TATA STEEL

TATA INNOVISTA
Celebrating Innovation

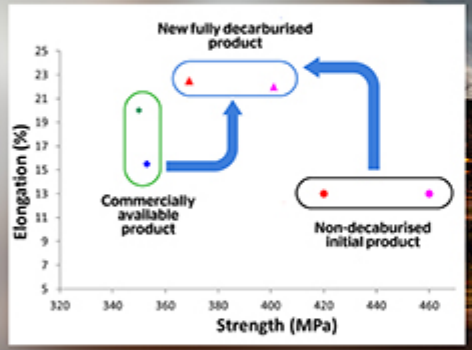
Full Decarburisation - High Formable Steels

By Tata Steel Europe | Category: Dare to Try

Full decarburisation is not desired in the steel process and significant amount of research has been dedicated to preventing it. Tata Steel Europe viewed the problem differently and turned it into an advantage to produce high formable steel with precipitate to give a certain strength to the material. The conventional process for ULC and IF implies the use of a vacuum degassing oven, which is a process bottleneck. The company aims to replace this step by removing carbon during the annealing.

The Context

Vacuum oven necessitates keeping the liquid steel for a long period, which is high energy and time consuming. With this process, though, the company is able to produce high formable steels during the annealing, thereby avoiding the vacuum oven step.



Potential Impact of the Innovation

revenue impact

€800,000

Overcoming Challenges

Challenge #1

Increase the decarburisation kinetic avoiding the formation of large oxide layer that would limit the decarburisation process.

Challenge #2

Check that the decarburisation did not significantly affect the carbonitride precipitates and that no free carbons were still present in fully decarburised samples.

The Innovation

The idea was to move up the well-known Elongation-Strengths banana plot. Free carbon removal drops the strength (compared to non-decarburised reference grade) but is partially compensated with grains refinement by adjusting the annealing cycle. The fully decarburised steel has equivalent elongation to an existing grade but has higher strength. The approach of the problem was divided into 2 steps:

Step 1: Investigating the benefit of the full decarburisation on the mechanical properties. The company used batch annealing since the heating time is long, and therefore suitable for a full decarburisation. Mechanical properties of decarburised samples were better than non-decarburised samples. This is due to HSLA to the initial high concentration of carbon and nitrogen, which promotes the formation of Nb (C, N). This is not the case for the ULC/IF grades.

Thus, the principle should be adapted to Continuous Annealing (CA) line. The challenge was to obtain full decarburisation in the CA industrial process.

Step 2: Focus on optimising the full decarburisation for CA by adjusting the annealing gas atmosphere, the dew point, and soaking time / temperature. The decarburisation was applied to low carbon and to HSLA with diverse composition. Strips with 1 mm gauge could be fully decarburised with the lowest production speed of CA production line. However, it was found that the method might not be suitable for all products. However, a similar texture with Bake Hardenable IF grades has been obtained, but with non-ageing problem (benefit for customers). The method was applied to an extended list of material grade. It was found that fully decarburised samples could have similar properties to DP grades.