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EXPERIMENTS IN THE LABORATORY CONDITIONS OF CONTACT SPOT WELDING ELECTRODES WITH COMPOSITE LAYERS CLADDED ON THE ACTIVE SURFACES

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Abstract: *The paper presents a simple method to manufacturing contact electrodes for resistance welding using cladding by welding on the active parts of composite layers based on tungsten carbides and experimental researches on their behaviour in welding of materials in laboratory condition.*
Keywords*: contact electrodes, composite layers, cladding by welding, pressure electrical welding*

1. INTRODUCTION

The usually material used for manufacturing of contact electrodes for resistance welding is copper and its alloys (alloys with chromium, beryllium, cobalt, zirconium) or sintered materials based on copper and tungsten, copper and tungsten carbide, molybdenum, tungsten, silver and tungsten (Iovanas, 2006). These materials are generally costly and expensive and the manufacturing process is also difficult and complex.

Sintering is the operation of manufacturing parts from powder by pressing and heating. This requires preparation in advance of the powder, mixing the powder (or mixture of powders) with a related substance, pressed powder (or mixture of powders), sintering the powder (or mixture of powders), which consist in heating of the pressed product into ovens warming at high temperatures and subsequently additional operations (metal cutting and heat treatments).

Therefore, we propose a simple method of manufacturing of contact electrodes for resistance welding, which are obtained composite layer based of tungsten carbide in cooper metal matrix, which are cladded by welding on the electrode active surfaces with special filler material (Ceorapin et al., 2009). The method advantage is that composite layers are obtained directly in the process of cladding, no longer needing of other operations, except manufacturing addition materials (coated electrodes).

Similar researches were undertaken in 2006 when has been tried deposition of composite layers on active surfaces of contact electrodes for resistance welding using electro-spark deposition process. This involved obtaining previously of composite material and its subsequent deposition on the basic material. The coating was designed as a barrier to prevent electrodes from alloying with the Zn-coating leading to degradation by pitting or erosion.(Zheng & Zhou, 2006).

The paper presents the performed experimental research to determine the operational behaviour of the contact electrodes manufactured on this principle.

2. EXPERIMENTAL RESEARCHES AND RESULTS

By this technology has been made removable heads (figure 1) with clumping on the exterior cone for laboratory experimentations (Ceorapin et al., 2009).


Fig. 1. Finite form of removable heads


Fig. 2. Contact electrodes mounted on the welding machine

For the experiments, the electrodes were mounted on the welding machine (figure 2) from research laboratory (TECNA 4068) and made a series of welding on different types and thicknesses of materials, with adequate technologies and observing their behaviour in service.

It was made spot welds on non alloyed steel plates (figure 3) and copper plates, respectively, the contact electrodes were used to spot pressure brazing of cooper plates with usual brazing materials and other new materials amorphous type (figure 5) (Iovanas et al., 2009).

Appearance of some spot welded respectively spot pressure brazed samples with the new electrode is shown in figure 4.

To the debutoning of the welds the ruptures occurred by uprooting and breaking of samples in heat affected zone (figure 3) and the welding behaviour of these contact electrodes didn't show differences compared to the classical contact electrodes made from cooper alloys.

For pressure spot brazing (procedure code (918) according to EN ISO 4063) the technological parameters are presented in table 1, the current intensity ranging from 400 to 9500 amps and brazing time between 5 and 30 periods. It is clear that electrodes were used in the most adverse conditions without forced cooling water.


Fig. 3. Making of spot welding with the new contact electrodes

Fig. 4. Comparison between spot welded and brazed samples

Fig. 5. Making of spot brazed samples from cooper plates

Sample	Intensity [A]	Time [per.]	Air pressure [bar]	Electrodes type
-1	4000	5	3	Cupru + CW
0	6500	5	3	Cupru + CW
1	8000	30	3	Cupru + CW
2	9500	30	3	Cupru + CW

Tab. 1. Technological parameters for spot brazing

Sample	Breaking force, [kgf]	Yielding force, [kgf]
-1	100	100
0	300	270
1	700	650
2	-	-

Tab. 2. The results of traction test for spot brazed samples

The control was done by visual examination with loops and adequate measuring instruments and has been remarked the appearance of heat affected zones and possible distortions arising due to overheating.

The brazed samples by overlapping were tested to the traction, the results being showed in the table 2.

The ruptures occurred in the basic material, after appearance of some considerable elongations, breaking force increasing proportional with the brazing current intensity.

The researches had not revealed differences concerning the behaviour of these contact electrodes pending welding operations and neither dimension errors of the welding spots towards specified limits.

3. CONCLUSIONS

By the proposed method we can manufacture contact electrodes for pressure spot welding eliminating the disadvantages of the sintering process and powder manufacturing.

It can alsoimprove the technical characteristics of the contact electrodes for resistance spot welding in the sense for increasing the hardness of active parts for increase their liferespectively reducing the intermediate processing times or them changing from the welding machine.

The contact electrodes were obtained by cladding have a good impact resistance and compression and the electrical conductivity is not affected clearly (this aspect was revealed by measuring the electrical resistivity researches (Ceorapin et al., 2009)).

The method of obtaining contact electrodes for pressure spot welding by cladding composite layers has technically and economically benefits as follows:

- increase sustainability in service due to "protect" areas of wear with adequate materials(composite layers) about on characteristics of resistance to requests from service;
- reduce the use of special materials (especially for alloying) by using only copper, over which are cladded (by welding) compatible materials, satisfyind the specific requirements of resistance;
- increase the operating safety and reduce the risk of damage due to improving quality standards;
- reduce the production costs;
- reduce the time of manufacture of contact electrodes with approx. 25%;

The method can be extended and applied successfully to manufacture the electric roller for seam welding, to massive electrodes for projection welding and to clamping pieces (tanks) for pressure electric butt welding

4. FUTURE RESEARCHES

It wants by the further researches to be carried to determine a way to balance the proportion of cladded carbides onto active surfaces and an optimal percentage that does not affect clearly the electrical conductivity of the contact electrodes, but they increase equally the hardness and life. This will be done by optimizing the recipes of coated electrodes already conceived or by making other addition materials, such as powders based on copper and carbides content to be cladded by flame or plasma. If the powder recipes will allow a very small grit, then the cladding will be made by metalizing with flame or laser with high efficiency and high productivity.

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