

**Andrzej Massel: From an Experimental Division to the Railway Research Institute**

In 1923, in the then Ministry of Railways, an Experimental Division, with Professor Albert Czczcott as its head, was established. The purpose of the Division was to specify the characteristic structural and operational features of the particular types of steam locomotives, especially new ones, and to test inventions and devices in order to verify their value and usefulness. Most of the research was conducted in railway sections located in the Eastern Borderlands of the Second Polish Republic, in the Vilnius Directorate. By 1938, the features of 26 steam locomotives had been described.

In connection with the introduction of new, heavier types of locomotives in the 1930s, new research on track response to increased dynamic load commenced. The research was carried out by Aleksander Wasiutyński, a professor of the Warsaw University of Technology. The research carried out at the Włochy post allowed, among others, the resilience coefficient of the track bed to be determined based on the vertical bending of tracks. In 1934, the Central Research Laboratory of the Polish State Railways was established in order to improve and standardize the quality of the materials supplied to the railways. The development of railway research in Poland was interrupted by World War II. However, in 1945, the Experimental Division of the Ministry of Transport was re-established and research on railway vehicles was re-commenced. In 1951, utilizing the resources of the Division and the Central Laboratory, the Railway Science and Research Institute (today's Railway Research Institute) was formed.

Keywords: testing, rolling stock, steam locomotive, laboratory, track

**Mirosław Dusza: Rail Vehicle Model Dynamics of Motion Along Straight Track with Vertical Irregularity**

During the long-term exploitation of railway tracks, possible changes in ground conditions may result in downgrading the quality of the drainage systems. The lack of adequate drainage of the track substructure leads to a lowering of the track formation cohesion ensured during the track construction phase as a result of ballast tamping. This potentially leads to pushing ballast into the subsoil, affecting the ballast which is present directly below the sleepers loaded during passage of the vehicles. As a result, the sleepers are no longer supported by ballast. The loss of support may affect a single sleeper or a set of neighbouring sleepers, depending of the length of the zone with inadequate drainage. Rail vehicle runs over such zones cause track vertical irregularities. This article is devoted to analysis of the influence of such irregularities on the rail vehicle dynamics. An arrangement model comprising a passenger coach and ballasted track was created with the VI-Rail tool. Coach runs were simulated within the range of operational speeds. Attention was paid to observation of the wheel-rail contact forces, which appeared during runs over different lengths of vertical irregularities. The obtained results are compared with currently binding criteria and regulations.

Keywords: rail vehicle dynamics, track irregularities, wheel-rail contact forces, numerical simulation

*Lukasz John, Artur Dłużniowski:* **Measurements of the Magnetic Fields Generated by Electronic Devices Installed on Railways Rolling Stock**

This paper covers the measurements of the AC and DC magnetic fields generated by electrical and electronic equipment in-stalled on rolling stock. It discusses the methodology for measuring magnetic fields with the EN 50500 standard. Moreover, it covers measuring equipment used for testing and methods of selecting measurement points inside and outside the rolling stock. The article shows exemplary results of measurements on the example of diesel and electrical railway rolling stock.

Keywords: railway rolling stock, magnetic induction, methodology of measurements, measuring equipment

*Władysław Koc:* **Analysis of Turnouts with Non-linear Curvature of Diverging Track for Different Train Running Speeds**

The paper deals with the issue of shaping variable curvature in diverging track of a railway turnout. A solution without a circular arc in the central zone, containing two zones of nonlinear curvature with the same length and zero curvature values at the end points, was adopted as a model, on the basis of previously conducted dynamic tests. The optimum type of curvature was selected from the perspective of the kinematic conditions. An analytical record of the curvature and the tangent inclination angle along the diverging track and of the Cartesian coordinates of the diverging track are presented. The obtained theoretical correlations were verified by computing. Verified correlations were used to determine geometrical parameters of some turnouts with non-linear curvature of the diverging track for different assumed train running speeds on it. The criterion was to minimize the length of the entire turnout with a predefined ordinate of the end of its diverging track.

Keywords: railway turnouts, diverging track, curvature modelling

*Paweł Kwaśniewski, Krystian Franczak, Grzegorz Kiesiewicz, Tadeusz Knych, Andrzej Mamala, Artur Kawecki, Szymon Kordaszewski, Wojciech Ścieżor, Radosław Kowal, Artur Rojek, Wiesław Majewski, Marek Kaniewski, Roman Majnusz, Romuald Wycisk, Michał Śliwka:* **Research on the Operational Properties of the New Generation of Railway Carbon Contact Strips Designated for Pantographs. Part II**

Along with the continuous expansion and modernization of railway lines in Poland, there is a need for new solutions designed to transfer electricity in the traction contact lines. One of the key elements of the electricity transfer from the traction contact lines to locomotives is the carbon contact strip. In Poland until 2011, contact strips made of copper were used which caused much faster wear of contact wires. The order to use carbon contact strips, due to the lack of domestic solutions, meant that foreign solutions in this area were adopted. Due to the type of Polish railway lines, which are supplied with 3 kV DC, adapted contact strips show a number of problems during operation in traction lines in Poland. This article is the second part of the study of the new generation of contact strips and has been focused on the research of exploitation properties that enable their use in railway lines managed by PKP PLK S.A., namely the President of UTK List.

Keywords: carbon contact strips, carbon composite, pantograph, railway, contact system

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*Jolanta Maria Radziszewska-Wolińska: Non-Metallic Materials in Rail Vehicles – Application and Recycling*

The article features the reasons for the relative lack of interest in the recycling of rail vehicles and presents available methods for recycling plastics (mechanical, raw material, biological and energetic recycling) as well as some materials made from natural raw materials. Prerecycling activities are also discussed. It is pointed out that the success of recycling requires cooperation within social, technological, economic, manufacturing, environmental and political realms.

Keywords: plastics, mechanical recycling, raw material recycling, energy recovery, circular economy, rail vehicles

*Marek Stolorz: Co-financing of the Activities of Railway Infrastructure Managers Under the Multi-Annual Program Based on Article 38a of the Polish Law on Railway Transport*

The article discusses the issue of changes to the system of financing railway infrastructure managers, which the concepts of a multi-annual program and a multi-annual contract implementing this program have been introduced to. The existing solutions allow the comprehensive co-financing of the operations of infrastructure managers with public funds, unlike the previous solutions, where the focus was only on investment operations. The multi-annual program is also a way to guarantee financing over a longer period of time, being a form of departure from the principle of budget annuality. Thanks to the program and the accompanying multi-annual contract, it is guaranteed that an infrastructure manager will receive public funds; however, its activities have to be in accordance with the contract. A multi-annual contract may also be executed between an infrastructure manager and a local government entity; however, this is not obligatory, and therefore may have a negative impact on regional railway infrastructure. The article also presents the evolution of the solutions concerning the financing of railway infrastructure managers and briefly discusses each of them.

Keywords: multi-annual program, multi-annual contract, law on railway transport, infrastructure managers, financing of infrastructure

*Andrzej Wojciechowski, Adam Doliński, Jolanta Maria Radziszewska-Wolińska, Marta Wołosiak: Environmentally Friendly Recycling of Wooden Railway Sleepers*

The paper presents directions for ensuring development while protecting the environment and natural resources. Mineral raw materials and natural energy resources should be replaced by secondary raw materials from post-consumer and post-production waste, which is constantly increasing. These demands are the basis of the Community program: Zero Waste for Europe. The circular economy concept should also be implemented in the rail sector to ensure proper waste management as well as energy savings and material recovery. The recycling process should include, among others, depleted wooden railway sleepers impregnated with creosote oil, which cause a great environmental problem.

The principles of application and requirements for wooden railway elements impregnated with creosote oil are discussed. There are also factors that impede a comprehensive approach to recycling of the products concerned. At the same time, methods for the thermal

decomposition of organic waste by thermolysis and properties of the obtained products from old wooden railway sleepers are characterized.

Keywords: thermal decomposition, waste, Circular Economy, creosote oil, railway sleepers