BULETINUL Universităţii Petrol – Gaze din Ploieşti	Vol. LXII No. 2/2010	25 – 28	Seria Tehnică

The Sonorous Emission Analysis of Electric Arc Welding as the Possibility of Estimating the Mass Transfer to Short-arc Welding

Victor Belcin, Dănuț Mihăilescu, Gabriel-Marcel Neniță

Universitatea @Dunărea de Jos" din Galați, Str. Domnească nr. 47, Galați
e-mail: vbelcin@ugal.ro

Abstract

To the short arc active-gas metal-arc welding, is emitted a specific sound, caused by the phenomena who are in progress, in the electric arc, to a such method and the operating conditions. The catchments and subsequent this analysis, of the sound, can constitute the criterions of estimate the frequency of the short-circuits, conditioned by the droplets transfer, of molten metal, to the welding bath.
The variations of sonorous pressure, determinated by the reignition of the electric arc welding, can be thus recorded and permit, subsequently, the determination of short-circuit frequency. It is setting and an estimate connection, about the mass transfer achievable, on the parameters of the pursued operating conditions.

Key words: *short-arc, sonorous emission, mass transfer.*

Introduction

Short arc welding operating conditions, is proper to specially method of G.M.A.W. welding process, in the low current range and has a large practical applicability, chiefly for the realization of arc-welding seams, with thin elements, but in the case of out of position welding.
The mass transfer is produced in a specific mode, namely, through persistently short-circuits, the process take place to the limit of stability of arc welding(minimal length of arc welding, reduced voltage of the arc welding to the range of 14-20 V).

To each short-circuit is transfered, to the metallic molten bath, only a droplet from the molten metal of the wire electrode, moment when the voltage of the arc welding falls, to minimum values, and welding current from circuit touches the maximum. The frequency of these short-circuit persistent phases is common, in the range of 50-100 Hz.

These abrupt and persistent variations of local pressure, from the zone of the electric arc welding, are concentrated and are generated in a reduced volume[1], so that is generated, a namely properly sound, typically, easily recognized, with an special intensity, but who can be recorded and.

As far as may highlight, from the sonorous emission of the short arc welding, the frequency of these variations of pressure, becomes possible, to established, just the pass frequency, of molten metal droplet, in the welding bath.

These specific phenomena, who may be meeting to short arc welding, have else be putted in evidence [2, 3] and was analyzed under the appearance of practical applicability, for the stability study, continuity and uniformity of technological process of welding.

Experimental Details

The recording, but and the subsequent stockage and analysis of the sound, who was emitted thus, by the welding arc, in selected working conditions, becomes a facilely and interesting possibility of global monitoring evolution, of continuity and stability of short arc welding, but and development of the process of welding.

In this paper, it follows and is applied, the principle elements yet presented, for regimes of operating conditions, of zone with short-arc welding, in gas protection with Corgon 18, just varying the current values of work(through variation of wire feed rate, for the electrode wire).

In what concerns the parameters of experimental work, is shown as the testing consisted of the deposit of weld beads, with ascending current of operating conditions, in the current range of short-arc welding, with the registration of emissive sound of the electric arc, the parameters be show in Table 1.

Table 1. Experimental data

Weld bead nr.	Wire feed rate		Welding speed		Welding current I[A]			Arc voltage U[V]			Welding time [sec]	Frequency [Hz]
	Div.	Value [m/min]	Div.	Value [m/min]	Max.	Med.	Min.	Max.	Med.	Min.		
1	7	2,200	8	0,200	175	86	57	18,6	17,9	20,1	20	22
2	8	2,640			161	110	94	17	17	18,1	19	27
3	9	2,920			229	137	117	15,1	16,2	17,3	17	77
4	10	3,600			391	150	86	13,3	15,8	18,4	19	95
5	11	4,080			277	165	136	13,7	15,2	16,1	18	100
6	12	4,800			389	188	86	12,5	14,5	17,4	17	125

In the other elements of work and experiment, stated:

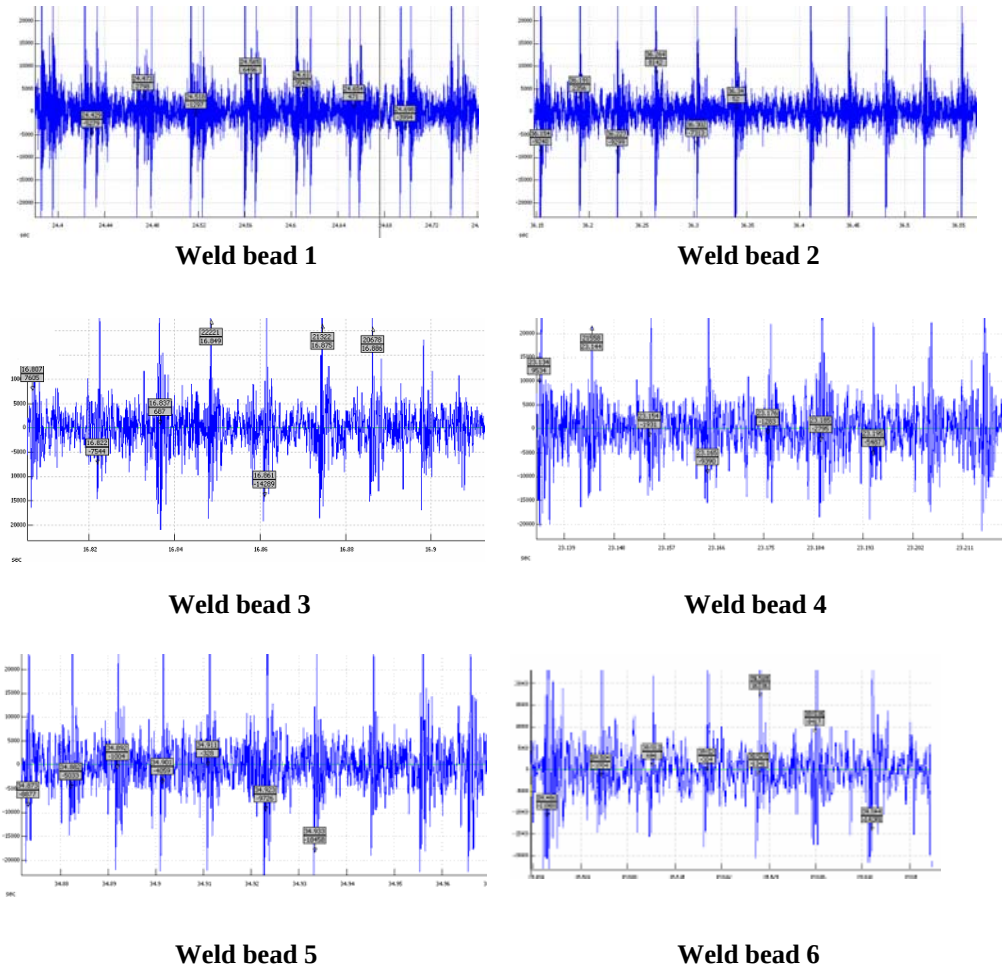
- the welding. was carried out in a short-arc welding, in horizontal position, in protection of Corgon 18 (gas flow 16 l / min), with current supply by CSR-400, 0,200 m/min welding speed.
- the diameter of wire electrode, for tests, was by 1.2 mm,
- the recording of noise emissions was achieved with a digital player, the iRiver T10 type and its built-in microphone, with a level of working frequencies in the range 20-20.000 Hz, with total harmonic distortion of 0.1% and the rate of 8 - 320KB /sec. Sound recording distance was kept constant, ie 0.5 m, for each test.
- sound signal visualization, and processing of the signal was made by a computer program (Sigview), which allows both increased and appropriate selection of the area of interest in registration, but also identifying the peak of pulse noise, and the times at who is produced the pulse. Sigview computer program was used, in this case, for processing of audio files obtained from experiments. This program allowed and not only an appropriate local enlarge interesting portions of the contents of sound files, but labeling the coordinates of time and amplitude, pulse characteristic areas and maximum amplitude taken into analysis.

Thus it became possible that in the time-amplitude coordinates the registered sonorous semnal to be graphic represented in the interest and expanded area, from the sound files of tests, performed for each of the 6 schemes of operating conditions, all these representations are concentrated in Fig. 1.

To determine the average time between two pulses, each weld bead and its sound recording were taken into account differences in time, between the 7-8 successive pulses, viewed on each of the graphs, in Fig. 1.
Gas-shielded welding was developed with machine welding type Mansfeld ZIS 453 / 1.

Results

After made experiments, results the following graphs of variation, for the 6 test chosen regimes, for sound pulses generated and produced by short circuits, at the transition of metal melting droplet, by the space of arc: The analysis of the times, at which the impulse noise occurs for the 6 cases and operating conditions have resulted respective frequencies, shown in the final part of Tab.1. It is evidently, that by the increase of working current, due to the increasing of the electrode wire feed rate, increased frequency of short circuit, and of the drops of molten metal, entering in the metal bath.



Weld bead 1 **Weld bead 2**

Weld bead 3 **Weld bead 4**

Weld bead 5 **Weld bead 6**

Fig. 1. Sound emission by the operating conditions

Conclusions

At gas short-arc welding, with Corgon 18, becomes possible to estimate the frequency of crossing movement, of molten metal droplets, to the metal bath, even by global analysis provided by the noise emission of the arc, specifically to the working process. Also, the noise emission, who is the overall guide of operator, at the semi-mechanized welding, where he fits and adapts its working parameters.

The experiment was done, in this case, with the Corgon 18, precisely because this combination of protection gases ensures better stability of the arc welding and a noise emission resulting clear, uniform, easily recorded and subsequently analyzed.

There is upward trend of the frequency of short circuit, increasing the amount of mass transfer, with increasing of welding current. The estimated crossing frequency of droplet, in comparison with the wire electrode feed rate and the wire electrode diameter, will allow even an estimate of the mass calculation of a drop, but even the size of this.

The experiment and results have shown perfect correlation with known data from literature, but also, the practical value and sufficient precision how to estimate the mass transfer in short-arc welding

By development of frequency short circuits, of the droplets that pass to metal bath (Fig.1), is confirmed and the experimental data presented in the paper [4], but the situation that the maximum frequency for wire electrode of 1.2 mm is reached to the value of 125 Hz.

References

1. Cudina, M., Prezelj, J., Polajnar, I. - Use of audible sound for on-line monitoring of gas metal arc welding process, *METABK* **47**(2), 81/85 (2008).
2. Warinsiriruk, E., Poopat, B. - Welding Engineering Production Departament, King Mongkut's University of Technology Thonburi, Bangkok, Thailand.
3. Ggrad, L., Grum, J., Polajnar , I., Slabe, J. M. - Feasibility study of acoustic signals for on-line monitoring in short circuit gas metal arc welding, *International Journal of Machine Tools& Manufacture*, **44** (2004), pp. 555-561.
4. Anghelea, N., Matragoci, C., Grigoraş, A., Popovici, V. - *Sudarea în mediu de gaze protectoare,* Ed. Tehnică, 1981, pp. 19-20.

Analiza emisiei sonore a arcului electric ca posibilitate de estimare a transferului masic la sudarea cu arc scurt

Rezumat

La sudarea cu protecție gazoasă şi arc electric scurt se emite un sunet specific, determinat de fenomenele ce au loc în arcul electric la un astfel de procedeu şi regim de lucru. Captările şi ulterior analiza acestui sunet pot constitui criterii de estimare a frecvenței scurtcircuitelor determinate de transferul picăturilor de metal topit în baia metalică. Variațiile de presiune sonoră, determinate la reamorsarea arcului electric, pot fi astfel înregistrate şi permi,t ulterior,r determinarea frecvenței de scurtcircuit.Se stabileşte şi o legătură estimativă asupra transferului masic realizat la parametrii regimului de lucru urmărit.