Investigation of different variants of the chemical surface treatment in the process of the cold pilgering of the plain carbon tubes on the mill CTR (Cold Tube Rolling mill)-90

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Abstract
Effectiveness estimation of various schemes of lubricant compositions, which are applied while producing of cold-rolled pipes made of carbon and alloyed steel grades, is presented in the article. It is found that the application of corresponding chemical treatment allows reducing index of friction in the deformation zone and increasing of rolling rate of cold-pilgering mill up to 30%.
Key words: COLD STRAIN, UNDER-LUBRICANT COVERING, LUBRICANT, PILGERING, ROLLING PATTERN

Introduction

One of the most important objects of technology for the cold metal treatment is the choice of the under-lubricant coatings and lubricants. The successful solution of this problem predetermines the success in achieving reliability of technological process and the high quality of product surface. The output of equipment, the value of one-time deformations and cyclicity of the process and, subsequently, the value of manufacture expenses depend on the right choice of the lubricant.

While choosing the lubricant the specialists [1] are guided first of all with satisfaction of the basic functional requirements: decrease of the contact stresses and reduction of power expenses connected with friction overcoming; increase of tooling durability and the surface quality of products; preventing of seizure and metal sticking on the tool and cooling of the latter. Besides that, the lubricant is to satisfy the requirements of technical, economic and sanitary-healthy character. These are: stability of the lubricant composition and physical and chemical properties while using it; convenience in feeding lubricant onto the tool and billet,; simplicity in making the lubricant; clearing and regeneration of the lubricant in the process of exploitation; easiness in removing the lubricant off the surface of products; no harmful action on metal and equipment; untoxicity and absence of obnoxious odor; minimum soiling of working place and contamination of environment; economic expediency of using the lubricant and its availability. Lubricants and lubricating compositions for specific processes of metal forming are chosen in heuristic way using information about analogs. Information from the field of metal science about the structure of lubricating agents and additions to them is of importance as well as results of investigation of physical and chemical interaction of these materials with the surface of the billet and formation of the plasticized layer. Development of mechanics of the contact interaction in the system tool – lubricant – metal are helpful in formulating requirements as to physical and mechanical properties of lubricating compositions. In such situation the right choice of mechanical tests for studying viscosity, adhesion and anti-friction properties of lubricants is important.

Evaluation of the basic functions of the process lubricants for the cold conversion is an actual problem. It leads to decrease of the value of friction forces as well as of the value of friction factor, and to increase of the value of feed and, conformably, of the hourly output of the rolling mill.

The objective of the present work was:
- evaluation of efficiency of the basic functions of schemes for treatment of lubricating compositions available in TRS (Tube Rolling Shop)-3;
- increase of the output of the CTR mills while filling the orders for cold-rolled tubes of the plain carbon and alloyed steel grades according to the State Standards 8733/8734;
- increase of the durability of the rolling tools in the CTR mills;
- improvement of quality of the outer and inner surface and precision of the rolled tubes;
decrease of the load for the main drive of the mill CTR-90.

Procedure of investigations

Reduction route had been chosen as it mentioned below:
73x5.0x5300→42x3.0x10000mm.

The hot-deformed tubes, of dimension 73x5.0x5300mm, steel grade 20, have been rolled on the tube rolling unit "ТПА (Tube Rolling Unit) 30-102" at the closed joint-stock company "INTERPIPE NICOTUBE".

The tubes of dimension 42x3.0x10000mm were rolled in the public joint-stock company "INTERPIPE NTZ" on the CTR mill (the rolling mill of the third make, construction (design) "EZTM" (Works for heavy machine-building in the town of Electrostal) equipped with epicyclic distributiv-feeding device (design of "NKMZ" (Machine-building works in the town of Novokramatorsk)).

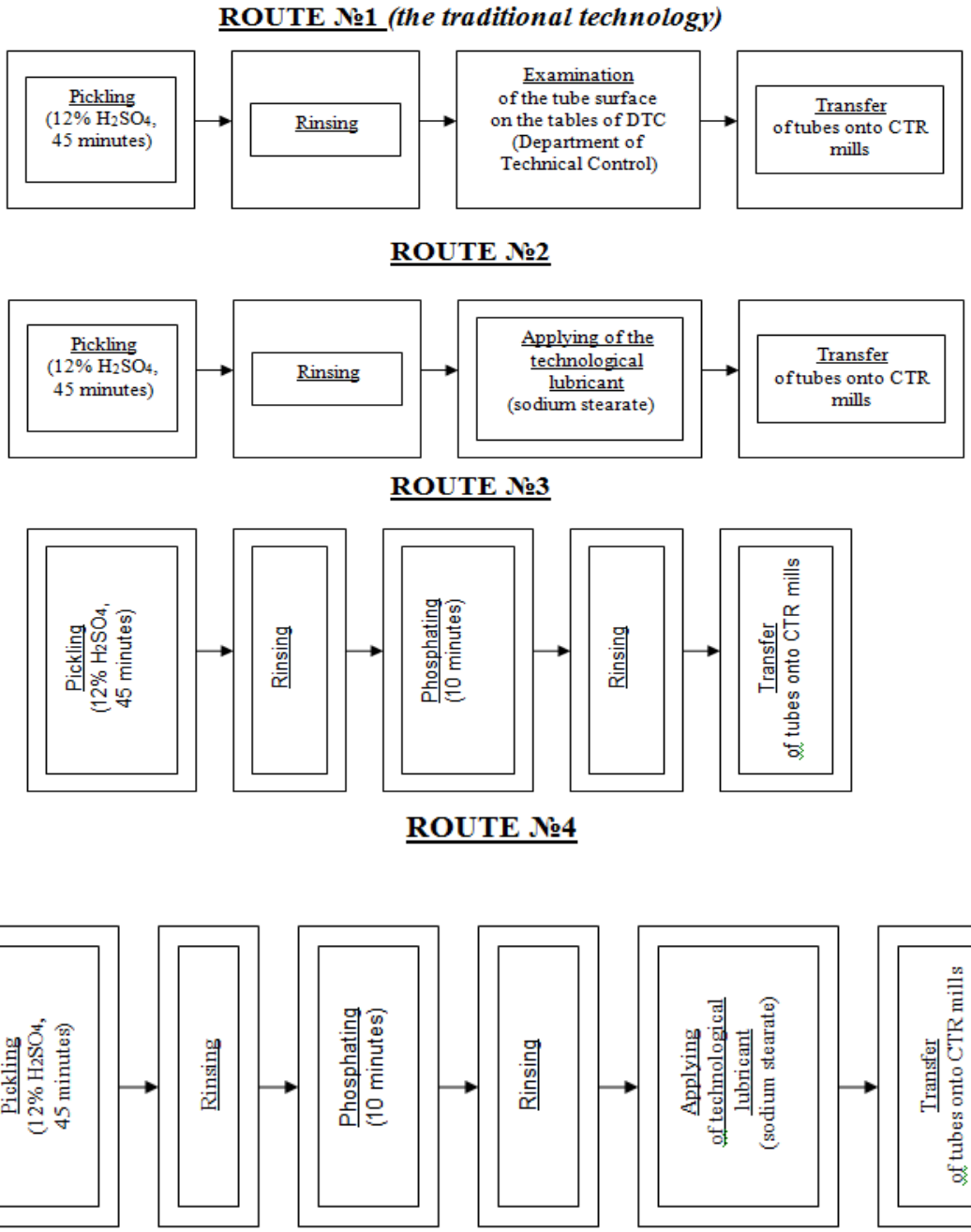
After rolling on the CTR mill the measurement of the geometric tube parameters had been carried out.

The chemical treatment of the tube round billet had been carried out along four routings:
- routing №1 – the traditional technology in accordance with technological (operating) instructions as to rolling and chemical treatment of the surface (TI NTZ - Tr3 – 04 – 2007;
- routings №2, 3 – improved technologies (see the scheme of operation sequence);
- routing №4 is the routing used in the TRS-3 for chemical treatment of tubes before drawing while manufacturing tubes of increased precision for SEM (submerged electric motors) and SEP (submerged electric pumps), in accordance with operating instruction (TI NTZ – Tr-3 – 04 – 09).

In the process of rolling the stability of feed (throws) had been evaluated and in the case of the absence of evaluation , the smooth increase of the feed had been carried out with the step 5%. While doing this, the quality of the tubes surface to be rolled has been evaluated as well as changing of technological parameters of the mill operation.

The sequence of operations in the used technologies is presented on the schemes 1-4

Scheme of the chemical treatment of tube workpieces



Results of measurements of technological parameters in the process of cold deformation and precision of the tube geometry are presented in tables №№1-4.
Variant 1.

Table 1. Technological parameters of the cold rolling process on the mill CTR-90 according to the variant 1.

Feed value, mm	28	30	28	35	Turn of tube, degrees		102	98
Number of double strokes per minute	58	58	60	58	Diameter, mm	max	57,20	57,
						min	57,05	57,
					Wall thickness, mm	max	3,60	3,6
						min	3,35	3,4
					Ovality, mm		0,15	0,2
					Wall thickness deviation, mm		0,25	0,2

Under the given regime of the chemical preparation it is necessary to note the instability of the mill operation (number of

double strokes varies from 58 to 60 strokes per minute).
The external appearance of the tube surface and precision of geometric parameters (diameter, wall thickness) comply with requirements of the State Standard GOST 8733/8734.
Variant 2.

Table 2. Technological parameters of the cold rolling process on the mill CTR-90 according to the variant 2.

Feed value, mm		37,5
Number of double strokes per minute		58
Turn of tube, degrees		92
Diameter, mm	max	57,30
	min	57,05
Wall thickness, mm	max	3,50
	min	3,40
Ovality, mm		0,25
Wall thickness deviation, mm		0,1

The second route of the chemical preparation of the tube billets allowed to increase the value of axial feed during deformation on the mill CTR-90 for 34-45%. The load on the mill engine was in the limits of the norm.
The quality of external surface of the finished tubes was satisfactory. Ovality of diameter and the lateral (cross) wall thickness deviation complied with requirements of specifying forms and records and requirements of the State Standard GOST 8733/8734.
It is necessary to note the instability in the mill operation as to the number of double strokes from 58 to 63 strokes per minute.
Variant 3.

Table 3. Technological parameters of the cold rolling process on the mill CTR-90 according to the third variant

Feed value, mm		31	
Number of double strokes per minute		60	
Turn of tube, degrees		100	
Diameter, mm	max	57,20	
	min	57,05	
Wall thickness, mm	max	3,50	
	min	3,35	
Ovality, mm		0,15	
Wall thickness deviation, mm		0,15	0,2

The rolling process followed the stable course, the throws of the feed were not watched. In this variant of the chemical preparation of the tube billets, the smooth increase of the feed for 20% was taking place in the process of rolling on the mill CTR-90. The load on the mill engine was in the limits of norm.

40	43	45
60	63	61
97	102	102
57,25	57,30	57,30
57,05	57,05	57,05
3,50	3,60	3,60
3,35	3,40	3,40
0,20	0,25	0,25
0,15	0,2	0,2

In the case of increase of the feed value for more than 20%, the small scratches appeared on the external surface of tubes. In this connection the further increase of the feed value had been suspended.

The quality of external surface of the tubes was satisfactory. The geometric parameters of tubes complied with requirements of the State Standard GOST 8733/8734.
4. Variant 4.

Table 4. Technological parameters of the cold rolling process on the mill CTR-90 according to the fourth variant.

Feed value, mm		34	34
Number of double strokes per minute		59	62
Turn of tube, degrees		100	110
Diameter, mm	max	57,20	57,25
	min	57,05	57,05
Wall thickness, mm	max	3,50	3,50
	min	3,35	3,35
Ovality, mm		0,15	0,15
Wall thickness deviation, mm		0,15	0,15

31	35	35
62	63	63
120	120	110
57,20	57,20	57,25
57,05	57,05	57,05
3,55	3,55	3,60

This route of manufacturing the cold-deformed tubes allowed to increase the feed value for 30-45%. The load on the mill engine was in the limits of the norm.

The quality of external tube surface was satisfactory. The geometric parameters of tubes complied with requirements of the State Standard GOST 8733/8734.

Concluisions and recommendations

In comparison with traditional technology of treatment of tubes-workpieces before the cold deformation, the use of the chemical treatment according to the variants 2-4 allows to decrease the friction factor in zone of deformation and to increase the output of the mill CTR to 30%. In this case the worsening of the quality and precision of geometric characteristics of tubes to be rolled does not take place.

According to results of measuring the currents of loading on the electrical engine of the mill CTR while rolling the tubes-workpieces with different routes of treatment, deviations of the load current have not been recorderd.

While controlling the geometric parameters deviations of their values from the standard have not been ascertained.

In connection with positive result as to the influence of the chemical treatment of the tubes-workpieces on the increase of the output on mills CTR-90, authors propose to make alterations to the process of the chemical tubes preparation before the cold deformation. It means the alteration to the specifying forms and records for the carrying out the process of the chemical preparation of the tubes surface before the cold deformation according to the route №4 – phosphating with the following applying of the sodium stearate.

It is necessary to carry out the similar tests of considered routes of the chemical surface treatment during the cold rolling of tubes being manufactured of the bearing steels (100CR6, SHKH15(ШХ15), SHKH15V(ШХ15В), SHKH15SG (ШХ15СГ) and so on).

While choosing the technology for applying the chemical treatment before rolling tubes on the mill CTR, it is necessary to take into account:

- grade of steel and group of strength;
- technical state of the mill;
- rolled stock, diameter – wall thickness ratio.

References

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