NEW WAY OF ALUMINOTHERMIC WELDING AS A SOLUTION FOR HEAVY HAUL 4.0

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INTRODUCTION

New developments in the rail's mechanical proprieties, reduction of track maintenance costs, and safety improvements are all major factors which constitute new challenges to address for developing dedicated welding products in alignment with railroad requirements.

For many years, Pandrol has invested in technological solutions related to Industry 4.0 in order to improve the mechanical proprieties of the aluminothermic welds for use in heavy haul applications. Pandrol's welding research and development department has adopted rapid digitization, rapid prototyping and digital simulation solutions.

This technology was employed to assist with understanding and reducing weld defects.

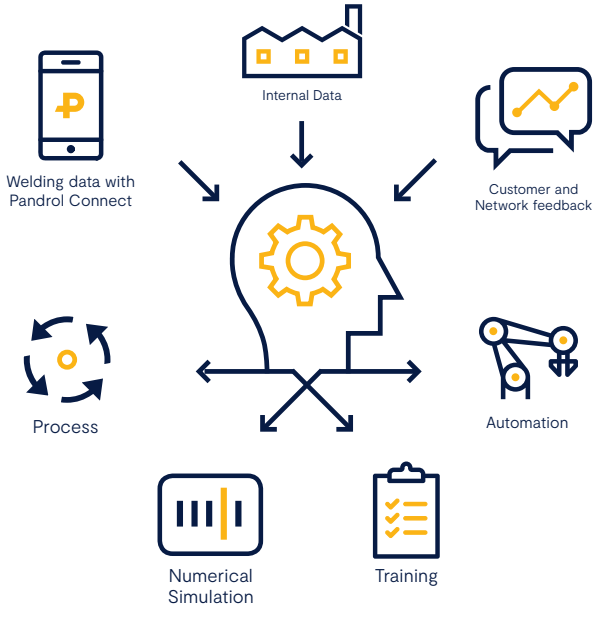


Fig 1. 4.0 Technology in Aluminothermic Welding

INVESTIGATION & ANALYSIS

Figure 2 shows an example defective weld assumed, according to the on-site preliminary findings, to be due to preheating and sandmould geometry issues. Pandrol undertook a large number of test welds in order to confirm the assumption. Testing showed that an overheating of moulds in addition to a shrinkage could be seen cause the defect.

In addition to test welds, Digital Simulation was undertaken to develop a better understanding of the aluminothermic welding process – Figure 2. This technology helped the R&D department understand complex physical phenomena that occurred during the weld. The Pandrol Preheating Controller, Figure 3, allowed Pandrol to accurately measure the preheating parameters during the test welds.

Thanks to the use of digital simulation and the precision allowed Preheating Controller, the investigation has shown results that accurately confirmed the on-site findings. The preheating and defects were able to be accurately reproduced.

DEVELOPING THE SOLUTION

Based on this results, a geometry improvement, casting slope, and optimization of the weld cast parameters were identified as the necessary interventions to provide a solution.

Digital simulation allowed Pandrol to accelerate prototyping phases and reduce development and laboratory time. Moreover, it offered the possibility to optimize casting parameters: collar shape, temperature, cooling and preheating using the Preheating Controller.

These two innovative tools have been used to define the optimized geometry and the appropriate preheating to get a best weld. Thus, the achieved results associated to the lab ones contributed in improving the weld. All controls - ultrasonic, bending and fatigue tests – have confirmed the weld performance. The optimized process was to keep the same current welding parameters and modify the sandmould geometry.

To ensure ongoing recording of data before, during and after welding, Pandrol has introduced the Pandrol Connect phone App ensure tracking and traceability of the weld parameters.

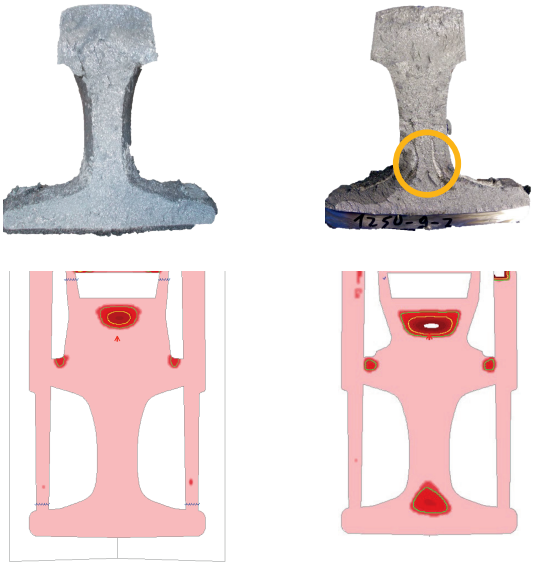


Fig 2. Test welds and digital simulation results

WELDS REMOVED

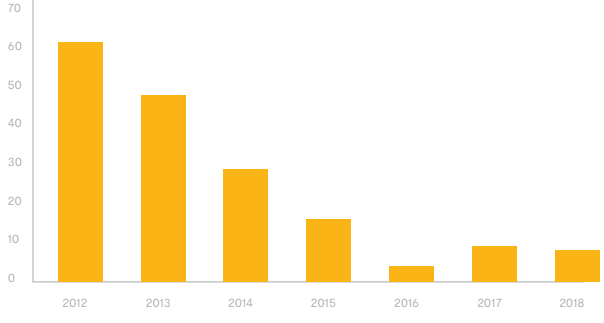
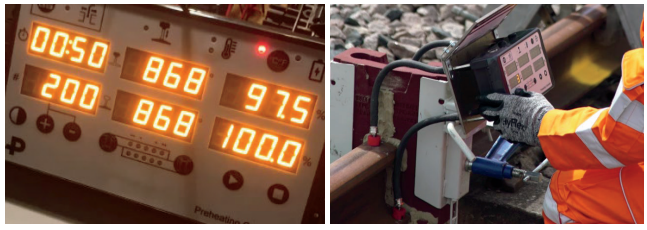


Fig 4. On-track removed welds evolution - 2012 to 2018

PREHEATING CONTROLLER

Unlike other mean of measure, the Preheating Controller integrates influences of all environment settings such as gas quality, low temperature, altitude and can measure actual preheating on track.



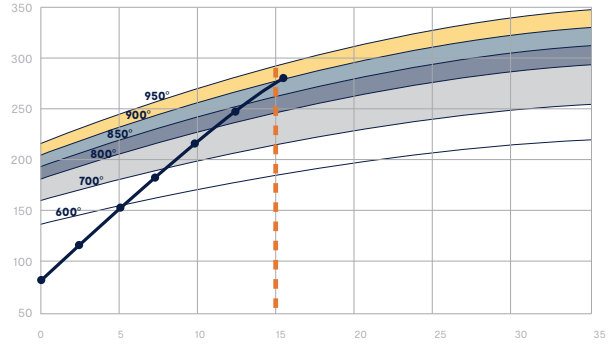


Fig 3. Preheating Innovation

CONCLUSIONS

Figure 4 shows the impact that these improvements have delivered on the number of defective welds in track. Thanks to these continuous improvements, Pandrol remains a world leader in aluminothermic with best-in-class product quality and the lowest failure rate.

A continued investment in new technologies, including digital simulation, the Preheating Controller and the High Flow Preheater, supports Pandrol's market leadership and commitment to adding value for customers. These technological tools allow Pandrol to support customers with bespoke products related to their requirements, utilising Idustry 4.0.

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Application deployment.
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