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DEVELOPMENT AND MASTERING OF PRODUCTION OF COATED ELECTRODES FOR CUTTING AND GOUGING METAL MATERIALS

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Abstract: This paper presents the results of mastering the composition of coatings and production technology of two metallurgical quality coated electrodes for metal cutting and gouging. Experimental work has included designing coating formulas based of manganese ore for one type of electrode and hematite based for the second electrode type. Mastered was the production technology using the experimental equipment according to the designed formula for two types of coated electrodes intended for cutting and gouging. Preliminary electric arc cutting and gouging of steel and gray cast iron with two quality produced coated electrodes was carried out in the laboratory of the Research and Development Center in Belgrade during mastering of production. Experimental electric arc cutting and gouging of steel and cast iron with two produced qualities of the coated electrodes was performed in the IHIS RDC laboratory and a gray iron foundry.

Keywords: coated electrode, electric arc metal cutting, metal gouging

1. INTRODUCTION

Because In cast iron and steel foundries as well as mounting conditions outdoors in hard to reach places and in many other cases manual metal electric arc cutting and gouging with special coated electrodes is applicable. This method of cutting with respect to the use of the gas cutting process with acetylene and oxygen does not require special preparation or a compressed air supply to the cutting site as well as special training of workers [1-3,7]. Development and mastering of the formula of coating was done for a certain quality of the steel core and the selected metallurgical quality of the electrode intended for cutting and gouging metal. Mastering production technology of designed quality electrodes for metal cutting was carried out on experimental equipment which is located in the Research and Development Center in Belgrade.

The coated electrode for cutting consists of a metal steel core which is uniformly coated with a formulated compound, and which consists of milled metallic and nonmetallic powders mixed with a suitable binder. When using a specially coated electrode the coating provides a stable electric arc and a high heat value when using the appropriate amperage and voltage of the electric arc. The coating should ensure high fire resistance and provide oxidation of the liquid metal for its easier removal from the location of cutting or gouging. By using the coated electrodes the cutting speed of cast iron and cast steel is 1.5-2.0 times greater than when using a carbon electrode in the same mode in air-electric arc cutting [1, 3, 5-7]. Using the coated electrodes yielded a clean, cut surface covered with oxides.

2. MATERIAL AND METHODS

— Experimental production of coated electrodes

The desire Based on literature and practical knowledge a coating formula was made for the development and mastering of production of two types of electrodes for cutting and gouging of metal materials.

- a) Electrodes of IHIS SR 2B quality have a basic coating based on hematite and quartz (classification according to standard EN 499, DIN 1913 AWS A-5.1). Thick coated electrodes are designed for cutting, gouging parts made of steel, cast iron, copper alloys. Application of the electrodes is possible to remove defective weld metals, cracks, inlet systems, etc. The grooves are uniform and smooth and do not require additional processing of the cut surfaces.
- b) Electrodes of IHIS SZ MN quality (classification according to standard EN 499, DIN 1913-AWS A 5.1) have an acidic coating with the base consisting of manganese ore. Thick coated electrodes are designed for cutting, grooving and cutting of all metal materials. The coated electrode can be used in all positions for cutting except vertically upwards. The grooves are uniform and smooth and do not require additional processing of the cut surfaces.

The mastered metallurgical quality of electrodes are intended for manual electric arc cutting and gouging of all metals except magnesium, and are particularly suitable for gouging cracks during repair welding of gray cast iron. Suitable also for application during assembly and repair of metal structures in installation conditions in open space and in hard to reach places.

For preparing the core of the electrode selected were steel rods 3.25 mm in diameter and standard length of 350 mm, and a rod a diameter of 5.0 mm, length 450 mm, they are made by the technological process of flattening and cutting from solid drawn steel wire produced by multistage drawing.

View of produced coated electrodes for cutting and gouging metal material internal code: IHIS SZ MN, Figure 1a, and view of produced coated electrodes internal code: IHIS SR-2B, Figure 1b.



Figure 1. Produced coated electrodes, a diameter of 3.25mm and 5.0mm for cutting and gouging of metal materials, internal codes: IHIS SZ MN (a) and IHIS SZ-2B (b)

— **Experimental electric arc cutting with produced coated electrodes**

With produced coated electrodes, internal code: IHIS SZ-MN and IHIS SZ-2B, with a diameter of 3.25mm and 5.0mm preliminarily and then experimental electric arc cutting and gouging were performed. For the purpose of comparison of properties and quality of the cut obtained were SEKATOR 1 and SEKATOR 2B electrodes (manufacturer Jesenice).

The preliminary cutting and gouging using the two produced qualities of coated electrodes IHIS SZ-MN and IHIS SZ-2B, was done by MEA procedure with parameters given in Table 1.

Table 1. Cutting and gouging parameters using the MEA method

Electrode	d [mm]	Cutting parameters		Gouging parameters	
		Welding current, I, [A]	Welding current, I, [A]	Welding current, I, [A]	Welding current, I, [A]
IHIS SŽ-2B	3.25	110-200		140-300	
IHIS SŽ-2M	5.0	250-350		350-450	

Based on comparison of the quality of cutting and gouging with two mastered qualities of the coated electrodes IHIS SZ-MN and IHIS SZ-2B and purchased two types of electrodes (SEKATOR 1 and SEKATOR 2B) of the well-known electrodes manufacturer -Jesenice established was:

- ≡ That the electrode IHIS SZ-2B showed very good results for cutting and gouging operations of steel materials and cast iron, similar to electrode SEKATOR 2B (Jesenice).
- ≡ That the electrode IHIS SZ-MN showed satisfactory properties in cutting and gouging operations of steel materials and cast iron similar to electrode SEKATOR 1 (Jesenice).

Based on the results of comparison of quality in the preliminary cutting and gouging with the two produced coated electrodes IHIS SZ-MN and IHIS SZ-2B, and based on the indicators of health safety of welders, it was concluded that the applied electrode marked IHIS SZ-2B has the advantage in relation to the electrode marked: IHIS SZ-MN.

Experimental arc cutting was performed with the selected coated electrode IHIS SZ-2B, a diameter of 3.25 mm and 5.0 mm, under laboratory conditions at IHIS RDC and industrial conditions at MIN foundry in NIS, Figure 2 (a-c), Figure 3 (d-f). In the photographs in Figure 2 (a, b, c) shown are electric arc cutting and gouging of steel samples using the produced electrode IHIS SZ-2B, with a diameter of 3.25 mm. In the photographs in Figure 3 (d-f) shown is electric arc cutting of gray cast iron with the electrode IHIS SZ-2B, with a diameter of 5 mm.

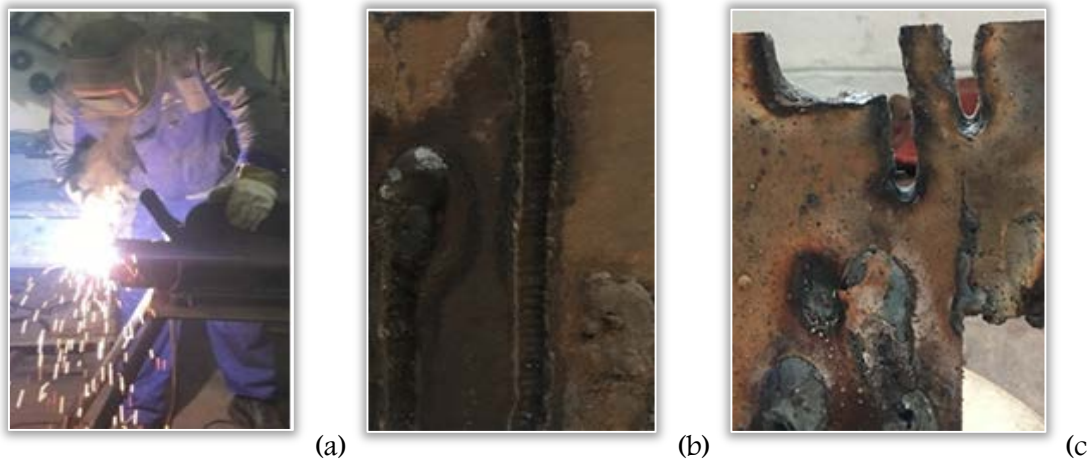


Figure 2. Experimental electric arc gouging (ab) and cutting (c) of steel samples with the electrode IHIS SZ-2B, with a diameter of 3.25 mm

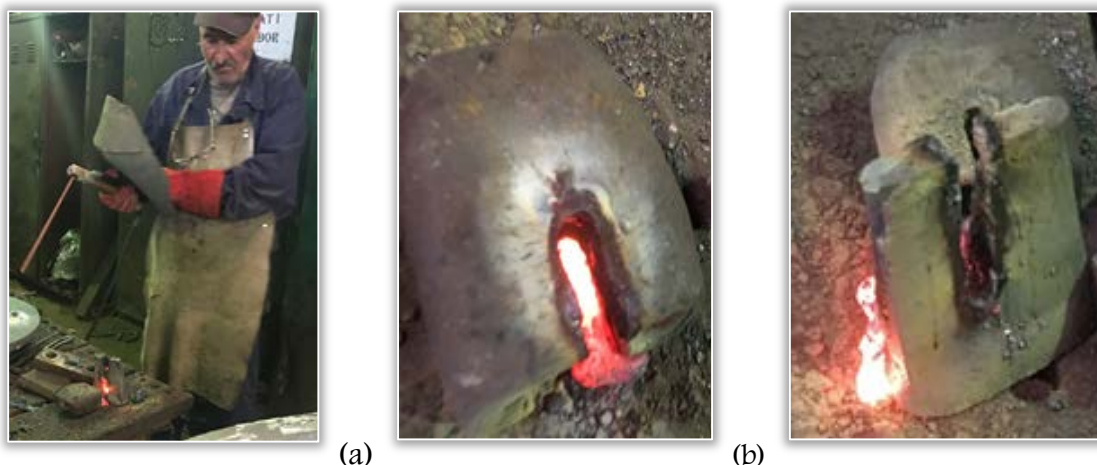


Figure 3. Experimental electric arc cutting (a-c) of gray cast iron with the electrode IHIS SZ-2B, with a diameter of 5 mm

3. CONCLUSIONS

On the basis of the comparative results obtained with experimental electric arc gouging and cutting of steel and gray cast iron with the electrode IHIS SZ-2B and electrode SEKATOR 2B (manufacturer Jesenice) concluded was:

- ≡ that the new electrode IHIS SZ-2B showed very good results for cutting and gouging operations of steel materials and gray cast iron,
- ≡ that from the aspect of hygienic-sanitary point of view the applied electrode IHIS SZ-2B has an advantage compared to the similar electrode IHIS SZ-MN,
- ≡ that the above mentioned metallurgical quality of the coated electrode can be recommended for industrial applications.

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