

# AHSS X-RAY PHASE FRACTION MEASUREMENT AND CONTROL



**MOST INNOVATIVE PARTNER**

Drever International's breakthrough system for measuring and controlling microstructure properties inside an annealing furnace has facilitated the production of advanced high-strength steel grades at Tata Steel.

## THE CONTEXT

Drever International is a leading manufacturer of continuous annealing furnaces used for producing advanced high-strength steel (AHSS). The annealing process is a key element in determining the mechanical properties of the final steel product. However, given the sensitivity of AHSS, conventional control parameters such as annealing temperatures are weak indicators of the final mechanical properties of the product. Hence, the company wanted a breakthrough technological system for measuring microstructure properties inside an annealing furnace to facilitate and improve the production of modern steel grades.

Drever was working with Segal to implement a furnace mathematical model together with an online device for measuring quality. They were developing this in close collaboration with the SMS group, which was focusing on fundamental research in metallurgy. On realising that their X-Ray diffraction technique was on the brink of achieving a real-time application, SMS and Drever sought out IMS, a leading manufacturer of x-ray, isotope and optical measuring systems for metals. The three conducted a collaborative laboratory study in 2015 when Tata Steel was talking to Segal for a tie-up.

As part of this, Drever agreed to provide its furnace model and engineering competence while IMS would provide the technical know-how for implementing innovative high-performance measuring technology and SMS, its metallurgical expertise.

## THE INNOVATION

The production of AHSS places high demands on the metallurgical route to produce steels. The annealing/galvanising process, especially for the automotive market, is a key element in influencing the final product's mechanical properties.

In the conventional process, a fraction of the manufactured steel coil is downgraded, resulting in economic losses. Drever developed a novel x-ray diffraction (XRD) gauge in the annealing furnace, which measures the steel phase fraction online. Based on this, a targeted control mechanism then corrects the process conditions for any possible deviation. The XRD innovation enables the production of advanced steel grades with higher yield, increased throughput and greater value-addition.

## KEY CHALLENGES

### TO OPERATE THE SYSTEM IN REAL TIME IN A PROCESSING LINE

The team achieved this by designing and selecting the right hardware components and designing the image processing and phase analysis algorithm.

### TO DESIGN A PHASE ANALYSIS METHOD THAT WORKS WITHOUT ANY ADDITIONAL USER INPUT FOR PARAMETRISATION

Laboratory procedures require reference measurements and user intervention for preparing a measurement. This is not acceptable for an industrial system. Calibrations must be performed automatically, quickly and without parameter inputs by operating personnel. The team designed the phase analysis method to run stably with automatic compensation of influencing variables and self-triggering calibrations for the x-ray detector.

## THE IMPACT

The new control and measurement system have enabled Tata Steel to produce AHSS grades and thereby increasing its revenues.