Assessment of Integral Indicators of the Surface Skating of the Rail Head in Sections of Speed and High Speed Train Traffic

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Annotation--- *The article discusses the condition of the surface skating of the rail head in sections of high-speed and high-speed train traffic to assess the integral indicators of the surface skating of the rails (long waves, medium waves, short waves).*

Keywords--- *Rail, Assessment, Experimental Plot, Undulating Wear, Arithmetic Mean Value, RMS Deviation.*

I. INTRODUCTION

The development of high-speed and high-speed traffic on the railways of the Republic of Uzbekistan is an integral part of the country's transport policy, the strategic goal of which is to ensure, through the accelerated development of transport. The accelerated and stable development of the national economy, the growth of its competitiveness, and the welfare and quality of life of the population of each region [1, 2].

In the presence of initial wave-like defects in the process of dynamic influences during the movement of trains, especially on high-speed and high-speed lines, the defect develops further, and wave-like irregularities (long waves) form with an increase in their amplitude [3, 4, 5]. Their origin and development are associated both with the technology of rail production, and with the conditions and nature of their work under a moving load. The origin and development of irregularities on the surface of the rails leads to deterioration of the track structure, rolling stock, wheel-rail contact and the discomfort of passenger trains. With an increase in the depth of wave-like wear and with a decrease in the wavelength (at a constant depth of wear), the wheel load on the rail increases in direct proportion. There is a need to prevent and reduce the development of wave-like wear [6, 7, 8].

To improve the condition of the rolling surface of the rails, which is determined by the length, depth and shape of the irregularities, profile grinding is intended. The experience of the railways of the USA, Canada, France, Germany and other countries shows that by such periodic polishing the service life of rails can be increased by 1.5–2 times. Further research is needed, including to determine the effect on the performance of rails of the outline of their “repair profiles” under various operating conditions [3, 9, 10]. To evaluate the integral indicators, the state of the rolling surface of the rails within the experimental plots was carried out by many fragments of the plot, which depend on the number of observations of deviations in depth. Four experimental sections were selected within the Tashkent-Samarkand railway line, the characteristics of which are given in Table. 1. To determine the average deviations of the depths on the surface of the rails, it is necessary to calculate the arithmetic mean and standard

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deviation. The study of the conditions of the rail heads in the experimental sections was carried out according to the track measurements with track measuring car No. 106. For the initial assessment, the track lengths in the experimental sections for the presence of wave-like wear along the section lengths were considered (Table 2).

The operating conditions of the rails and their service life in many respects depend on some basic factors, such as the load intensity, plan and profile of the railway, which also determine the mode and speed of trains; construction of the upper construction of the track; traction and mass of trains. Climatic conditions and the class of under-rail soil are no less significant factors.

According to [11, 12, 13], the assessment of bumps on the rails is made by the length of bumps with the division into ranges — short bumps (SB) from 0.03 m to 0.25 m, average bumps (AB) from 0.25 m up to 1.5 m, long irregularities (LI) from 1.5 m to 3.5 m.

Table 1: Characteristics of the Experimental Plots

№	Parameters	Experimentalplots			
		Plot№1	Plot №2	Plot №3	Plot №4
		Dastabad –Jizzakh oddway	Dastabad –Jizzakh evenway	Jizzak – Gallaaral oddway	Gallyaaral - Samarkand oddway
1	The length of the site, km	59,74	57,00	25,18	88,20
2	Yearoflaying	from 2006 to 2011	2011 г	since 2003 to 2004	2006, 2007, 2013
3	The radii of the curves, m	from 285 to 1858	from 285 to 4004.5	500 to 3580	from 410 to 4004
4	Railtype	P65	P65	P65	P65
5	Railmanufacturer	OAO «KuznetskMetallurgicalPlant»	OAO "MetallurgicalplantAzovstal"	OAO «KuznetskMetallurgicalPlant»	NipponSteelCorporation (NSC), OAO "Iron and Steel Works "Azovstal"
6	Missed tonnage, million tons gross	188,2 – 727,2	100,5 – 224,2	3620 to 3622 - 2.4 Therest - 284.0	с 3631 по 3641 км – 287,0 с 3641 по 3660 км – 21,9 с 3673 по 3698 км – 231,1 с 3699 по 3704 км – 243,1
7	Typeofsleepers	Reinforced concrete sleepers type BF70	Reinforced concrete sleepers type BF70	Reinforced concrete sleepers type SH1-1	Reinforced concrete sleepers of type BF70
8	Sleepersdiagra	1720; 1840	1720; 1840	1840; 2000	1720; 1840
9	Type of intermediate rail fastening	PandrolFastclip	PandrolFastclip	Клеммно–болтовое	PandrolFastclip
10	Set speed, km / h pass / load	120/100	230	150	160

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Table 2: The Length of the Path for the Presence of Wave-Like Wear of the Rail in the Experimental Sections

Experimentalplots		Plotlength	Track lengths with wave-like rail wear	
№	Nameofsites	km	m	%
1	Dashtabad - Jizzakh oddway	59,74	2074	3,47
2	Dashtabad - Jizzakh evenway	57,00	54949	96,40
3	Jizzakh - Gallaaral oddway	25,18	23567	93,59
4	Gallyaaral –Samarkand oddway	88,20	71724	81,32
Total		**230,12**	**152314**	**66,19**

The arithmetic mean value is determined by [14]:

$$\overline{X} = \frac{x_1+x_2+x_3+\ldots+x_n}{n} \qquad (1)$$

wherex_n – particular value

n – number of observations.

Based on arithmetic mean values of depth deviations for fragments of experimental plots, graphical interpretations in the form of histograms are constructed (Fig. 1-4).

The results of the analysis of arithmetic mean values of deviations of depths in the experimental plots are given in table. 3.

Table 3: Average Value of Deviations of Depths, mm

№ experimentalsite	Longwaves		Mediumwaves		Shortwaves	
	Rightthread	Leftthread	Rightthread	Leftthread	Правая нить	Левая нить
1	0,53	0,60	0,40	0,50	0,10	0,15
2	0,25	0,28	0,20	0,23	0,08	0,09
3	0,28	0,32	0,20	0,24	0,08	0,10
4	0,30	0,31	0,24	0,26	0,09	0,11

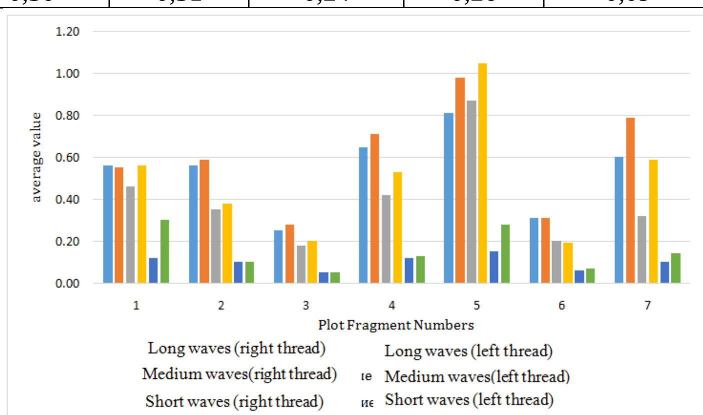

Figure 1: The Arithmetic Mean of the Deviations of the Depths (mm) on the Experimental Plot№1

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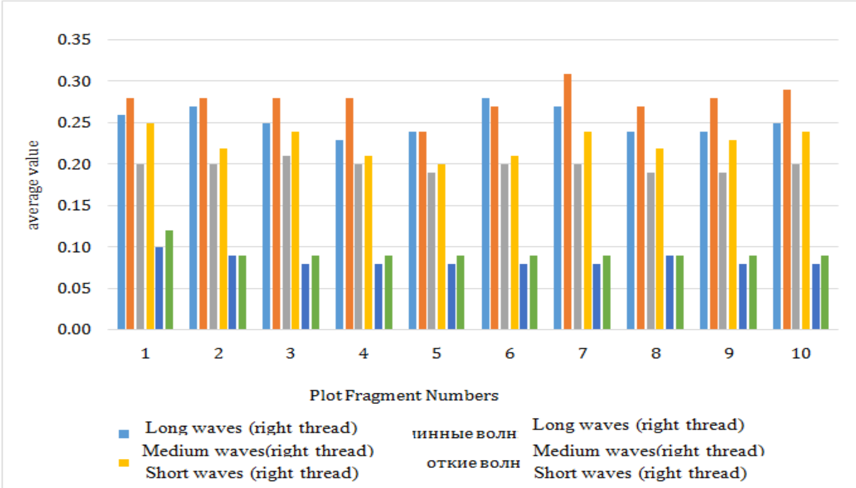

Figure 2: Average Arithmetic Deviations of Depths (mm) at the Experimental Plot№2

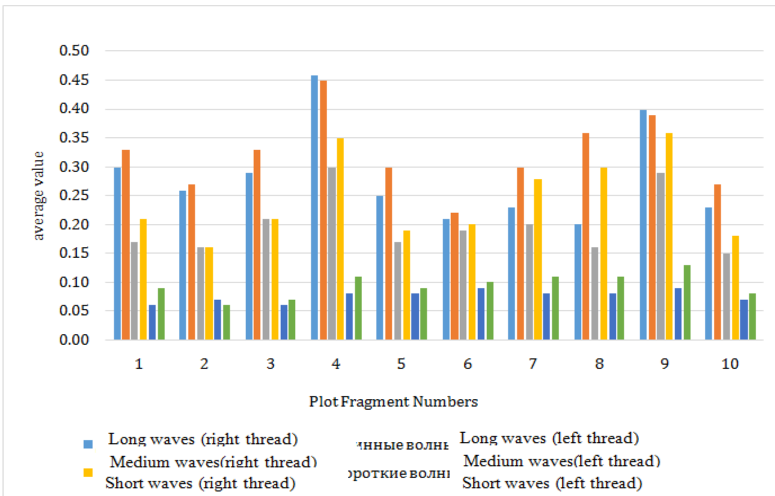

Figure 3: Average Arithmetic Deviations of Depths (mm) at the Experimental Plot№3

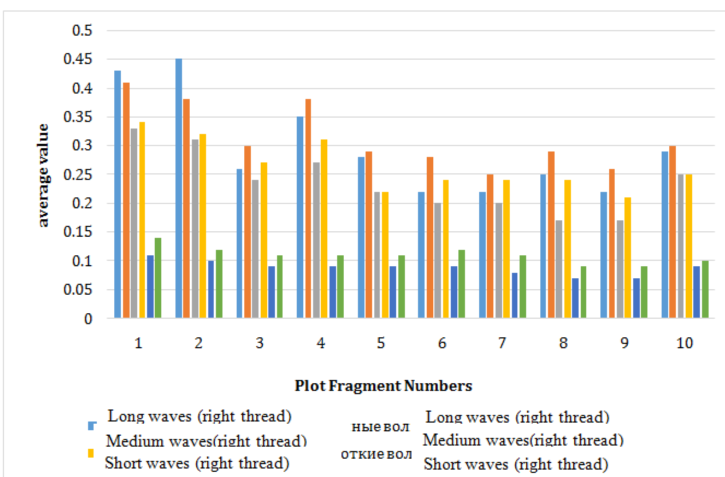

Figure 4: Average Arithmetic Deviations of Depths (mm) at the Experimental Plot№4

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In order to take into account the deviation of particular values from the mean, i.e. the degree of scatter of points indicating partial values, it becomes necessary, in addition to the arithmetic mean value, to evaluate the degree of dispersion of partial values, which is called dispersion in mathematical statistics. In this regard, to estimate the degree of dispersion of the partial values of variables, the obtained differences $(\bar{x} - x_i)$ between the arithmetic mean value and each particular value is squared, summed, and the sum is divided by the number of particular values of n and the square root is extracted from the obtained value. There sult is the standard deviation[14]:

$$S = \sqrt{\frac{\sum(\bar{x} - x_i)^2}{n}} \tag{2}$$

Using this formula, the root-mean-square deviation of the depths (mm) was calculated for the experimental plots. The calculation results are given in table.. 4.

Table 4: Mean-Square Deviations of Depths, mm for Experimental Plots

№ experimentalsite	Longwaves		Mediumwaves		Shortwaves	
	Rightthread	Leftthread	Rightthread	Leftthread	Rightthread	Leftthread
1	0,19	0,25	0,23	0,29	0,04	0,10
2	0,02	0,02	0,01	0,02	0,01	0,01
3	0,08	0,07	0,05	0,07	0,01	0,02
4	0,09	0,06	0,06	0,04	0,01	0,01

From the table of root-mean-square deviations of the depths, the presence of irregularities on the rolling surface of the rail head in the experimental sections is evident. It should be noted that the intensity of the unevenness depends on the duration of the operation of the rails and the missed tonnage.

In modern conditions, the most promising direction in solving this problem is the technology of grinding rails with the use of rail grinding trains, which allows the machining of the rail head without dismantling them in the conditions of the railway track [15, 16]. In this case, one of the main goals of grinding is the formation of the transverse profile of the rails. Periodic adjustment of the profile by grinding allows you to ensure the best contact of the wheel with the rail and thereby extend its service life by 15 ... 20%. One of the most promising areas in resource conservation is the grinding of rails, which provides an extension of their service life by 30-40% and gives significant advantages in the field of saving material resources, traffic safety and the environment [15-18].

II. Conclusions

1. Irregularities on the surface of rolling of the rail head, in the experimental sections of high-speed and high-speed train traffic, have been identified to evaluate the integral indicators of the surface of rolling of the rails (long waves, medium waves, short waves).
2. The arithmetic mean values of deviations of the unevenness depths from the fragments of the plots are determined, graphical interpretations in the form of histograms are constructed.
3. The root-mean-square deviations of the depths were calculated according to the lengths of the experimental plots to assess the characteristics of irregularities on the rails.

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