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SELECTED GUIDELINES FOR THE DESIGN OF CHASSIS COVERS FOR RAIL VECHICLES

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SUMMARY

The idea of the work is related to the extension of knowledge in the field of designing composite covers used to protect the chassis of rail vehicles against stone impacts. The work has been divided into two parts, the first of which concerns the scope of theoretical knowledge in the area under discussion, while the second contains a description of experimental tests and numerical calculations that have been performed in order to simulate the above mentioned phenomenon.

In the theoretical part, the solutions currently used for securing the chassis of rail vehicles have been presented, together with the presentation of the current requirements applicable in the process of their design. All that is complemented with the analysis and presentation of the causes of chassis damage together with the general issues related to composite materials. On this basis, a phenomenological model was developed, which made it possible to create a model for FEM analyses as well as to carry out stationary experiments. On the basis of tests of a composite cover dismantled from an electric multiple unit operated on the Polish railway lines, an analysis of damages occurring in the process under discussion was performed. The knowledge in this respect was supplemented by a visual inspection performed using a scanning electron microscope.

On the basis of the above-mentioned analyses, a methodology for conducting experimental research was developed and presented, while the aim, thesis and research tasks to be carried out in the study were also defined.

In the research part, with the use of experimental research and numerical simulations, the thesis was verified.

Composite materials, which are used for the production of covers are characterized by the possibility of a wide adaptation of their properties in the process of element construction, thus the influence of factors related to the stiffness and friction of the outer layers of composite samples was verified in this study. Such factors can be influenced by the designers at the design stage of the covers. Using test stands designed for the purpose of this study, which enabled the measuring of restitution and resistance coefficient to angular impact of composite samples, an assessment was carried out of the influence of the selected factors on the change of the resulting damage area. The statistical analysis of the conclusions enabled the influence of the identified factors and their interrelationships on the degree of resistance of the covers for the considered type of impact to be summarized. The complete research was summarized in the chapter describing the influence of particular factors on the results. The model prepared and adjusted for FEM analysis was used to verify the results obtained during experimental research and was also used to simulate other variants, which for various reasons could not be carried out on test stands.

The summary part contains the most important conclusions resulting from the conducted empirical research as well as literature analysis. Additionally, the possible directions for further research in the future have been provided.

As a result, the obtained research material together with the analysis performed enabled the guidelines presented in the theoretical part related to the design of composite covers of rail vehicle chassis to be enriched with new observations.

Moreover, the research results broaden the current knowledge of the general resistance of composite specimens to the impact of a sharp-edged element at a small angle. This information draws attention to the possible change of direction in the approach to the design of composite covers exposed to unidirectional damage. The results obtained in the course of the research process allowed us to confirm the validity of the thesis concerning the influence of specific material properties on the degree of the resistance of a protective cover.