# ABSTRACT

Three TRIP aided steels based on CMnSiAlP (low-Si grade), CMnSiAlNb (low-Si grade) and CMnSiNb (high- Si grade containing 1.5 wt% Si) compositions were designed aiming improved coatability and weldability. The attributes of these three grades in terms of microstructure, mechanical properties, coatability and weldability were compared. An ANN model was developed to predict the amount of retained austenite as a function of composition and heat treatment parameters. The amount of retained austenite predicted through the ANN model agreed closely with the values measured experimentally through optical microscopy and X-ray diffraction technique. The heat treatment parameters were designed based on the combination of the empirical ANN model, theoretical calculation through Thermo-Calc and dilatometry studies using Gleeble 1500D simulator.

The heat treated materials tested under quasistatic condition as well as under high strain rate condition showed high ultimate tensile strength, low yield strength / ultimate tensile strength ratio with high strain hardening exponent, very good total and uniform elongation and a capacity for high energy absorption. These results confirm excellent strength and formability combination of the material. The results also indicated the suitability of the material for crash resistance applications in auto-bodies. Experimentally, the progressive transformation of stable retained austenite was also confirmed. Reduction of silicon in the two low-Si grades did not have much effect on the amount and stability of austenite. However, the effect of reduction of silicon content is reflected in the low strength values in the two low silicon grades.

Introduction of post weld heat treatment cycle (i.e. tempering) during resistance spot welding improved the weldability of all the three grades. However, the low silicon grades showed better results than the high silicon grade containing 1.5 wt% silicon.

TRIP steels with silicon level of around 0.5 – 0.6 wt% with Al and Nb/ P showed improved coatability during galvanising when compared with the conventional TRIP aided steel containing 1.5 wt% silicon. Further improvement was achieved through maintaining higher dew point during thermal processing before galvanising.

The results of this work are encouraging in terms of its scientific value as well as its significance for the development of high strength steel for light-weight auto bodies with additional requirements of good formability and crash resistance properties along with improved coatability and weldability.

**Key words:** TRIP aided steel, Microstructure, Retained austenite, Artificial Neural Network (ANN) model, Strength and Ductility, Crash Resistance, Coatability, Weldability.