EFFECT OF RESISTANCE SPOT WELDING PARAMETERS ON TENSILE-PEEL FORCE OF S700CR STEEL JOINTS

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ABSTRACT

Resistance Spot Welding is the most applied joining method in automotive industry. A vehicle can contain between 3000-5000 spot welds. As well as strength of material itself, mechanical properties of joining structure should be investigated. In this work, joinability of S700cr steel which is relatively new member of Advanced High Strength Steel (AHSS) have been studied. The weldability is evaluated in terms of current density, welding time and its relationship with tensile-peel force. The conclusions illustrates that the maximum tensile-peel strength is obtained as 2150N at 9,7 kA welding current and 20 period welding time.

Keywords: S700cr, Tensile-Peel force, resistance spot welding

1.INTRODUCTION

In recent years, it is aimed to produce parts that have the same quality with less material without losing safety in automotive and trailer industry [1]. Furthermore, sensitivity to weight reduction, fuel saving and greenhouse gasses is also driving motivation for new material development efforts [2]. To meet these requirements and design problems, steel companies have developed new generation steels called Advanced High Strength Steels (AHSS)[3]. The S700cr steels are among the most important new generation steels in the trailer sector. Cold rolled s700cr steel a robust structural steel. These steels allow lightweight design structures.

Resistance Spot Welding (RSW) method is a fast metal joining method which is simple, suitable for mass production and can work with automation systems[4][5]. RSW does not require additional materials compared to other welding methods. RSW starts with the compression of two sheet plates between two electrodes. Heat is generated between by electrical resistance which passes through sheet plates. The highest electrical resistance formed on the interface where the plates contact each other. Therefore, heating and melting due to this electrical resistance is formed at this point. When the current passing through the electrodes and plates is halted, the melted microstructure is solidified by the water cooled electrodes and thermal conductivity of material itself. Solidification is also characterized by holding time forms the welding core rapidly. Then, the welding process is completed. The duration of this process takes less than a second.

However, in view of the application quantity, their weldability should be investigated in detail to obtain information for future design problems. S700cr is widely utilized in trailer design and their resistance spot weldability not coincided in literature. In this study, the effects of welding time and welding current intensity on tensile peel force of S700cr steel sheet were investigated.

2. Material and Method

RSW experiments were performed in an industrial machine with 120KVa welding current capacity and welding time controlled pneumatic system. Electrodes with 6 mm tip diameter and water-cooled Cu-Cr electrodes were used. The S700cr sheets with 1.5 mm thickness were sliced to 30x100mm. Then, the surfaces were ultrasonically cleaned for 30 min to remove dirt, oil and other contaminants. The chemical composition is shown in Table 1.

C	Si	Mn	P	S	Cr	Ni	Mo	V	Ti	Cu	Al	Nb	B	Cekv
0.134	0.18	1.46	0.012	0.004	0.03	0.04	.00	0.02	0.00	0.01	0.049	0.015	0.0001	0.39

Table 1. Chemical composition of S700Cr

Figure 1. Sample of tensile-peel test

The welding times were adjusted between 10-30 periods (1 period equals to 0,02sec) with 5 period increments. The current ranges determined between 6,3-13,1 kA in the light of pre-experiments with 0.5 Ka increments. Specimens were welded with a positioning fixture and bended from 30 mm (ISO 14270:2016). The electrode pressure adjusted as 5 kN. The detailed processing parameters illustrated in Figure 2. The whole experiments executed under constant electrode force. All experiments repeated 3 times and the average results have been cast in graphic with curved interpolation.

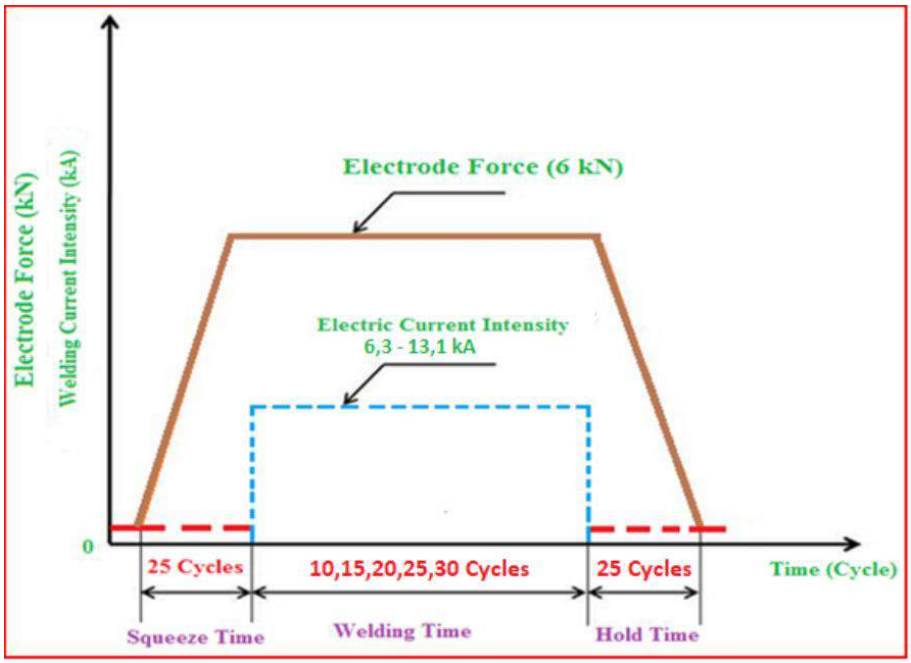

Figure 2. Detailed processing parameters

3.Results and Discussions

The effect of the welding time on the tensile-peel force of RSW applied S700 CR steel sheet joints are shown in Figure 3. According to the tensile-peel test results, the heat input which affects the welding core size increases as the period duration increases and then the tensile-peel force increases. However, it causes expulsions from weld center at high periods causing excessive heat input, and as a result, tensile-peel forces are reduced. Similarly, the same behavior occurred at lower periods as the current increased. The highest tensile-peel force is observed at 9.7 kA current intensity during the welding period of 20 cycles.

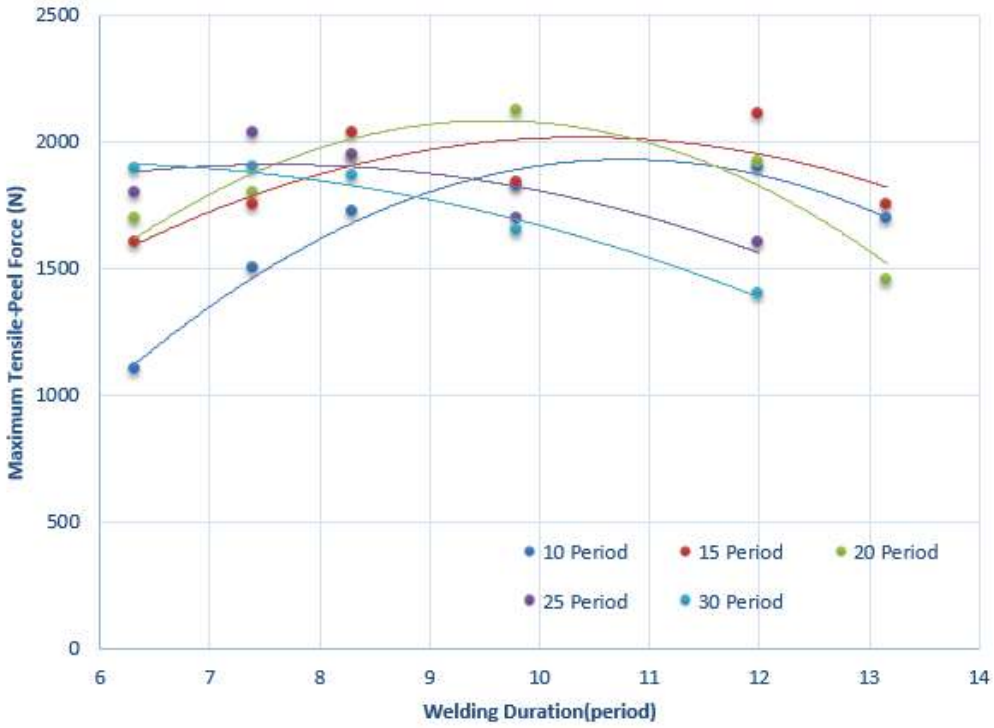

Figure 3. Effect of welding time on tensile-peel force

The effect of welding current intensity on tensile peel force is shown in Figure 4. Small welding nugget sizes were observed at low welding currents. The tensile peel force is decreased because of insufficient weld nugget diameter due to low heat input.

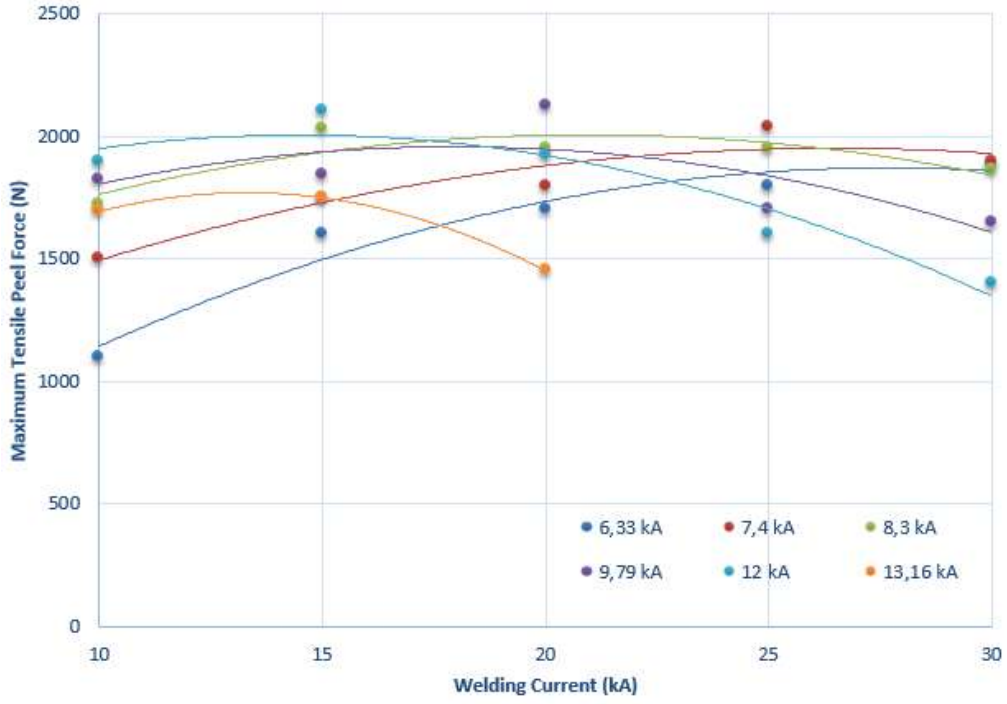

Figure 4. Effect of welding current on tensile-peel force

4.Conclusions

Based on this investigation, following conclusions can be drawn;

1. S700 cr steel sheet joints successfully welded with RSW.

2. The maximum tensile-peel force obtained at 9,7 kA welding current and 20 period welding time as 2150N.

3. The optimum weldability ranges are between 15-25 period Welding durations and 6-10 kA welding currents.

4. Tensile peel forces are soared at a maximum level, and then decreased due to expulsions induced by high heat input.

5. A taguchi method can be applied for experiments to achieve results more quickly and efficiently.

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