



STUDY OF THE EROSIVE CHARACTERISTICS OF A TUBULAR COPPER ELECTRODE WITH APERTURE OF THE PLASMA GENERATOR FOR CUTTING METALS

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Abstract – The results of study of the erosive characteristics of the tubular copper electrode with aperture of the plasma generator for cutting metals are presented. It is shown, that for the electrode with aperture the erosive characteristics of the last and modes of operation of the plasma generator are improved.

Keywords: *plasma generator, plasma arc cutting, tubular copper electrode, specific erosion, erosion characteristics, resource of the internal electrode.*

1. INTRODUCTION

The plasma generator for cutting metals developed at the Technical University of Moldova [1] is successfully used at a series of enterprises of the Republic of Moldova and other countries of the CIS due to some essential advantages compare with other types of plasma generators. It is obvious, that for increasing the efficiency of the cutting process, it is necessary to improve the characteristics of this generator and of the whole process.

2. GENERALIZATION

One of the main elements of the mentioned generator is its internal tubular copper electrode which works in the extremely thermal conditions being in the direct contact with a plasma arc which is strongly compressed in the nozzle channel. In these conditions the intensive deterioration of the electrode takes place caused, basically, by thermal and electrical processes in the spot of the electric arc on its surface. Taking into account the fact, that the copper electrode is the most worn element of plasma generator, it is expedient to ensure its service life as large as possible. In [2,3] is proposed and analyzed the way of reduction of the specific erosion of the electrode of amplification of effect of vortex stabilization of the arc in the discharge chamber of plasma generator and increasing of the efficiency of cutting process. This method consists in evacuation of a part of gas from the discharge chamber of

plasma generator through the aperture in the bottom of the internal electrode. As a result the pressure inside the discharge chamber considerably decreases, the tangential component of speed of gas near the surface of the electrode and, certainly, the speed of movement of the plasma arc spot on this surface essentially increase. It is important that in this case, there is a possibility for plasma torch to work at the small plasma air flow rate that allows to reduce the turbulence of a plasma flow on output of the nozzle of the plasma torch and to increase its length, providing thus a cutting of the large thickness of metals. In the given work the results of research of the specific erosion of the internal copper electrode of plasma generator for cutting metals are submitted.

3. EXPERIMENTAL RESULTS

The plasma generator with copper tubular electrode [1] with evacuation of a part of gas from the discharge chamber [2] has been taken as object of research is accepted. On the base of experience of long period of research and operation of the given types of plasma generators for a series of their constructive and regime parameters the optimum values has been accepted. Among these parameters were the following: the diameter and the length of the internal cavity of the copper electrode, the diameter and the length of the cylindrical part of the nozzle channel, the distance from nozzle up to the metal, the number and the cross section of vortex apertures. Among variable parameters were: the working arc current from 300 up to 450 A and the plasma air flow rate from 0,72 up to 1,44 g/s.

$$\gamma = \frac{Me_1 - Me_2}{I \cdot t}, \quad (1)$$

Where I is the working arc current; Me_1 and Me_2 – weights of electrodes before and after experiment; t – duration of experiment.

The experiments were realized in order appropriate to the table of random numbers. Each experiment was repeated three times, and the specific erosion was determined as average of three tests. According to the results of experiments the dependences of the

specific erosion of the tubular copper electrode on the plasma air flow rate (fig.1) and the working arc current (fig.2) have been drawn. In the first series of experiments the arc current was kept constant at 350 A, and in the second series the plasma air flow rate was kept constant at 0,72 g/s. The analysis of the received dependences shows, that the specific erosion of the copper electrode grows practically linearly with the increase of the plasma air flow rate. This fact can be explained by the increase of the pressure inside the discharge chamber of plasma generator, and consequently by the reduction of the speed of rotation of the gas vortex and the supporting spot of the arc on the internal surface of the electrode. It is necessary to emphasize, that in case of plasma generator with copper electrode with evacuation of a part of gas from the discharge chamber, the specific erosion is relatively small even for small plasma air flow rate (0,72 g/s). The plasma generator in this state works stably, because at the small plasma air flow rate the turbulence of the plasma flow on the output from plasma generator nozzle is essentially reduced and its length is increased. As a result the noise suddenly decreases during the work of plasma generator, assuring by this the quiet mode, more favourable, for the personnel participating in process. At the same time, as a result of the extension a of plasma flow on the exit of nozzle of the plasma generator because of the evacuation of a part of gas from the discharge chamber, and also because of much more elongation of the arc in a cavity of the kerfs, a cutting of large thickness metals is assured.

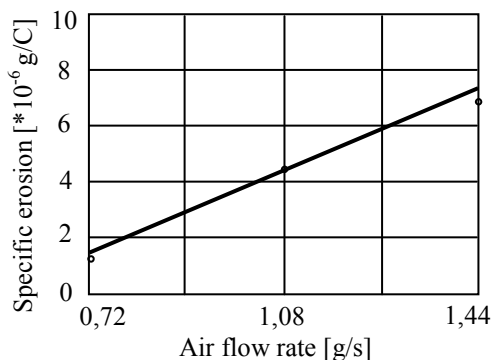


Figure 1: Variation of the specific erosion of the internal copper electrode function of air flow rate for the working arc current 350 A.

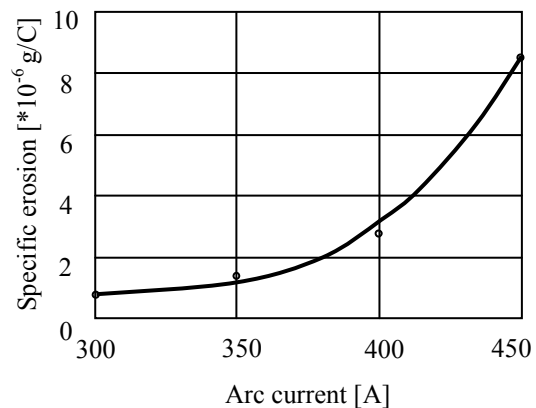


Figure 2: Variation of the specific erosion of the internal copper electrode function of working arc current for the air flow rate 0,72 g/s.

4. CONCLUSIONS

The analysis shown, that such specific erosion for the weight of about 0,165 kg of the electrode provides a significant resource of its work. It is established, that for the operating conditions the resource of the copper electrode makes 8...10 shifts. For the same conditions for plasma generator with thermo chemical cathode for one shift it is necessary to have 3...4 electrodes.

References

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