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Improving fatigue performance of rail thermite welds

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Abstract

Rail transport development offers economic and ecological interests. Nevertheless, it requires heavy investments in rolling material and infrastructure. To be competitive, this transportation means must rely on safe and reliable infrastructure, which requires optimization of all implemented techniques and structure. Rail thermite (or aluminothermic) welding is widely used within the railway industry for in-track welding during re-rail and defect replacement. The process provides numerous advantages against other welding technology commonly used. Obviously, future demands on train traffic are heavier axle loads, higher train speeds and increased traffic density. Thus, a new enhanced weld should be developed to prevent accidents due to fracture of welds and to lower maintenance costs.

In order to improve such assembly process, a detailed metallurgical study coupled to a thermomechanical modelling of the phenomena involved in the thermite welding process is carried out. Obtained data enables us to develop a new improved thermite weld (type A). This joint is made by modifying the routinely specified procedure (type B) used in a railway rail by a standard gap alumino-thermic weld. Joints of type A and B are tested and compared. Based on experimental temperature measurements, a finite element analysis is used to calculate the thermal residual stresses induced. In the vicinity of the weld, the residual stress patterns depend on the thermal conditions during welding as it also shown by litterature [1, 2]. In parallel, X-Ray diffraction has been used to map the residual stress field that is generated in welded rail of types A and B. Their effect on fatigue crack growth in rail welds is studied. An experimental study based on fatigue tests of rails welded by conventional and improved processes adjudicates on the new advances and results will be shown.

References

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