

## Neutron Diffraction Measurement and FEA Modelling of Residual Stresses in Aluminothermic Rail Welds

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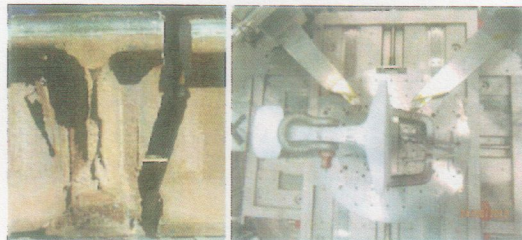
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Aluminothermic rail welding is an in-track process which continuously welds rail tracks on site. This weld has high rate of failure due to its cast structure and operator dependency which results in its variable quality. One of these failure modes is straight break (figure 1 a) which initiates at the edge of the weld collar in the lower head and upper foot sections [1]. The existence of residual stresses in this weld is one of the main factors which affects the formation and propagation of these cracks. The magnitude of these stresses depends on the welding parameters such as preheating temperature, gap size, etc. 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 and fatigue life of these welds. In this paper, the result obtained from neutron diffraction measurements of the head and the foot of the weld in the critical regions for 2 samples with different preheating temperatures is presented. These measurements are conducted using strain scanner Kowari (Figure 1 b) at ANSTO. The microstructure and hardness of the welds in these areas are examined as well to determine the correlation between the residual stresses, microstructure, and hardness. Besides, the casting process has been modeled numerically using FEA, and the numerical and experimental results have been compared.

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



### References

- [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.

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