MEASURING AND MONITORING SYSTEMS ELECTRICAL AND MECHANICAL PARAMETERS FOR VIBRATION IN RUNNING TRAMS

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Abstract-In urban public transport, a large share is based on transport by rail traction. The analysis of energy losses in the system according to the charts Sankey [1] traction is lost 13.28% on mechanical transmission mechanisms. An important part of this is the quality of running which can be diagnosed .

Key words: Electric traction, Runway , wear Wave , polishing, vibration wheel – rail,mechanical transmission.

1. INTRODUCTION

An essential part of measuring and monitoring mechanical and electrical parameters for running rail is to measure the vibrations and noises in rail traffic. In this regard has changed a motor car Tatra KT4D into laboratory car.

Table 1. Analysis of energy losses in electrical traction

Feature size	[kWh]	[%]
Energy in $[W_a]$	18204,79	100
Energy aut $[W_I]$	18204,79	100
1.Useful energy $[W_U]$	12210,16	67,07
2.Power Loss [PW]	5994,63	32,93
•engines $[\square W_M]$	2272,56	12,48
•Electric $[\square W_{RG}]$	900,33	4,95
•other electrical components $[\square W_{AT}]$	404,49	2,22
•mechanical mechanisms $[\square W_{mec}]$	2417,24	13,28

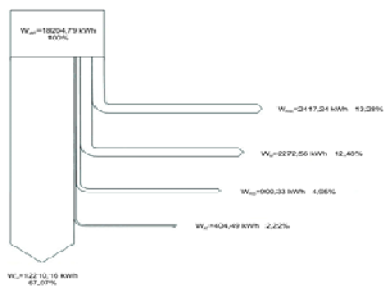


Fig.1. Sankeycharts for electrical traction

Over the years and because the current requirements in rail transport, revealed a number of negative phenomena: high dynamic loading wheel-rail contact, movement instability seals, wear sharp tread and wheel-rail rolling noise intensified. These phenomena affect traffic safety, passenger comfort and habitat conditions in the surrounding areas of railways, reliability and cost-effectiveness of rail transport. All the issues mentioned departing train wheel vibrations on the tread which are called the wheel-rail vibration. Changes in stiffness due to beams gives these vibrations parametric character [2],[3].Frequency response of the wheel tread is analyzed, including the influence of the axle. On this basis, will study the frequency response of wheel-rail system to identify how the essential parameters influence the vibration system level.

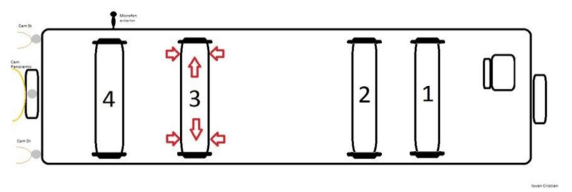
2. DESCRIPTION OF THE RESEARCH WORK

Measurements are made before and after processing a section of 600m simple way track, located between Decebal Square and Dacia Boulevard stations.
To obtain the status tread consider the following necessary conditions:

- Used wagon has bandages in good condition
- The same car is used on all sectors
- Travel speed is as constant as possible

The car was equipped with the following sensors:

- Vibration sensor mounted on three axes (vertical, axial and on travel direction) in axle No. 3.



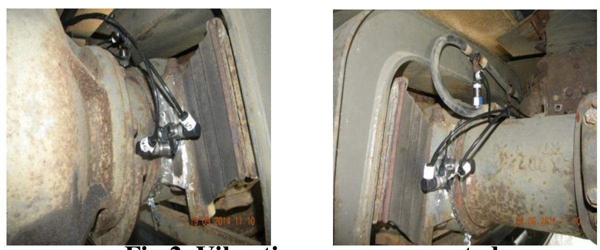


Fig.2. Vibration sensor mounted

Fig.3.Sound level meter mounted on the outside

Fig.4 Cameras at each track and one in the middle for location controlled area.

- GPS sensor for location and map drawing state infrastructure.

Fig.5. GPSsenzor

For recording and data processing a signal amplifier type has been used, with 8 channels, one splitter for coupling cameras and a GPS connected to the acquisition board. Vibration registration is given concomitantly with GPS position of cameras and level meter recording.

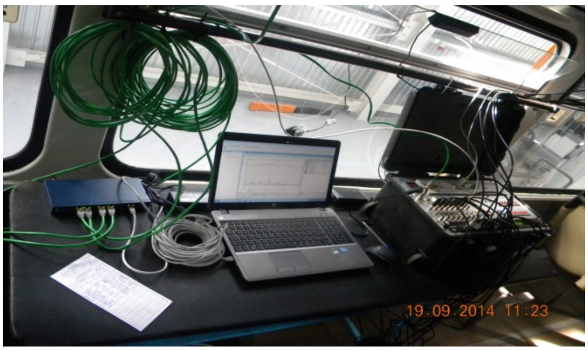


Fig.6. Signal amplifier

On 08.08.2014, the first measurements were made and the entire railway network was traveled. There has been vertical vibration level, exemplified in the chart below:

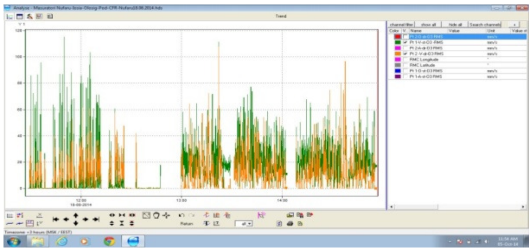


Fig.7. Vertical vibration chart

To highlight the obtained values, vibration domain was divided in 14 areas with different colors, namely a range of 0-103 mm/s. After processing and overlapping Oradea Map was obtained in an intuitive form the tram line status:

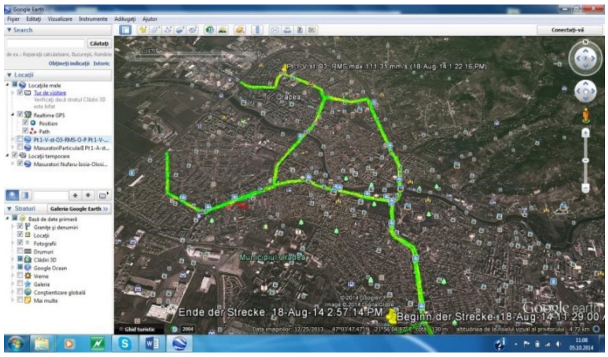


Fig.8. Oradea map with railway network and vibration

On track, the most important defect of the tread is wearing wave generating vibrations. There are three categories of wear and wave, depending on the wavelength: Wave wear short, medium and long. The three types of wear Wave differ not only by the wavelength and amplitude, but also by developing mechanisms. For economic reasons, grinding rail defects must be made when the amplitude reaches an elevation of 0.05 mm. In terms of damage and weakening businesses rail track geometry, the threshold limit for the magnitude of these defects is 0.01 mm.

A particular case is the portion of P- Square station Decebal and Dacia Boulevard station.

Wave measurements on both wear -lane were obtained average values of 0.6-0.7mm.

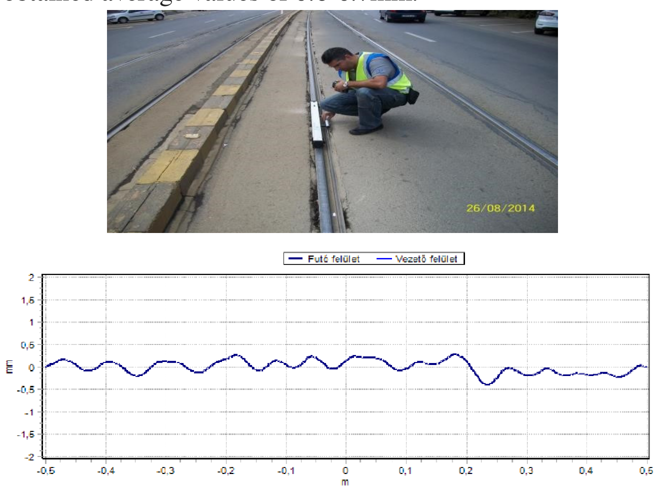


Fig.9. Wave measuring and the chart wear

In the figure above, for a length of 1 m difference between maximum and minimum is 0.67mm.

The vibrations are measured in the same section:

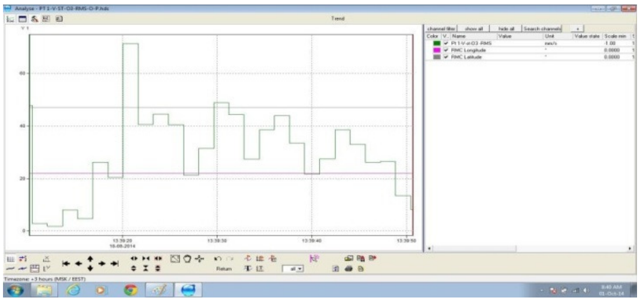


Fig.10. The vibrations chart in this section

These vibrations transformed into colors reflected on the Oradea map are shown in the figure below:

Fig.11.Oradea map with vibration level

Checking on the same segment noise level meter is:

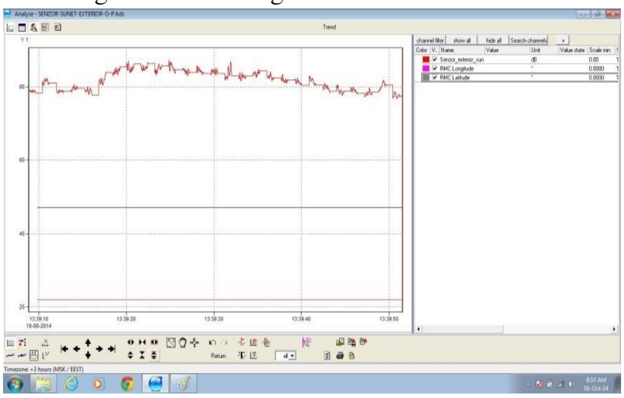


Fig.12 Noise level

By grinding the rail,following readings were obtained:

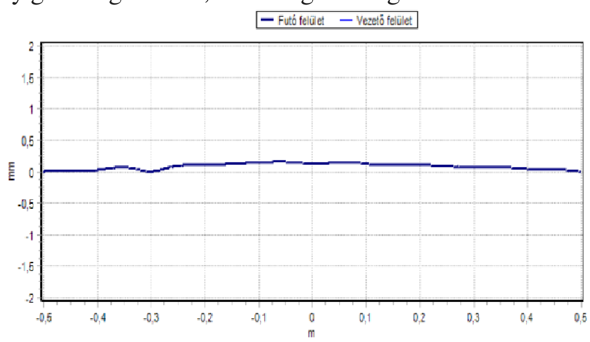


Fig.13.Wear chart after grinding

Table 2. Wear measurements in different points

Measure	Value before	Value after
1	0.068	0.096
2	1.173	0.820
3	0.506	0.246
4	2.004	1.0212
5	0.655	0.062
6	0.241	0.065
7	0.67	0.158
8	0.443	0.054
9	0.844	0.194
10	0.26	0.112
11	0.905	0.056
12	0.556	0.049
13	0.286	0.121
14	0.611	0.133
15	0.696	0.082
16	0.871	0.175
17	0.982	0.315
18	1.236	0.560
19	2.367	1.055
20	0.750	0.359
21	1.550	0.360-0.600
22	1.033	0.459
23	0.356	0.089
24	1.042	0.369
25	0.435	0.186
26	0.797	0.159
27	0.370	0.115
28	0.377	0.070-0.163

The same measurements as before grindingshows lowering vibration and noise

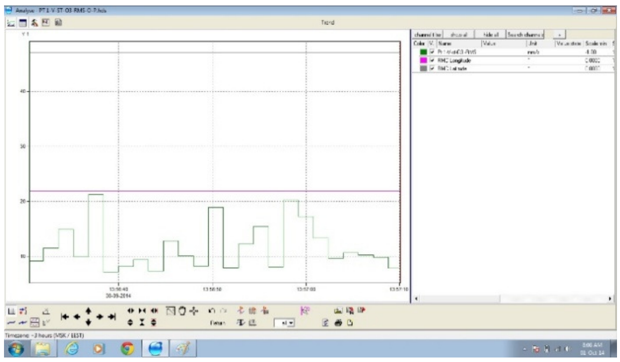


Fig.14. The vibrations chart

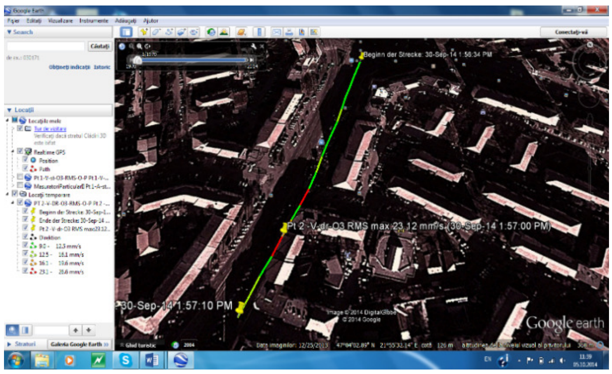


Fig.15. Oradea map with vibration level

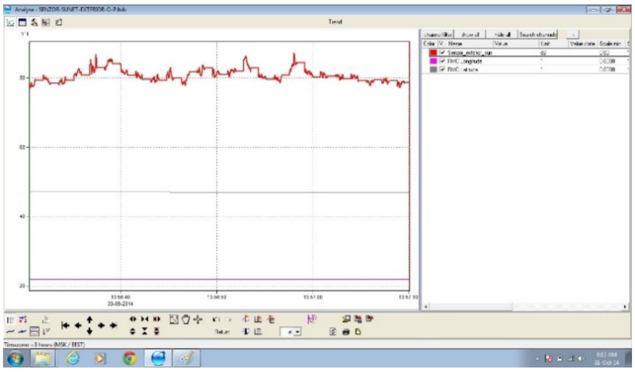


Fig.16. Noise level

3. CONCLUSIONS

With the measurement of vibration at the vehicle traveling by rail we obtained a graphic and a territorial infrastructure status. Note that in the presented document we have analyzed only the vertical vibration values that are affected by wear and quality joints between tracks.

The same analysis can be extended to axial vibrations that give us information about the forces that occur in registration cornering or passing over switches or horizontal vibrations that are influenced by the torque or braking.

Analyzing this particular case, the following conclusions can be drawn:

- Baseline vibration decreased from values exceeding 60 mm/s under 23.12 mm / s.
- Values wear wave decreased by rail grinding 20-25% or more.
- Noise reduced rolling average from 85 dB to 80 dB below.

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