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SCIENTIFIC PROCEEDINGS OF RIGA TECHNICAL UNIVERSITY

MAŠĪNZINĀTNE UN TRANSPORTS

TRANSPORT AND ENGINEERING

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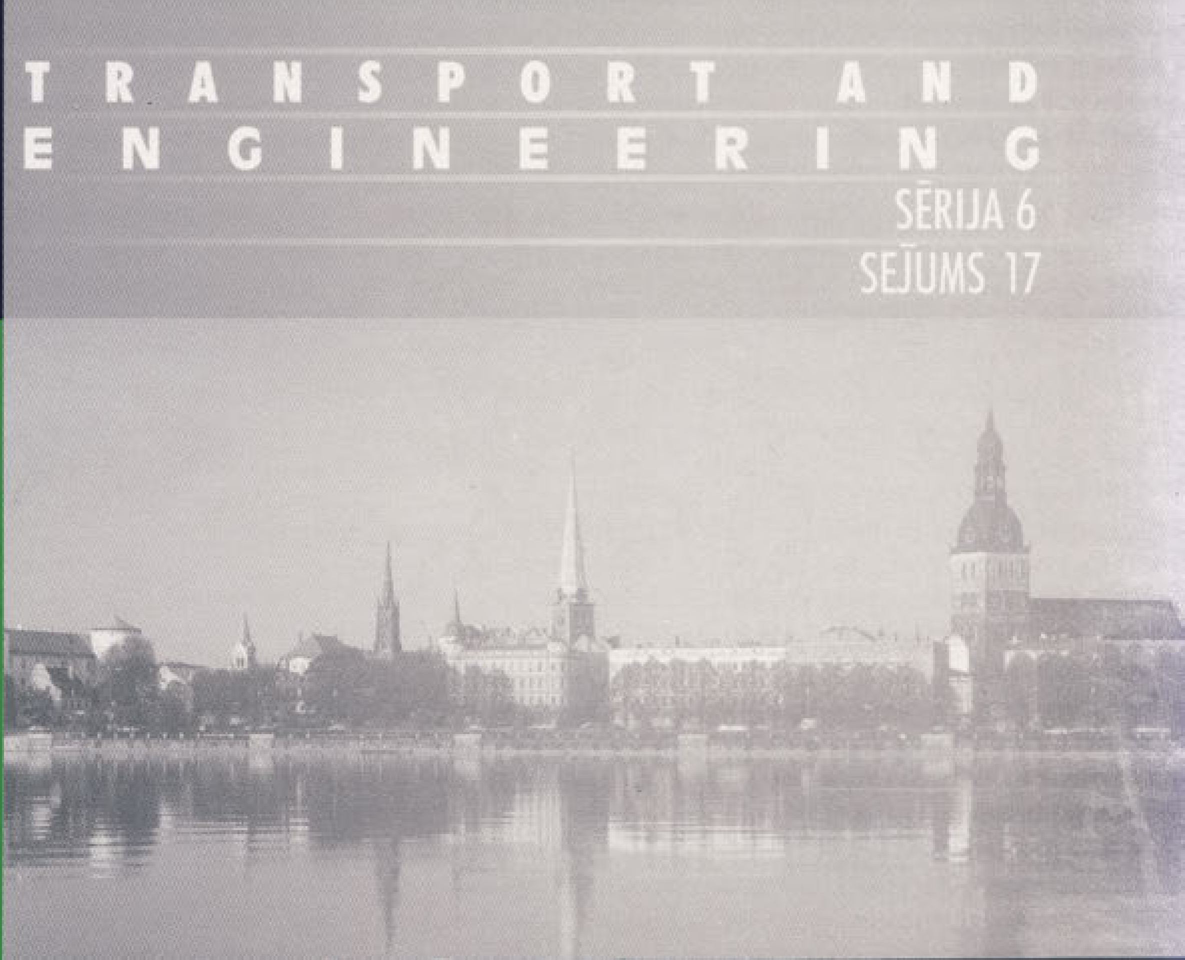

RĪGA 2004

CONTENTS

WEAR ANALYSIS OF WHEELS AND RAILS AT INDUSTRIAL TRANSPORT

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Keywords: wheelset, rails, wear analysis

INTRODUCTION

Railway wheelset is one of most important element of rolling-stock unit; its quality has significant influence on safety in railway transport. Despite the fact that there are a lot of innovations concerning constructional matters of the railway wheel, as well as using of new materials and technologies, problem of wear of railway wheels still appears during operation process and this is the result of wheel – rail interaction. Problem of wear is principally connected with tread profile, which must be renewed, in order to guarantee correct geometric dimensions of railway wheelset. Every year thousands of railway wheels are renewed in Poland and abroad. Investigative data concerning railway wheelset defects and in particular - wear of tread profile - are very important, because of their usefulness in choosing of practical method of improvement the durability and reliability of wheel construction.

The paper presents analysis of wheels wear of TEM2 diesel locomotive and analysis of rails wear for industrial railway transport.

WEAR ANALYSIS OF WHEEL TREAD PROFILES

Geometric measurements of wheel working profile were carried by using 'A-B profilometer' for railway wheel tyres (fig.1) manufactured by PTU GRAW Gliwice. The 'A-B profilometer' is the property of Railway Transport Department in Katowice, Poland.

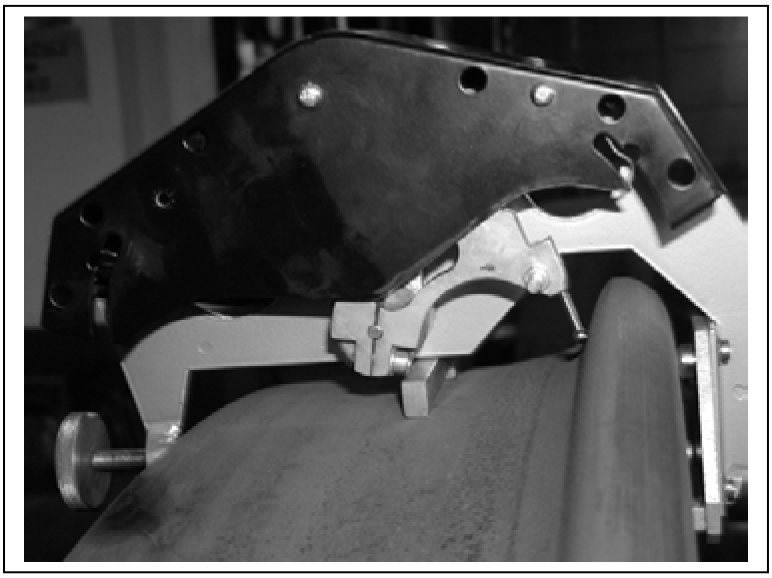

Fig. 1. 'A-B profilometer' for railway wheel tyres

The profilometer is made for the purpose of scanning of working profile of wheels with 0,01 mm accuracy and enables recording obtained data in DXF format.

In order to determine the mechanism of railway wheel wear for diesel locomotives, operating researches of wear process were carries out. Researches were carried out in CTL Maczki Bór Ltd. Co., in Sosnowiec Dluga 9 Street for six TEM2 locomotives no. 015, 210, 232, 241, 284, 295.

The investigation also contained measurements of the following parameters: flange height, flange thickness and flange slope for wheelsets manufactured from 1997 to 2003. These measurements were carried out by workers of CTL Maczki Bór, by the use of multifunctional measuring instrument.

Fig. 2 presents the wear of a working surface of railway wheelset (profile 28UIC140) of TEM2 six-axial locomotive with 100 000 km - age compared to a standard profile.

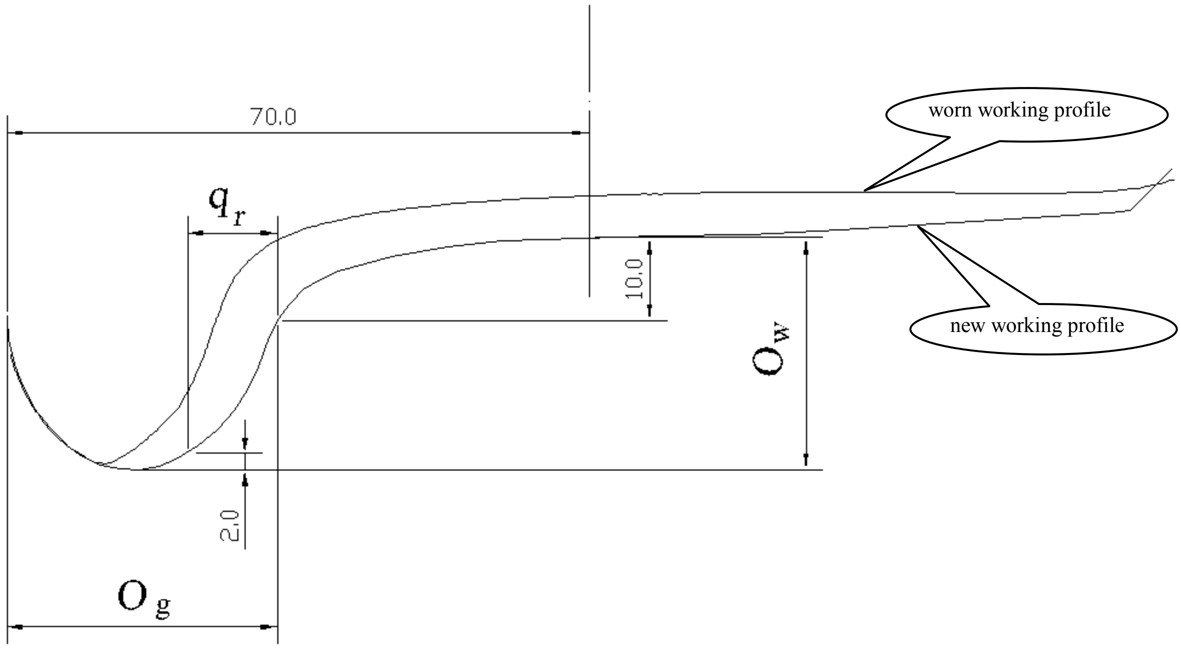

Fig. 2. Wear of working profile, type 28UIC140 after 100 000 km – age

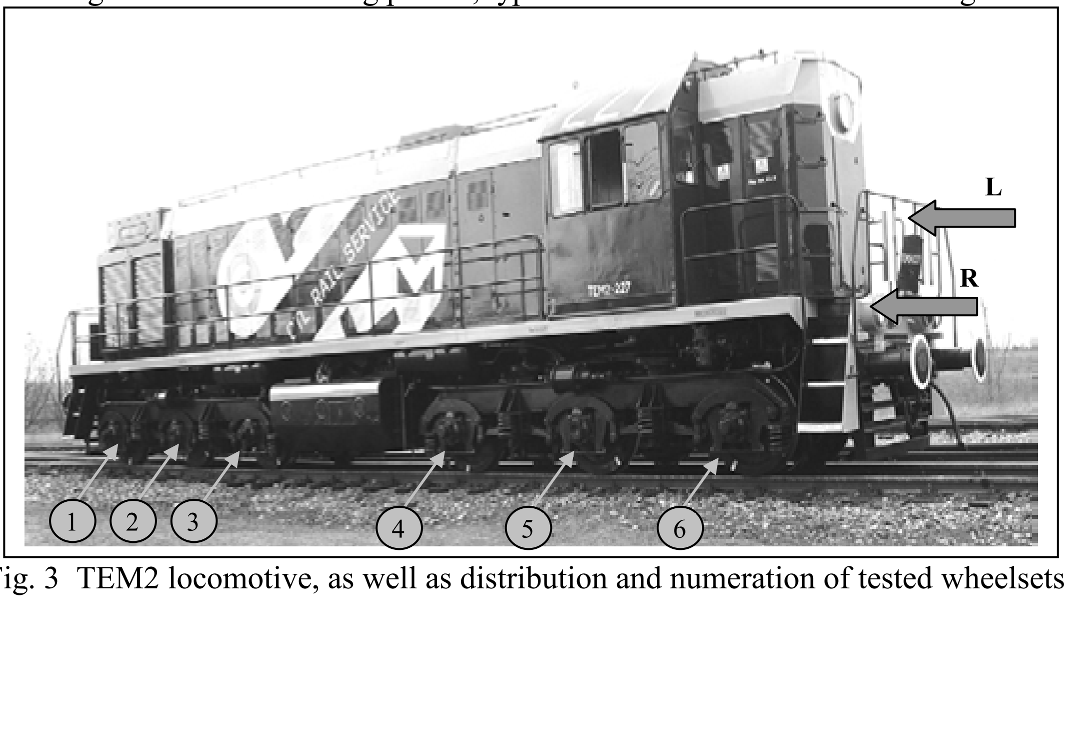

Fig. 3 TEM2 locomotive, as well as distribution and numeration of tested wheelsets

Table 1 presents the wear evolution of railway wheelsets for locomotive no. 241 depended on time. Middle wheelsets were not included, because the measurements had not been made before.

Table 1

Wear evolution of railway wheelsets for locomotive no. 241 depended on time

Wheelset no.1													
Date of measurement	26.06.97	13.12.97	09.06.98	13.11.98	22.02.99	26.04.99	10.07.99	15.11.99	01.09.00	29.01.01	05.09.01	06.06.02	14.11.02
"O_w" flange height L	28	28,5	29	29	29,5	29,5	30	30,5	28,5	30	29,5	32	32
"O_g" flange thickness L			29	27,5	27,5	27,5	28	26	31	31	28,5	28	27
"q_R" flange slope L									8	7	6	7,5	10,5
"O_w" flange height R	29	28,5	29	29,5	29,5	30	30	30,5	28,5	29,5	30	31,5	32
"O_g" flange thickness R			29	28	27,5	27	26,5	26	31,5	31	29,5	28,5	28
"q_R" flange slope R									8	7	7	8	11
Wheelset no.3													
Date of measurement	26.06.97	13.12.97	09.06.98	13.11.98	22.02.99	26.04.99	10.07.99	15.11.99	01.09.00	29.01.01	05.09.01	06.06.02	14.11.02
"O_w" flange height L	28	28,5	29	29,5	29,5	30	29,5	30	28,5	29	29,5	31	31,5
"O_g" flange thickness L			29,5	28	28	28	27,5	27	32	31	29,5	28	28
"q_R" flange slope L									8	7	7	7,5	10
"O_w" flange height R	28	28,5	28,5	29	29,5	29	30	30	28	29	29	30	31
"O_g" flange thickness R			29	28	28	28	25,5	27	30,5	29,5	28,5	27,5	27
"q_R" rim slope R									8	7	6,5	6	10
Wheelset no.4													
Date of measurement	26.06.97	13.12.97	09.06.98	13.11.98	22.02.99	26.04.99	10.07.99	15.11.99	01.09.00	29.01.01	05.09.01	06.06.02	14.11.02
"O_w" flange height L	29	28,5	29	30	30	30,5	29,5	30,5	28	28,5	29	30	31
"O_g" flange thickness L			28	26,5	26,5	27	27,5	24,5	31	29,5	29,5	27,5	27
"q_R" flange slope L									8	7	6	6,5	10
"O_w" flange height R	28	28,5	29	29	28	29	30	30	28,5	29	29	31	31,5
"O_g" flange thickness R			29,5	28	27	27	27,5	26,5	31,5	30	29	28	27
"q_R" flange slope R									8	6,5	6	6,5	10
Wheelset no.6													
Date of measurement	26.06.97	13.12.97	09.06.98	13.11.98	22.02.99	26.04.99	10.07.99	15.11.99	01.09.00	29.01.01	05.09.01	06.06.02	14.11.02
"O_w" flange height L	28,5	28,5	29	29,5	29,5	30	30	31	28	29	29,5	30,5	32
"O_g" flange thickness L			29	27,5	27	27,5	26,5	26	31	30	29	28	28
"q_R" flange slope L									8	7,5	7	7	10
"O_w" flange height R	28,5	28,5	29	29,5	30	30	30	30,5	28	29	29	31	32
"O_g" flange thickness R			29,5	28	28,5	28	27	27	31,5	31	29,5	28,5	28,5
"q_R" flange slope R									8	7	6,5	7	10,5

Fig. 4 shows diagrams of wear course of rolling profiles in TEM2 locomotive no. 241. Interruptions in continuity of diagram line mean that the wheelset was turned.

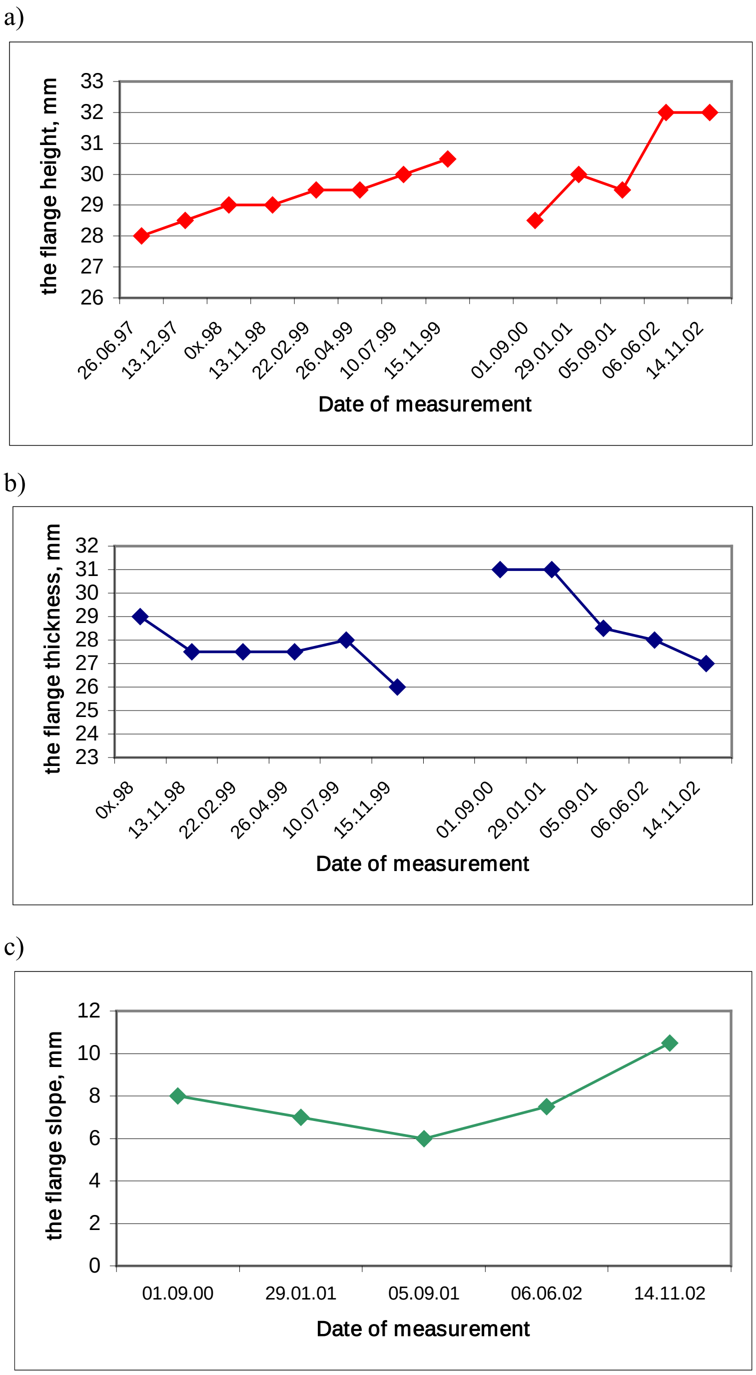

Fig. 4 Examples of the wear diagrams for tyre working profiles in TEM2 locomotive no. 241:

a) The process of changing of the flange height;
b) The process of changing of the flange thickness;
c) The process of changing of the flange slope.

Table 1 and fig. 4 show changes of working profile parameters, which are changeable depending on time only, because km-ages data were not available. Fig. 4c presents flange slope measurements, but only last five ones because of lack of data.

Upon analysis selected wheelsets we can reach the conclusion that the most wearable is external part of the wheelsets: numbers 1 and 6. We can also notice increase of flange height value as a result of the reduction of wheel rolling circle diameter and the decrease of flange thickness and flange slope values as a result of undercutting of wheel flanges. More precise analysis allows us to deduce that the highest increase of the value of flange height concerns wheelset no. 1 and significant decrease of flange thickness concerns wheelsets no. 1 and 6. Average period of locomotive km-age between profile repairs amounts to 2 years approximately, which corresponds to approx. 180 000 km.

WEAR ANALYSIS OF WORKING PROFILES OF RAILS

The geometry of rail working profiles were measured by 'PXY profilometer' for measurement of cross-section of rails and turnouts, manufactured by PTU GRAW, Gliwice (fig. 5). PXY profilometer is made for the purpose of scanning of the rail and turnout working profile with 0,01 mm accuracy.

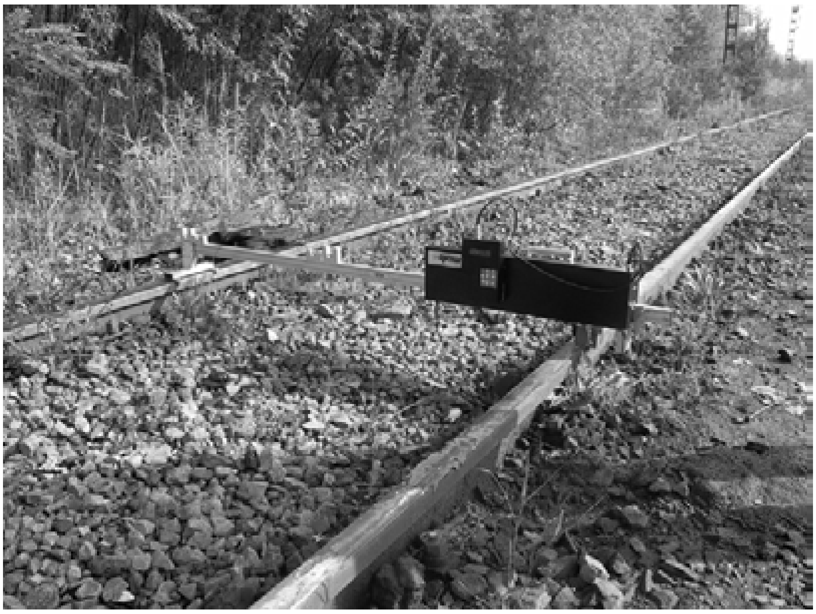

Fig. 5. Rail and turnout XY profilometer

The measurements of rails wear were carried out in July 2003 on railway tracks belonging to „CTL Maczki Bór". Investigated railway track is laid of S49 rails of the II category. The measurements were carried out on straight and curve pieces of line. There are also measured some rails, whom position was interchanged after they profiles had reached border values. The profile of worn rail was obtained, and it was put on model profile afterwards. It allowed to obtain the visualization of damages compared to new standard rail. Next, each profile of worn rail was measured in order to determine its operation usability.

Fig. 6 presents example of a wear of S49 rails for different track section.

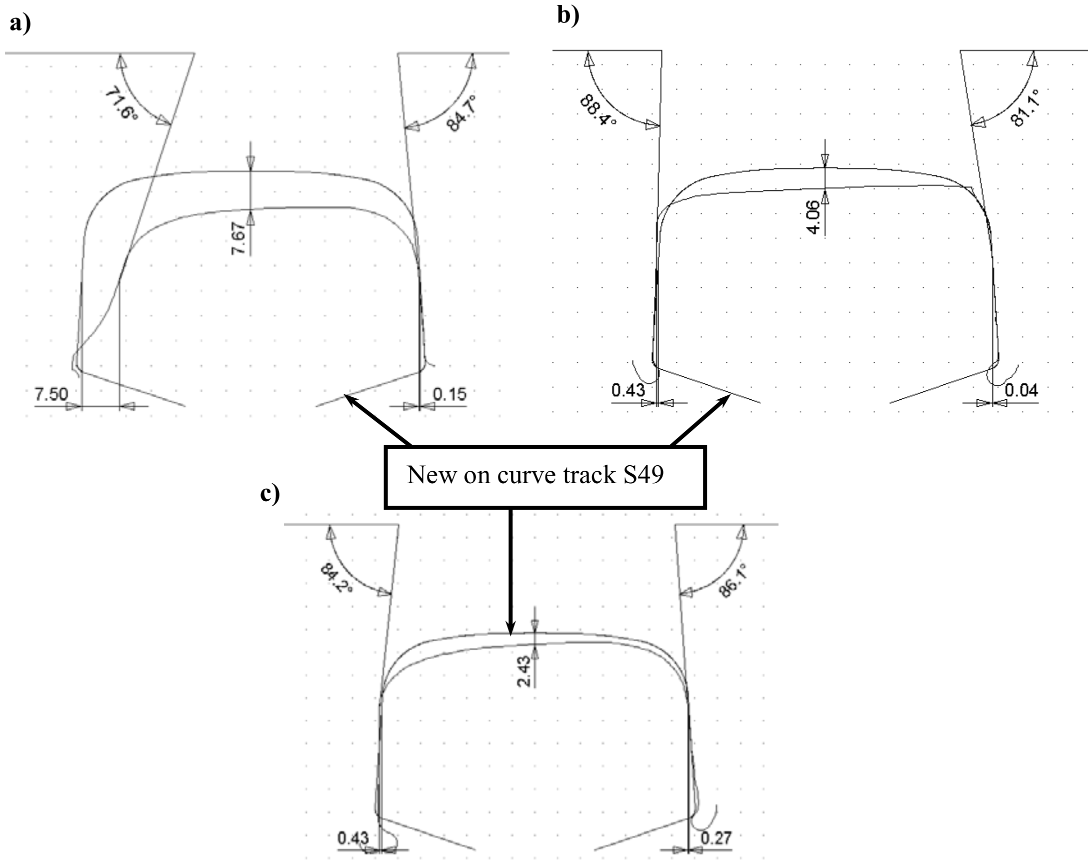

Fig. 6 Comparison of worn S49 rail and the new standard profile:

a) worn profile on curve track, external side;
b) worn profile on curve track, internal side;
c) worn profile on straight track.

Described researches brought series of results. The largest wear of investigated rails was observed on curve track, on their external sides. It was found that both, rail head wearing and side wearing, were proceed simultaneously. Cracks and even buckling of some parts of rails were also noticed. The largest rail wear concerns curve track with small diameter. A large majority of investigated rails does not suited for further exploitation. They ought to be replaced immediately.

Straight tracks are characterized by much lesser wear. Although the most significant fault concerning straight tracks was vertical wear of rail head, which was the largest on branch lines. But in consequence, values of wear for mentioned rails does not involve the necessity of replacing these rails.

CONCLUSIONS

Changes of basic geometric parameters of wheel working profiles are possible to show on condition that several locomotives with high km-age were investigated. Described analysis resulted in approximate mechanism of wear process of wheel tread profiles, because there were no precise data concerning km-age of separate locomotives. In refer to rails, definition of wear problem was much simple, because in Maczki Bór Co. there were no replacements of rails, and their age amounts to 30 years. As proved, most of rails – mainly on their external side - does not meet the requirements of operation conditions and ought to be replaced immediately.

Described researches concerning wear process of working surface of wheels and rails resulted in determining of the mechanism of wear process of wheel – rail system.

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Sładkowski A., Kuminek T. Wear analysis of wheels and rails at industrial transport
Investigative data concerning railway wheelset defects and in particular - wear of working profile is very important, because of their usefulness in choosing of practical method of improvement the durability and reliability of wheel construction. The paper presents analysis of wheels wear of TEM2 diesel locomotive and analysis of rails wear for industrial transport. Described researches concerning wear process of working surface of wheels and rails resulted in determining of the mechanism of wear process of wheel – rail system.

Сладковский А., Куминек Т. Исследование износа колес и рельсов на промышленном транспорте
Большое значение придается исследованию характеристик дефектов железнодорожных колес и в частности изнашиванию их поверхностей катания, поскольку это может быть использовано в качестве практического способа улучшения долговечности и надежности конструкции колеса. В статье приведен анализ износа колес тепловоза ТЕМ2 и исследование износа рельсов промышленного транспорта. Результаты проведенного анализа износа рабочих поверхностей колес и рельсов позволили описать механизм износа в системе колесо -рельс.