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Kolumbić, Zvonimir; Samardžić, Ivan; Klarić, Štefanija

COMPARISON OF MAIN WELDING PARAMETERS STABILITY – AUTOMATIC AND SEMIAUTOMATIC MAG WELDING

Zvonimir Kolumbić, Ivan Samardžić, Štefanija Klarić
University in Osijek, Mechanical Engineering Faculty, Slavonski Brod, http://brod.sfsb.hr/
Trg I.B. Mažuranić 18., 35000 Slavonski Brod, Croatia,
tel. + 385 35 446 188, fax. + 385 35 446 446, e-mail: zvonko.kolumbic@sfsb.hr

Abstract:
Stability of main welding parameters (welding voltage and welding current, welding speed) during fusion arc welding process is very important for obtaining satisfactory quality of welded joints. This paper presents examples of welding data acquisition and processing at semiautomatic and automatic MAG welding, with solid and flux cored wire, in different shielding atmosphere. Data acquisition is performed by On-line monitoring system with sampling frequency up to 20 kHz per channel.

Key words: welding parameters, stability, MAG welding, On-line monitoring

1. INTRODUCTION

Measurement and recording of main welding parameters (welding voltage, welding current, welding speed) is important activity in the selection of optimal welding parameters for accomplishing optimal quality of weld joint as well as in the control and quality assurance during welding on welded products and constructions. Main welding parameters determinate heat input, therefore heating and cooling rate and has influence on mechanical and other weld joint properties.

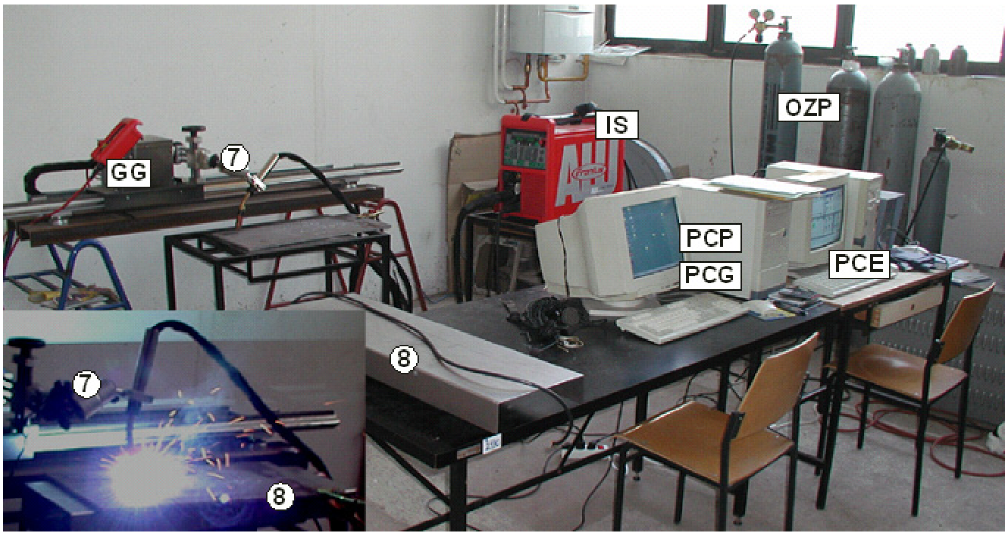
Monitoring of main welding parameters with On-line monitoring system (system for measuring, acquisition and data processing) is one method for control stability of welding process during welding. This paper presents results of experimental measurements of main welding parameters at semi-automatic and automatic MAG (Metal Active Gas) welding.

2. SHORT DESCRIPTION OF LABORATORY ON-LINE MONITORING SYSTEM

Laboratory system for the monitoring and registration of MAG welding parameters is being developed on Mechanical Engineering Faculty in Slavonski Brod (figure 1). At this moment laboratory system is consisted of welding power source Fronius TPS 2700 (1), shielding gas supply system (2), welding torch motion system Fronius Tracking Vehicle FTV 4 with remote control unit FCU-4-RC (3), on-line monitoring system for monitoring and acquisition of welding current and voltage (4), audible sound monitoring system (5 and 6) and 1D motion control of work piece (7 and 8). Module for temperature field monitoring and optical module for light intensity monitoring are still developing.

3. PLAN AND PROVIDING OF EXPERIMENT

Plan of experiment predicts surfacing of bead on steel plate (16 Mo 3) by automatic and semi-automatic MAG welding process. CO_2 was used as a shielding gas. Two types of filler material were used: basic and rutile flux cored wires. Semi-automatic welding was performed on welding power source LAH 500 (ESAB) and automatic welding was performed on welding power source TPS 4000 (Fronius). The flux cored wires and CO_2 shielding gas was used because of the fact that this combination of wire and shielding gas is optimal solution (cost/quality standpoints), at MAG welding process in steam boilers power plants production.



Legend:

1 Power source
2 Shielding gas
3 Driving system for automatic welding
4 PC for welding parameters acquisition and processing
5 PC for sound signals acquisition and processing
6 Sound sensor
7 PC for 1D motion control of work piece
8 Driving system for automatic welding under PC control

Figure 1 Laboratory system for monitoring, acquisition and processing of main welding parameters [1]

Table 1 Plan of experiment and welding parameters

Welding process	Welding parameters	Rutile flux cored wire	Basic flux cored wire
Semi-automatic MAG welding	Specimen	2.3 (9)	1.3 (3)
	Welding current, I, A	300	296
	Welding voltage, U, V	32.5	34
	Wire feed rate, v, m/min	9.5	9.4
	Wire diameter, D, mm	1.2	1.2
	Shielding gas flow rate, q, l/min	20	18
	Polarity (+ / –)	(+)	(–)
Automatic MAG welding	Specimen	RC22	BC22
	Welding current, I, A	290	292
	Welding voltage, U, V	32	32
	Wire feed rate, v, m/min	11,4	11,5
	Wire diameter, D, mm	1,2	1,2
	Shielding gas flow rate, q, l/min	15	15
	Polarity (+ / –)	(+)	(–)
	Specimen	60	60

Table 2 Filler materials used in experimental at semi-automatic welding

Wire type	Wire mark according to standard	Wire diameter, D, mm	Producer mark	Type
Rutile flux cored	SGMo (DIN 8575)	1,2	Böhler, D	DMO-IG
Basic flux cored	E Mo B 20+ (DIN 8575)	1,2	Böhler, D	DMO Kb-FD

Table 3 Filler materials used in experimental at automatic welding

Wire type	Wire mark according to standard	Wire diameter, D, mm	Producer mark	Type
Rutile flux cored	T MoL P M 1 H5 (DIN EN 12071)	1,2	Böhler, D	DMO-IG
Basic flux cored	E Mo B 20+ (DIN 8575)	1,2	Böhler, D	DMO Kb-FD

4. RESULTS OF THE EXPERIMENT

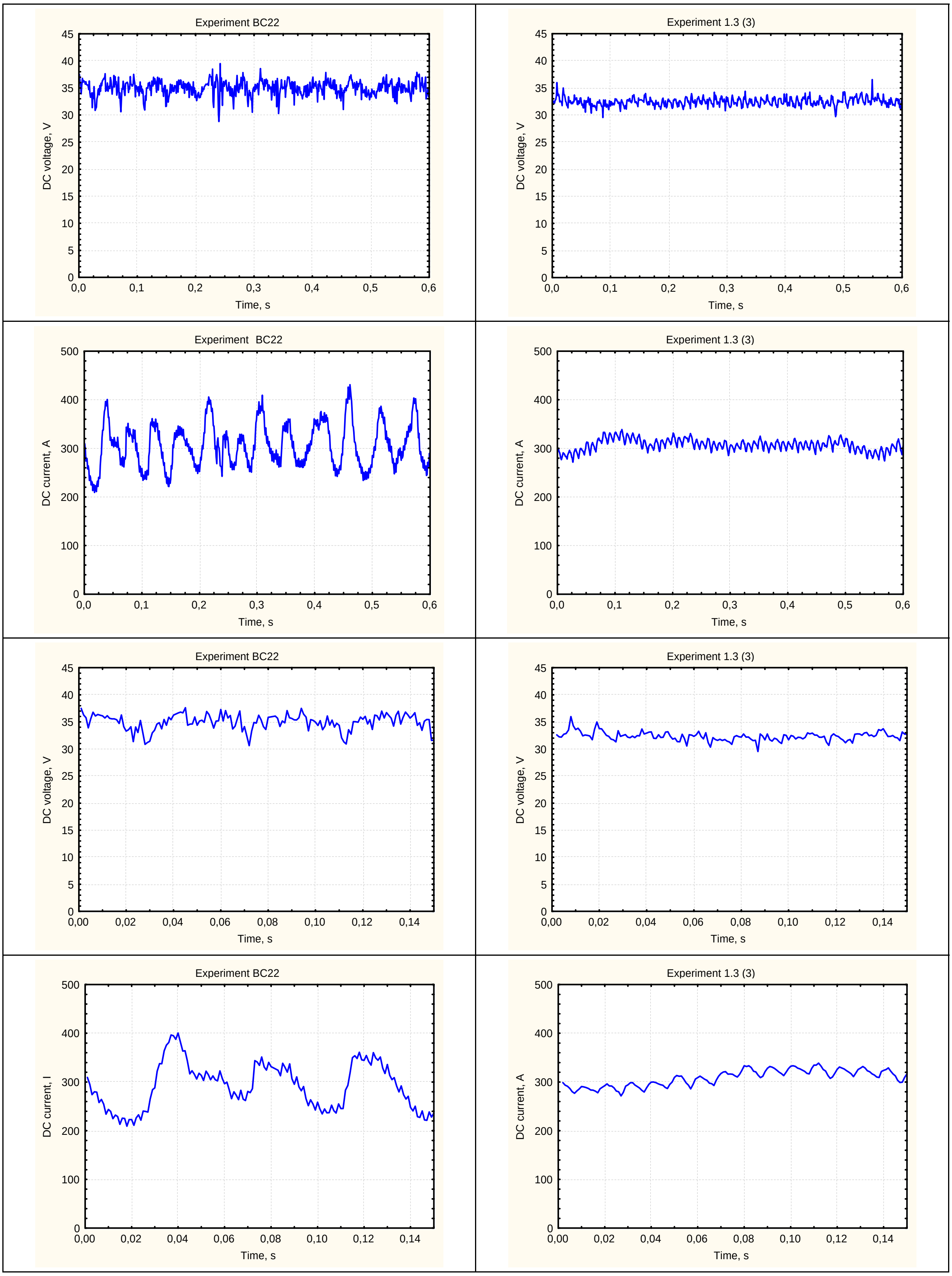


Figure 2 Real time DC voltage and DC current distribution for automatic MAG welding (left column) and semiautomatic MAG welding (right column), basic flux cored wire, CO_2 shielding gas, different power sources type. Sampling frequency was 1 kHz.

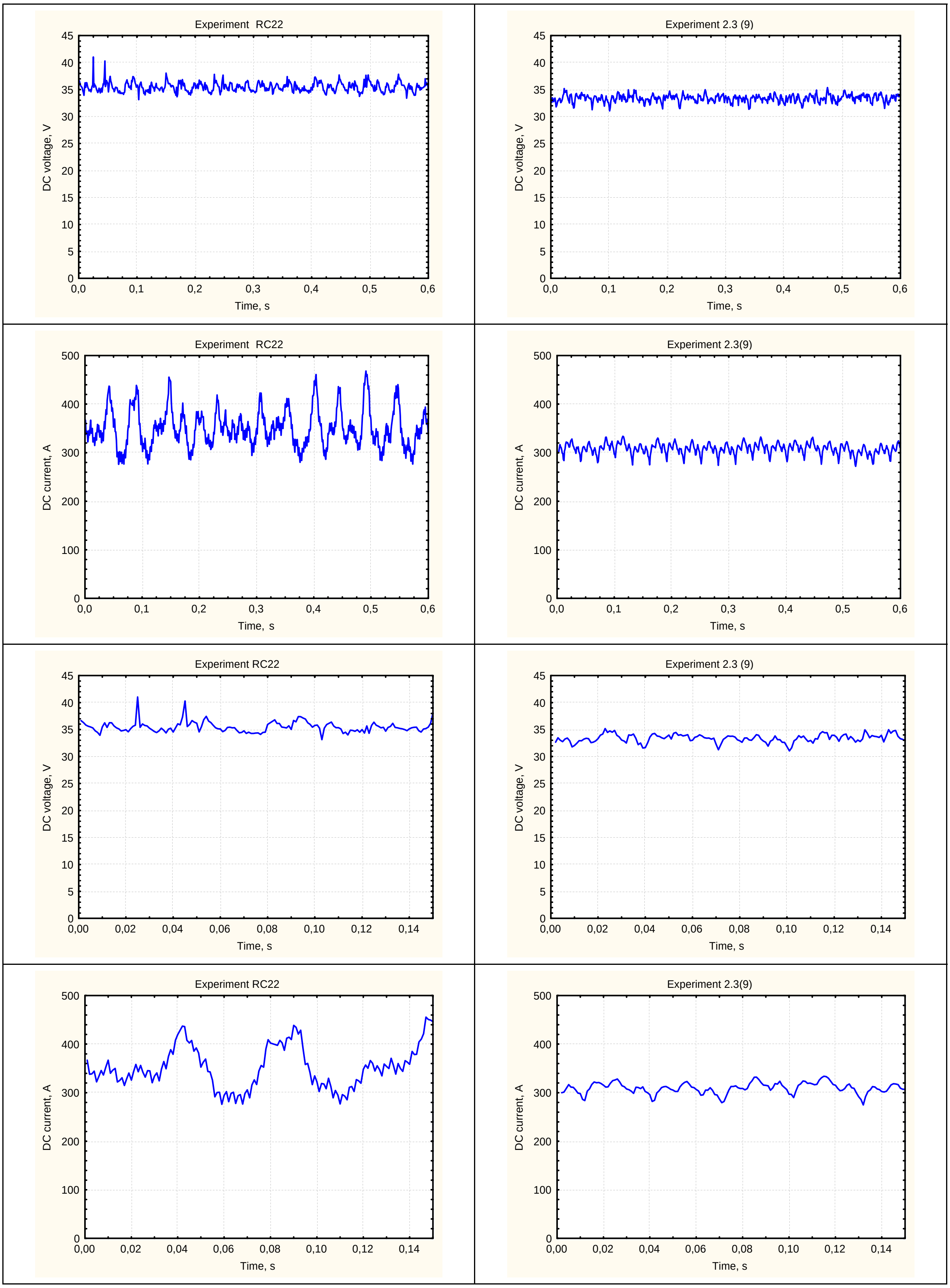


Figure 3 Real time DC voltage and DC current distribution for automatic MAG welding (left column) and semiautomatic MAG welding (right column), rutile flux cored wire, CO_2 shielding gas, different power sources type. Sampling frequency was 1 kHz.

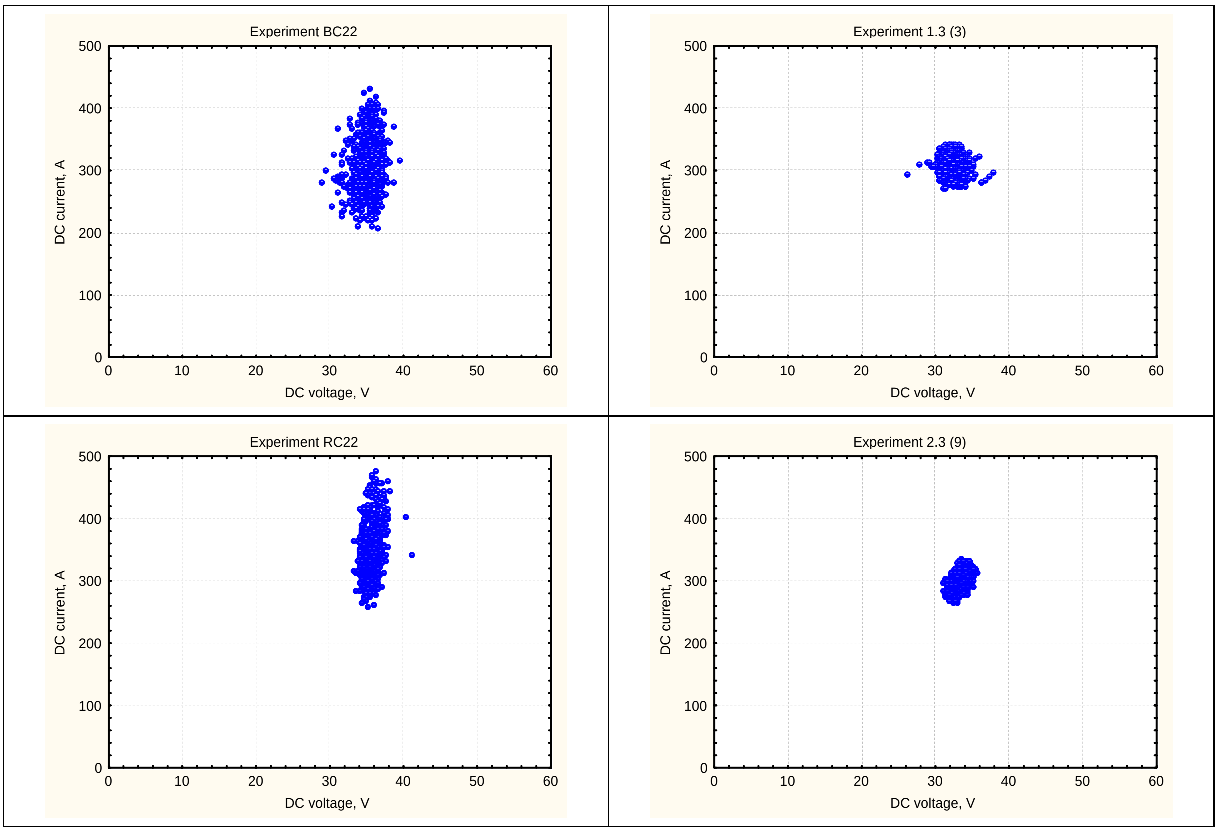


Figure 4 Current and voltage interrelationship for automatic and semiautomatic MAG welding, basic and rutile flux cored wire, CO_2 shielding gas, different power sources type. Sampling frequency was 1 kHz.

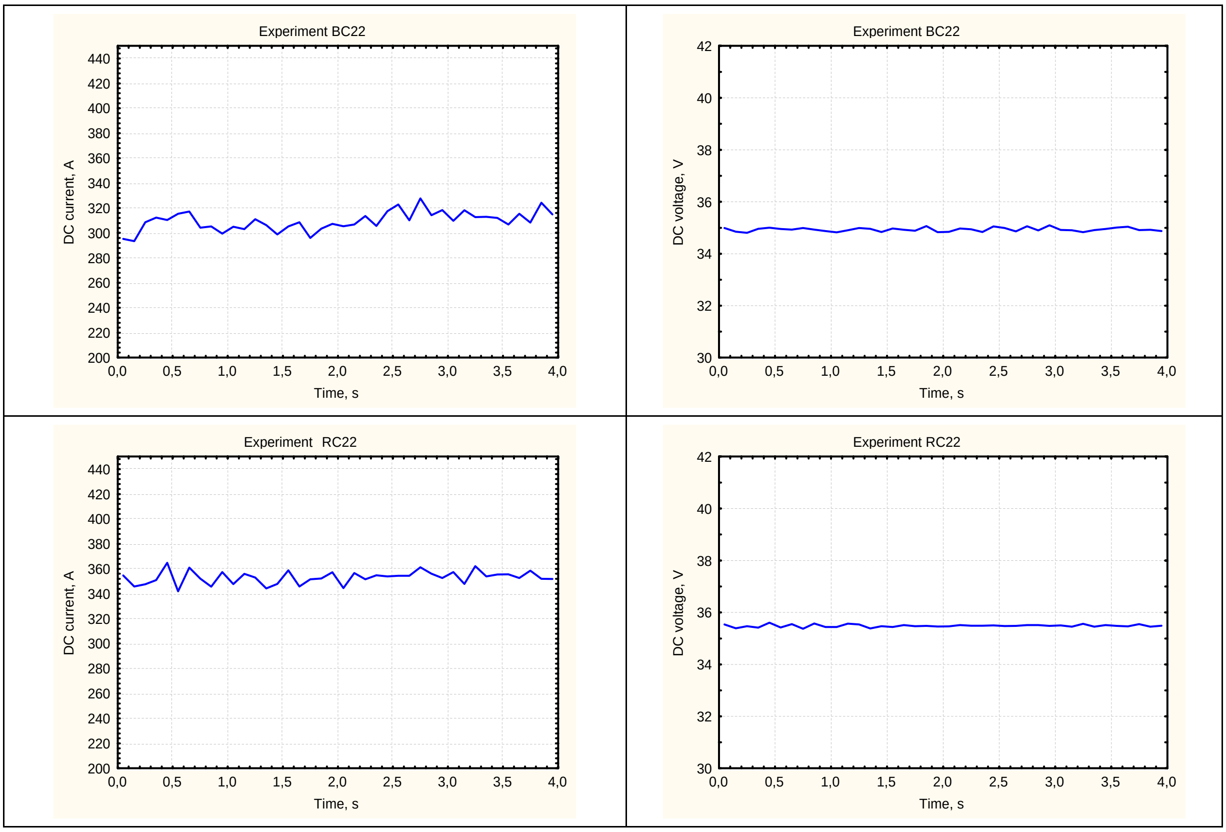


Figure 5 Moving average current and voltage distribution for automatic MAG welding with basic and rutile flux cored wire in CO_2 shielding gas and different power sources type; sampling frequency 1 kHz

Suitable software for specific off-line data processing was developed (fig. 6).

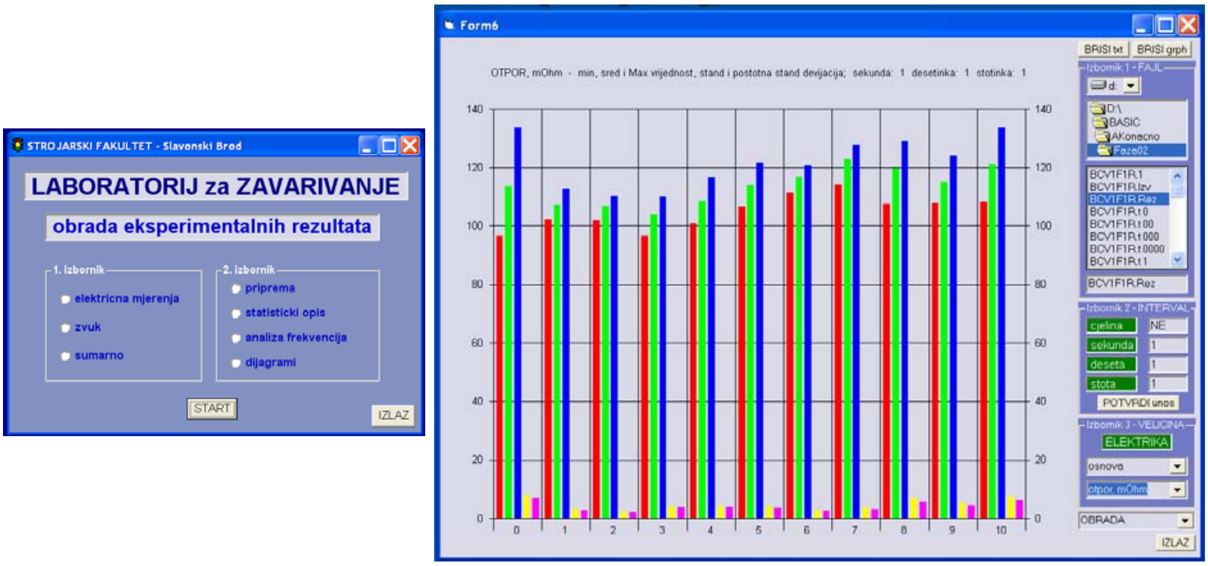


Figure 6 Developed program – main menu and an example of the results (main welding parameters – diagrams)

CONCLUSION

Performed experiments (semi-automatic and automatic MAG welding) gave satisfactory welding parameters data as well as visual quality of weldments. The material transfer mode at all performed experiments was dominantly spray arc (fig. 3 and 4). The stability of welding parameters at semi-automatic MAG welding process is just a little better than at automatic MAG welding process (fig. 5). The reason for that is manual setting of the welding parameters at semi-automatic MAG welding. At automatic MAG welding process we selected programmed and in power source stored welding parameters, good enough but not the optimal for performed welding. Figure 4 shows moving averages of main welding parameters (welding current and voltage). It gives an opportunity for control stability of welding parameters and welding process as well as heat input during welding. Additional off-line data processing is also possible. On-line monitoring system has maximal sampling rate of welding current and voltage up to 20 kHz per each channel. Usually, sampling rate of 10 kHz is enough for monitoring the majority of arc welding processes used today in practice.

LITERATURE

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