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Exploring the electrodes alignment and mushrooming effects on weld geometry of dissimilar steels during the spot welding process

NACHIMANI CHARDE

[1]Department of Mechanical, Material and Manufacturing Engineering,
The University of Nottingham Malaysia Campus, Jalan Broga,
43500 Semenyih, Selangor Darul Ehsan, Malaysia
[2]Department of Mechanical Engineering, Faculty of Engineering, University of
Malaya, 50603 Kuala Lumpur, Malaysia
e-mail: nachi.charde@nottingham.edu.my;nachimani@um.edu.my

Abstract. The class two of RWMA electrode caps has very common application-purpose for the welding of steels and withstand for high thermal application on wrought cast. It has been experimentally used to weld carbon and stainless steels up to 900 weld attempts using AC waveform, C-type JPC 75 kVA, Japanese made spot welder. So the electrode alignments and resulting mushrooming effects are finally analysed in this research as well as the weld geometry of dissimilar (carbon and stainless) steels. When considering such weld joints, the heat imbalances are very interesting factors on spot welding research and therefore I have simulated the dissimilar weld joints using Ansys 14. Initially, it was simulated and later those results are compared with real welded samples. The common welded regions such as: fusion zones, heat affected zones, heat extended zones and base metals are all well-noticed for carbon steel sides but not for stainless steel sides. Besides, the electrode mushrooming effect on both sides of electrodes are not parallel deterioration and it has some demerits on internal structure indeed. Some of the dissimilar welded samples and electrode caps are eventually underwent metallurgical test to identify the improper alignment.

Keywords. Spot welding; dissimilar joints; electrode deformation; electrode mushrooming.

1. Introduction

The geometry of dissimilar weld joints is basically made of asymmetrical weld nuggets. In such welding joints, the heat imbalances will be the main factor and it has to be properly aligned in the middle of base metal to produce a proper weld nugget (Aravinthan & Nachimani 2011a). So the electrode alignment during welding process plays a significant role on the formation of weld

geometry. In this research, the carbon and stainless steels are analysed for the weld nuggets alignment as well as the mushrooming growth of electrodes after 900 welds were done. The growth of the weld nugget is therefore determined by the welding current, sufficient time for current delivery, reasonable electrode pressing force and sufficient area for current delivery (electrode tip) (Aravinthan & Nachimani 2011b). Basically, the welding current and weld time lead to the root generation of heat in the welding process while the electrode pressing force and electrode tips' accomplish it successfully (Mehdi *et al* 2008). Although the welding current and weld time cause the heat generation at the concerned areas (electrode tips' area); the electrode tips diameter and electrode pressing forces are also directly influencing the welding process (Nachimani 2012). So the class two electrode types are engaged in the welding process and consequently monitored the deformation and mushrooming effects after approximately 900 welds were done.

2. Experimentation

The carbon and stainless steels were prepared in rectangular shape (Chang *et al* 2006) with a size of the length (200 mm); width (25 mm) and thickness (1 mm). A pair of water cooled (2 litters per minutes) 30 degree truncated type of electrodes (5 mm of diameter) was used to join (JPC 75 kVA) of these base metals as shown in figure 1. The pair of test sample was initially loaded on the top of lower electrode (tip) of the welder as overlaying 60 mm on each other (lap joint) and then the initiating pedal was pressed. The upper electrode lever has moved towards the lower electrode and squeezed the based metals that placed in between (Rao *et al* 2009). The welding current was released immediately after the squeezing cycles of pneumatic based electrode actuation is achieved. Thereafter the electrode pressing mechanism has consumed some time for cold work and eventually returned to the home position of upper electrode (Yeung & Thornton 1999). These process controlling parameters (welding current, weld time and electrode pressing force)
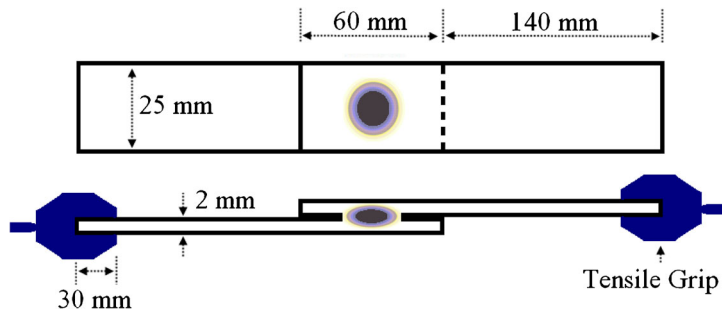

Figure 1. Lap joint welding process.

Table 1. The chemical properties of base metals.

304L (2B) Austenitic stainless steel							
Element	C	Cr	Ni	Mn	Si	S	P
	0.048	18.12	8.11	1.166	0.501	0.006	0.030
Carbon steel							
Element	C	Cr	Ni	Mn	Si	S	P
	0.23			0.90	0.006	0.050	0.040