INFLUENCE OF THE ENERGY ACTION MODES ON HEAT AND MASS TRANSFER OF SURFACING MATERIAL, FORMATION OF STRUCTURE AND PROPERTIESOF COATINGS

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Purpose of work

Study of the influence of surfacing modes on the characteristics of heat and mass transfer of the electrode metal, on the formation of a dispersed structure in coatings and increasing their properties when modifying the molten metal using pulsed energy effects.

Experimental procedure

Feb-315 "MAGMA"

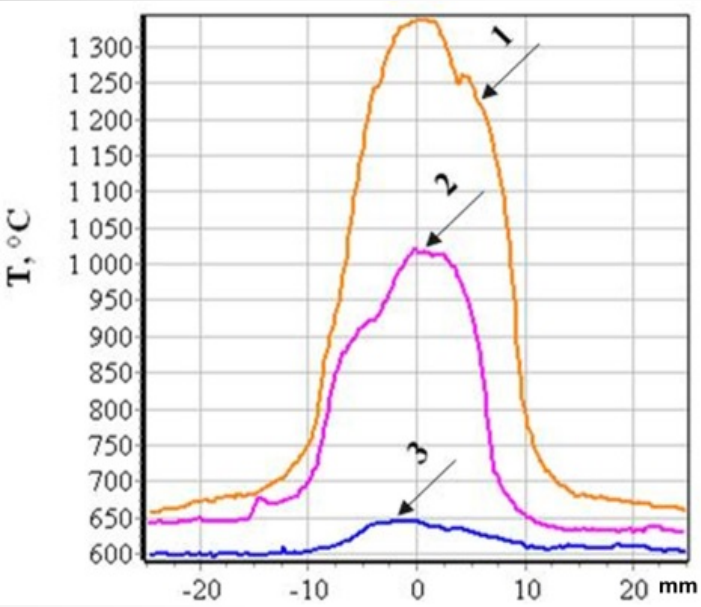
Metallographic microscope Neophot-32

Results and discussion

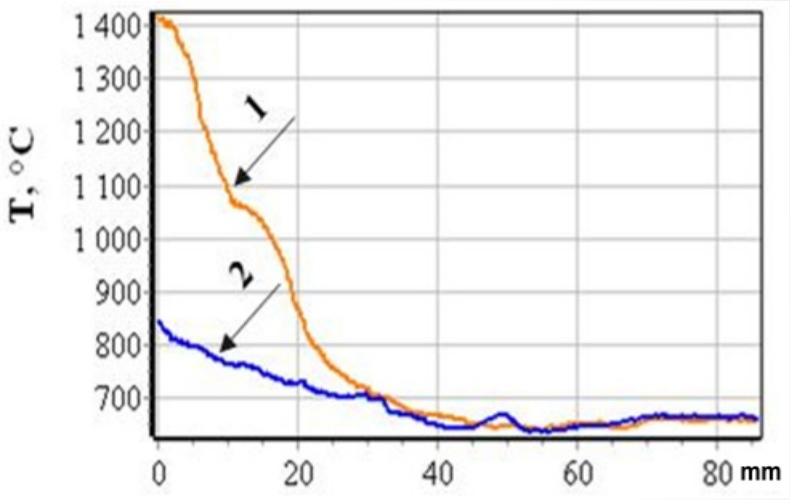
Table 1. Modes of surfacing coatings

№	Mark's electrode (welding conditions)	U_{avg}	I_{avg}	I_{pulse}	I_{pause}	t_{pulse}	t_{pause}	$N_{S/c}$	$T_{S/c}$ 10^{-3} s	Kd	$I_{S/c}$	q
1	T-590-N (DCM)	18,2	174,2	-	-	-	-	18	14,4	0,48	226	0,959
2	T-590-N (MCM)	18,7	179,6	200	60	0,3	0,3	61	8,6	0,24	292	0,790

where $U_{average}$ – secondary voltage, *V*; $I_{average}$ – average current, *A*; I_{Pulse} , $I_{Constan}$ – current, pulse and pause, *A*; t_{pulse} ,t_{pause} – pulse duration and pause, *s*; $N_{Short\ circuit}$ – the number of short circuits, pc.;
$T_{Short\ circuit}$ – the average duration of the short circuits, s 10^{-3} *S*; K_d – coefficient of variation of the duration of the short circuits; $I_{Short\ circuit}$ – maximum short-circuit current, *A*; *q* – heat input when welding, k*J*/mm. DCM – surfacing on direct current, MCM – surfacing with low-frequency modulation of energy parameters of the mode.



(a)



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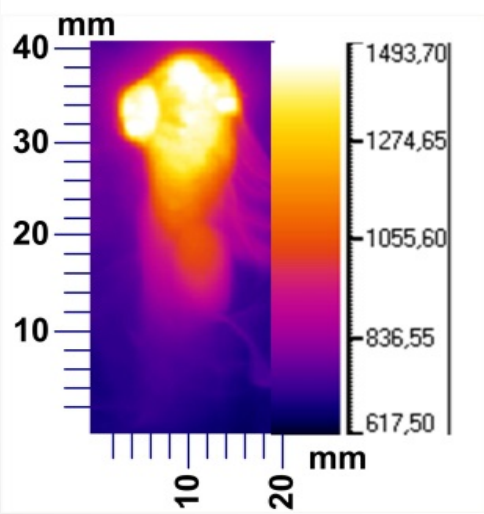
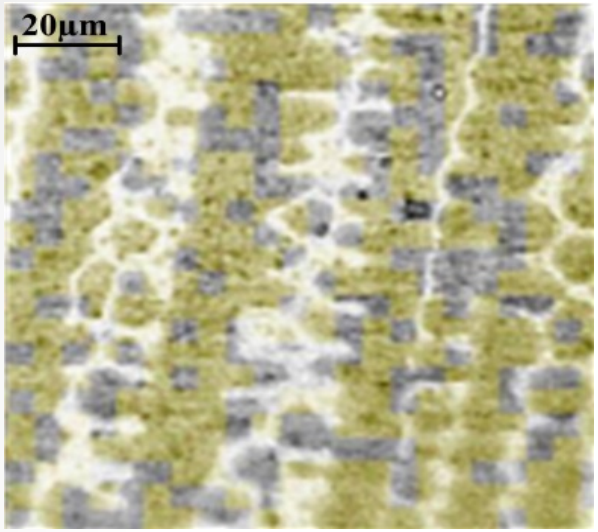
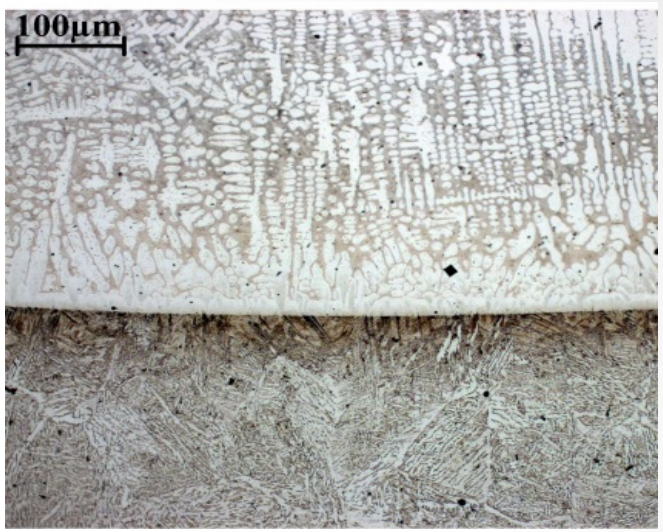


(c)

Figure 1. Results of thermal imaging studies: a) the curves of thermal cycles (CTC) across the surfaced coating in the temperature range: 1-1400 °C, 2-1000 °C; 3-700 °C; b) CTC along the coating axis - 1, along the HAZ - 2; c) temperature field during direct current surfacing.



(a)



(b)

Figure 2. Microstructure of the deposited composite coating with T-590-N electrodes and the border with the base-steel 09G2S: a) coating, ×1000; b) border.

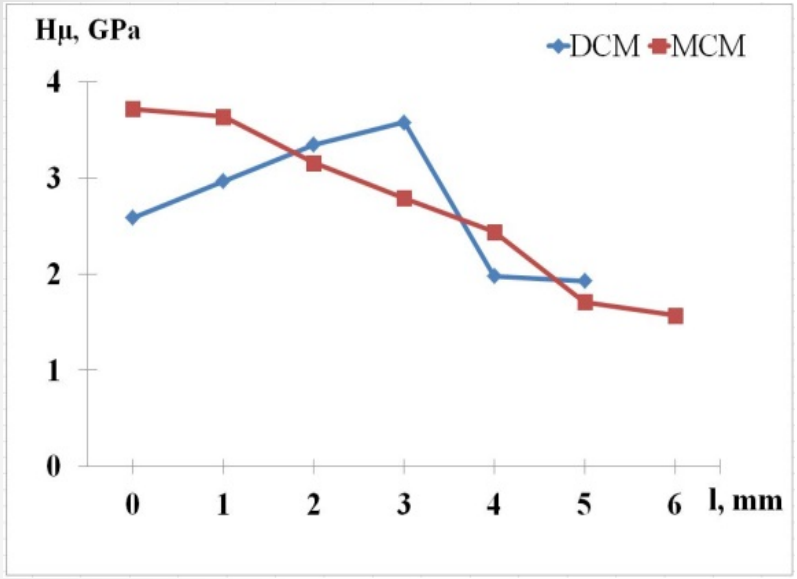


Figure 3. Change in microhardness at the boundaries of the sections "T-590-N - steel 09G2S surfaced coating" in the DCM mode and in the mode of pulse change of energy parameters (MCM).

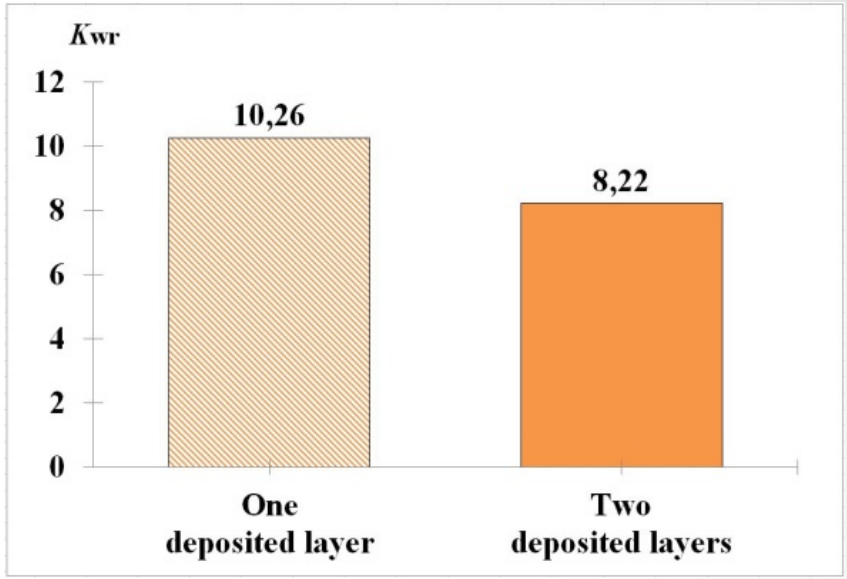


Figure 4. Histograms of the average level of wear resistance of coatings deposited with T-590-N electrodes in DC modes, made in one and two layers.

Conclusions

- A comprehensive approach to improving the properties of coatings using surfacing methods in controlled heat input modes, which contributes to the modification of the structure and improve the performance of processed products.
- It is Established that the control of energy parameters during surfacing allows to reduce the structural heterogeneity of the coating cross-section by reducing the size of the structural components in it, which significantly increases the performance properties of products operating in the low temperatures of the Far North.
- It is shown that the research diagnostic complex for registration of fast-flowing processes of heat and mass transfer allows to perform a quantitative assessment of the influence of energy parameters of the regime on the characteristics of heat and mass transfer, as well as to ensure high performance of the research process at low time and material costs.

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