FE analysis of wheel-rail connection

In a railway wheel-rail connection, we can define several tread surface failures of the wheel. The research is focusing on the so-called micro-thermal and sub-surface fatigue cracks. These are two of the most frequent failure types both wheel and the rail. The aim of our investigation was to map the appearance and the generation background of these failures using a multistage FE modelling procedure which consisted of coupled transient thermal and elastic-plastic contact FE simulations.

During intensive wheel-braking of the railway vehicles, equipped with disk brake only, it appears that the wheel slides on the rail. While the macroscopic sliding speed is restricted it is not eliminated by the WSP (Wheel Slide Protection System). Through the sliding process considerable heat is generated between the connecting parts. This heat may cause micro-cracks on and under the wheel tread. These phenomena can be observed not only on vehicles equipped with brake pads but also on those with a disk brake.

Previously a modelling method was developed in FEA environment which could help understanding the generation procedure of these micro-cracks caused by the heat generation. In the current state of the research, using an extended FE model method, the effect of the different operation conditions (movement speed, different coefficient of friction, etc.) and the coupled effect of the micro-cracks and the subsurface fatigue cracks can be observed. The results showed that which are the sliding speed limits of the WSP systems (beside different braking conditions), where it may not causes micro-cracks on the surface of the wheel tread. Using the results of the elaborated calculations the setup of the WSP systems can be modified under different braking conditions which helps minimizing the failures of the wheels and the rail.

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