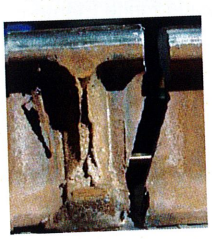
Investigating the Effect of Pre-heating on the Magnitude of Residual Stresses in Aluminothermic Rail Welds Using Neutron Diffraction

B. Khodabakhshi[a], A. Paradowska[c], P. Mutton[b], R. Ibrahim[a],

[a] Faculty of Mechanical Engineering, Monash University, Victoria 3800, Australia
[b] Institute of Railway Technology, Monash University, Victoria 3800, Australia
[c] Bragg Institute, ANSTO, New South Wales 2234, Australia

Aluminothermic rail welding is an in-track process which continuously welds rail tracks on site. This weld has a high rate of failure (Fig. 1) due to its cast structure and variable quality [1]. The existence of residual stresses which are developed during the casting process is one of the main factors affecting the formation and propagation of the cracks in the foot and head of the rail. Magnitude of these stresses depends on the welding parameters such as preheating. Hence, it is desirable to determine the correlation between the residual stresses and welding parameters in order to decrease the residual stresses and increase the life span of these welds. In this paper, the effect of pre-heating on the magnitude of residual stresses in the foot and head of the rail weld is investigated using strain scanner Kowari at ANSTO (Fig. 2). Previously, residual stresses in these welds have been measured using neutron diffraction [2]. However, this is the first time that measurements are conducted for a full sample non-destructively. The results indicated that the magnitude of residual stresses decreases by optimizing the preheat procedure, and this is quite promising and can assist the railway industry to improve the integrity of the rail welds in future.



a.



b.

Figure 1 Aluminothermic rail weld (a) with the crack initiated at the foot of the rail and (b) overview of the rail weld during the transverse measurements on the Kowari strain scanner

[1] P. Mutton and E. Alvarez (2002), Failure modes in aluminothermic welds under high axle loads, Engineering Failure Analysis Vol 11 Issue 2, pp.151-16A.

[2] P. J. Webster, G Mills, X. D. Wang, W. P. Kang and T. M. Holden, Residual stresses in alumonithermic welded rails, The journal of Strain Analysis for Engineering Design, 32:389-400 (1997)