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EVOLUTION ACT OF THE THERMAL STRESS, ABOUT BEHAVIOR IN EXPLOITATION OF THE ROLLING MILL CYLINDERS

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ABSTRACT:
The research of the thermal stress that action in the rolling cylinders is impetuously necessary not only to diminish the fissures caused by thermal fatigue, to increase the exploitation duration, but also to avoid thermal shocks, which are very dangerous in the exploitation process and produced by large variations, temperature snapshot that lead to shearing of caliber beads in cylinders. The paper propose to evaluated the thermal stresses produced by the temperature fields in the hot rolling mill cylinders using experimental date.

KEYWORDS:
thermal, stress, variation, cylinders, temperature

1. INTRODUCTION

The hot rolling mill cylinders are machinery parts which produce plastic deformation of the metal within the rolling process and are the most stressed parts from the whole rolling equipment. The temperature variation on the surface of the cylinder, during one rotation where angle $\varphi = 2\pi$ rad has a maximum limit t_{max}, with values more reduced than the temperature of the laminate, and a minimum limit t_{min} with values closed to that of the cooling water. The temperature variation on the surface of the cylinder is represented by an exponential curve. This curves both on the surface of the cylinder and in the radial section are obtained experimentally, in a research laboratory belonging to the Faculty of Engineering Hunedoara.The number values of the experimental rolling cylinders entailed statistical after the number of rotation of cylinders from the industrial rollers, resulted n_1=32,5rot/min, n_2=65,2 rot/min, n_3=95,3 rot/min n_4=226,4rot/min, [1]. To be do not influence the character of exponentiale variation of the temperature fields which is in function of the number of rotation of the rolling mills have registreded the variations of the temperature in rolling mills to unghiular speeds constants, on which new appoint states izocrone in cylinders.

2. THE VARIATION OF THERMAL STRESSES

For the researches of the variation of the thermal stresses which apear in the hot rolling cylinders, the Laboratory of Technological Equipment from the framework

Faculty of Engineering Hunedoara disposes of an experimental rolling mill with the diameter of 220 mm, presenting the advantage were a scaled-down copy (1:5) of the industrial rolling mill with a diameter of 1300 mm. This rolling mill represents a complex equipment which corresponds all the parameters of roughing rolling mills incorporate in the technological process of industrial production. The experimental rolling mill is endowed with a plant for the determination of the variations of temperature in cylinders, which uses the electronic calculus technique, [2]. This temperature variation is represented by exponential diagrams which are presented in the next four figures.

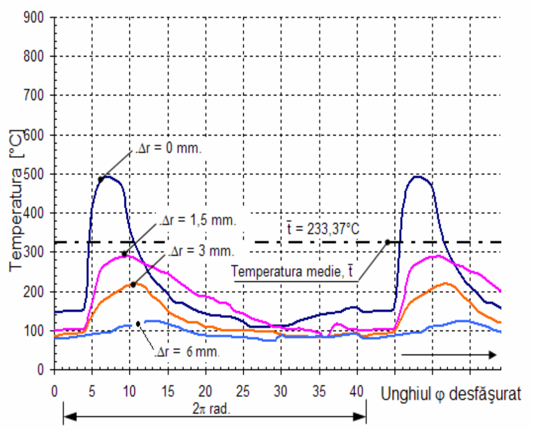

FIGURE 1. The variations diagram of the hot rolling mill cylinders for a rotation of the hot rolling mill cylinder, in time of experimental rolling with n_1=32,5 rot/min

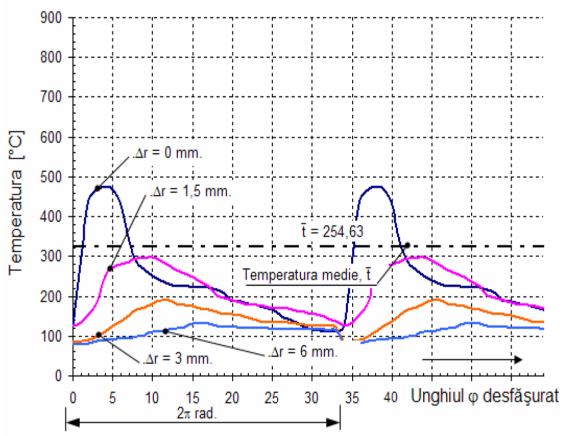

FIGURE 2. The variations diagram of the hot rolling mill cylinders for a rotation of the hot rolling mill cylinder, in time of experimental rolling with n_2=65,2 rot/min

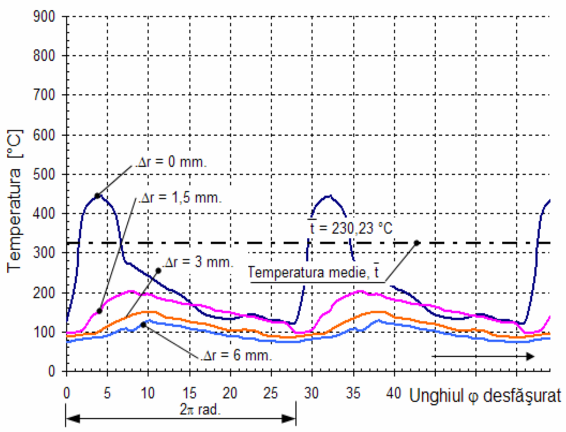

FIGURE 3. The variations diagram of the hot rolling mill cylinders for a rotation of the hot rolling mill cylinder, in time of experimental rolling with n_3=95,3 rot/min

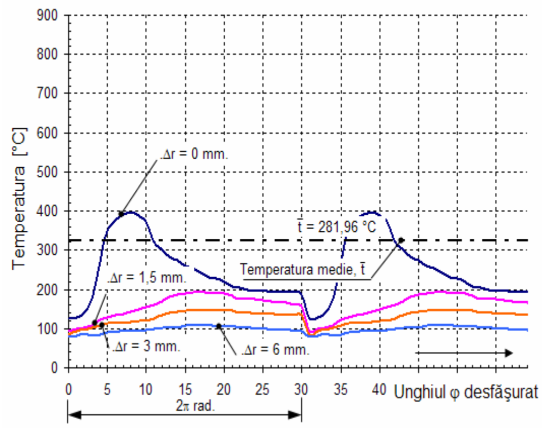

FIGURE 4. The variations diagram of the hot rolling mill cylinders for a rotation of the hot rolling mill cylinder, in time of experimental rolling with n_4=226,4 rot/min

The data processing from these diagrams allowed the determination of the symmetrical and asymetrical temperature fields, which action on surface and in radial section of hot rolling mill cylinders. Separating the temperature fields in radial symmetrical and asymmetrical fields allows the separate study not only of temperature fields but also of the produced thermal tensions.

In table1 enters indicative dates synthesis for the temperature fields registred to the experimental rolling, from analysis registred diagrams distinguishes the character exponential of curves was of presumed temperature in logical analysis of hot rolling process.

TABLE 1. The synthesis dates for the temperature fields registred to the experimental rolling, from analysis registred diagrams

Isocronal diagram figure 1, with n_1= 32,5rot/min			
The angle for introduction heat $\varphi_{\hat{i}}$		The angle for evacuation heat φ_e	
$\varphi_{\hat{i}} = 81^{0}C = 1,413$ rad		$\varphi_e = 279^{0}C = 4,867$ rad	
The determined temperature			
t_{max} [^{0}C]	Δr [mm]	$\bar{t}$ [^{0}C]	t_{min} [^{0}C]
493,3	$\Delta r = 0$	233,37526	108,3
289,9	$\Delta r = 1,5$	187,80601	80,7
220,1	$\Delta r = 3,0$	137,85123	83,1
125,8	$\Delta r = 6,0$	104,84721	71,7
Isocronal diagram figure 2 , with n = 65,2 rot/min			
The angle for introduction heat $\varphi_{\hat{i}}$		The angle for evacuation heat φ_e	
$\varphi_{\hat{i}}=102\,^{0}54'\,^{0}C=1,786$rad		$\varphi_e=257^{0}\,46'\,^{0}C=4.494$rad	
The determined temperature			
Maximă t_{max}[^{0}C]	Δr[mm]	Medie $\bar{t}$ [^{0}C]	Minimă t_{min}[^{0}C]
457,9	$\Delta r = 0$	254,63496	110,4
297,9	$\Delta r = 1,5$	184,52471	125,1
191,2	$\Delta r = 3,0$	152,67694	85,3
134,1	$\Delta r = 6,0$	117,71828	80,1
Isocronal diagram figure 3 , with cu n = 95,3 rot/min			
The angle for introduction heat $\varphi_{\hat{i}}$		The angle for evacuation heat φ_e	
$\varphi_{\hat{i}}=133\,^{0}\,33'\,^{0}C = 2,325$rad		$\varphi_e=226^{0}\,67'\,^{0}C = 3,955$rad	
The determined temperature			
t_{max} [^{0}C]	Δr [mm]	$\bar{t}$ [^{0}C]	t_{min} [^{0}C]
444,0	$\Delta r = 0$	230,23953	123,9
204,4	$\Delta r = 1,5$	168,79632	96,1
150,3	$\Delta r = 3,0$	124,1695	84,4
128,0	$\Delta r = 6,0$	104,49997	71,8
Isocronal diagram figure 4 , with, cu n = 226,4 rot/min			
The angle for introduction heat $\varphi_{\hat{i}}$		The angle for evacuation heat φ_e	
$\varphi_{\hat{i}}=106\,^{0}\,8'\,^{0}C = 1,862$rad		$\varphi_e=253^{0}\,2'\,^{0}C = 4,418$rad	
The determined temperature			
t_{max} [^{0}C]	Δr [mm]	$\bar{t}$ [^{0}C]	t_{min} [^{0}C]
396,9	$\Delta r = 0$	281,96502	124,9
191,7	$\Delta r = 1,5$	184,31451	92,8
147,1	$\Delta r = 3,0$	121,0654	85,5
107,5	$\Delta r = 6,0$	113,96455	80,3

It was maximum variation of temperature are to small rolling speeds, respective small numbers of rotation of cylinders. In cases majority after the calibre surface arrive in jets angles zone of cold watery, temperature to this becomes smaller than shallow stratum temperature until to depth of about 3 mm according as increase the number of rotation of cylinders this diference of temperature becomes smaller whole. In that time was observing as top of temperature to different levels under surface. They are displaced horizontally, having a gap to a certain angle, fact what shows the time sending of warmth in cylinder meal. The resultates presented in table

1 will be used for the study of the durability of the hot rolling mill cylinders and their behavior in explotation.

3. THE CONCLUSIONS

The research on thermal stresses evolution is to be extended further on different brands of steels and irons used for the manufacturing of hot rolling mill cylinders, depending on the durability's up to the point of fissures and thermal fatigue cracks. Therefore, it is recommended to use the most rational and economical materials, as well as new, more performing materials to manufacture hot rolling mill cylinders.

The evolution act of thermal stresses that action in the rolling cylinder`s is impetuosly necessary not only to diminish the fissures caused by thermal fatigue, to increase the exploitation duration, but also to avoid thermal shocks, which are very dangerous in the exploitation process and produced by large variation, temperature snapshot that lead to shearing of caliber beads in cylinders.

The resultates presented in this work will be used for the study of the durability of the hot rolling mill cylinders.

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