International Journal of Agricultural Engineering, Vol. 2 No. 2 (October 2009 to March 2010) : 202-206

Research Paper :

Process optimization in joining aluminium alloy 7039 using TIG arc welding process

PAWAN KUMAR SHARMA, K.P. KOLHE AND C.K. DATTA

Accepted : *May, 2009*

See end of the article for authors' affiliations

Correspondence to:

PAWAN KUMAR SHARMA
Department of Mechanical Engineering, Delhi College of Engineering, DELHI, INDIA

ABSTRACT

This paper depicts an application of GTA Welding for Aluminium alloy 7039 (AA7039) using pure argon gas as a shielding agent with sinusoidal AC wave. Variations of microhardness of AA7039 from weld zone to unaffected base metal were studied at various currents and frequencies. Microstructural changes of welded AA7039 were also studied. AA7039 is a heat treatable and weldable Aluminium-4.5%, Zinc-2.5% magnesium alloy. Magnesium is alloyed with aluminium for increasing mechanical properties, corrosion resistance and easy machinability. Zinc is usually added to improve mechanical properties through formation of hard intermediate phase, such as Mg_2Zn. Gas Tungsten Arc Welding process (GTAW) was found to be the the best preferred welding process for high strength Aluminium alloy due to easier adaptability and better economy.

Key words : GTA Welding process, Aluminum Alloy 7039, Microhardness, Microstructure

A demand for lighter and stronger aluminium armour for protection against high explosive shell fragments in the early 1960s led to the introduction of AA7039. Heat treatable aluminium alloys are widely used in aircraft structural applications and are susceptible to localized corrosion in chloride environments, such as pitting, crevice corrosion, intergranular corrosion, exfoliation corrosion and stress corrosion cracking. AA7039 is employed in aircrafts, automobiles, high-speed trains and high-speed marine applications due to their low density, high specific strength and excellent corrosion resistance. It was used in the armoured hulls of M551 light tanks and XN723 IFV in USA. AA7039-T64 exhibits better performance against ball and armour piercing than 5083. Creation of this material made it possible to design and put into full scale production one of the best infantry fighting vehicles in the world–BMP–3. The aluminium armour of the vehicle ensured at least 1500 kg of weight savings as compared to a steel armoured hull of the same protection level. Many of the aluminium alloys also exhibit excellent weldability as a prime requirement for any engineering structure, where welding is a predominant fabrication route. Aluminium is an excellent conductor of heat. It requires large heat inputs when welding begins, since much heat is lost in heating the surrounding base metal. As welding progresses, much of this heat moves ahead of the arc and pre-heated base metal to a temperature requiring less welding current than the original cold plate. If the weld is continued farther on to the end of the two plates where there is nowhere for this pre-heat to go, it can pile up to such a degree as to make welding difficult unless the current is decreased. The GTAW process is one of the most well established processes, which not only weld all metals of industrial use but also gives the best quality welds among the arc welding processes. The pulsed GTAW process was developed in the Soviet Union. The advantage of this process includes the better control of heat input and penetration (Becker and Adams, 1978).

The increased numbers of variables in the pulsed GTAW process also support the possibility of increased control of the solidification process. The current and arc length are selected to adjust the weld depression and width behind the weld pool rear in order to control the full penetration state. The change in either the current or the arc length will generate variations in both the weld depression and weld width in gas tungsten arc welding (Zhang *et al.*, 1996). The basic requirements of all GTAW processes are similar, *i.e.* a power source, a hand or machine manipulated torch, a pressurized supply of a suitable inert gas or gas mixtures from cylinders and cables of correct size to conduct welding current from the power source to the torch and tungsten electrode. GTAW is the best preferred welding process for high strength aluminium alloys due to easier adaptability and better economy.

The use of non-heat treatable fillers that can resist hot cracking is more meaningful in welding 7xxx series alloys. In these alloys, as long as possible the weld metal contains 3% Mg or more, hot cracking is not a serious problem (Balasubranian *et al.*, 2007 and 2008a). Ramesh (1977) reported that pulsed current automatic TIG welding