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Increase of mechanical properties of hot plate due to introduction of a cycle of high-speed asymetry of work rolls on four-high mill 5000

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Abstract: In the given work results of researches asymmetric rolling on reversive mill 5000 are considered. By definition of boundary modes of asymmetry and an opportunity of application results of precomputations are resulted in production for various circuits of rolling. Results of influence of asymmetric rolling on physic and mechanical properties, structure and geometry hot sheets are shown, recommendations to introduction of modes of asymmetry in a production cycle of manufacturing of sheet-rolling production of the improved quality are developed

Key words: hot rolling; reversive mill 5000; asymmetry cycle; physic and mechanical properties

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Asymmetry of plastic deformation for hot plate mill is reached, first of all, due to a mismatch of linear speeds of work rolls. The mismatch of speeds of rolls results too occurrence in the center of deformation of a zone with opposite directed forces of friction and increases a shift component of deformation, that favorably affects study of a microstructure of rolled stock[1, 2].

Realization of process of asymmetry carried out with the help of software and automation of technology. This system provides individual regulation of speeds of everyone rolls in a range 0-80 r/min, nominal speed form 32 r/min. At realization of this process in conditions hot plate mill 5000 have been established limiting values of a mismatch of linear speeds which are in limits $\alpha = V1/V2 = 0.1$, and the circuit of a mismatch of speeds has been carried out by system of rotation of the main nonrigid drive.

At asymmetric rolling distinction in boundary conditions on contact of a strip with rolls reduces size of normal pressure of metal in the center of deformation. It occurs due to occurrence of a zone to opposite directed forces of friction.

At the initial stage of work have been carried out metallography of sheets from the steel 3 (GOST1577-81), the received at usual and asymmetric cycles.

The control of a macrostructure was spent on the samples which have been cut out in longitudinal directions. A macrostructure of samples, rolled on both cycles, dense, grey color, in an axial zone increased etching as thin strips. Differences in a structure of a macrostructure it was not observed. At studying not etched polished section of metal of both tests of 0.01-0.02 mm which at an estimation in accordance with GOST 1778-70 corresponded to 2 ballet are observed silicate inclusions in the size.

A microstructure of a sample rolled by a asymmetry cycle on a structure both in longitudinal, and in cross-sec-

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tion directions identical-banded structure of ferrite-perlite, strips of ferrite in width of 0.01-0.015 mm alternate with very narrow strips (as hyphens of perlite). The size of a grain at an estimation in accordance with GOST 5639-82 corresponds to 10 ballet. In a superficial layer on depth of 0.7 mm the increased degree of deformation (grains of ferrite are extended at length up to 0.1 mm) is observed.

In a sample of a sheet rolled at a usual mode the width of strips of ferrite achieved 0.025 mm, and the size of a grain corresponded to 8 ballet in accordance with GOST 5639. In an axial zone on both samples deformation is less, grains of ferrite more округлые, microdefects is not observed.

The hardness measured on a surface has made: on a sample received at asymmetric rolling-145 units. HB, and on a sample received at usual rolling-125 units. HB. Microhardness of ferrite has made 128-144Hv at asymmetric cycle and 92-102 Hv at usual rolling.

Metallography researches of metal of skilled tube strip have shown the further to steel, that in a microstructure of sheets, rolled with coefficient of asymmetry α from 1.01 up to 1.10, on a surface insignificantly deformed grains of ferrite on depth up to 4 mm were observed. At a surface of a sheet grains No. 11 and 12 (prevail at usual rolling), in an axial zone No. 10. Crushing of a grain is consequence of additional shift deformations at asymmetric rolling.

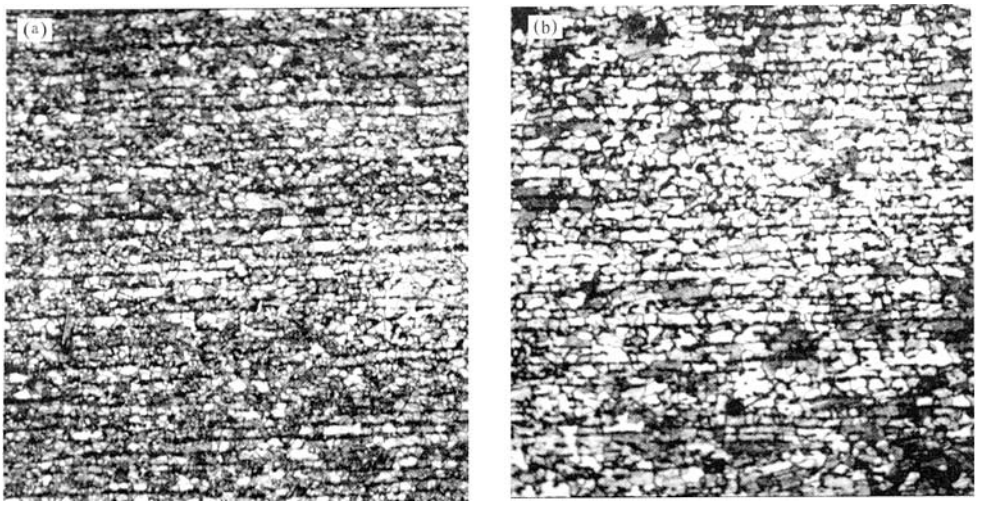

Fig. 1 Microstructure (X 100) of hot sheet from steel Ст3(GOST1577-81)
(a)—a rolling with asymmetry; (b)—a usual rolling

As controllable a rolling it is carried out in a temperature interval of phase transformations change is intense - a deformation condition of metal in the asymmetric cycle the center of deformation and occurrence of additional longitudinal pressure promote improvement of plastic characteristics of metal.

At a rolling in biphase area for this reason there is the asymmetry of mechanical properties increasing a range of their dispersion and percent of sheets, not stacking in frameworks of the standard. The following data on disorder of mechanical properties have been selected at symmetric a rolling of sheets by thickness of 20 mm from steel of mark 09Г2С (GOST 5520-79) Table 1. From the submitted data follows, that "failure" of mechanical properties it is possible to expect on time resistance to break and relative lengthening. The data of experience of steel 09Г2С became submitted in Table 2.

Table 1

Mechanical properties	A range of instability	Minimally allowable rejection level (ГОСТ 19282)
$\sigma_т$, H/mm^2	295-335	295
$\sigma_в$, H/mm^2	430-580	440
δ, %	19-24	21
KCU^{60}, J/cm^2	64-85	59

Table 2

Degree of high-speed asymmetry, α	Mechanical properties			
	$\sigma_т$, H/mm^2	$\sigma_в$, H/mm^2	δ, %	KCU^{+0}, Дж/cm^2
1.01—1.04	300—400	440—560	20—28	29—30
1.05—1.06	390—410	440—570	22—28	30—32
1.07—1.1	390—420	440—580	23—28	30—33

As follows from Table 2, strength characteristics ($\sigma_т$, $\sigma_в$) at increase α grow insignificantly, and the share of the sheets close on a limit of fluidity to the bottom allowable border (480 H/mm^2), are decreases. Influences of asymmetric rolling on plastic properties of metal much more strongly. The increase α with 1.01 up to 1.10 raises of specific elongation relative lengthening δ on 1%-2% at the bottom allowable border 21%. (increase on 10%-20%) from realization asymmetric rolling have received the steadiest positive effect at tests of samples for impact strength. Thus, the technology asymmetric rolling reduces a miss rolling on a yield strenght and on specific elongation. Improvement of mechanical properties of sheets will allow to shift The bottom border of dispersion of parameters of mechanical properties concerning a rejection level and, thus, to increase probability of reception of sheets with a required level of mechanical properties.

Conclusions

It is established, that at introduction of a cycle of asymmetry (a mismatch of speeds of rolls) in conditions hot plate reversive mill 5000: (1)Crushing structure; (2)Increase in hardness with 125 up to 145 units HB; (3)Increase of mechanical properties of a thick sheet ($\sigma_т$ up to 30%, $\sigma_в$ up to 5%, δ up to 15%, KCU-40 - up to 10%).

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