

Management of processes of electrochemical dimensional processing

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Abstract. In different industries a lot high-precision parts are produced from hard-processed scarce materials. Forming such details can only be acting during non-contact processing, or a minimum of effort, and doable by the use, for example, of electro-chemical processing. At the present stage of development of metal working processes are important management issues electrochemical machining and its automation. This article provides some indicators and factors of electrochemical machining process.

Introduction

Electrochemical machining is widely used for the treatment of extra-fragile, and highly heat-resistant alloys, high purity tungsten, for the manufacture of electrical contacts of power relays, magnets made of samarium-cobalt alloys. Production of details of these materials by traditional methods is practically impossible due to the occurrence of a number of technological challenges, including the emergence of mesh cracks, chips, failure to tolerances on physical parameters. Forming such details can only be acting on the workpiece during non-contact processing, or a minimum of effort, and doable by the use of electrochemical or elektroabrasive processing under the local effect of an electric current, which is carried out by controlling the electric field in the gap.[1]

Processes indicators and factors of electrochemical dimensional processing

Management of processes of electrochemical dimensional processing and its automation at the present stage of development of processing of metals is very important. At automation of process of electrochemical dimensional processing perhaps two approaches: ensuring stability of process or to enter amendments into process during processing of each detail. The first path is very difficult as during processing changes of structure, impurity, a causeticity, temperature of electrolyte, an interelectrode gap, resistance of chain units and other parameters are inevitable.

The second path is flexible production systems - the technologies having huge potential in the environment of small and medium business. In this regard many higher educational institutions enter into curricula in the engineering directions discipline "Flexible production systems". Flexible production systems are characterized by an opportunity to consider changes in process, in particular in the course of electrochemical processing. [2]



Currently, in scientific and technical literature is available enough materials describing relations between various parameters of process that allows to use these dependences for the fissile monitoring and management of processes of electrochemical dimensional processing.

However electrochemical processing is characterized by a number of the interdependent phenomena that complicates the analysis and the choice of criteria for process control. Methods of mathematical statistics can be applied to the analysis and the choice of criteria.

Research electrochemical dimensional processing with the fixed electrodes

The research of electrochemical dimensional processing with the fixed electrodes was conducted for the choice of significant criteria of management of processes. Process of dimensional electrochemical processing can be carried out at the fixed relatively each other electrodes and with movement of one of them in processing. Process of dimensional electrochemical processing with the fixed electrodes is applied when their movement in processing is difficult or inexpedient. With the fixed electrodes it is necessary to refer simplicity and reliability of a design of an inventory in which there are no composite mechanisms and systems of automatic keeping track of by giving of electrodes and the composite rapid systems of protection against short-circuits to electrochemical dimensional processing method advantages. The method with the fixed electrodes is perspective at exercise of a number of the difficult and unique technological operations where removal of metal is insignificant, including in case of manufacture of details with a contour of various configuration in a sheet, during the marking, flash removal, etc. [1]

On section exemplars with sizes of 10*10*20mm from steel 12X13. The cathode was manufactured of L62 brass by the sizes 3*3mm. NaNO₃ electrolyte. For a research were a number of parameters and limits of their variation is chosen, there are shown in Table 1.

Table 1 Parameters and limits of their variation for a method of electrochemical dimensional processing with the fixed electrodes

Name and units of measure of a factor	Coded identifications	Variation levels		
		Lower level	Basic level	Upper level
Initial interelectrode gap, mm	X ₁	0,05	0,3	0,5
Electrolyte pH value	X ₂	2,5	5	7,5
Electrolyte concentration, %	X ₃	5	7	10
Electrolyte temperature, °C	X ₄	19	30	40
Electrolyte speed, m/sec	X ₅	0,2	6	12
Treatment time, sec	X ₆	3	31	60
Operating voltage, V	X ₇	7	17	27

Efficiency of process (Y1) was estimated by print depth. Accuracy of processing (Y2) was estimated by a difference of the sizes of the cathode and the sizes of a print on the anode. The surface roughness after processing (Y3) was estimated by height of roughnesses. As a result of data interpretation the regression equations were received:

$$Y1=142,23-16,69X_1-6,59X_2+20,31X_3+18,21X_4+97,75X_5+110,53X_6+84,41X_7-56,39X_1*X_5+72,08X_5*X_6+56,73X_5X_7+61,27X_6X_7,$$

$$Y2=1160,77+271,71X_1+21,21X_2+136,29X_3+39,66X_4+79,52X_5+404,59X_6+426,38X_7+192,49X_1*X_5+90,62X_1*X_6+151,51X_1*X_7-84,27X_2*X_3-71,23X_2*X_5+67,82X_6*X_7,$$

$$Y_3 = 54,49 - 9,47X_1 - 5,73X_2 - 4,99X_3 - 7,40X_4 - 7,13X_5 + 7,16X_6 - 4,69X_7 + \\ + 6,32X_1 * X_2 + 6,68X_1 * X_4 + 6,63X_1 * X_5 + 7,18X_3 * X_4 - 6,27X_5 * X_6 - 6,21X_6 * X_7.$$

Conclusions

Follows from the analysis of the received equations of regression that the main criteria influencing electrochemical dimensional processing with the fixed electrodes are tension on electrodes, outlet velocity of electrolyte. Management of processes maintaining of a constant current density for the account by management of tension allows to increase efficiency of process and accuracy of copying, at slight increase of a roughness of the processed surface.

It is also revealed that the print sizes at defined values of tension and speed of electrolyte can be less than the sizes of the cathode. This phenomenon can be used when obtaining necessary accuracy of the sizes of a print at electrochemical dimensional processing.

References

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