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EXPERIMENTAL RESEARCH OF RELAXATION AND HYSTERESIS OF TRAPEZOID BELTS

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ABSTRACT
Relaxation and histereses of belts are two phenomena know only as terms, but experimentally quite unknown. In this paper, I have presented the results gained experimentally for relaxation and histereses of trapezoid belts. In the lab I have observed the relaxation of belt type AV10x725La in the case of acting of two forces with various intensities. In the same way, I have repeated the relaxation experiment in the same testing belt. The histereses has been researched for AV13x950La profile. The results gained for the relaxation and histereses have been presented in a chart and a table.
Keywords: Belt, Histereses, Relaxation

1. RELAXATION OF BELTS
The transmitter's power conveyance with trapezoid belts is completed through the friction, which is created on the contact surface between the belt and the pulleys. In order to create the friction force the normal force F_n must act on the contact surface. The normal force is realized through the tension of the belt with the force of installation tension - $F_{pr.}$
With relaxation it is understood the decrease of installation tension force by itself. Of practical importance is the determination of the value by which the force on the belt decreases by itself as well as the time during which this phenomenon occurs.
The relaxation experiment has been completed in the research machine used for determining the cutting force of belts, respectively for the statistical research of trapezoid belts.

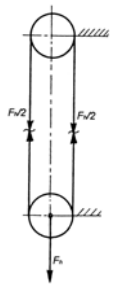

Figure 1. The belt during the relaxation experiment

The research belt relaxation has been completed according to the schema presented in figure. 1. The researched belt has been placed on the pulleys with same diameters. The top pulley is static and the bottom one is displaced from the acting of the researched force.
When the value of the researched force is reached for which the relaxation phenomenon F_h is analyzed, the acting of the load is stopped and the varying (decreasing) of the force is observed on the research machine. The decreasing of the force happens because of the belt relaxation. This phenomenon is called belt relaxation.

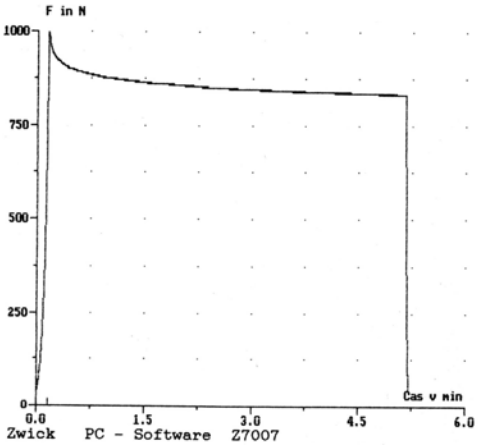

Figure 2. The varying of force during the relaxation of the belt type AV10x725La time

Table 1. The varying of force during relaxation experiment

TEST RESULTS :

n	Fmax N	Travel at Fmax %	Lo mm
1	1017	6.86	218.4

n = 1.	Fh = 1.004	kN	Fdif = 0.000	kN	t = 9.23	s
n = 1.	Fh = 0.914	kN	Fdif = 0.090	kN	t = 19.23	s
n = 1.	Fh = 0.898	kN	Fdif = 0.106	kN	t = 29.28	s
n = 1.	Fh = 0.888	kN	Fdif = 0.116	kN	t = 39.28	s
n = 1.	Fh = 0.882	kN	Fdif = 0.122	kN	t = 49.33	s
n = 1.	Fh = 0.876	kN	Fdif = 0.128	kN	t = 59.38	s
n = 1.	Fh = 0.872	kN	Fdif = 0.132	kN	t = 69.38	s
n = 1.	Fh = 0.869	kN	Fdif = 0.135	kN	t = 79.43	s
n = 1.	Fh = 0.863	kN	Fdif = 0.141	kN	t = 89.48	s
n = 1.	Fh = 0.862	kN	Fdif = 0.142	kN	t = 99.53	s
n = 1.	Fh = 0.859	kN	Fdif = 0.145	kN	t = 109.53	s
n = 1.	Fh = 0.856	kN	Fdif = 0.148	kN	t = 119.58	s
n = 1.	Fh = 0.846	kN	Fdif = 0.158	kN	t = 179.61	s
n = 1.	Fh = 0.838	kN	Fdif = 0.166	kN	t = 239.64	s
n = 1.	Fh = 0.834	kN	Fdif = 0.170	kN	t = 299.68	s
n = 0.	Fh = 0.039	kN	Fdif = 0.170	kN	t = 312.64	s

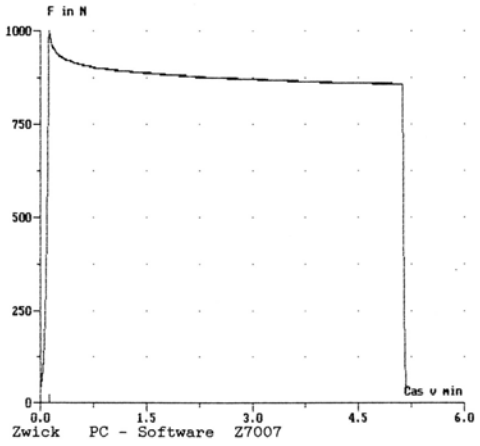

Figure. 3. The varying of force during the relaxation of the belt type AV10x725La

Table 2. The varying of force during repeated relaxation experiment on the same belt.

TEST RESULTS :

n	Fmax N	Travel at Fmax %	Lo mm
3	1021	5.31	221.9

n = 1.	Fh = 1.004	kN	Fdif = 0.000	kN	t = 7.25	s
n = 1.	Fh = 0.932	kN	Fdif = 0.072	kN	t = 17.25	s
n = 1.	Fh = 0.918	kN	Fdif = 0.086	kN	t = 27.25	s
n = 1.	Fh = 0.908	kN	Fdif = 0.096	kN	t = 37.30	s
n = 1.	Fh = 0.902	kN	Fdif = 0.102	kN	t = 47.35	s
n = 1.	Fh = 0.898	kN	Fdif = 0.106	kN	t = 57.35	s
n = 1.	Fh = 0.894	kN	Fdif = 0.110	kN	t = 67.40	s
n = 1.	Fh = 0.890	kN	Fdif = 0.114	kN	t = 77.45	s
n = 1.	Fh = 0.888	kN	Fdif = 0.116	kN	t = 87.45	s
n = 1.	Fh = 0.885	kN	Fdif = 0.119	kN	t = 97.50	s
n = 1.	Fh = 0.882	kN	Fdif = 0.122	kN	t = 107.55	s
n = 1.	Fh = 0.882	kN	Fdif = 0.122	kN	t = 117.60	s
n = 1.	Fh = 0.872	kN	Fdif = 0.132	kN	t = 177.63	s
n = 1.	Fh = 0.863	kN	Fdif = 0.141	kN	t = 237.67	s
n = 1.	Fh = 0.858	kN	Fdif = 0.146	kN	t = 297.70	s
n = 0.	Fh = 0.039	kN	Fdif = 0.147	kN	t = 310.55	s

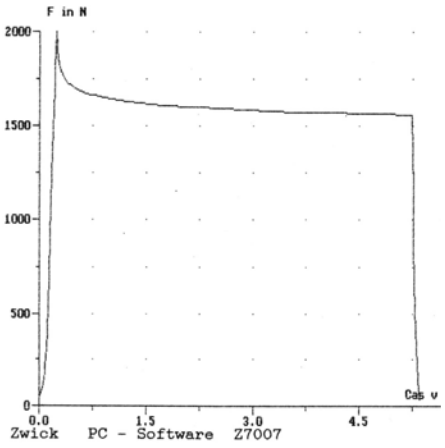

Figure. 4. The varying of force during AV10x725

Table 3. The varying of force during relaxation for experimental double force.

TEST RESULTS :

n	Fmax N	Travel at Fmax %	Lo mm
3	1021	5.31	221.9

n = 1.	Fh = 1.004	kN	Fdif = 0.000	kN	t = 7.25	s
n = 1.	Fh = 0.932	kN	Fdif = 0.072	kN	t = 17.25	s
n = 1.	Fh = 0.918	kN	Fdif = 0.086	kN	t = 27.25	s
n = 1.	Fh = 0.908	kN	Fdif = 0.096	kN	t = 37.30	s
n = 1.	Fh = 0.902	kN	Fdif = 0.102	kN	t = 47.35	s
n = 1.	Fh = 0.898	kN	Fdif = 0.106	kN	t = 57.35	s
n = 1.	Fh = 0.894	kN	Fdif = 0.110	kN	t = 67.40	s
n = 1.	Fh = 0.890	kN	Fdif = 0.114	kN	t = 77.45	s
n = 1.	Fh = 0.888	kN	Fdif = 0.116	kN	t = 87.45	s
n = 1.	Fh = 0.885	kN	Fdif = 0.119	kN	t = 97.50	s
n = 1.	Fh = 0.882	kN	Fdif = 0.122	kN	t = 107.55	s
n = 1.	Fh = 0.882	kN	Fdif = 0.122	kN	t = 117.60	s
n = 1.	Fh = 0.872	kN	Fdif = 0.132	kN	t = 177.63	s
n = 1.	Fh = 0.863	kN	Fdif = 0.141	kN	t = 237.67	s
n = 1.	Fh = 0.858	kN	Fdif = 0.146	kN	t = 297.70	s
n = 0.	Fh = 0.039	kN	Fdif = 0.147	kN	t = 310.55	s

Since, in practice, the belt undergoes sporadic tension, it is important to determine if the relaxation phenomenon happens every time or only one time.
To answer this question, the relaxation experiment is repeated on the same testing belt. The diagram presented in figure 3. has been gained from the experimentally gained results (table 2).
The belts must be tightened with various forces in different working conditions.
In the same way different profiles are tightened with different forces. The following results in table 3 are given in order to determine whether the force of tension of the belt in the relaxation phenomenon is acting. The relaxation diagram for AV10x725La type testing belt is presented in figure 4.

2. HISTERESES OF TRAPEZOID BELTS

The histereses is the deviation of the deformation point (or the force-deformation diagram) during the loading and unloading of the belt with assigned force. The theoretical examination is shown through the diagram in figure 5. The OM line shows how the acting force on the belt, respectively on the unloading line, is increased. The MA line shows how the acting force on the belt, respectively on the unloading line, is decreased.
The surface within OMM'O lines shows the work completed during the loading of the belt for length units. The surface within AMM'A lines shows the work completed during the loading of the belt. The surface between the loading and unloading line shows the amount of histereses loss. The energy of this loss is converted into heat. This heat increases the temperature of the belt during the research.

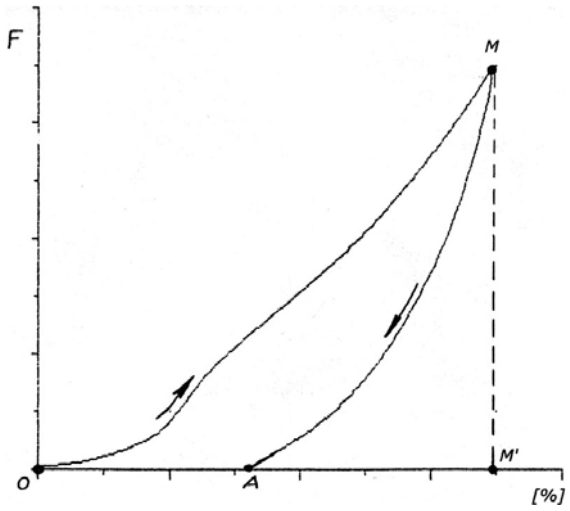

Figure 5. The histereses theoretical diagram

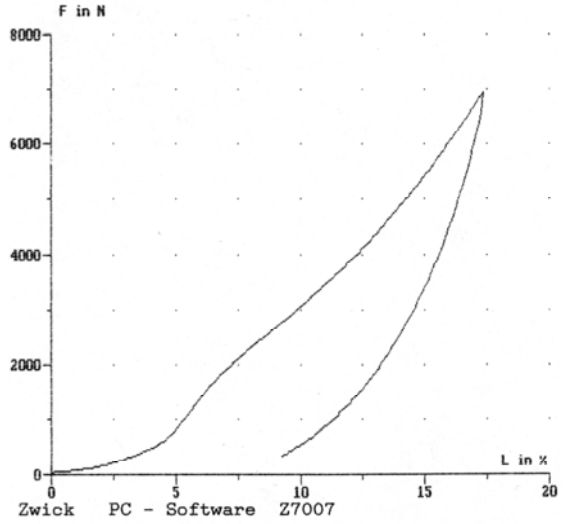

Figure 6. The histereses diagram for AV13x950La profile.

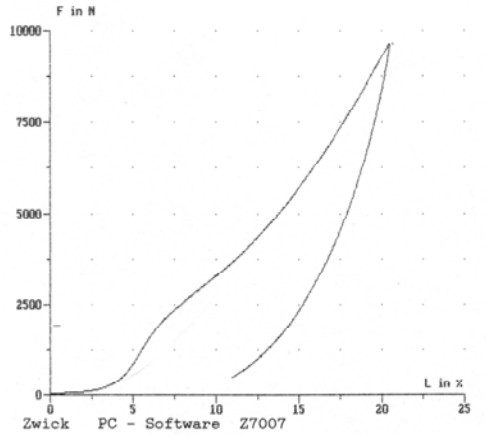

Figure 7. The histereses diagram for 17x950 profile.

Figure 6 shows the histereses diagram gained through the experiment for AV13x950L_a belt.
Figure 7 shows the histereses diagram for 17x950 belt also gained experimentally.

3. CONCLUSION

Based on the results gained through experimental research for relaxation and histereses of the belt, it can be concluded that:

- The relaxation of the belt is the phenomenon of the spontaneous decreasing of the force that acts on the belt, as a result of the belt loosening.
- A significant decrease of the belt installation tension happens during the relaxation in 1 minute time after the final value of this force.
- The relaxation is at final after 4-5 minutes.
- The relaxation happens every time during the belt installation tension and re-tension.
- The installation tension must be controlled every time after 4-5 minutes after the placing of the transmitting belt.
- The decreasing of force during relaxation depends on the intensity of force during tension.
- The decreasing of force during relaxation depends on the intensity of force during installation tension.
- The histereses experiment proves the theoretical diagram for this phenomenon
- The deformations left the belt during this experiment can be read from the histereses diagram.

4. REFERENCES

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