The Steam Age meets the Neutron Age as train wheels take the strain

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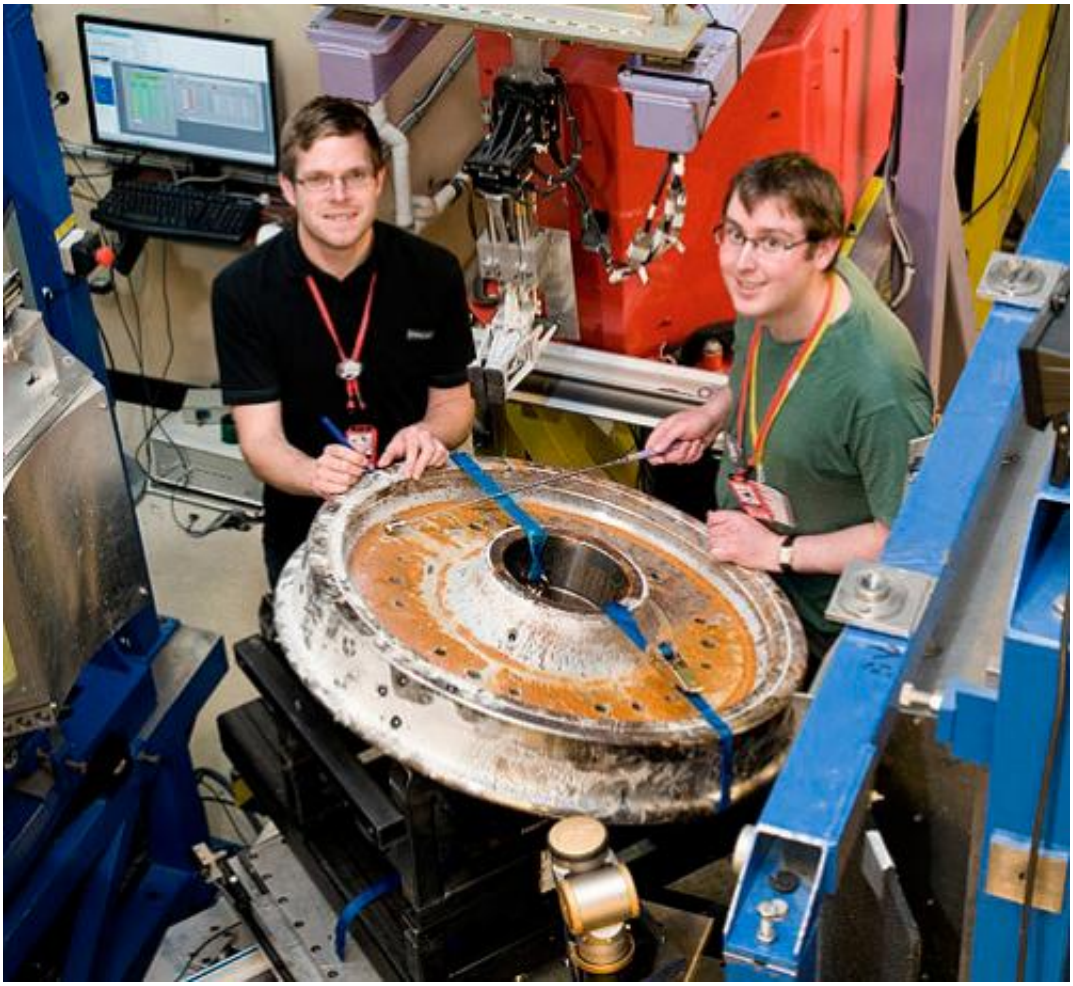

ISIS users Robert Jones and David Crosbee, Huddersfield University, using the ENGIN-X instrument to examine train bogie wheel, experiment RB1255011 at the ISIS facility, STFC's Rutherford Appleton Laboratory, 7th June 2013. Credit: STFC

Train carriages in the UK should be spending less time out of service due to wheel stress cracks thanks to a new technique of using neutron diffraction to measure several centimetres into the steel wheels.

The work has been undertaken at the ENGIN-X instrument at the Science and Technology Facilities Council (STFC) Rutherford Appleton Laboratory in Oxfordshire and allows engineers the opportunity to test such large and heavy components as train wheels rather than just metal samples.

This new method for understanding how train wheel cracks begin and spread was explained to UK Business Secretary Vince Cable today on his visit to ISIS where he had an opportunity to see the ENGIN-X instrument and had this to say:

"ISIS is one of the world-leading facilities that makes Harwell such a draw for researchers of all kinds. Continuing UK investments in ISIS, such as a new instrument to help companies test microelectronics, will enable it to be at the forefront of academic and industrial research for many years to come."

Maintenance and renewal of train wheels make up a significant proportion of the cost of our rolling stock and every five years or so, every wheel on every train in the UK has to be replaced. In everyday use the wheels are subjected to stresses and strains that can cause cracks to develop, particularly in the wheel rims as they travel thousands of miles on our tracks. A group from the University of Huddersfield has been using ENGIN-X at ISIS to study new and used train wheels to better understand how these cracks begin and spread.

Their work is funded by a consortium including the Rail Safety and Standards Board, the Association of Train Operating Companies, Siemens, Lucchini, and EPSRC.

The manufacturing process of train wheels is designed to try and minimise the likelihood of cracks appearing. A process of heating and cooling the wheel hardens the rim and puts it under compressive strain, making it difficult for cracks to start.

However some cracking is inevitable and when these cracks have developed to a certain level the wheel is put on a lathe to remove the outer layer and any cracks that have formed. This exposes material underneath that is slightly less hardened, and can be more prone to cracking.

Dr Adam Bevan, who led the study for the University of Huddersfield, explained:

"We know that during operation, and during turning on the lathe, the stresses within the wheel also change. We know that the cracks grow more quickly toward the end of the wheel's life, and this is true for various types of trains operating in different conditions. We wanted to know which was more important: the change in hardness or the change in residual stress. Hardness is easy to measure, but measuring the distribution of residual stress in the wheel is more difficult. Neutron diffraction allows us to measure several centimetres into the steel, and the big advantage of ENGIN-X at ISIS is the ability to test such large and heavy components."

Sean Barson, Technical Services Manager at Lucchini UK in Manchester, said of the project:

"We are always willing to support Universities in genuine new research such as this. We have extensive facilities in Italy but we don't have anything like ENGIN-X at ISIS."