Effect of cutting-edge condition on stress-corrosion cracking susceptibility of Advanced High Strength Steels

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Advanced high strength steels (AHSS) offer the possibility to develop lighter cars to reduce fuel consumption and CO₂ emissions but also higher crashworthiness of vehicles. Eventual failure in a long-term use under mild corrosive environments is potentially a crucial problem for structural components of AHSS. There are several stages in the manufacturing process of Body in White (BIW) parts which promote stress corrosion cracking (SCC). Specifically, cutting operations may increase SCC susceptibility of AHSS and even reduce the service life of a component, leading to possible catastrophic failures. Therefore, appropriate research on the effect of cutting-edge surfaces on SCC susceptibility of AHSS has to be carried out aimed at optimising cutting technologies.

The main focus of this work is to determine the effects of cutting-edge surfaces on the stress-corrosion cracking behaviour of boron alloyed steel 22MnB5 (Usibor 1500) with an Al-Si coating commonly used in hot stamping. SCC susceptibility depending on cut edge conditions has been assessed using slow strain rate tests (SSRT) according to ASTM G129 in an aqueous solution containing 5% of sodium chloride at room temperature. SSRT have been conducted in specimens with a central hole with different edge surface conditions. Central holes have been punched by different cutting technologies, giving rise to different edge qualities. Sheared edge quality have been characterised using optical microscopy and scanning electronic microscopy. Focus variation technique has been used to optically analyse surface features and form, as well as surface roughness of cut edges. Finally, SCC susceptibility has been related to the punching parameters and material properties.