



An Alternate Means of Manufacturing High Formability Dual Phase Steels

Alex Harrison

Andrew Thorn

School of Engineering

BEng (Hons) Material Engineering

Introduction

Dual Phase steels are a category of steels that see widespread use in the automotive market which values their enhanced strength and formability. [1],[2]

Recent efforts to optimise DP steels have suggested several techniques capable of enhancing the material, including the use of a heat treatment cycle between hot and cold rolling. This creates conditions more favourable for Niobium precipitation [3]

This paper aims to apply principles discussed in the 2021 paper “A route for production of elevated strength Cold Rolled Steel” [4] to production of Dual phase steels currently supplied by Tata steel UK.

Materials and method

An experimental production route was simulated inserting an intermediate annealing cycle between hot and cold rolling. The material was annealed at 600°C for 2 hours then normalised.

The product was then compared to material which was produced under standard processing conditions. Comparison was performed using uniaxial tensile testing and optical microscopy.

All samples were cold rolled then annealed using a Continuous Annealing Simulator (CASim).

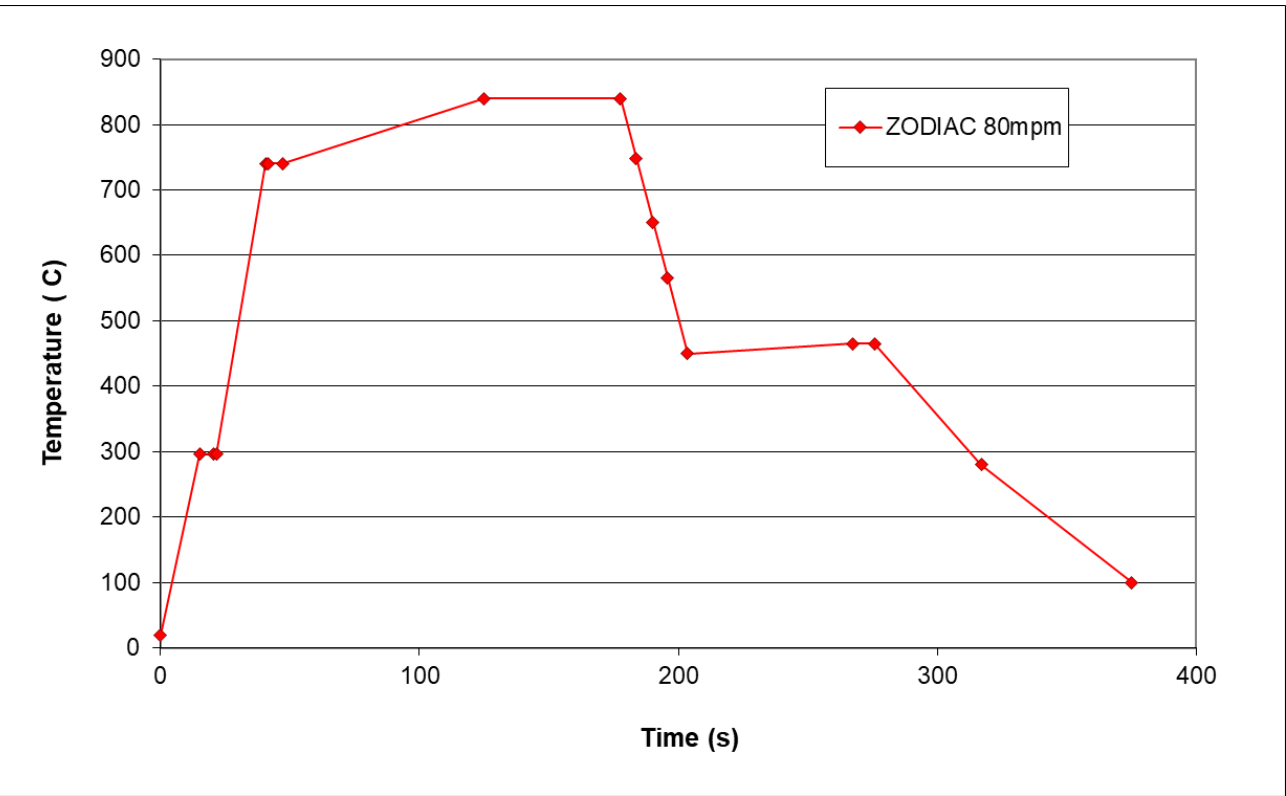
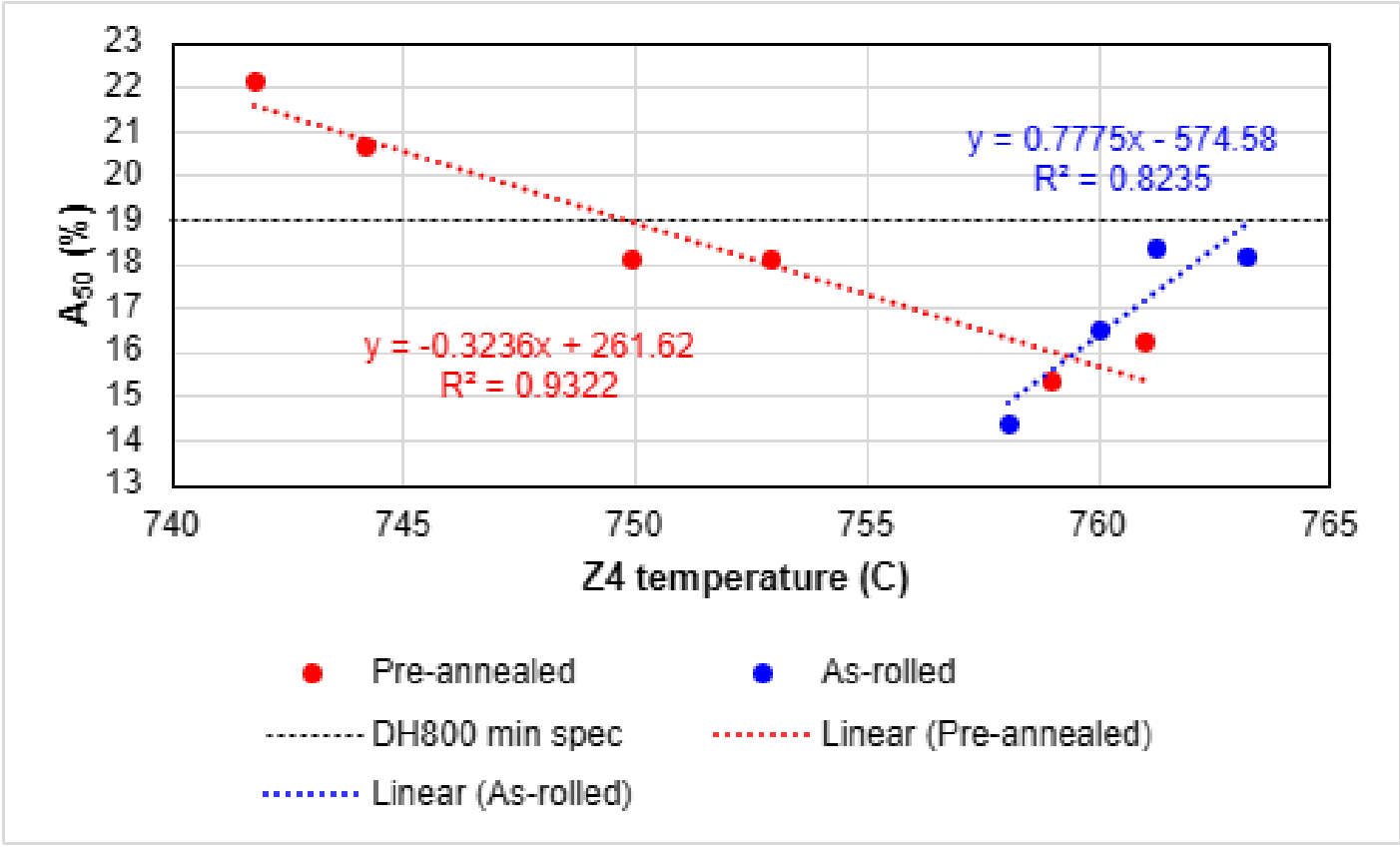


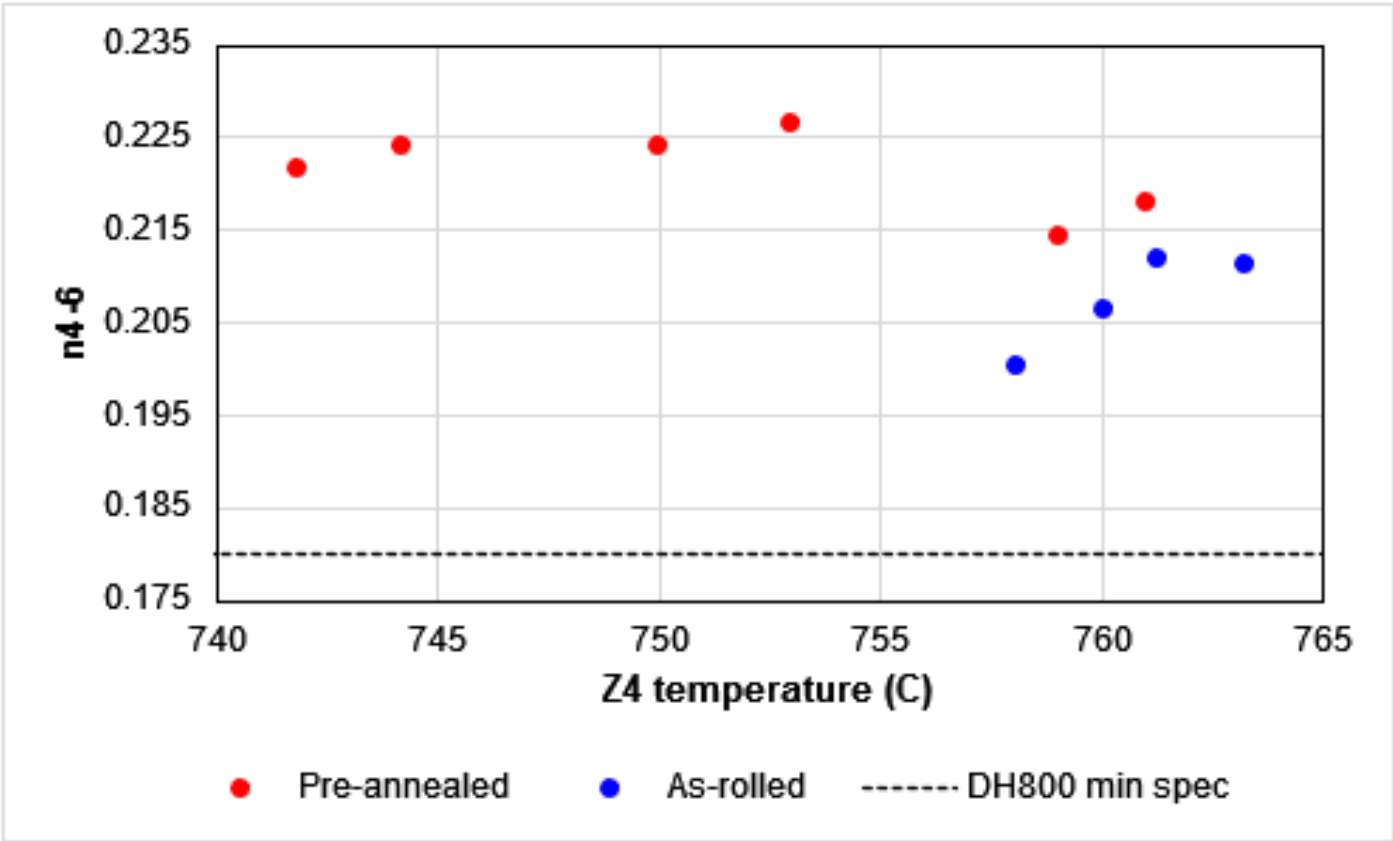
Illustration of the annealing process both test groups experienced after cold rolling. This mimics conditions found on the galvanising line this product is intended for.

Findings

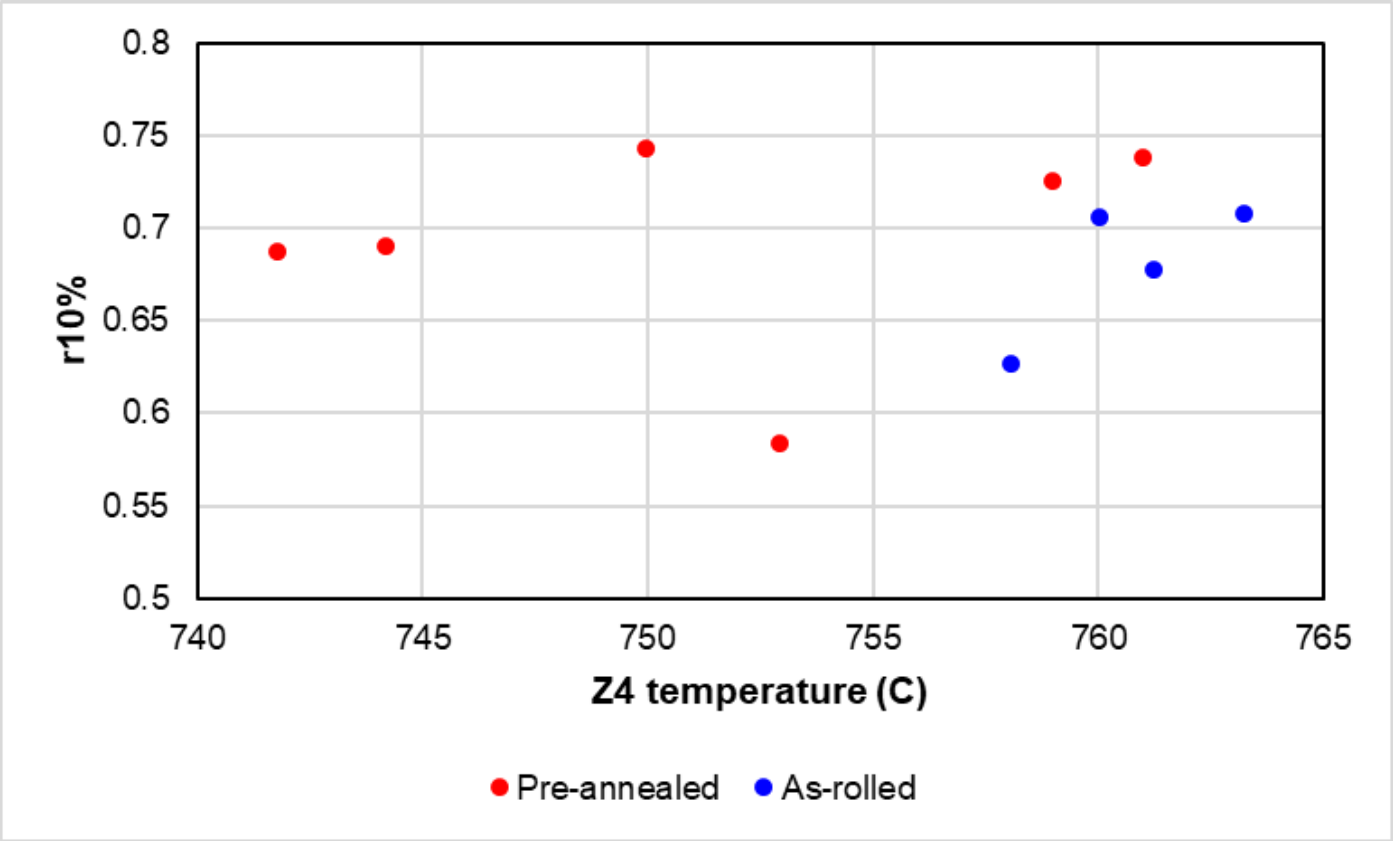
Experimental results met expectations, material that had the additional heat treatment cycle exhibited improved elongation, increased strain hardening, and a similar plastic strain ratio.



Elongation of test material compared to Maximum anneal temperature.
With a lower temperature in final annealing, the product has elongation properties in line with a DH800 grade



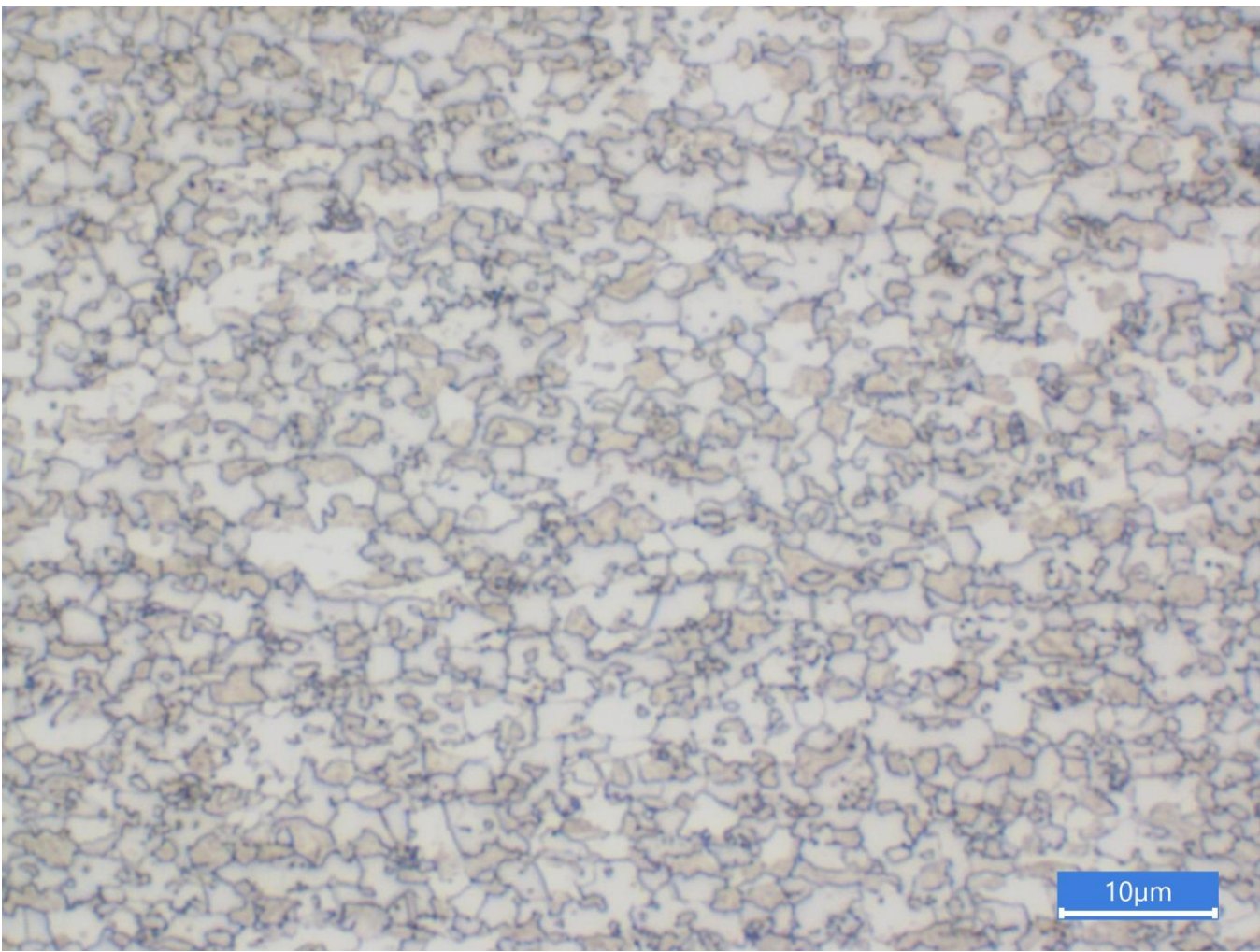
Strain hardening co-efficient of test material compared to Maximum anneal temperature.
While both test groups achieve the specification the test group performed consistently better.



Plastic strain ratio of test material compared to Maximum anneal temperature.
Both groups performed similarly, this indicates the test material remains reliable when used in pressing applications.

Based on the experimental findings the use of an intermediated heat treatment cycle offers a means of manufacturing dual phase steels with enhanced formability.

This manufacturing route can be performed without the need to re-engineer any part of the manufacturing process, offering opportunities for less technically capable equipment to compete in more advanced markets.



Microstructure of final product. The final result is a typical example of a Dual Phase steel. Sample was prepared in resin and etched using 5% Nital.

Acknowledgements

James Lelliot – Product technologist
[Metallurgical Design & Evaluation](#)

Neil Johnston – Metallurgist
[Metallography Department](#)

References

H K D H Bhadeshia and R W K Honeycombe (2017). Steels : microstructure and properties. Amsterdam: Butterworth-Heinemann.

Willian D. Callister, D. G. (2019). Callister's Material Science and Engineering:Global edition. Singapore: Wiley.

Mohrbacher, H. (2020). Metallurgical Effect of Niobium in Dual Phase Steel. Metal: advanced multiphase steels, 10-27.

C.Mathew Enloe, F. D. (2021). A Route for production of elevated Strength Cold Rolled HSLA Steel.