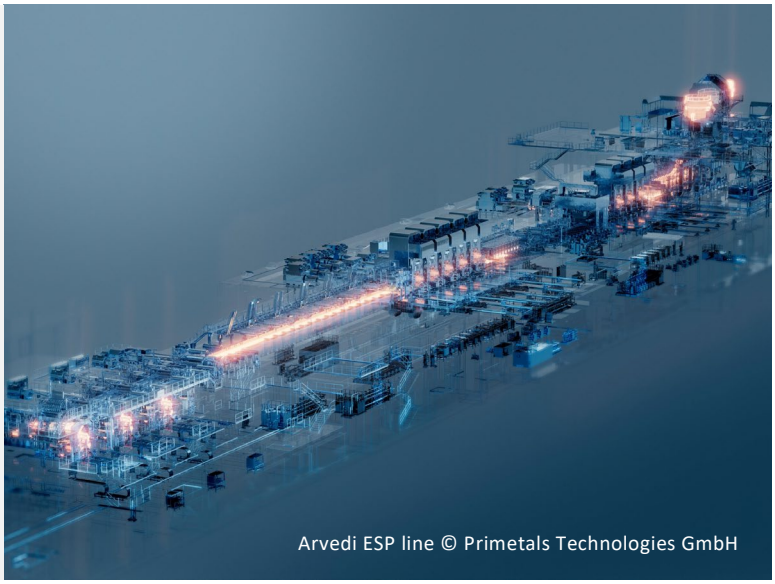
SUCCESS STORY

IC-MPPE
Integrated Computational Materials, Process and Product Engineering

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-K2 Centre

Type of project: AdvancedESP, 2018-2021, multi-firm


Arvedi ESP line © Primetals Technologies GmbH

NEW COMPUTER-ASSISTED METHODS FOR PRODUCTION OF TRIP STEEL WITH ESP – ENDLESS STRIP PRODUCTION

SIMULATION METHODS FOR HIGHLY EFFICIENT AND ZERO-CARBON EMISSION PRODUCTION OF TRIP STEEL ON ARVEDI ESP LINES

TRIP (Transformation-Induced Plasticity) steels are special high-strength grades with high ductility which, thanks to their high energy absorption capacity, are used in crash-relevant components in the automotive sector.

TRIP steels are typically produced in multiple processing steps, including slab casting, reheating, hot rolling, cold rolling and annealing. In contrast to this extensive processing, new strategies for producing hot-rolled TRIP steels for direct application using Endless Strip production (ESP) offer major energy and cost savings.

Another advantage, in addition to energy and cost savings, is that unlike conventional hot strip production and other direct casting and rolling concepts, the Arvedi-ESP process does not generate any significant direct CO2 emissions.

The main requirement for casting TRIP steels on thin slab casters is to avoid a peritectic solidification reaction. This is mandatory for the high casting speeds necessary for endless production.

With the help of sophisticated comprehensive simulation tools covering both the casting and the rolling/cooling part of the ESP line, TRIP steels with dedicated compositions were derived using through-process computer models. These newly developed types feature both proper castability as well as the

Federal Ministry
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Version 01/2020

necessary processing stability in the rolling/cooling part of the ESP line.

The ESP route for hot rolled TRIP steel consists of the material passing through the finishing mill in the austenitic state after casting and roughing. The strip is cooled to an intermediate temperature and held there isothermally for a few seconds to obtain the desired ferrite phase fraction on the laminar cooling line.

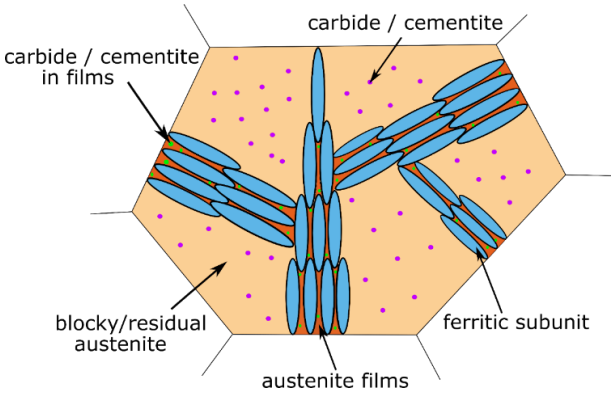

Fig. 1: Schematics of the formation of the main microstructure constituents bainite and residual austenite,
Image: TU-Wien/IMST)

In a second cooling step right in front of the coiler the strip is finally quenched to temperatures around 350°C, where most of the remaining austenite starts to transform into bainitic ferrite. This bainitic ferrite stabilizes the remaining metastable film-like austenite microstructure surrounding it by expelling its excess carbon, see Fig. 1.

The final microstructure after coil cooling then consists of ferrite, ferritic bainite and retained austenite. During deformation, for example in a car crash, the retained austenite then transforms into the strong phase martensite while consuming the crash energy during plastic deformation.

Impact

These new computer-assisted methods strongly accelerate the development of highly advanced value-added steel grades via the energy-efficient and environmentally-friendly ESP technology. In this way, the attractiveness of ESP as the leading direct casting and rolling technology is increased further.

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- TU Wien, Austria
- Primetals Technologies Austria GmbH, Austria
- RHI Magnesita GmbH, Austria

This success story was provided by the centre management and by the mentioned project partners for the purpose of being published on the FFG website. IC-MPPE is a COMET Centre within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMDW, and the federal states of Styria, Upper Austria and Tyrol. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet