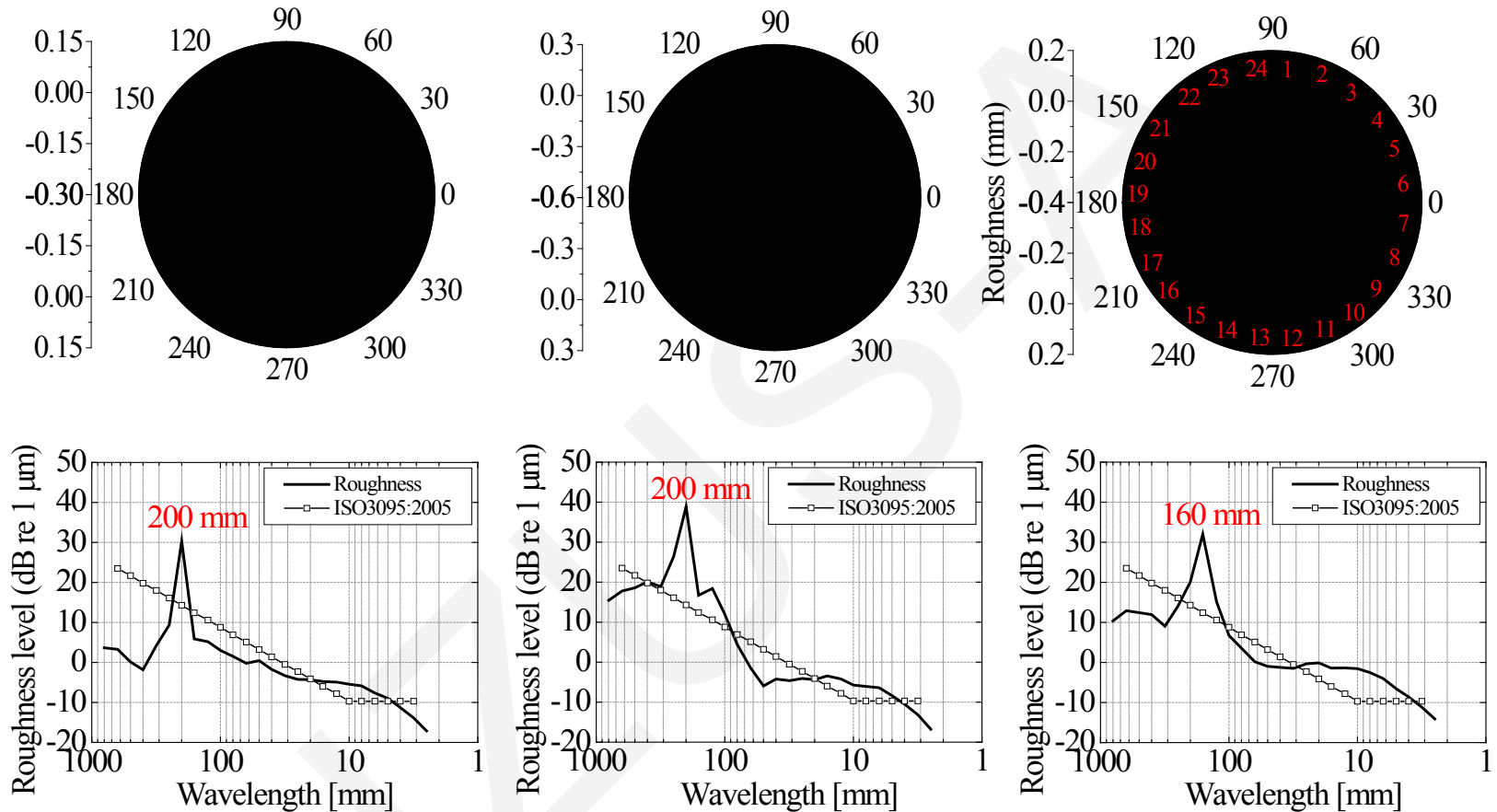


Fig. 1 Typical polygonal wear wheels with 18, 19 and 24 harmonics, respectively, from left to right. (a) Described in the polar coordinate system and (b) the 1/3-octave band spectrum of the measured irregularities.

Formation and development process

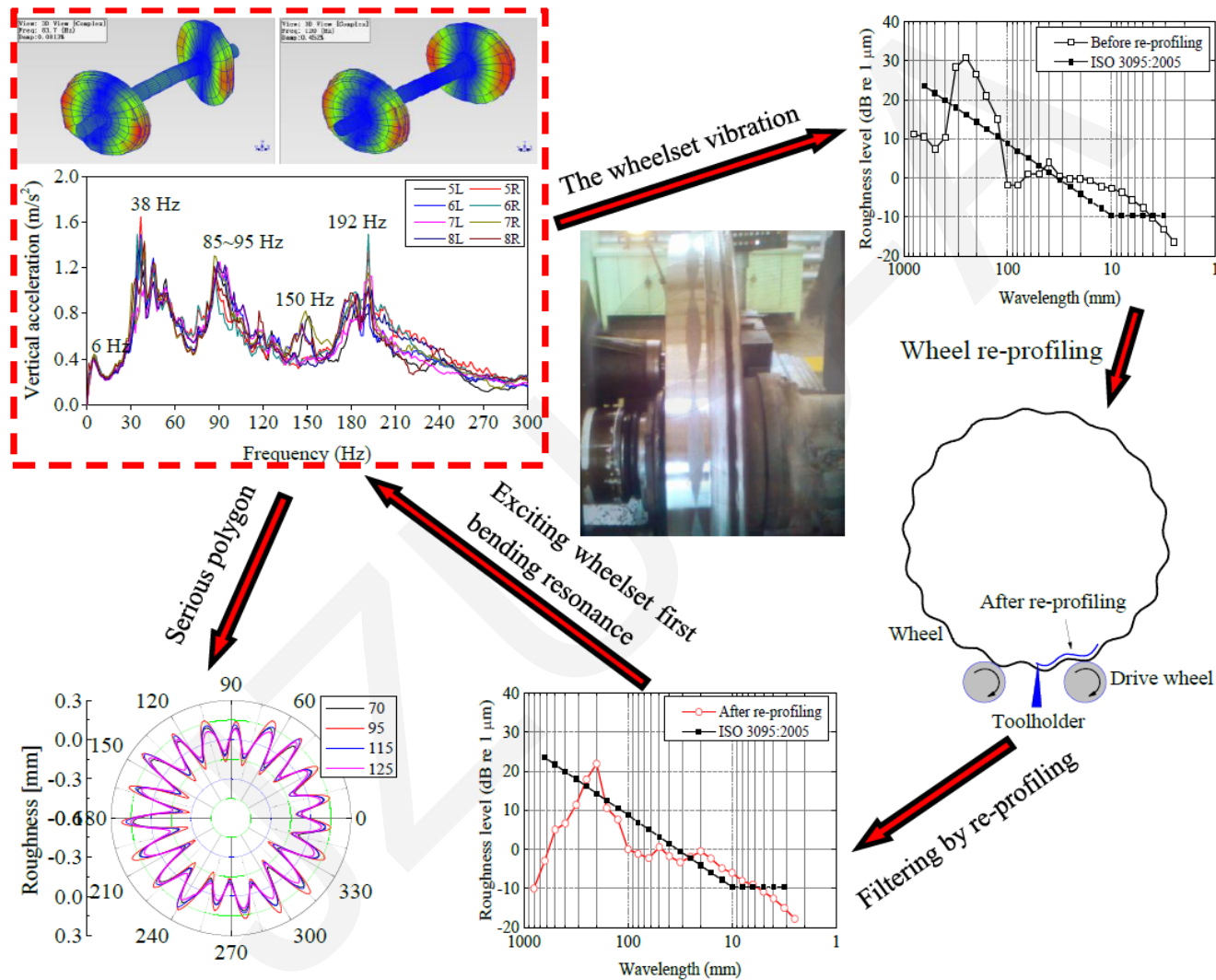


Fig. 2 Formation and development process of wheel polygonal wear.

Countermeasures: Improving the structure of the wheelset

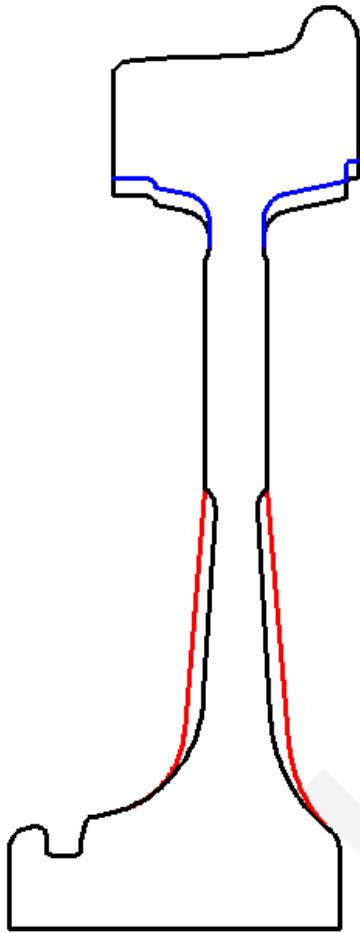


Fig. 3 Comparison of the original and the newly designed wheels.

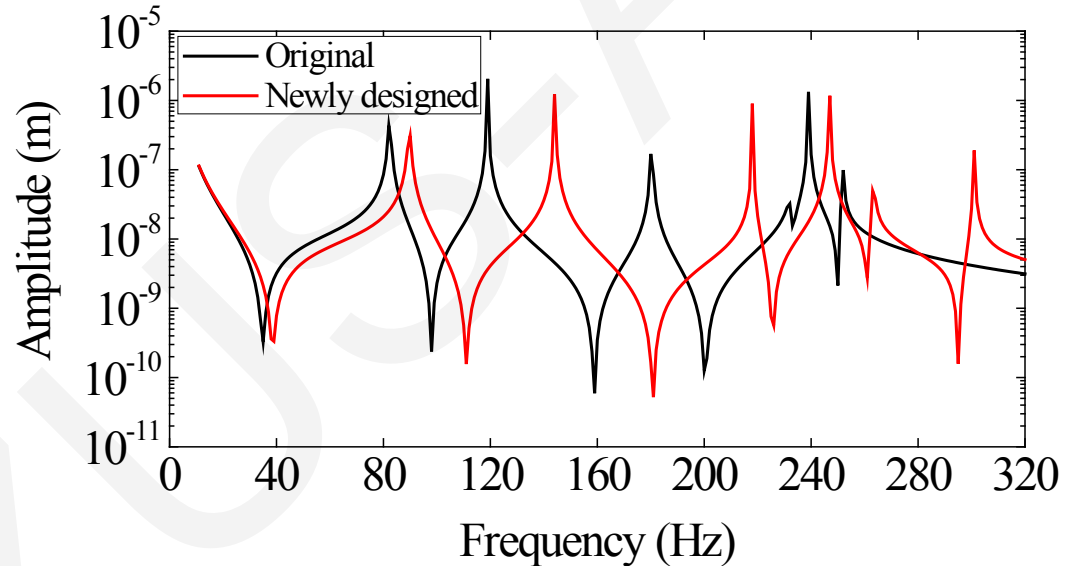


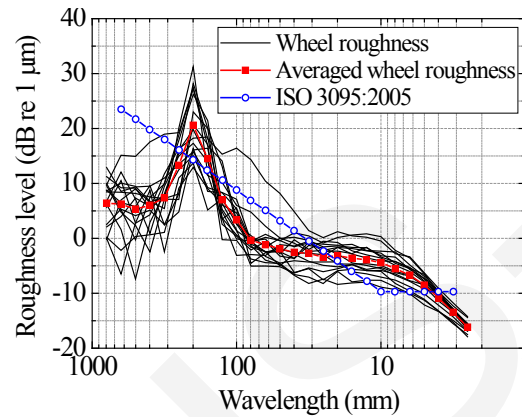
Fig. 4 Comparison of the frequency response function of the original and the newly designed wheelset under harmonic excitation.

Countermeasures: Improving the quality of wheel re-profiling

type-B underfloor wheel lathe



Before re-profiling



After re-profiling

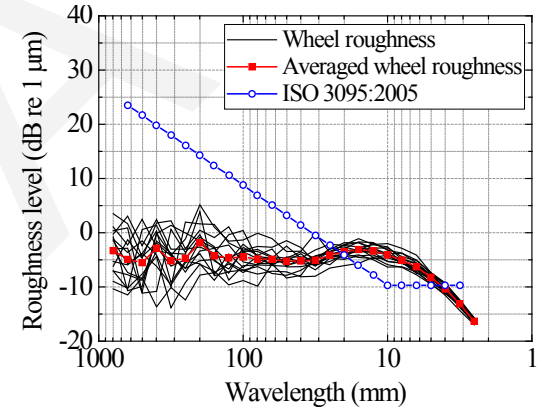
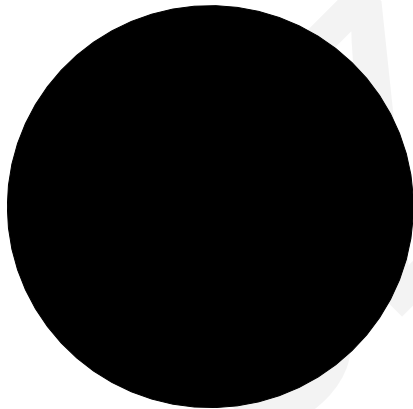


Fig. 5 Center wavelength in 1/3 octave bands measured (a) before and (b) after wheel re-profiling by using type-B underfloor wheel lathe.



$$\begin{cases} x_{wo} = \frac{(R_r + r)^2 - (R_l + r)^2}{4d} \\ y_{wo} = \sqrt{(R_r + r)^2 - \left[\frac{(R_r + r)^2 - (R_l + r)^2}{4d} - d \right]^2} \end{cases}$$

Conclusions

- The natural vibration of the wheelset is the inherent factor of wheel polygonisation. Poor re-profiling quality is the key external factor.
- The first bending vibrations of the wheelset can be excited by the remaining polygonal wear after wheel re-profiling, which results in the rapid development of wheel polygonisation.
- Improving the structure of the wheelset and the quality of wheel re-profiling are two main countermeasures.

Related references

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