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## DETERMINATION THE EFFECT OF FACTORS AFFECTING THE TENSILE STRENGTH OF FABRIC CONVEYOR BELTS

### OCENA WPŁYWU CZYNNIKÓW NA WYTRZYMAŁOŚĆ NA ROZCIĄGANIE TAŚM PRZENOŚNIKOWYCH TKANINOWO – GUMOWYCH

*The Design of experiment (DOE) method was used in this paper to rubber conveyor belt tension testing. Using DOE method were from experimentally obtained data established effects of factors and interactions that affect the value of the measured strength and also were determined regression models, which apply input and output variables to the relation. The regression model presents the complete multifactor experiment that contains main factors and interactions.*

**Keywords:** mechanical testing, tension, conveyor belt, DOE method (Design of Experiments).

*Metoda planowania eksperymentu (DOE) w artykule użyta do testowania napięcia taśm przenośnikowych tkaninowo – gumowych. Korzystanie z metody DOE były ustalonych poszczególnych czynników oraz ich interakcji ze danych uzyskanych w sposób doświadczalny. Czynniki i interakcje wpływające na wartość zmierzonej wytrzymałości, a także określono modele regresji, wykazującego związku pomiędzy zmiennymi wejściowymi i wyjściowymi. Model regresyjny przedstawia kompletny wieloczynnikowy eksperyment obejmujący podstawowe zmienne oraz ich interakcje.*

**Słowa kluczowe:** testy mechaniczne, napięcie, taśma przenośnikowa, metoda DOE.

#### 1. Introduction

Belt conveyor system is a high-power conveyance system broadly applied in practice [16]. The main reason of such broad application is its structural and economic adaptability [26]. According to [14, 25], a belt conveyor represents the most cost-effective solution in the loose material transportation. It can be broadly used in the fields, such as coal mining, ports, chemical industry, electric energy, metallurgy, architecture, and food supplies [13]. Requirements demanded by production plants regarding minerals are currently rising, which results in the increasing traffic intensity of material flows in mining companies within the transportation of bulk solid materials. Bulk materials are currently transported mainly by trucks. Therefore, an alternative to this kind of transport must be searched [21, 23]. Transportation solution is offered by the continuous belt conveyor system with the crushing carried out directly in the quarry, using portable crushers [6].

Large scale belt conveyor is a key (one of the most important) device to transport bulk-solid material for long distance at high rates [5]. Belt conveyors are complex systems with drive groups as functionally very important components [15]. For belt conveyors, the transport task can be defined as a process whose purpose is to transport the set quantity of handled material within a defined time between the set loading and offloading locations [12].

Due to the fact that a conveyor belt, as a carrying and tractive element, represents the most important part of a belt conveyor, it is essential to reduce the costs of manufacture and maintenance thereof. Maintenance cost reduction can be achieved by improvements in utility properties of conveyor belts [16]. Conveyor belt properties significantly affect the reliability of the entire belt conveyor system. Insufficient strength of a conveyor belt can cause its rupture and subsequent downtime due to repair and replacement thereof. Rupture of a conveyor belt represents unacceptable risk in the operation of a belt

conveyor system and [3] classify it as unsystematic risk in an underground mine plant.

During the operation, a conveyor belt is affected by various stresses that cause its damage and wear-out [8]. Awareness of mechanical properties of conveyor belts is very important for a smooth operation of belt conveyors [24]. Requirements regarding conveyor belts depend on the method of their use; therefore, entire belt conveyor, as well as its individual components, is subject to compulsory tests. Required properties of conveyor belts are identified by tests determined by standards and technical or technological regulations.

According to Hardygora [10] and Taraba [22] tests of conveyor belts can be divided into three groups: standard tests, certification tests and non-standard tests. The first group includes tests of physico-mechanical properties for their compliance with the standards in force. The second group comprises certification tests on belts required for permitting the latter to be operated in underground mines. The third group embraces non-standard tests – specialist tests performed on special test stands, usually not covered by standards but concerning parameters important for the operation of belts.

Non-standard tests include, for example, determination of the impact resistance of a conveyor belt. The methodology of testing the impact resistance using a special testing equipment is described by authors [7] and determination of impact resistance on the basis of experimental measurements, with the results evaluation using the regression analysis, is described by authors [1, 4]. By using DOE methods in the examining stress conveyor belts in relation to their resistance to breakdown deal works [2, 9].

Conveyor belt tests carried out within the experimental research and the results presented in this article can be classified as the group 1st tests, according to [10]. In addition to the results obtained by standard testing, the article presents a new approach to the evalua-

tion thereof, with the determination of the impact of the selected factors on the tensile strength of a conveyor belt.

## 2. Materials and experimental procedure

### 2.1. Experimental material

A belt conveyor as a composite consists of several materials. Fabric conveyor belts usually consist of a wear resistant top layer ('top cover'), a fabric carcass providing tensile strength, skim layers for adhesion between rubber and carcass, and a bottom layer ('bottom cover') to cover the carcass and provide sufficient friction to the drive pulley [18].

Experiments were carried out using conveyor belts (CB) of TRANSBELT type intended for general use. They are textile conveyor belts intended for the transportation of loose and piece materials in common operating conditions. They are typically used in the mining and processing industries, as well as in operations, such as gravel sand works, lime works, cement works, thermal power plants, dumps and docks. Their cover layers (CL) are made of rubber in five categories, depending on the type of transported material. The conveyor belt carcass (Fig. 1) consists of one to five fabric plies. The plies are made in two versions. In the first version, individual layers of fabric reinforcement are made of polyamide fibres in the lengthwise and transversal direction. In case of polyamide reinforcement material, the mark of a conveyor belt type contains letter P. In the second version, individual plies are made of the combination of polyamide and polyester fibres.

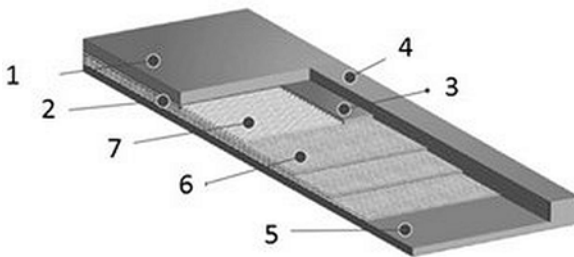


Fig. 1. Structure of a conveyor belt with a textile carcass 1 – top cover layer, 2 – carcass, 3 – adhesive mixture, 4 – protective rubber selvage, 5 – bottom cover layer, 6 – fabric plies, 7 – bumper

Table 1. Used types of conveyor belts

Ord. no.	Carcass material		Nominal tensile strength [N/mm]	Number of layers	CL category	CB mark
	Warp	Woof				
1.	P	P	800	3	AA	P 800/3 AA
2.	P	P	800	4	AA	P 800/4 AA
3.	E	P	800	3	AA	EP 800/3 AA
4.	E	P	800	4	AA	EP 800/4 AA
5.	P	P	1000	3	AA	P 1000/3 AA
6.	P	P	1000	4	AA	P 1000/4 AA
7.	E	P	1000	3	AA	EP 1000/3 AA
8.	E	P	1000	4	AA	EP 1000/4 AA
9.	P	P	1250	3	AA	P 1250/3 AA
10.	P	P	1250	4	AA	P 1250/4 AA
11.	E	P	1250	3	AA	EP 1250/3 AA
12.	E	P	1250	4	AA	EP 1250/4 AA

Table 2. Required mechanical properties of the examined conveyor belts

Property	Unit	Conveyor belt type		
		800	1000	1250
Tensile strength				
• along the warp, min.	N/mm	800	1000	1250
• in woof, min.		160	200	250
Permitted tensile stress (reference load), max.	N/mm	80	100	125
Elongation at break along the warp, min.	%	10	10	10
Proportional elongation with permitted stress, max.	%	3	3	3

In such case, polyester fibres are used in the lengthwise direction of the fabric (in warp). Transverse direction of a ply, also called woof, consists of polyamide fibres. In such version of the fabric reinforcement, a conveyor belt type is marked with letters EP. Experiments were carried out using CBs (Table 1) with cover layers of AA category – for the transportation of very abrasive, grainy, and loose material. Required mechanic properties of the examined CBs are listed in Table 2.

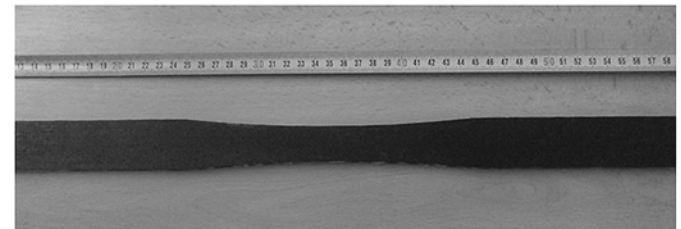
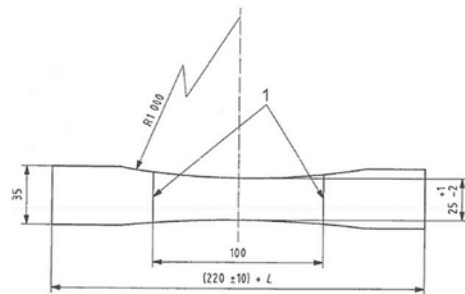


Fig. 2. Type A testing specimen, L – Testing specimen length [mm], 1 – reference lines

### 2.2. Testing specimens

Type A testing specimens were prepared using a cutting die by cutting them out from each type of a conveyor belt in the quantity of three pieces, in the lengthwise direction, as specified in [11]. None of the ply objects contained joints. Shapes and dimensions of testing specimens are documented in Fig. 2. Two reference lines were drawn on the testing specimens across their lengthwise axes in their working sections, in the distance of 100 mm. Subsequently, these objects were conditioned pursuant to [11]. Tensile tests were carried out immediately after the conditioning period terminated.

### 2.3. Test fundamentals and procedure

*Test fundamentals* – a testing specimen, cut out from the whole thickness of a conveyor belt, is loaded, under the prescribed conditions, on the tensile testing equipment, applying the tension, until the testing object disturbance is observed. Experimental tests of mechanical properties of conveyor belts were carried out using a testing machine of the Zwick Roell Z 100 type. Due to the need to measure the elongation of the testing specimen during the test, the testing machine was equipped with the videoXtens extensometer, which applies the contactless deformation measurement principle. The main advantage of this extensometer is that it can be used until the sample's rupture without any damage. A full-area camera scans a digitalized image of a tested specimen and processes it in the real time. The system automatically identifies reference marks, while calculating their displacement as the specimen is loaded [27].

*Test procedure* – Testing specimens were symmetrically fixed between grips of the testing machine so that the lengthwise axes of a testing object, the central line of the grip, and the direction of tensile force were aligned. Testing specimens were loaded with the constant loading rate of 100 mm/min. During the test, elongation was recorded at the instance of reaching the reference load, corresponding to one

tenth of the nominal tensile strength in the lengthwise direction (Table 2), multiplied by the width of the testing specimen in mm. The testing continued, until the specimen's rupture, first signs of carcass disturbance, or reaching the maximum value on the force measuring device. This maximum force and the elongation at such force were recorded. The same procedure was carried out with all testing objects. Recorded values are invalid, if a testing specimen is not disturbed between the reference lines, or if during the test the specimen is skidding between the grips [20], which, however, did not happen.

### 2.4. Determination of mechanical properties

Experimental research determined the following mechanical properties of the examined CBs, determined pursuant to [19]:

- **Full thickness tensile strength** – the most intensive force measured during the tensile test, divided by the testing specimen's width:

$$f_s = \frac{F_r}{b_t} \quad (1)$$

Table 3. Maximum measured values of mechanical properties of the examined CBs

Type CB	$f_s$ [N/mm]				$\epsilon_r$ [%]				$\epsilon_t$ [%]			
	$x_1$	$x_2$	$x_3$	$\bar{a}(x_i)$	$x_1$	$x_2$	$x_3$	$\bar{a}(x_i)$	$x_1$	$x_2$	$x_3$	$\bar{a}(x_i)$
P 800/3	893	979	939	937	19	20	20	19.7	1.1	1.2	1.2	1.2
P 800/4	1004	1009	987	1000	22	22	22	22.0	1.3	1.4	1.5	1.4
EP 800/3	943	885	942	923	18	18	18	18.0	1.0	1.1	1.1	1.1
EP 800/4	1050	1069	1059	1059	19	19	19	19.0	0.9	0.9	0.9	0.9
P 1000/3	1250	1255	1275	1260	25	24	25	24.7	1.5	1.6	1.6	1.6
P 1000/4	1240	1167	1209	1205	24	22	23	23.0	2.4	2.6	2.5	2.5
EP 1000/3	1270	1239	1219	1243	19	18	18	18.3	1.1	1.2	1.4	1.2
EP 1000/4	1240	1250	1290	1260	18	19	19	18.7	0.9	1.0	0.8	0.9
P 1250/3	1460	1500	1471	1477	22	22	22	22.0	1.6	1.7	1.7	1.7
P 1250/4	1583	1569	1660	1604	24	25	25	24.7	1.5	1.6	1.5	1.5
EP 1250/3	1575	1580	1581	1579	20	20	20	20.0	0.8	0.7	0.7	0.7
EP 1250/4	1830	1667	1791	1763	18	18	18	18.0	1.1	1.3	1.2	1.2

Table 4. Minimum measured values of mechanical properties of the examined CBs

Type CB	$f_s$ [N/mm]				$\epsilon_r$ [%]				$\epsilon_t$ [%]			
	$x_1$	$x_2$	$x_3$	$\bar{a}(x_i)$	$x_1$	$x_2$	$x_3$	$\bar{a}(x_i)$	$x_1$	$x_2$	$x_3$	$\bar{a}(x_i)$
P 800/3	862	848	870	860	23	22	22	22.3	1.8	1.6	1.7	1.7
P 800/4	950	968	970	963	21	21	21	21.0	1.4	1.3	1.3	1.3
EP 800/3	884	835	894	871	18	19	18	18.3	1.3	1.2	1.1	1.2
EP 800/4	880	856	861	866	20	20	20	20.0	1.2	1.0	0.9	1.0
P 1000/3	1167	1180	1220	1189	27	26	25	26.0	1.8	1.7	2.1	1.9
P 1000/4	1102	1074	1100	1092	20	20	20	20.0	1.5	1.6	1.6	1.6
EP 1000/3	1159	1138	1156	1151	17	16	17	16.7	0.9	0.9	1.0	0.9
EP 1000/4	1127	1122	1126	1125	17	18	18	17.7	1.0	1.1	1.1	1.1
P 1250/3	1361	1367	1364	1364	24	25	24	24.3	2.5	2.5	2.3	2.4
P 1250/4	1580	1494	1529	1534	24	25	25	24.7	1.5	1.7	1.6	1.6
EP 1250/3	1333	1342	1340	1338	18	18	18	18.0	1.1	1.1	1.1	1.1
EP 1250/4	1291	1295	1315	1300	21	21	20	20.7	0.8	0.8	0.7	0.8

where  $f_s$  – tensile strength [N/mm],  
 $F_r$  – sample load force at rupture [N],  
 $b_t$  – specimen width [mm].

The resulting value of the tensile strength is the arithmetic average of the values for three testing objects in the lengthwise direction.

- **Elongation at break** – elongation at the maximum force expressed as the percentage gain in the distance between two reference lines

$$\varepsilon_r = \frac{(L_2 - L_1)}{L_1} \cdot 100 \quad (2)$$

where  $\varepsilon_r$  – elongation at break [%],  
 $L_1$  – distance between reference lines prior to loading [mm],  
 $L_2$  – distance between reference lines at specimen's disturbance [mm].

- **Elongation at the reference load** – is expressed as the percentage gain in the distance between two reference lines with the reference force:

$$\varepsilon_l = \frac{(L_R - L_1)}{L_1} \cdot 100 \quad (3)$$

where  $\varepsilon_l$  – elongation at the reference load [%],  
 $L_R$  – distance between reference lines with the reference load of the testing specimen [mm],  
 $L_1$  – distance between reference lines prior to loading [mm].

The resulting value of the elongation at break and the elongation at the reference load is the arithmetic average of values for three testing objects in the lengthwise direction.

For each examined type of a conveyor belt, we tested the testing objects marked as  $x_i$ , where  $i = 1, 2, 3$ . Results of the measurements are listed in Tables 3 and 4.

### 3. Design and evaluation of experiment

In this work, we monitored the impact of three main factors (Table 5): nominal strength, i.e. specified minimum value of the tensile strength (factor A), type of carcass (factor B), and number of plies (factor C). Our task was to determine which of the factors, or which of their interactions, have a significant impact on the response, i.e. the tensile strength of a conveyor belt.

We have developed a plan of the complete three-factor experiment with two levels without repetition together with two-factor interactions (first-order interactions), whereas the number of all steps is  $2^3$  – the square root represents the number of levels and the exponent represents the number of factors. For one experiment design, it was necessary to enter 8 values of the response on the upper and lower levels of each factor, which are listed in Tables 3 and 4. For the DOE method, maximum and minimum values of measured tensile strength of CBs were applied separately for 3 strength intervals: a) 800 and 1,250 N/mm, b) 800 and 1,000 N/mm, c) 1,000 and 1,250 N/mm; i.e. totally 6 designs of experiment. Each experiment design can be

Table 5. List of input factors and their levels

Factors		Low level (-1)	High level (+1)
A	Nominal strength [N/mm]	$X_i$	$X_j$
B	Carcass type [-]	P	EP
C	Number of plies [-]	3	4

Where:  $X_i X_j$ : a)  $X_1 X_3$  800 and 1,250 N/mm, b)  $X_1 X_2$  800 and 1,000 N/mm, c)  $X_2 X_3$  1,000 and 1,250 N/mm

graphically represented using a cube (Fig. 3), whereas cube corners contain the entered response values.

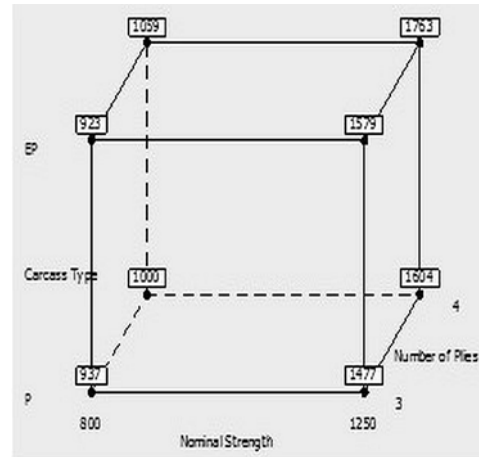


Fig. 3. Graphical representation using cube

#### 3.1. Designs of experiments for maximum response values

In the assessment of the significance of effects and their interactions, the DOE method facilitates the use of several graphical outputs, such as:

- Graphical representation of main effects;
- Normal probability plot of the significance of factors and interactions;
- Interaction plot of main effects.

As several individual experiments designs were carried out, the most frequently used Pareto chart was selected (Fig. 4), which defines factors and interactions with the statistically significant impact on the monitored response. Significance of individual impacts of factors or interactions was tested using the t-test and by the determination of the p-value on the significance level of  $\alpha=0.05$ . In all the monitored intervals for the maximum values of the measured tensile strength of CBs, statistically significant impact of three main factors was confirmed. Insignificant impact on the measured tensile strength value was observed only in certain first-order interactions.

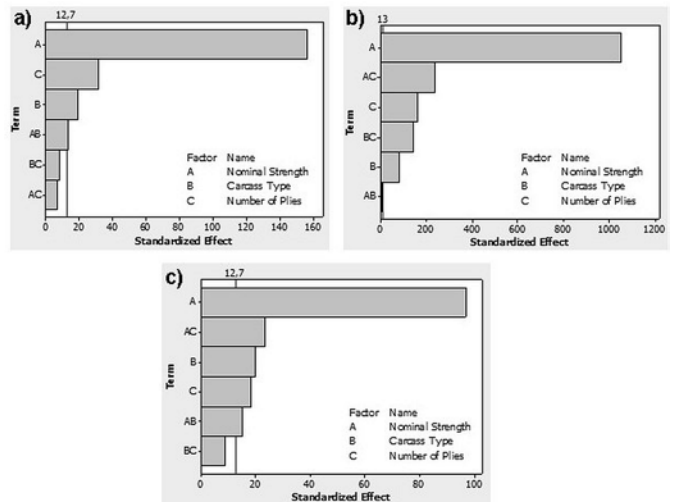


Fig. 4. The Pareto chart of the significance of factors and interactions; a) 800 and 1,250 N/mm, b) 800 and 1,000 N/mm, c) 1,000 and 1,250 N/mm

Table 6 shows the average values of the response on the upper and lower level of each factor, as well as effects of individual factors.

Table 6. The main effects of factors

800 & 1250	A	B	C
$\bar{y}_-$ (low level)	979.75	1254.5	1229
$\bar{y}_+$ (high level)	1605.75	1331	1356.5
Effect of factors	626	76.5	127.5
800 & 1000			
$\bar{y}_-$ (low level)	979.75	1121.25	1131
$\bar{y}_+$ (high level)	1242	1100.5	1090.75
Effect of factors	262.25	20.75	40.25
1000 & 1250			
$\bar{y}_-$ (low level)	1242	1386.5	1389.75
$\bar{y}_+$ (high level)	1605.75	1461.25	1458
Effect of factors	363.75	74.75	68.25

The strongest significance on the monitored response in all strength intervals was observed in factor A (nominal strength).

The model of a full three-factors experiment containing the main factors and all two-factors interactions is determined by the relation:

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_{12}x_1x_2 + \beta_{13}x_1x_3 + \beta_{23}x_2x_3 + \varepsilon \quad (4)$$

where  $y$  is the response,  $x_1, x_2, x_3, x_1x_2$  up to  $x_2x_3$  represent values of factors A, B, C and interactions between the respective two factors (e.g.  $x_1x_2$  represents the AB interaction).

The point estimate of the regression model is:

$$y = \hat{\beta}_0 + \hat{\beta}_1x_1 + \hat{\beta}_2x_2 + \hat{\beta}_3x_3 + \hat{\beta}_{12}x_1x_2 + \hat{\beta}_{13}x_1x_3 + \hat{\beta}_{23}x_2x_3 \quad (5)$$

Table 7. The coefficients point estimate of the regression model

	coefficient	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_{12}$	$\hat{\beta}_{13}$	$\hat{\beta}_{23}$
800 & 1000	value	1110.88	131.12	10.37	20.13	-0.87	-29.63	18.12
<b>100%</b>	p-value	0.000	0.001	0.008	0.004	0.090	0.003	0.004
800 & 1250	value	1292.75	313	38.25	63.75	27.00	14.00	16.25
<b>99.97%</b>	p-value	0.001	0.004	0.033	0.020	0.047	0.090	0.078
1000 & 1250	value	1423.88	181.88	37.38	34.12	27.87	43.62	16.13
<b>99.94%</b>	p-value	0.001	0.007	0.032	0.035	0.043	0.027	0.074

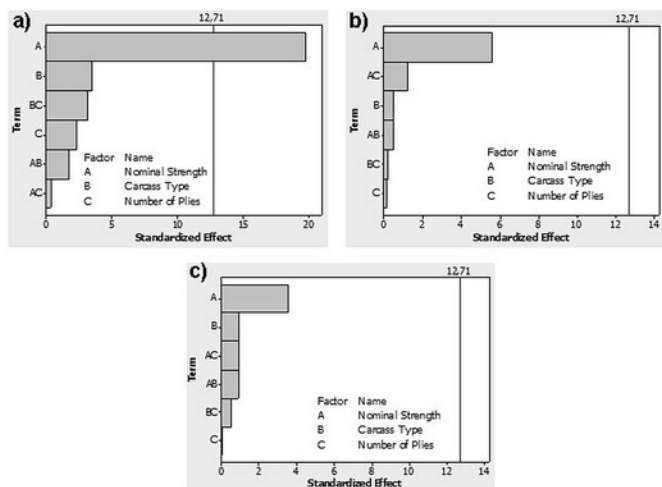


Fig. 5. The Pareto chart of the significance of factors and interactions; a) 800 and 1250 N/mm, b) 800 and 1000 N/mm, c) 1000 and 1250 N/mm

where  $\hat{\beta}_0, \hat{\beta}_1, \dots, \hat{\beta}_{23}$  are estimates of the regression model coefficients that can also be calculated using the effects [17]. Values of all model coefficients and the value of the **determination coefficient** in % are shown in Table 7.

### 3.2. Designs of experiment for minimum response values

Almost in all the monitored intervals for the minimum values of measured tensile strength of CBs, statistical significance of main factors and first-order interactions was not confirmed, with the exception of the 800 and 1250 N/mm interval, where the significance of factor A was manifested (nominal strength), Fig. 5.

Table 8 shows the average values of the response on the upper

Table 8. The main effects of factors

800 & 1250	A	B	C
$\bar{y}_-$ (low level)	890	1180.25	1108.25
$\bar{y}_+$ (high level)	1384	1093.75	1165.75
Effect of factors	494	-86.5	57.5
800 & 1000			
$\bar{y}_-$ (low level)	890	1026	1017.75
$\bar{y}_+$ (high level)	1139.25	1003.25	1011.5
Effect of factors	249.25	-22.75	-6.25
1000 & 1250			
$\bar{y}_-$ (low level)	1139.25	1294.75	1260.5
$\bar{y}_+$ (high level)	1384	1228.5	1262.75
Effect of factors	244.75	-66.25	2.25

and lower level of each factor, as well as effects of individual factors. Again, the strongest impact on the monitored response in all strength intervals was observed in factor A (nominal strength), even though it is not significant in all intervals. The values of all model coefficients and the value of the **determination coefficient** in % are shown in Table 9.

## 4. Discussion

This paper is focused on the experimental research of the tensile strength of fabric conveyor belts. The research was carried out applying the Design of Experiment method (DOE), whereas the relation between the strength properties of conveyor belts was monitored in the selected factors. Six experiments were designed, in which 12 conveyor belts types were used with the nominal strength of 800, 1000 and 1250 N/mm. Conveyor belts of the same nominal strength were also differing in the number of plies and the material of the textile carcass. In all experiments, the setting of factors B and C values (type of carcass and number of plies) was identical. Only the upper and lower levels of factor A were changing (nominal tensile strength).

In all the monitored intervals for the maximum values of the measured tensile strength of CBs, significant impact of all examined factors – the nominal tensile strength (factor A), a type of carcass (factor B), and the number of plies (factor C) on the response (tensile strength of a conveyor belt) was confirmed. Also the impact of some interactions on the given dependent variable was manifested. The scope of the experimental program did not allow supplementation of one more factor. The setting of the strength interval has thus a decisive impact on

Table 9. The coefficients point estimate of the regression model

	coefficient	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\beta}_3$	$\hat{\beta}_{12}$	$\hat{\beta}_{13}$	$\hat{\beta}_{23}$
800 & 1000	value	1014.63	124.63	-11.38	-3.13	10.13	-27.63	-4.62
100%	p-value	0.014	0.113	0.701	0.912	0.729	0.433	0.870
800 & 1250	value	1137	247	-43.25	28.75	-21.75	4.25	-39.50
98.34%	p-value	0.007	0.032	0.179	0.261	0.332	0.791	0.195
1000 & 1250	value	1261.63	122.38	-33.13	1.12	-31.88	31.88	-17.12
56.60%	p-value	0.018	0.177	0.516	0.979	0.529	0.529	0.709

Table 10. Significant factors and interactions in the monitored intervals for the minimum and maximum values of the measured tensile strength of CBs

Strength interval	Factors and interactions	
	MIN	MAX
800 and 1250	A	A, C, B, AB
800 and 1000	-	A, AC, C, BC, B
1000 and 1250	-	A, AC, B, C, AB

Table 11. Interval range for the maximum measured values

Strength interval	[%]		
	MIN	MAX	Interval range
800 and 1250	15.4	41	25.7
800 and 1000	15.4	26	10.6
1000 and 1250	20.5	41	20.5

Table 12. Interval range for the minimum measured values

Strength interval	[%]		
	MIN	MAX	Interval range
800 and 1250	7.5	22.7	15.2
800 and 1000	7.5	18.9	11.4
1000 and 1250	9.2	22.7	13.5

the determination of the impact of factors. In the monitored intervals for the minimum values of the measured tensile strength of CBs, only the statistically significant impact of factor A was confirmed (nominal strength) in the interval of 800 and 1250 N/mm. The list of all significant factors and interactions is presented in Table 10.

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The differences between the measured tensile strength and the nominal strength of conveyor belts were used to determine the range of individual strength intervals. On the basis of the maximum (MAX) and the minimum (MIN) values, separately for the maximum (Table 11) and minimum (Table 12) measured values, the strength interval range was determined. With the falling interval range in the maximum measured values, the number of more significant interactions is rising. However, in the minimum measured values, particularly in the broadest strength interval of 800 and 1250 N/mm, significance of factor A was confirmed.

#### 5. Conclusions

During the operation, a conveyor belt is exposed mainly to the uniaxial quasi-static tensile stress in the lengthwise direction, due to its required initial tension for the transfer of tensile forces and the dynamic stress in the transverse direction induced by its troughability. Improper dimensioning of conveyor belt mechanical properties and selection of inappropriate cover layers or a conveyor belt carcass can result in the belt rupture. Therefore, the experimental research was focused on the testing of tensile strength of fabric conveyor belts, while monitoring the relation between the mechanical properties of conveyor belts and the selected factors. To achieve improved strength parameters of conveyor belts, it is important to identify possible impact of input factors. Using the DOE method, factors and their interactions affecting the response – tensile strength of a conveyor belt were identified. The impact of three monitored factors was confirmed, i.e. the nominal strength (factor A), the number of plies (factor C), and the type of carcass (factor B), as well as certain mutual interactions, for the maximum values of the measured strength. In certain two-factor interactions, however, statistically significant impact was not confirmed.

The results indicate that the nominal strength has the strongest impact on the tensile strength of a conveyor belt, i.e. on the monitored response in all experiment designs, although it is not significant in each case. In the examined responses, the relation between the DOE method and the range of the input experimental data was not manifested.

Regression models were also determined to describe the functional relation of the output characteristics and the input factors. Each obtained regression model represents a complete three-factor experiment containing factors and first-order interactions.

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