13th International Research/Expert Conference
”Trends in the Development of Machinery and Associated Technology”
TMT 2009, Hammamet, Tunisia, 16-21 October 2009

THE INFLUENCE OF WELDING PARAMETERS ON THE SURFACE WELD METAL GEOMETRY OF AL-ALLOYS

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ABSTRACT
In this paper is shown the influence of welding parameters (protective atmosphere and welding speed) on the weld width and reinforcement. Prepared plates of Al alloy AlMg4,5Mn were surface welded by MIG process, in four different gaseous protective atmospheres, with same filler material. It is shown that increase of He content in protective atmospheres affects the increase of weld width, but the decrease of reinforcement. It is also shown the effect of welding speed on the surface weld metal geometry.
Keywords: Al alloy, MIG welding, weld geometry, welding parameters

1. INTRODUCTION
Safety of welded joints to a large extent determined by exploitation safety and efficiency design. The presence of defects in the welded joints, non-required properties, shape and homogeneity of weld, as well as the properties and homogeneity in the heat affected zone, it can disrupt sturdy and exploitative characteristics of the structure. The appearence of defects in the weld, among other things, to influence and improper welding parameters selected. Choice of protective gas, current strength, voltage and welding speed can significantly affect the quality of welded joint. Dimensions and visual appearance of the weld, affect the safety of welded structure, and among other things, depends on the type of protective atmosphere during welding [1].
Welding in protection gas mixture provides a number of advantages in relation to welding in the protection of pure gases, such as more efficient filler metal transfer, better liquidity, stabilization of the electric arc, higher penetration, lower spattering and increase of welding speed [2,3]. Over the physical properties of the protective gas affects the degasation of metal pool, regulation of penetration profile and ability to soaking.
In an atmosphere of argon is easy to establish an electric arc, which is cylindrical shape, clearly illuminating and hard limited. Because of its high density, argon well-protects welding pool, is not prone to turbulence and shows the strong effect of cleaning the cathode surface. Argon is in use in the process of welding with consumable and nonconsumable electrode, and for steel and non-ferrous metals. Argon has a low thermal conductivity and ionisation potential, properties that contribute to the low heat bringing the arc. This forms the narrow arc that forms a narrow and deep shape of the weld.

In the MIG welding of pure aluminum mixture of argon helium provide a high weld quality, where a component of helium increases voltage of arc and allows the increase of welding speed and penetration, increasing the width and depth of penetration. Due to larger heat input, reduces the amount of pore and the possibility of incomplete fusion. The advantage of the wider arc is greater reliability in deposition of filler material [4].
In the recent development of the new mixture for welding aluminum. Thus, addition of oxygen to argon in the amount of 300ppm leads to the stable arc, with measurable results through the stabilization of current and voltage with minimal fluctuations. Improvements are visible in the HAZ narrowing and increase of welding speed, and finer edges and weld appearence [5].

2. EXPERIMENT AND DISCUSSION

With a view to estimate the influence of welding parameters on the weld geometry, prepared plates of Al-alloy AlMg4.5Mn were surface welded by MIG process, in different protective atmospheres, as shown in Table 1. The used filler material was wire with zirconium addition, AlMg4,5MnZr, Ø 1,2 *mm.* The strength of current and voltage were choosen to provide optimal arc stability. Figure 1 shows surface welded plate No. 4.

Table 1. Composition of protective atmospheres, welding parameters, weld width and reinforcement

Plate No. and gas composition	No. of surface weld	I (A)	U (V)	V (cm/min)	Q (kJ/cm)	width (mm)	reinforcement (mm)
I Ar	1	210	26	33.6	9.8	13.63	3.98
	2	215	27	37.7	9.3	13.42	3.21
	4	208	26	53.1	6.1	10.49	2.66
II Ar+30%He	1	206	26	33.4	9.6	14.02	3.46
	2	203	27	32.0	10.3	14.28	3.62
	4	207	26	53.7	6.0	11.17	2.54
III Ar+50%He	2	218	27	40.6	8.7	15.66	2.87
	3	220	26	36.8	9.3	16.16	3.47
	4	210	26	59.1	5.6	11.86	2.10
IV Ar+70%He	1	224	28	45.5	8.3	15.12	2.61
	2	227	29	41.1	9.7	15.60	2.76
	3	218	28	38.2	9.6	16.63	3.25
	4	224	28	60	6.3	13.32	2.13

Table 1 clearly shows that increase of helium content in protective atmosphere affects the increase of strength of current and voltage. The increase of helium content in protective atmosphere also affects the welding speed increase (surface weld No.4 at all plates). On the basis of experimental data given in Table 1, Figures 2a and 2b represent the influence of composition of protective atmospheres on the weld width and reinforcement, as well as the influence of welding speed on the weld width and reinforcement, with protective atmospheres mentioned above (Figures 3a and 3b).
In Figure 2a is clearly seen that increasing the content of helium in protective gas increases the surface weld width (welding speed 53,1-60 cm/min, welds No.4 at all plates). This increase in width of surface weld is more marked with a greater proportion of helium, even if the welding speed is higher (plates III and IV). Of course, it should bear in mind that the increase of helium content affects the increase of strength of current. The lowest width is detected in plate I (surface welding in protective atmosphere of pure Argon).
In Figure 2b is shown the influence of protective atmospheres on the reinforcement, which can be seen that with increasing helium content in the protective gas leads to decreasing of reinforcement, except in plate IV coming to the discrepancies. This negligible increase of reinforcement can be attribute to higher strength of current that are implemented, due to arc stability with greater helium content.

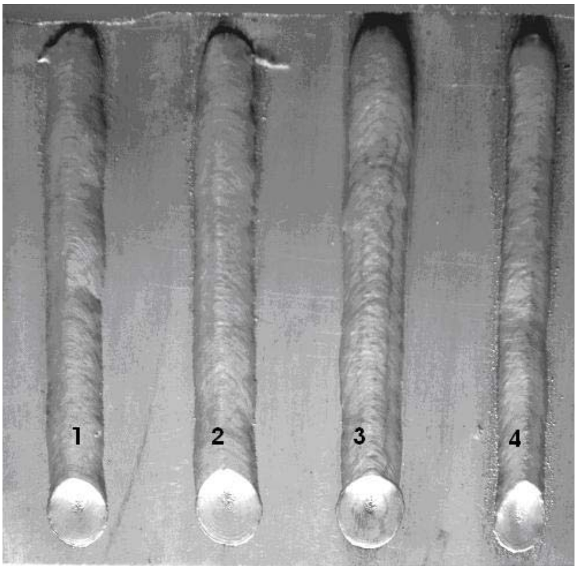

Figure 1. Surface welded plate IV with four different welding parameters

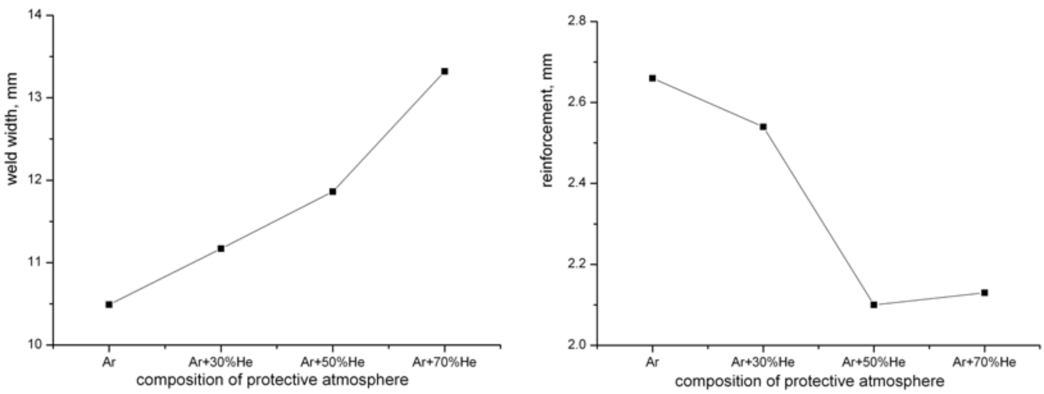

Figure 2. Composition of protective atmosphere vs. a) weld width, b) reinforcement

Figure 3 shows the influence of welding speed on the weld width, in different protective atmospheres. Higher speed causes lower weld width. The composition of protective gas significantly affects the weld width, so that a higher content of helium in the atmosphere causes higher weld width. Increase of welding speed also affects the lower reinforcement, which is shown in the Figure 4. Also, the increasing proportion of helium decreases reinforcement.

By visual examination of surface welded plates is observed that increase of helium content in protective gas affects the better spilling of molted material which gives slightly transition from weld to base metal. The worst spilling is observed on the plate welded in protective atmosphere of pure Argon , and the best spilling on the welded in protective atmosphere of Ar +70% He. Increasing proportion of helium in the protective gas also affects the better uniformity of width and height of surface weld, and better weld forming. In this way, could be avoid a rush transitions from weld metal to base metal, which often can be stress concentrator.

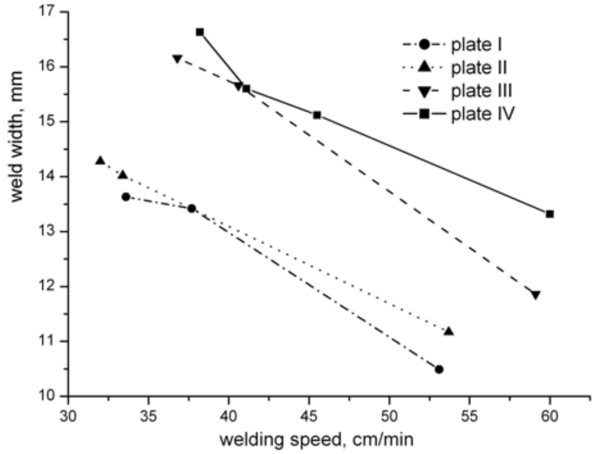

Figure 3. Welding speed vs. weld with

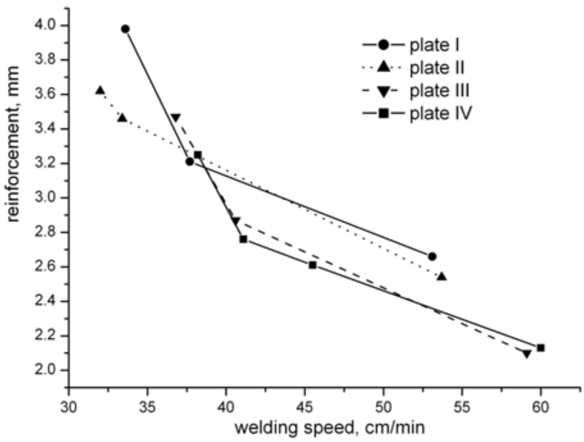

Figure 4. Welding speed vs. reinforcement

3. CONCLUSION

1. The increase of helium content in protective atmosphere affects the better spilling of molted metal, improve weld appearance and equableness of weld geometry (width and reinforcement)
2. The increase of helium content in protective atmosphere affects the increase of weld width and decrease of reinforcement, what directly affects the uniformly transition from weld to base metal..
3. The protective atmosphere of pure argon is better to use for lower weld widths, while for higher widths it should increase helium content in protective atmosphere.
4. The increase of helium content in protective atmosphere causes higher welding speed

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