Industry Update: Wheel Rail Interface Projects

The CRC for Rail Innovation continues to deliver the single largest research program in the history of Australian Rail. Over seven years, $100M will be used to research significant issues affecting the Rail Industry.
Efficient wheel and rail interactions are critical to the success of railway operations worldwide. When the wheel and rail do not interact in harmony, serious maintenance and safety issues will develop over time.

The CRC for Rail Innovation is supporting a number of research projects which could result in expanded knowledge and potential improvements for wheel and rail management by the Australian rail industry; potentially achieving large enhancements in performance and productivity.

Developments of CRC projects studying the wheel rail interface are summarised in the following sections.
Our projects

**INSULATED RAIL JOINTS** R3.100

Insulated Rail Joints (IRJs) provide rail track joins with structural stability whilst maintaining electric circuit integrity for track-based signal systems. Unfortunately, IRJs also have the shortest mean service life out of all railway track components and constitute a major maintenance issue.

Increased heavy haul and urban transport demands put increased tonnage pressure on the IRJ links in the track system. The CRC research is investigating a new IRJ design to improve performance and durability.

**Project Status:**

Following successful testing, the researchers plan to provide guidelines for revised dimensions and tolerances in manufacturing, installation and maintenance of insulated rail joints. The findings could be incorporated into the IRJ standard AS1085.12 and also into a manual to be published as “Best Practice Manual for Design and Maintenance of Insulated Rail Joints”.

**Benefits to Industry:**

Assuming the anticipated goals of a better IRJ with a longer use life emerge from the project, there will likely be savings for rail operators through reduced maintenance and improved reliability.

**RAIL SQUATS** R3.105

Rail squats are a type of metal fatigue resulting from wheel impacts on the railhead which ‘bruise’ the steel and over time lead to degradation of the track. Often the squat will grow under the surface as a hidden damage zone evidenced by a white etching zone at the railhead. Squats will further deteriorate the rail metal through the effects of water and weather. If left unmanaged, squats can lead to rail degradation and even fracture.

Current practice uses grinding equipment to remove squats from the track and restore a workable rail surface. In severe cases of squat damage, extra materials are welded back to replace missing metal. These repair methods are labour intensive and do not guarantee the squat will not redevelop.

**Project Status:**

The purpose of this project was to identify and examine previously unknown features of the rail squat, its occurrence, growth, characteristics, and impact on the rail steel and to investigate possible means for controlling the problem.

**Benefits:**

This project will develop a greater level of understanding of rail squat formation, research the changes squats bring to the metal structures and investigate potential methods of prevention. This knowledge may suggest methods to reduce rail squat formation thereby reducing maintenance costs and extending rail life.
CURVE LUBRICATION  R3.110

Train motions through curves can cause major damage to wheels and rail, thereby raising maintenance requirements, causing noise pollution and increasing costs. In order to reduce the impact of rail curve damage, researchers focussed on wheel/rail wear, types of lubricators and lubricants and the placement and operation of curve rail lubrication systems. The study looked critically at the use of various lubrication technologies and compared the results of current industry practices with trials which demonstrated improved practice.

Project Status:
The project researched the effectiveness of different lubrication units, applicators and greases in different technical situations, configurations and climates. The resulting innovation was the identification of the most effective grease formula, more efficient positioning of equipment and improved greasing application techniques.

The Curve Lubrication project runs in alongside two additional CRC projects, Integrated Wear-Fatigue Lubrication and Rail Grinding Best Practices. Plans are to combine the outcomes from the three projects into an Industry Best Practice Manual.

A recent project to start is a study of top-of-rail (ToR) lubrication technology and its application for Railways. The project outcome will complement the curve lubrication project by providing supporting research information for total friction management solutions.

Benefits:
Properly and efficiently applied lubricants should lessen squeal on corners and reduce overall rail noise. These results will lower the stress on Rail’s urban neighbours, improve Rail’s environmental performance and help maintain a “community licence” for urban rail operations.

Correctly applied lubricants can reduce wear on track and wheel, particularly on the contact zone on the outside curve, which is the major wear site for track operators. Replacing curve rail is very expensive. Longer wheel and track life will deliver substantial savings to the industry.

RAIL GRINDING BEST PRACTICES  R3.109

The application of grinding equipment to rail always treads a fine line between removing too little or too much metal. The researchers are developing an algorithm to guide rail grinding to achieve the optimum effect of reconditioning the railhead with the minimal amount of metal removed.

The challenge is to incorporate all the surface defect elements involved, so as to guide the grinding procedure to the best outcome. Aspects of rail to be factored into the researcher’s algorithm include; achievement of optimal rail and wheel profiles, elimination of corrugations and headchecks, and maintenance of rail surface topographies providing for smooth wheel/rail performance and noise reduction.

Project Status:
The project researched the effectiveness of current grinding practices in Australian heavy haul systems through analysing the rail wear data collected for different track configurations and rail profiles. It also studied and compared various non-destructive testing methodologies to quantify the rail defects including rolling contact fatigue (RCF).

The resulting innovation was a new rail grinding quality index incorporating the RCF factors and eddy current based technology to quantify RCF three dimensionally. These outputs will be incorporated into economic decision models to determine optimum grinding quantity and cycle.

Benefits:
Assuming the project achieves its goal of refining the engineering practices used to manage and correct damage to the railhead, this research will bring significant savings to the rail industry. Even small but significant adjustments to grinding practices which can improve accuracy and efficiency could save millions of dollars each year for each rail operator. A guide to achieving Best Practice in Rail Grinding is also expected from the project.
NEW WHEEL STEELS  R3.101

Railway wheels are subjected to stresses that make them one of the most maintenance-intensive components of a railway. Research conducted by the previous CRC (CRC for Railway Engineering and technologies) uncovered a technique for treating rail wheel steel which promises to impart superior mechanical and metallurgical properties when compared to conventional wheel steels.

The micro-structure of selected steel can be transformed to provide improved properties and the challenge for the research project is to produce test wheels to validate the research findings under real world conditions. Several years will be required to prove the concepts in practice. Then the next step would be to develop a commercial method for producing the improved steel wheels.

Project Status:

The primary objective of the project was to develop the application of low carbon bainitic-martensitic (heat treated) steels to provide sample rail wheels with superior cost effectiveness. These new wheels may resist the fatigue cracks which plague non-treated wheels and they may run longer and truer before requiring maintenance machining. Should all the benefits of the research be established over time, then railroad operators, rollingstock owners and track owners would have an improved product with better performance and economy.

Benefits:

Benefits will potentially flow from an anticipated longer life for rail wheels and less maintenance costs to other parts of the rail line as the harder steel will create less damage to the rail track.

Further potential costs savings could also extend to nationally significant industries reliant on rail, such as resources and export industries. With less damage to track and a longer lasting rail wheel, non-financial benefits such as increased productivity could also be a reasonable expectation.

NOISE  R1.105

Train noise in built up areas has been a significant environmental issue to the rail industry. For existing rail networks, train noise has been recorded as the dominant cause of community concern and pollution complaints. At the time of project inception, the rail industry had already implemented methods to reduce rail noise. This project provided further investigation into the sources of train noise and identified the best solutions to reduce rail noise stresses.

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Benefits:

This project provided the foundation for the identification of reliable, effective and cost efficient treatment for noise issues, both for existing infrastructure and new developments.

LOCOMOTIVE ADHESION  R3.119

High adhesion locomotives have been available and in use for many years, however, there are still concerns about damage to rail and other components required to make a rail track.

Upon commencement of the project there was limited research into aspects of locomotive adhesion. This project is piloting investigations into locomotive adhesion; developing knowledge on the effects high adhesion locomotives have on rail.

Project Status:

This project will assess the damage and stresses caused to rail by high adhesion locomotives compared to lower performance locomotives. The key deliverable will be a report on rail contact forces associated with high adhesion. This output will provide information in ‘common language’ (i.e. rail contact forces) allowing infrastructure owners to assess impacts and costs and adjust management plans accordingly.

Benefits:

This project is developing a greater understanding of rail stresses associated with modern high adhesion locomotives. Such understanding is expected to improve targeting of rail maintenance and increase the adoption of modern high adhesion locomotives; taking advantage of improved performance and reduced capital costs.
For more information

Visit www.railcrc.net.au for full details on Wheel Rail Interface projects and a range of others covering the Australian Rail Industry.

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Committed to industry led research for the Australasian Rail Industry