STUDY OF THE INFLUENCE BELTS JOINT REGIME PARAMETERS FOR IMPROVING THE TIME OF OPERATION OF THE CONVEYOR BELTS

PETRE ARMĂŞOIU[1], VLAD ALEXANDRU FLOREA[2]

Abstract: Indifferent of the type of rubber conveyor belt and reinforcing material (textile insertion or metallic insertion) most often occurs while a degradation of the rubber in the surface layer belt. Conveyor belts vulcanization joint must be made that the mechanical characteristics to be the same or very similar to those of the rest of the belt and to obtain homogeneity of the entire carpet belt conveyor. Joining belts with metal and textile inserts is an operation particularly important in maintaining the belt conveyors in operation for which the area joining the two belts is necessary to obtain a structure as similar as possible from that of original belt. The experimental results obtained can be used to achieve vulcanization joints and of other products made of rubber or rubber matrix composites. This paper presents results of research on the study of the influence of temperature, vulcanization time and pressure joining of belts from rubber ATRBZ which have five layers of insertion type PE 250.

Keywords: belts conveyor, vulcanization, tensile strength, specimen, technological parameters,

1. INTRODUCTION

Rubber products used in various fields of industry can be made in the manufacturing process either the operation required dimensions or to other smaller and this determines the use of the vulcanization process for their joining so that as to obtain the necessary quality their exploitation. This category of products includes mainly conveyor belts that are used in the transport of raw materials and materials and transport distances are longer in length than production of conveyor belts.

Thus the importance belts conveyor which must have high mechanical properties have different structure inserts (textile, metal) and their properties are based adhesions rubber insert and used for equipping high capacity conveyors or working

[1] *Eng. PhD, Student at University of Petrosani, armasoiup@yahoo.com*
[2] *Eng. PhD, Lecturer at University of Petrosani, vladalexandruflorea@gmail.com*

under high solicitation (pronounced slope, high speed, length reduced by frequent alternations with straight direction and crossings on drums) that require a very good tensile strength, great flexibility and high reliability.

Strong adhesions of the polymer and the metal are based on chemical reaction of the polymer with the metal and also Van der Waal's type forces. The majority of polymers and polymer composites is transferred to the metal surface in the form of lumps or rolls. Lumps size is about 1 μm in diameter medium. Because diameter is very small capacity to transfer most polymers on metal surfaces is reduced.

The rubber conveyor belts loses its tensile strength due to aging process and while this process may cause a decrease in the degree of polymerization and a change in chemical composition. These changes can be analyzed by using nuclear magnetic resonance spectroscopy (NMR), but this method can only be make evident rubber effects caused by the aging process.

Regarding the mechanism of fracture of rubber networks can be assumed that it is the result of a vibration energy action is the most important part of subharmonics with higher frequency of 16 kHz. Experimentally it was found that breaking connection of rubber at belts conveyor is the result of the ultrasonic vibration energy action.

The conveyors exposure to light, heat, moisture, chemicals and gaseous causes a reduction in their lifetime. Especially light and ultraviolet rays initiates photo-oxidation and appearance cross-linking in the rubber molecules. Ozone and oxygen can exacerbate oxidative degradation. The ozone has a specific action on the rubber, and this causes the appearance of transverse cracks in the rubber belt which further can influence their lifetime. Also the presence of ozone can cause harmful reactions why break connections of rubber polymer in different proportions. These changes affect the viscosity and strength properties of rubber and final product performance even if part of the property does not change.

2. SOLUTIONS TO IMPROVE THE TECHNOLOGICAL PROCESS PARAMETERS VULCANIZATION

Any of the vulcanization process of the rubber product is made by adjusting three technological parameters, namely:

- vulcanization time;
- vulcanization temperature;
- pressure of the product ends.

Adjusting the vulcanization time of rubber, their connection to be made depending on the thickness of the rubber joining them. To adjust temperature vulcanization is envisaged type of rubber used in the vulcanization process and the pressure of pressing is determined by the thickness of the rubber and its structure.

The three parameters mentioned above can take different values depending on a type of rubber product, and if the adjustment of these parameters is not achieved at the optimum then the results obtained, regarding characteristics of the joining zone are

not corresponding. Poor results are due mainly to the presence in the combination of a highly porous material combination and this causes a decrease in the mechanical characteristics of the joints.

Reducing the porosity of the connection can be achieved by proper adjustment of the three technological parameters to optimal values. In the process of joining the vulcanization temperature is one of the parameters of importance. At present was issued differing opinions on the influence of temperature, but particularly research conducted refers to metallic materials and less materials such as rubber or rubber matrix composite materials.

Experiments have been used to achieve the conveyor ATRBZ general purpose rubber, which shows the structure of the five-layer type PE250 plies. Was chosen such belt conveyor because it must provide a good tensile strength, great flexibility and high reliability. The subject of the study conveyor is characterized by a width of 1800 mm and a thickness of 22 mm. To achieve connection through vulcanization was necessary end processing surfaces and in this respect the subject study was conducted belt conveyor ends processing in steps, and each step has a length of 600 mm (fig. 1). The rubber used to create connections between the ends of conveyor belt was also a type ATRBZ able unvulcanized rubber.

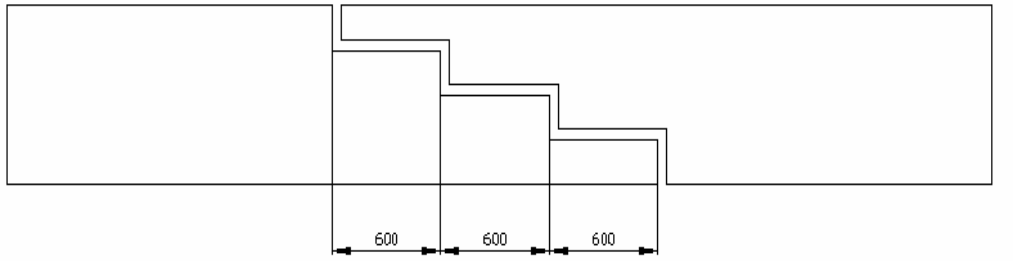

Fig. 1. One way of preparing the conveyor belt ends

To conduct experiments that method must be found to allow their deployment cost, short time, but without changing the expected results. The realization experience was followed two stages main namely:

- development experiences;
- analysis of the experimental data obtained.

Study a phenomenon in a particular field of activity is conducted through an analysis of the influence of various factors on this phenomenon and this can be achieved by studying the influence of each factor on this phenomenon by keeping other factors constant. Therefore, the experimental method used has been the experience factorial.

In order to simplify experimental research program was used for each influence factor, two levels: maximum and minimum of the second level up to that minimum level. Considering the above, the structure of the experimental research program consists of eight experiments (two levels for the three factors of influence:

vulcanization time, vulcanization temperature, pressure pressing) (table 1).

Table 1. **Experimental research program for conveyor belts vulcanization joints**

No	Pressure [bar]		Hold time [min]		Temperature [°C]	
	360	400	50	70	135	150
1	X		X		X	
2	X			X	X	
3	X		X			X
4	X			X		X
5		X	X		X	
6		X	X			X
7		X		X	X	
8		X		X		X

To conduct joint operations by vulcanization was used work scheme presented in figure 2.

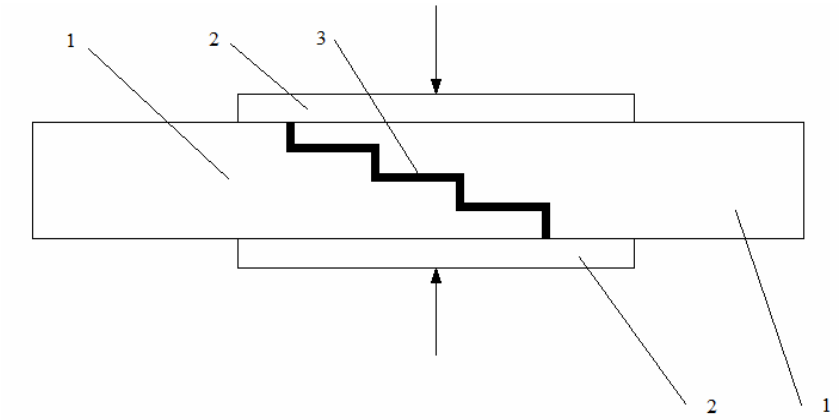

Fig. 2. Flow diagram of combining ply rubber carpet:
1 - belts conveyor which will be submitted to junction process,
2 - electric plates, 3 - rubber ATRBZ

After implementing of all experiments was intended as a first step to identify any goals (porosity) remaining in the joint. For this purpose we used ultrasonics analysis method because it is the only method that allows the identification of existing porosity such material. Following this analysis it was found that the pore volume for conventional vulcanization is between 2…4 % of total material to be vulcanization.

Also, all connections made was taken at a specimen (Fig. 3), which were tensile tested on a dynamometer with the following features:

- maximum force that the device can develop 100 kN;
- mobile clamp speed is constant and has a value of 100 ± 10 mm/min;
- dynamometer measurement error is greater is 1 %;
- maxim 1000 mm stroke length is.

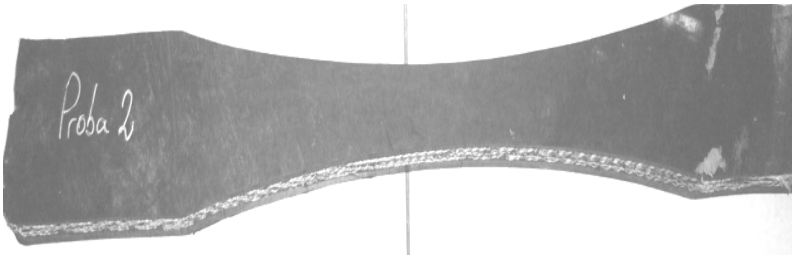

Fig. 3. Form tensile specimen tested

Tensile tests were performed for eight specimens, adequate infrastructure of eight experiments. The values of traction force which was submitted the test specimens are presented in table 2.

Table 2 **The values of traction force for eight test specimens**

Number experiment	1	2	3	4	5	6	7	8
The values of traction force [kN]	54,3	73,9	67,1	61,5	63,6	60,1	55,7	61,9

The results presented in table 2 allow us to conclude that the maximum tensile strength was obtained for the specimen made by adjusting the following parameters: pressure p = 360 bar, vulcanization time 70 min, vulcanization temperature 135 ºC ie specimen corresponding experiment no 2. Minimum tensile strength was obtained for the specimen made by adjusting the following parameters: pressure p = 360 bar, vulcanization time 50 min, vulcanization temperature 135 ºC, ie specimen corresponding experiment 1. The difference between the values of tensile strength can be explained by how to get homogeneity joints. Thus in figure 4 is show how the breaking of the specimen no 1 and in figure 5 is shown how to break the specimen no 2.

Fig. 4. Breaking mode of specimen no 1

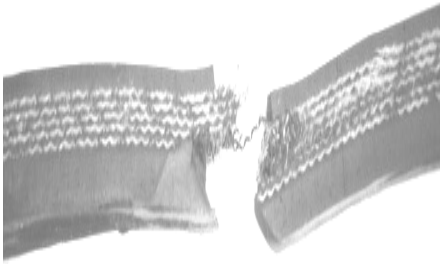

Fig. 5. Breaking mode of specimen no 2

From analysis of Figures 4 and 5 is observed that breakage of the specimen no 1. Was conducted along the joints, and in the specimen no. 2 breakage was carried across the joint area which demonstrates that the jointing material has the same features with the rest of the material conveyor.

The processing statistical data presented in table 2 were observed between the

three parameters that adjust the pressure vulcanizing press has most influence, and the next parameter in terms of influence is the temperature. This can be explained by the fact that both of the parameters contribute to the elimination of pores in the joining to achieve homogeneity of the material.

4. CONCLUSIONS

Theoretical and experimental research allowed to establish following conclusions:

- the best results where conventional vulcanization were obtained for a pressure p = 360 bar, a vulcanization time of 70 min and a vulcanization temperature of 135 ºC;
- application the vulcanization by adjustment the parameters of vulcanization to optimum values determines an increase in tensile strength with 30…40 % and a reduction in the porosity of the area joining below 0,2 % and even elimination if experiment proper specimen no 2;
- the technical solution proposed can be applied in practice with good results creating the possibility of achieving an increase in the lifetime of conveyor belts and a decrease in consumption of materials and energy consumption and ultimately a significant decrease of environmental pollution;
- experimental results obtained can be used for the vulcanization joints and other products made of rubber or rubber matrix composites.

REFERENCES

[1]. **Huidu, E., Glăvan, M., Burlan, D.,** 2011, *Utiaje pentru carierele de lignit din Oltenia,* Editura Măiastra, Târgu Jiu.
[2]. **Marian, I.**, 1982, *Transport minier,* Editura didactică şi pedagogică, Bucureşti.
[3]. **STAS 2077/1/84,** *Benzi de transport cu inserţii textile pentru uz general.*
[4]. **STAS 7539/1966/1982/1984,** *Transportoare cu bandă de cauciuc. Prescripţii de calcul.*
[5]. ***, *Benzi de transport, prescripţii generale pentru îmbinarea prin vulcanizare,* Institutul Român de Standardizare.