Tata steel packaging (TSP) is seeking a way to manufacture the strongest packaging grade steel. TSP make has a yield strength of 700 MPa above the Ac1 temperature. To remain competitive in the market, TSP need to develop cost savings above the Ac1 temperature, tensile strength (Tm) remains competitive in the High N., high HR, low ST. 900 MPa chemistries that will be used. Allow downgauging, material savings, cost savings, and remain competitive in the market.

The challenge is to produce a stronger packaging grade with the following properties:
- Yield strength (Rp0.2) = 650-750 MPa
- Elongation value (AS0) = >5% in all directions after a double reduction rolling.

Effect of heat treatments on microstructure

Both grades were subjected to a slow heating to low/high soak temperatures, and a fast heating to low/high soak temperatures. Followed by an over ageing treatment. These heat treatments were conducted using a Gleeble 3500.

Annealing above the Ac1 temperature will result in a recrystallised and a multi-phase microstructure after cooling. Annealing just below the Ac1 temperature (within current production capabilities) will result in a recrystallised microstructure. The effect of both will be compared.

The chemistries

A low and high nitrogen grade was lab-casted in Ijmuiden, the Netherlands. The effect of nitrogen on the mechanical properties has been studied.

Why these temperatures

Annealing above the Ac1 temperature will result in a recrystallised and a multi-phase microstructure after cooling. Annealing just below the Ac1 temperature (within current production capabilities) will result in a recrystallised microstructure. The effect of both will be compared.

Reason for project

1. Tata steel packaging (TSP) is seeking a way to manufacture stronger packaging grades of steel as this product is also proposed by competitors.
2. The strongest packaging grade steel TSP make has a yield strength of 620 MPa, whereas competitor B and competitor C make grades of 700 MPa and 750 MPa respectively.
3. To remain competitive in the market, TSP need to develop a packaging grade of steel of equal, or better, mechanical properties than their competitors.

Effect of heat treatments on Double Reduced properties

After DR, samples were imaged and tensile tested to determine:
- Proof strength (Rp0.2)
- Tensile strength (Tm)
- Elongation value (At)

The elongation (At) of each sample was measured (see graph on the right) and optical images were taken (see optical images on the left).

Why these heating rates

High heating rate (fast annealing) is chosen because it keeps interstitial elements in solution and provides a greater number of nucleation sites for recrystallisation. More nucleation sites will result in a greater number of grains, which according to the Hall-Petch relationship, a smaller grain size yields greater strength and ductility. A low heating rate is chosen to replicate current production capabilities. The effect of both will be compared.