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RESEARCH OF EFFICIENCY AND CHOICE OF TECHNOLOGICAL OIL FOR COLD ROLLING OF LOWALLOYED STEELS

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The results of researches of efficiency and choice of technological oil for the cold rolling of lowalloyed steels, are showed that the model of calculations of friction coefficient with the use of theoretical formulas on the basis of the executed experiments in relation to determination of passing of metal gives exact results which coincide with data of other works. Effective technological oil for the cold rolling of manganese, manganese-silicon and chrome-manganese-silisic steels on the reversible states of the cold rolling is selected.

Keywords: low alloyed steel, rolling mill, cold rolling, technological oil, friction coefficient

Introduction. A pin friction during rolling plays an important and besides double role exceptionally. On the initial stage of process of forces of pin friction between band and a technological instrument provide the delight of metal by rollers, and on the measure of filling of cell of deformation – passed to energy from working rollers to the metal, what is provide a deformation staff. A friction at the cold rolling differs in two features:

– a sliding friction between rollers and surfaces staff which deform, characterized by the high value of middle normal pin tension;

– the cold rolling for diminishing of value of forces of friction and the normal pin (p_{mid} = 500-1500 H/mm^2) tensions are executed with application of technological oil, due to what for this process characteristic is a semiliquid friction.

The thickness of layer of oil in the cell of deformation folds within the limits of 0.1-0,7 mcm [1]. In a technological aspect smeared, that entered cell of deformation, must diminish force of rolling, expense of energy on deformation and provide rolling staff of necessary quality on the state a surface, by a form, exactness of sizes, to level the abrasive wear of surface of barrels of rollers and not cause corrosion of equipment and surface of flatwork.

Raising of task. To find the simple, reliable and exact enough model of determination of friction coefficient during the cold rolling and criteria of comparison of their values without application of bulky formulas and calculations.

In works [2-3] the method of evaluation of properties of oil is pointed on the size of extraction of identical staff (samples), which roll with different oils at a permanent gap between rollers. A method is simple, does not need application of special тензометричної and power measuring apparatus. Such method was perfected in future, using large обтиснення, for rolling of samples minimum possible thickness.

Basic part of researches. To basis of the offered and conducted researches, namely quantitative determination of coefficient of friction it was fixed generally accepted in the theory of processes of rolling Amonton law of dry friction, in obedience to which force of friction of T is proportional to normal force *N*, id est.

$$T = f \cdot H \quad , \tag{1}$$

where f – a coefficient of proportion, that consider by the friction coefficient, namely it mean value for all cell of deformation.

Experimental part of researches was executed on the semiindustrial two-roll mill with the diameter of rollers a 200 mm, that it is made from steel of 9X, barrels of rollers are polished and some worked, roughness of surface of barrels of R_a = 1.8-2.2 mcm. The friction coefficient was determined in relation to passing of metal in the process of rolling of samples from an aluminium after annealing.

Model adequacy was checked up, measuring force of rolling For this purpose we used tensometric dynamometers, which add to the previous taring together with a measuring apparatus on the press УГ20/2. In the process of measuring a signal from dynamometers acts to the strengthener and recoroling device is fixed. Written on oscillograms decrypted by means of calibration chart.

For rolling prepared two parties of samples from which the first party of samples was rolled from cobbing 19-22 %, and second – with wringing 34-43 %. Samples of every party rolled with the use of dry rollers, water, emulsions of mineral oil industrial oil by concentration 5 % and oils of I-20. After rolling of every sample rollers deprived of fat and wiped from contamination. The thickness of samples was measured by a micrometre with exactness of 0,001 мкм, a width and length between керновими imprints was measured by caliper within a 0.01 mm.

From the theory of rolling it is known that expansion of metal Δb is evened:

$$\Delta b = b_1 - b_0 \quad . \tag{2}$$

The results of calculations showed that expansion of metal Δb was evened a 0.mits of a 0.40-0.80 mm. Sizes of expected are correlation of b_{cep}/l_d, that is near to 5, allow to draw conclusion, that the terms of deformation during rolling are near to even.

Thus, deformation is flat and for its formulas operates:

$$\alpha = \sqrt{\frac{\Delta h}{R}} \quad ; \tag{3}$$

$$\gamma = \sqrt{\frac{S \cdot h_1}{R}} \quad , \tag{4}$$

$$S = \frac{L_{ï} - L_{â}}{L_{â}} \quad , \tag{5}$$

On Enklund-Pavlov formula determined the friction coefficient f

$$f = \frac{0{,}5\alpha}{1 - 2\gamma/\alpha} \quad . \tag{6}$$

The results of calculations on experimental data show that the minimum friction coefficients are got in the conditions of rolling with the use in quality technological - mineral oil I-20.

Conclusions. The calculations of friction coefficient on the basis of experiments in relation to determination of passing of metal confirmed universality of this model. Among investigational oils the best characteristics is a mineral oil industrial I-20. Smeared I-20 applies during rolling of manganese, manganese-silicic and similar steels, which have high intensity of strengthening, on the reversible mills of the cold rolling. It is necessary to continue research of efficiency of technological oils with the purpose of the use of the offered models for determination of energy-power parameters of process of the cold rolling of new brands of lowalloyed and microalloyed steels.

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