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Problems of numerical simulation of stress and strain in the area of the adhesive-bonded joint of a conveyor belt[2]

Keywords: *adhesive-bonded joint, rubber material models, hyperelastic materials, numerical modeling*

Abstract: Belt conveyors are commonly used in-factory transportation devices built of sections of belt (e.g., a fabric-rubber belt) bonded into a continuous loop. Conveyor belt joints are exposed to substantial dynamic loads during the long time of their operation. Taking into account the fact that ensuring a high durability of conveyor belt joints is tantamount to guaranteeing their reliable operation and that the results of research conducted so far fail to provide unambiguous solutions to a number of problems that emerge in this case, it is advisable that advanced studies using computer techniques should be conducted within this area.

1. Introduction

Belt conveyors are basic in-factory transportation devices that are used by various production and service companies. Belt transport, due to a number of its merits, is used in numerous branches of industry, including, among others, mineral processing plants, metals-producing, extractive, cement-and-lime, and paper industries, sea and inland ports, construction industry, power plants, transshipment points, as well as agriculture and sugar plants. Belt conveyors (Fig. 1) enable fast and efficient transport of loose materials of different physico-mechanic properties, with a low degree of their degradation during high-speed and long-distance transfer [1-7]…….

2. The goals of numerical analysis of belt joints

The most important problems of belt transport in the current period are issues concerning the necessity to reduce energy consumption and to increase durability. Particularly significant is the strength and durability of conveyor belt joints since, despite numerous research and implementation studies, it still constitutes an important problem that every belt conveyor user has to face. One of the possibilities of increasing the durability of the belt and its joints is, among others, reduction of longitudinal stresses in the belt.

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[2] Title, abstract and key words in Polish and in English language version. For foreigners Polish language version if available.

According to Baldan [18, 19], studies of fatigue life of joints indicate a strong effect of longitudinal stresses in the belt on its durability and strength. That is why a lot of design work is being carried out which aims at working out appropriate tensioning device solutions. A second potential direction of research in this case is one aimed at increasing the durability and strength of the joint between belt sections by means of analysis and assessment of the distribution of stresses in the joint and the influence that the very structure of the joint has on them. In this case, interesting results may be expected from the use of the finite element method…..

3. Numerical analysis of stress and strain in the conveyor belt joint

Numerical analysis used in developing new design solutions for belt joints is aimed, among others, at estimating the possibility of using the developed FEM model of a joint for predicting the durability and strength of the joint as well as the possibility of using it at the stage of structural designing of the joint. It can be expected that the use of FEM-based numerical simulation …..

$$R_p \geq 0{,}85 \cdot R_r \cdot \frac{z-1}{z} \quad (3)$$

[3]

3.1. The scope of calculations and numerical characteristics of an adhesive joint

The finite element method, belonging to a group of most popular computer-aided methods used for solving mechanical issues, consists in replacing a continuous model of the analyzed mechanical system with its discrete model (Fig. 3, Fig. 4), which in a mathematical description assumes the form of a set of algebraic equations [22]. ……..

4. Conclusion

In the case of an adhesive joint connecting sections of a conveyor belt, there mainly occur shear loads and, in some rare cases, also peel loads. When the belt and the joint pass over pulleys and other elements of the load-bearing structure of the conveyor, there additionally occurs a momentary uneven shear load distribution as an effect of the action of forces that cause bending moments, which contributes to the increase of the tensile stress at the edges of the joint [36].

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[5] In accordance with the requirements of citation databases, proper citation of publications appearing in our Quarterly should include the full name of the journal in Polish and English without Polish diacritical marks, i.e., **Eksploatacja i Niezawodnosc – Maintenance and Reliability.**