SPECIAL SAM NOTES

FUSION CHARACTERISTICS OF AUSTENITIC STAINLESS STEEL GMAW WELDS

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***Abstract*— Shielding gas is a key element in GMAW (Gas Metal Arc Welding). It represents only a small percentage of the overall production cost, and its proper choice makes possible to obtain well shaped and faultless beads, increasing both productivity and quality and therefore resulting cost saving. The influence of several shielding gases on the fusion characteristics of GMAW using solid wires of austenitic stainless steels is assessed in this work. Beads on plate welds are performed on AISI 304 steel plates using ER 308LSi welding wire according to AWS A5.9 and the following shielding gases: Ar, Ar-O_2, Ar-CO_2, Ar-He-CO_2, He-Ar-CO_2, Ar-CO_2-NO, Ar-NO, Ar-He-H_2, Ar-He. For these gas mixtures, stability and geometry of the weld are evaluated, determining depth of penetration, bead reinforcement height, width of the bead, wetting angle, fusion angle, total fusion area, plate fusion area and dilution. A comparative analysis of the results which are obtained with the different gas mixtures is carried out.**

***Keywords*— Welding, stainless steel, shielding gases, GMAW process.**

I. INTRODUCTION

GMAW has become an efficient manufacturing method for producing many types of welded structures. The reasons for the rapid development of GMAW are associated with high productivity, flexibility, and automation potential (Svensson and Elvander, 1999).

Today, the users of this process have started to realize that the shielding gas is not simply a component of the welding process. It is a "key" element in the three fold welding process: power source – material – shielding gas.

It is well known that the shielding gas, which represents about 3% of the total cost, has a noticeable effect on the GMAW features. According to Irving (1999), a proper choice of the shielding gas may lead to increased productivity and quality, as well as considerable cost saving through the production of well-shaped faultless beads.

II. EXPERIMENTAL PROCEDURE

"Bead on plate" GMAW welds were performed by using different shielding gases. The components of the different gas mixtures which were used in this work are shown in Table 1.

AISI 304 steel plates (80 x 200 x 6.4 mm) were used as base material. As a filler metal, a 1.2 mm solid wire of ER 308LSi, was used according to AWS A5.9. Chemical compositions of the base material and the solid wire are shown in Table 2.

A direct current power source was used to perform the bead on plate welds by means of automatic GMAW process. Welding parameters were chosen in order to obtain spray transfer mode for all shielding gases. These parameters were recorded and monitored through specific software for welding and they are shown in Table 3.

Table 1. Chemical composition of shielding gases.

Gas	Components (%)
A*	Ar:81+He:18+CO_2:1
B**	Ar:98+O_2:2
C**	Ar:43+He:55+CO_2:2
D**	Ar:98+CO_2:2
E*	Ar:100
F*	Ar:96+CO_2:3+H_2:1
G*[1]	Ar:95+He:5
I*	Ar:98+O_2:2
J*[2]	Ar: 99.97+NO:0.03
K*[2]	Ar:97.97+NO:0.03+CO_2:2
L*	Ar:78+He:20+CO_2:2

***** Trade mixture
****** Certified mixture
[1] Usually recommended for GTAW
[2] NO is added for stabilizing the arc and reducing the ozone in working environment.