Novel press hardening process for Boron Steel

Overview
An improved press hardening process for Ultra High Strength Steel (UHSS or Boron Steel) reduces cooling cycle time by more than 50% leading to an increase in productivity of over 25%.

The use of UHSS is increasing rapidly in automotive body in white due to its use for weight reduction which contributes to fuel saving. It is typically used for safety critical panel components such as A-Pillars, B-Pillars, bumpers, side impact bars etc. The use of UHSS is expected to double over the next 5 years and this trend can be accelerated by the “Super Cool” in-die quench technique developed by engineers at Imperial College.

Technology
The “Super Cool” process can be used on existing grades of Boron Steel and process equipment but a pre-cooling step is introduced between the initial heating of the sheet material and its insertion into the forming tool. Using forced cooling on the sheet as it is transferred to the die, the austenised UHSS sheet is cooled to a lower temperature (i.e. 500°C), before being formed using a similar press but the in-die quench time is reduced to 3-5 seconds from 6-10 seconds. In this way, the material properties are carefully controlled to improve “drawability”, maintain and indeed enhance the material properties as well as reducing cycle time.

The “Super Cool” process not only improves productivity but also provides designers the ability to enhance the functional performance of components through creating more complex shapes, greater depth of features and potential for combination of parts. Other areas of process efficiency improvement include more uniform thickness distribution of formed parts, lower energy

Figure 1: In-die quenching time for cooling the formed part to 250 °C against initial sheet stamping temperature for different cooling contact pressures.

Brian Graves
Senior Technology Licensing Executive
e: brian.graves@imperialinnovations.co.uk
t: +44 (0)20 7594 6598
Technology reference number: 5877
input for heating, longer die life, lower costs die materials and less cooling requirement for dies. The technology has been proven in practice and B-Pillar sample components have been produced on production equipment.

**IP**
The process is patented by Imperial Innovations (published WO 2013/045933). There is also considerable know-how associated with applying this technique to specific component and process designs. The team at Imperial has a profound understanding of fundamental of the metallurgy and heat treatment effects, viscoplasticity of material in hot stamping conditions. This also includes strain and strain-rate hardening which enables higher formability and draw depth. This knowledge is enhanced by practical methods for measuring and controlling process parameters.

**Team**
The team is led by Prof. Jianguo Lin FREng (http://www3.imperial.ac.uk/people/jianguo.lin) who is one of the world’s foremost authorities on metal forming. Work on UHSS began in 2002 and has been developed through various projects (worth over £1m) which have included collaboration with major industrial partners to develop fundamental understanding the material behaviour and the production process.

The team is seeking a collaboration with an industrial partner to develop components for use on production vehicles.