

Using ISIS to optimise train wheel design with Lucchini UK



Science & Technology
Facilities Council



Researchers have been using STFC's ISIS neutron and muon source to investigate cracking in train wheels and potential methods of preventing it.

The challenge

The maintenance and renewal of train wheels makes up a significant proportion of the whole-life cost of rail vehicles. Railway wheels operate in a demanding environment with high stresses and strains which can result in initiation and growth of rolling contact fatigue cracks. On average, train wheels require replacement after five years of service. The manufacturing process of train wheels includes hardening the rim by a process of heating and cooling resulting in a compressive residual hoop stress, making the rim more resistant to cracks. Some cracking is unavoidable, however, and the eradication of these cracks means removing material from the surface of the wheel with a lathe. This exposes material underneath that can be more prone to cracking.

The solution

Researchers from the University of Huddersfield have used a beam line at STFC's ISIS facility to find out whether changes in hardness or changes in residual stress in a wheel are more influential in crack development. The Engin-X beam line at ISIS is optimised for the measurement of strain and stresses in engineering materials, so was the perfect facility for this project. UK rolling stock supplier Siemens and train wheel manufacturer Lucchini UK are co-funding the project as part of a consortium with the Rail Safety and Standards Board, the Association of Train Operating Companies and the Engineering and Physical Sciences Research Council (EPSRC).

The benefits

Measuring the distribution of residual stress in the wheel is more difficult than simply measuring the hardness, so an advantage of neutron diffraction is that it allows researchers to measure several centimetres into the steel, along with the ability to test large and heavy components - a necessary consideration when dealing with train wheels.

Siemens aim to utilise the results to optimise wheel maintenance for their own products, and they could also influence future choice of wheel material. The company hopes that the results will lead to cost savings without compromising on safety and could even lead to a change in standards of wheel manufacture and maintenance.

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"We are always willing to support new research such as this. We have extensive facilities in Italy but we don't have anything like ENGIN-X at ISIS. Collaboration between industry and academia can be very beneficial and lead to improvements in safety and processes." – Sean Barson, Technical Services Manager, Lucchini UK