

Influence of introduction of robotics on increase in efficiency of electrochemical production

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Abstract. The relevance of the study of the impact of the introduction of robotics to improve production efficiency is that it affects the level of development of domestic engineering. The article offers an economic justification of the use of the robot to automate the process of electrochemical machining of workpieces, in order to improve the quality of parts and improve production efficiency

The modern enterprises for increase in competitiveness and efficiency more and more attention is paid by production modernizations. An important role in this process is played by application of robotics.

The tendency of increase in the park of robots in modern industrial production is caused by a number of objective factors. As a rule, this increase in labor productivity at quality preservation of production at simultaneous reduction of expenses and a possibility of quick response to changes of objects of production and the consumer market [1].

Development of the direction of robotics has in recent years allowed to create effective decisions for production of small-scale and piece production with use of industrial robots. But at the moment, in Russia many enterprises, especially in mechanical engineering, use machines and technologies of semicentennial prescription which have already become outdated and don't show high efficiency [2].

As many scientists consider: the main push for rapid development of the domestic industry is introduction of new technologies. But unfortunately, the most part of hi-tech production are imported into Russia from the abroad as products of domestic production are noncompetitive or don't answer on these or those technical characteristics [3-7].

Robotics advantage - flexibility of application and a possibility of use in almost unlimited number of processes. Use of robots is possible, both separately, and in a complex. Feature of industrial robots – flexibility of change-over. For release of new products in most cases it is enough to enter other program. Such property is irreplaceable for the processing production as a half of volume of production becomes average or small parties.

If industrial lines aren't robotic, then on creation of products which are issued small volumes, only 5% of the general working hours will be spent. Other 95% will be occupied by setup of the machine, change of tools, loading and unloading of details, etc. If for production of the same party to use robotic



production, then the ratio of time will be considerably increased towards productivity. Other positive effect from use of robots – economy of raw materials and materials.

Industrial robots have very high precision of positioning - 0,05-0,1 mm, and the repeatability allows to reach the necessary level of processing of a product at minimization of a manufacturing defect. The exception of a human factor in technological process considerably reduces percent of working mistakes, and use of robots results in constant repeatability during all industrial cycle [8].

In the sphere of processing of preparations less robots, than are involved in others, but it doesn't mean that their application is inefficient. Robotization allows to solve successfully many problems in the field of welding, test, cutting, control, etc. Use of automatic machines in production allows to move long time the heated heavy details at great speed and to work in hostile environment.

Application of robotization in the sphere of processing is justified in that case when on one robot several machines are necessary, and the automatic machine is programmed not only on installation of a detail, but also on her removal, transportation on the following stage, etc.

Having studied activity of several plants, we have revealed the following problem. At many enterprises when processing a surface of products use already outdated methods, manual human skills on sites with harmful working conditions. And communication with it at the exit turns out finished goods with the hung-up quantity of the rejected production, with high prime cost.

For change of a form, the sizes and receiving a surface with small roughness with high qualitative characteristics, it is possible to use electrochemical processing of metals.

Electrochemical metal working is one of ways of giving of a detail of a certain form, the size and also character of a covering of a blanket. In other words, such processing can alter a metal detail and cover her surface with special dusting by means of electrochemistry.

And also at electrochemical processings can be provided high precision [9].

For carrying out similar processing the highly specialized equipment - electrochemical machines is used. Because of low productivity such technological installations are created only under a certain process, but the similar equipment is irreplaceable. Such machines can have access to those parts of preparation of metal, where not to reach any in a different way metal working.

By unique these machines are done that after their impact on a detail, there is no need to use polishing machines or the grinding equipment which only the highly skilled personnel have to operate.

And also at these enterprises process of loading of the raw preparations for processing isn't automated: preparations are loaded into machines manually. The operator manually places preparation on the machine, slowing down thereby a production cycle and doing it to more expensive. And because of not exact laying of preparations in machines, in processing of details the high level of marriage appears.

In addition, introduction of robots instead of the person in these spheres positively affects health of the last as working conditions are connected with high temperatures and hostile environment.

For the solution of these problems we offer robotization of process with use of the ABB Robotics IRB 6620 LX robot. One robot can replace work of four people. The cost of the ABB Robotics IRB 6620 LX robot - \$120 thousand; service life without repair of 10 years, with a condition of observance of rules of service. When studying opportunities on process automation, the choice I have fallen on this robot, because of his production characteristics and also because of the best ratio "price quality" [10].

Check of number of preparations at machines, their sorting according to a form and dimensions, control of the obtained data on compliance to the standard parameters specified in the drawing, etc. also belongs to automatic machine duties. That the robot could manage to perform necessary operations, it will have own transport network. And also development and creation of systems of automatic obtaining accuracy of processings and the systems of active control will help improvement of quality of finished products.

Robotization of process of loading of preparations on the electrochemical machine and their electrochemical processing will allow to increase accuracy, by stabilization of full processing, and

productivity due to reduction of the main and auxiliary time of processing (in the main time of subadjustments and preparatory and final time) [11].

Table 1 - Accounting of costs of quality before introduction of robotics

Main work	The costs of compliance with process		Costs due to non-compliance	
	The cost components	The value in rubles	The cost components	The value in rubles
Loading presets	The cost of loading raw workpieces for processing	32 hours*200 rubles= 6400 rubles	Losses due to the mismatch of materials, technology and tooling	600 rubles* 8 pieces = 4800 rubles
Quality management	The cost control of materials, processes and production, quality analysis, complaints handling	4 hours *150 rubles = 600 p.	Losses due to delay of operational quality information from the consumer. Losses due to failure of the evaluation criteria for acceptance	2000 rubles
Acceptance and storage	The cost of incoming inspection and storage	8 hours * 100 rubles = 800 rubles	Losses due to the mismatch between storage conditions	100 rubles *2 hours = 200 rubles
Process analysis and management	The cost of collecting, analyzing information, developing measures to improve the process	150 rubles *10 hours = 1500 rubles	Losses due to the lack of operational feedback necessary to transfer the process to a statistical managed state	2000 rubles
	Total costs of the compliance process	9300 rubles	The total cost due to imbalance	9000 rubles
	The full cost of the process		18300 rubles	

Table 2 - Accounting of costs of quality after introduction of robotics

Main work	The costs of compliance with process		Costs due to non-compliance	
	The cost components	The value in rubles	The cost components	The value in rubles
Loading presets	The costs of organizing work, the work load unprocessed workpieces for processing	7 hours*100 rubles= 700 rubles	Losses due to the mismatch of materials, technology and tooling	600 rubles * 3 pieces = 1800 rubles
Depreciation operation and maintenance	Depreciation and maintenance costs of the robot	7 hours * 700 rubles= 4900 rubles	Losses due to improper maintenance of the robot	100 rubles
Quality management	The cost control of materials, processes and production, quality analysis, complaints handling	2 hours *150 rubles = 300 rubles	Losses due to delay of operational quality information from the consumer. Losses due to failure of the evaluation criteria for acceptance.	1000 rubles
Acceptance and storage	The cost of incoming inspection and storage	8 hours * 100 rubles = 800 rubles	Losses due to the mismatch between storage conditions	100 rubles *2 hours = 200 rubles
Process analysis and management	The cost of collecting, analyzing information, developing measures to improve the process	150 rubles *5 hours = 750 rubles	Losses due to the lack of operational feedback necessary to transfer the process to a statistical managed state	1000 rubles
	Total costs of the compliance	7450 rubles	The total cost due to imbalance	4100

process		rubles
The full cost of the process		11550 rubles

For assessment of expediency of introduction of the robot from quality, the decision to carry out accounting of costs of quality on process before introduction of robotics has been made. For accounting of costs of quality it is possible to use the POD method (prevention, assessment, defects), recommended for use by the ISO 9004 international standard which cornerstone the structure of costs of ensuring quality offered by A. Feygenbaum is.

Having carried out accounting of costs of quality, we compare costs of quality before introduction of robotics and after introduction to estimate expediency of introduction of robotization. On table 1 accounting of costs of quality on process before introduction of robotics (average values on branch are taken), and is given in table 2 - after introduction. Data are provided with calculation of costs of loading 1000 pieces of the raw preparations.

Apparently, from tables with accounting of costs of quality, introduction of robotics for this process it is expedient as allows to lower by 36,9% of costs of quality on process of electrochemical processing of products. After her introduction also decreases the expenses provided on mitigation of consequences of accidents, injuries and on certification of jobs. The consumed energy decreases: the robot can work in the conditions of smaller illumination. And also other advantages of use of the robot:

- Decrease in losses from marriage: introduction of the robot allows to reduce quantity of the rejected production from not exact installation of preparations on machines to 3 pieces on 1000 products;
- Minimization of expenses on a manpower: economy on the wages fund of 1600 thousand rubles a year;
- Because of economy of working space, reduction of time of a production cycle;
- Increase in labor productivity, for the account reduction of time of a production cycle and decrease in quantity of the rejected production;
- An exception of a human factor, and therefore – low coefficient of marriage;
- High efficiency of the machine. Lack of human weaknesses: work in the round-the-clock mode, with stable result.

By sight the simple solution of use of the ABB Robotics IRB 6620 LX robot for separate auxiliary process allows to reduce processing execution time significantly. In general, all this will lead to improvement of quality and decrease in product cost. Use of the robot is more ergonomic, and his arrangement in the top part of the conveyor to provide considerable economy of working space.

Introduction of robotics in production leads to improvement of quality of production at simultaneous reduction of expenses. As we think, application of this experience in the enterprises of mechanical engineering will give positive effect for growth of the general indicators of branch, considering that a situation in which it is.

Robotizations of production to reduce influence of a human factor and will allow to reach the best quality and quantitative index of products at the expense of the accuracy of work and resistance to influence of external factors. In present time, the production only computerized, with use of robotics, it is capable to guarantee quality daily to products.

Today a task of producers of products of mechanical engineering - to reconsider own strategy and to reveal possibilities of involvement of robotics at production and rendering services to take advantage of use of such decisions, for increase in the advantages on the markets representing production with the high qualitative characteristic and low prime cost.

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