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PARAMETERS OF MODE AND CHARACTERISTICS OF THE PROCESS OF BROAD LAYERED FACING OF THE CYLINDRICAL PARTS WITH THE HELP OF SELF-PROTECTIVE DUST

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Summary. The aim of the given research was to establish the influence of regime parameters on the melting and facing productivity and the loss of the melted metal. It is established that sufficient uniformity of the facing metal thickness and productivity 5.8 kg/h can be obtained at the current of 400A and under condition of the electrode offset from zenith 9-11 mm. Under such conditions 12-18% of the melted metal will be flowing from the facing surface in the form of separate drops.

Key words: facing, a broad layer of the metal, shaft, dust, parameters of mode.

INTRODUCTION

The fastest-degradable parts of farm technology have a cylindrical shape and work under conditions of abrasive and other types of degradation. The area of degraded surfaces (shaft neck, surfaces for bearings etc) does not exceed 10-15% of general part area surface. Deletion of such parts involves a lot of costs invested into working metal and non-degraded surfaces are being wasted.

One of the ways of proceeding with parts resources is their renewal. The special trait of this process is that there is a need to provide the ability of renewable part to work with minimum expenses and with the minimum damage of work surfaces.

The most widely used way of renewing is facing [7, 8, 16, 18]. High properties of the metal facing can be obtained with the help of alloying [2, 12]. The effective way of introduction of alloying elements under electric bow facing is including the dusts of the alloying element into the structure of the dust wire charge or dust tape.

A wide application in farm machine building and repair industry defines the facing as the self-protective dust wire [1, 17]. It looks like an extensive tape made of light steel with the core in the form of dust mixture of alloying metals, ferro-alloys, carbides and dusts of gas and slag making substances. Such material for facing has a lot of advantages comparing with a solid wire [1, 2]. These advantages consist in an easy change of chemical structure and in the lack of protective gas or flux or mechanisms for its creation as well as in the possibility to get a great range of built up materials.

Facing a broad layered metal with a solid electrode wire of a little diameter under flux layer is obtained by transferring the electrode along cylindrical surface along the screw line or separate circular cylinders [9, 14]. To obtain a given width of the layer it is necessary to remelt metal of the previous cylinder in 50-70%, and the thermal cycle of the first and the last cylinder differ a lot [15]. So, the uniformity of chemical structure of the built-up layer and its mechanical properties appear.

The application of multi-electrode facing [3, 4] greatly complicates the process and equipment and does not guarantee the necessary quality.

Self-protective dust wire under condition of absence of additional mechanisms for flux or gas supply allows an electrode to move in an oscillating way, perpendicularly to the vector of facing speed at the width of built-up layer. This technology in comparison with the screw line facing is characterized by the high productivity of facing and uniformity of built-up metal.

The scheme of broad layered facing is shown in Fig.1. The main parameters of cylindrical parts of the facing with the cross oscillation of the electrode are: speed of the electric wire supply (V_{ws}); voltage on the bow (U_b); facing speed (V_f); average speed of the electrode oscillation (V_o); the transferring speed of the electrode end at the extreme positions (V); escape of the electrode (l_e); offset *(e)* it from zenith and radius (*R)* of electrode oscillation.

Practical application of self-protective dust wire under the facing of cylindrical parts of a little diameter is restrained by the absence of the most convenient values of these parameters.

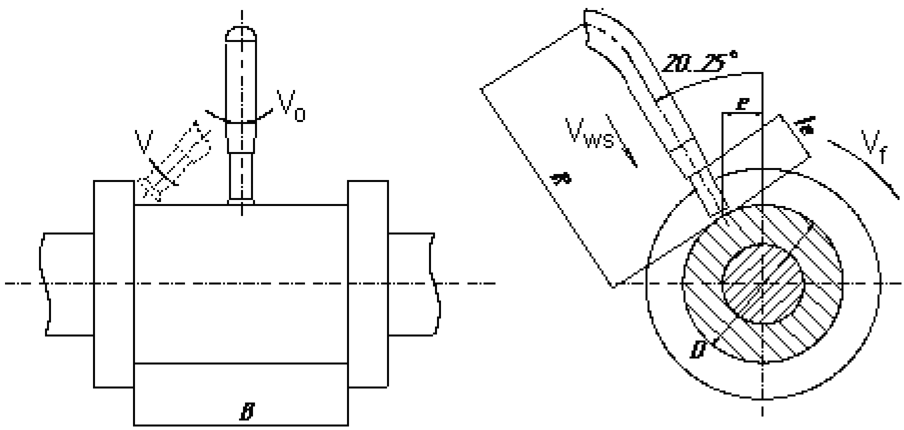

Fig. 1. The scheme of facing of cylinder surface with the diameter *D* with the cross oscillation of electrode on the width *B*.

AIM AND METHODS

Taking into consideration the complication of the experiment along with the great quantity of crucial factors, the aim of the work was to determine the influence of the most important parameters of the regime on the productivity of the wire melting and loss of the metal. The meanings of the other parameters in the experiments were being chosen as a result of previous experiments and as a result of the constructive consideration.

The samples of the 60 mm diameter and 50 mm width made of steel St3 were faced with the self-protective dust wire ПП-Нп 30Х3Г2СМ of the 2,0 mm diameter. The wire contained 1-14%

of the dusts of gas and slag making substances. The facing was conducted with the special device, with the source of the welding current using rectifier ВДУ-506.

While conducting experiments some parameters of the regime were of permanent value: the speed of the facing – 5,5 m/h; voltage on the bow – 27 V; average speed of electrode oscillation – 213 m/h; speed of the electrode oscillation in the extreme positions – 160 m/h. Current strength was changed regulating the supply speed of the wire within a 200-400 A, escape of the electrode - 16-30 mm; offset of the electrode from zenith – 8-12 mm, oscillate radius of the electrode - 80-145 mm.

Current strength and voltage were measured with the help of ammeter and voltmeter, time of bow burning - with electric stopwatch of P-30 type up to ± 0,05 sec. Mass of the samples under investigation before and after facing was measured by weighing up to ± 1g. Mass of the built-up metal was determined as the difference of the two numbers. Special device was made to determine mass of melted wire which was adjusted on mechanism of wire supply. The device consisted of ten-toothed cam tightly joined with the mechanism of wire supply, micro-switch, enclosed in the electric circuit of impulses meter and it worked while the cam turned. One turn of the feeding roller corresponded to meter indication of 10 impulses. Mass of the wire supplied per one impulse was measured experimentally.

Coefficient of melting, facing and losses of melted metal as well as facing productivity were calculated using the following formulas:

$$\alpha_m = \frac{G_m \cdot 3600}{I_w \cdot t};\ \alpha_f = \frac{G_f \cdot 3600}{I_w \cdot t};\ \mu = \frac{G_m - G_f}{G_m} \cdot 100;\ Q_f = \frac{\alpha_f \cdot I_w}{1000}.$$

In the above-presented formulas:

α_m, α_f – coefficients of melting and facing, g/A h;

μ - coefficient of losses, %;

G_m – mass of melted metal, g;

G_f – mass of built-up metal, g;

I_w – power of welding current;

t – time of bow burning;

Q_f – facing productivity, kg/h.

Calculation of coefficients of melting, facing and losses of the melted metal was carried out taking into account the presence of 10-14% of dusts of gas- and slag-making components in wire.

RESULTS AND DISCUSSION

The conducted experiments and calculations have shown significant changes of the process characteristics after the change of the mentioned parameters.

At the radius of electrode oscillation of 80 mm and excepted value of other parameters, facing productivity increases while increasing strength of welding current and escape of electrode (Table 1).

A smaller influence on the productivity of facing is caused by an increase of radius of electrode oscillation (Table 2), and at the value of R=145 mm the productivity even decreases. It is obviously connected with the closing of side surface of wire on beads bulging out at the sample ends (Fig. 2) and excessive sputtering of the melted metal which is proved by the data in Table 3.

Offset of electrode from zenith considerably influences productivity of facing. Data from Table 4 have proved the increase of losses of melted metal under conditions of research by offsets of electrode from zenith by more or less than 8-9 mm. It is connected with the flow of melted metal from the welding bath in form of drops before and behind the electrode.

Table 1.Dependence of productivity of melting on the strength of welding current and escape of electrode at R = 80 mm

Current strength, A	Escape of electrode, mm	Productivity of melting, kg/h
200	16	$\frac{2,65-2,74}{2,7}$
	23	$\frac{2,88-2,93}{2,9}$
	30	$\frac{3,11-3,28}{3,2}$
300	16	$\frac{4,62-4,79}{4,7}$
	23	$\frac{5,07-5,12}{5,1}$
	30	$\frac{5,40-5,58}{5,5}$
400	16	$\frac{7,11-7,32}{7,2}$
	23	$\frac{7,85-7,96}{7,9}$
	30	$\frac{8,70-8,90}{8,8}$

Thus, estimation of correctness of choice of electrode offset from zenith can be done by evaluation of the built-up layer of metal: if thickness of layer in the middle part is smaller – offset is too large, metal flows backwards, if thickness of layer in the middle part is larger – offset is too small, metal flows forwards at certain temperatures of the heated sample.

It is worth mentioning that offset of electrode from zenith will increase after certain time of working as a result of erasing of metal opening of current-carrying terminal of nozzle. Optimal offset of electrode will happen in case when thickness of layer is the same at any point.

Dependence of productivity of facing on the strength of current and offset of electrode at excepted values of other parameters is characterized by existence of extreme value at certain values of electrode offset (Fig.3).

Table 2. Dependence of productivity of melting on the strength of welding current and radius of oscillation at escape of electrode $l_e = 23$ *mm*

Current strength, A	Productivity of melting (kg/h) at radius of oscillation (mm)		
	80	115	145
200	$\frac{2,87-2,93}{2,9}$	$\frac{3,08-3,13}{3,1}$	$\frac{2,83-2,95}{2,9}$
300	$\frac{5,07-5,14}{5,1}$	$\frac{5,18-5,21}{5,2}$	$\frac{4,97-5,03}{5,0}$
400	$\frac{7,82-7,96}{7,9}$	$\frac{7,96-8,05}{8,0}$	$\frac{7,41-7,57}{7,5}$

Fig. 2. Appearance of built-up samples.

Table 3. The influence of strength of welding current and radius of oscillation of electrode on the losses of melted metal at escape of electrode l_e = *23 mm* and its offset from zenith *e = 8 mm*

Current strength, A	Metal losses (%) at radius of oscillation (mm)		
	80	115	145
200	$\frac{6,2-6,65}{6,4}$	$\frac{9,0-9,57}{9,3}$	$\frac{15,1-16,7}{15,8}$
300	$\frac{10,1-11,0}{10,5}$	$\frac{12,0-13,4}{12,7}$	$\frac{16,9-18,2}{17,5}$

Table 4. The influence of strength of welding current and offset of electrode from zenith on the losses of melted metal at escape of electrode l_e=*23 mm* and oscillation radius *R=80 mm*

Current strength, A	Losses of metal (%) at offset of electrode (mm)						
	0	4	8	9	10	11	12
200	13,5	8,2	6,4	8,2	10,7	13,4	16,4
300	17,1	11,8	10,5	12,1	14,9	18,1	21,2

Flow of the melted metal is the reason of such dependence. Taking into account the fact that the thickness of built-up layer should be even at the facing of thick layer of metal with cross oscillation of electrode, its offset from zenith should be chosen to obtain even thickness, allowing certain loss of melted metal at flow from welding bath back to electrode.

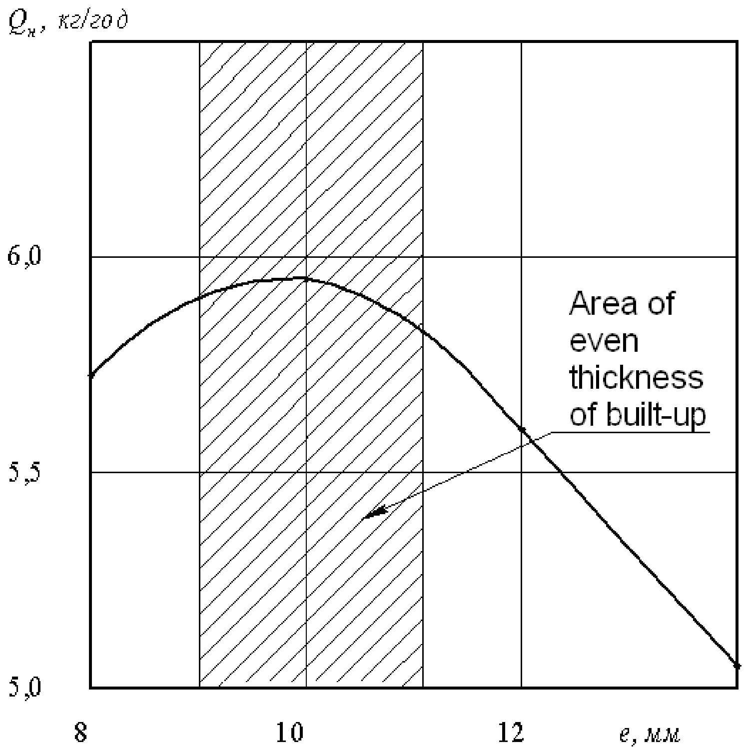

Fig. 3. The dependence of productivity of facing on the offset of electrode from zenith at strength of current 400 A, diameter sample 60 mm and layer thickness 50 mm.

SUMMARY AND CONCLUSIONS

1. Researched parameters of regime of facing of cylindrical forms with cross oscillation of self-protective dust wire considerably influence the productivity of melting and facing.
2. Maximal productivity of facing 5,8 kg/h at the speed of facing 5,5 m/h can be achieved at current 400 A and offset of electrode from zenith 9-11 mm. Increase and decrease of offset causes partial flow of metal of welding bath in form of separate drops.
3. Sufficient uniformity of thickness of built-up layer is achieved at offset of electrode from zenith 9-11 mm, when 12-18% of melted metal of welding bath will flow from built-up surface.

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ПАРАМЕТРЫ РЕЖИМА И ХАРАКТЕРИСТИКИ ПРОЦЕССА ШИРОКОСЛОЙНОЙ НАПЛАВКИ ЦИЛИНДРИЧЕСКИХ ДЕТАЛЕЙ САМОЗАЩИТНОЙ ПОРОШКОВОЙ ПРОВОЛОКОЙ

Аннотация. Целью работы было исследование влияния параметров режима на производительности плавления и наплавки и потери расплавленного металла. Установлено, что достаточную равномерность толщины наплавленного слоя и производительность 5,8 кг/час. можно получить на токе 400 А и смещении електрода из зенита 9-11 мм При этом 12-18% расплавленного металла будет стекать из наплавляемой поверхности в виде отдельных капель.

Ключевые слова: наплавка**,** широкий слой металла, вал, порошковая проволока, параметры режима