INFLUENCE OF TEMPERATURE ON THE PERFORMANCE TOOTHED BELTS – BINDER MAGNETIC

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Abstract

The synchronous transmissions are nearly universal application in all cases where the user wants to have a synchronous operation and without sliding. They are found in diverse areas as micromechanics, office automation, machine tools and industrial shredders. Considering the important role of synchronous belts in the mechanisms functioning, they are the subject of many studies and research in order to the more finely define. In this paper, one trapezoidal tooth profile will be considered with an initial pitch of 10 millimeters an different shapes along width. A test procedure has been defined for temperature measurements. The tests were performed on an original test bench, sensor devices and data acquisition will also be described. Further, results will be synthesized for all synchronous belts in order to make comparisons. Finally, a discussion will allow us to make connections between the influences of design parameters and physical phenomena.

Keywords: Belts, synchronous transmission, temperature measurement

Introduction

The belts are flexible elements that are used to transmit power when the motor shaft and the driven shaft are spaced apart from one another. A belt drive is a simpler and more economical than a gear pair solution. Moreover, the elasticity of these elements allow absorb shock and vibration, which helps make the silent transmission and increase their lifespan. The dimensions and characteristics of the belts are described in catalogs and various documentation provided by manufacturers. The role of the machines designer is therefore to make a wise choice based on procedures established by the manufacturers. To succeed, he must obviously know the principles of operation and the important factors that may influence the choice of these elements. (Play D., Monternot C., 1999)

The purpose of this paper is to gather information on the behavior of belts that differ mainly with the teeth shape in the transverse direction and especially the temperature influence of the various elements (belt pulley, bearing, motor, etc..).

Structure of the belts binder magnetic:

Transmission belts BINDER (Fig.1) are armed as standard in galvanized steel cable. With these cables, belts remain stable in length. However, like any metal, the steel deforms under stress according to Hooke's law.

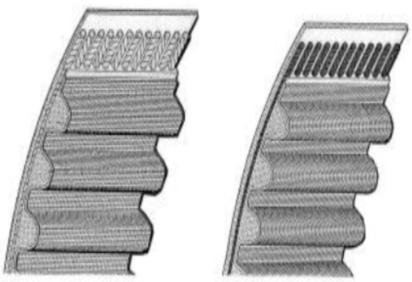

Fig.1 belt binder magnetic. (BINDER MAGNETIC, 2008)

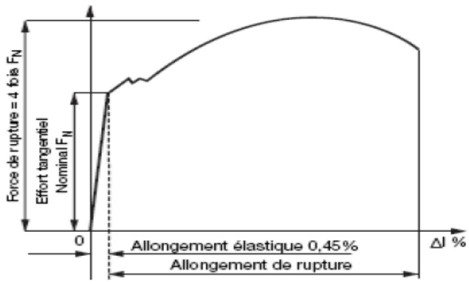

Fig.2 Stress-strain curve of the belts.

This law describes the deformation under stress in the elasticity phase. The belt elongation is proportional to the effort in the strand (Fig. 2).

Experimental

Device

Figure 3 shows of the test bench belts overall structure. the synchronous belt is mounted to ensure the transmission of motion from the drive pulley to the driven pulley. The assembly may be moved perpendicular to the axis of the shaft in order to allow to mount and adjust the tension belt elongation. So all the elements are clamped to a heavy rigid support. the input shaft (drive shaft) of a 40 mm diameter and the power of the DC motor is 70 kW. The angular velocity can be varied between 500 and 3000 rev / min. For a test, the angular speed and the elongation are held constant . the output shaft (driven shaft) is of 40 mm diameter and the braking torque is assure with the hydraulic pump. (Manin L., Play D, 2000 & Koyama T. et al., 1979).

A separate hydraulic circuit allows to set the pressure and the torque resistance for a given angular velocity. Resistant torque can vary between 25 and 100 Nm and each pulleys is mounted on the end of a parallel shaft and axially fixed with a screw and washer. After the pulleys mounting , the pulleys eccentricity maximum is 0.07 millimeter. The figure 4 gives a general view of the test bed and shows the location of the instrumentation used for to measure the variations of all physics parameters measurable (Dance J.M., Play D., 1991 & Play D., Merghache S,. Manin L, 2001).

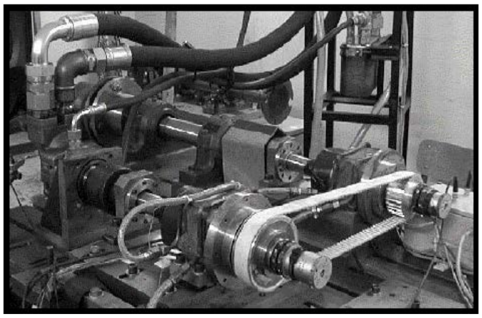

Fig. 3 Test bed belts.

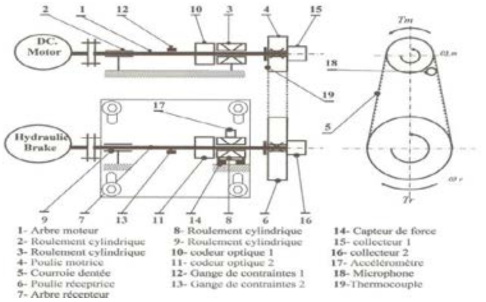

Fig.4 Kinematic diagram of the test bed belts. (Play D., Merghache S, Manin L, 2001)

Flexible couplings are also placed between the brake and hydraulic motor. They also provide an understanding of the thermal coupling between the motor shaft and driven shaft, and brake and hydraulic motor respectively. Note that water coolers are installed on behaviors for limiting the increase in high temperature.

The transmission belt evaluates the unit wich has a maximum of conventional detectors. The drive pulley and the driven pulley temperatures are measured with a thermocouple placed in the middle of a tooth pulley. Knowing that the average temperature of the belt is measured with an-infrared.

Materials and test conditions

Two types of belt were considered (Fig.5) [3].

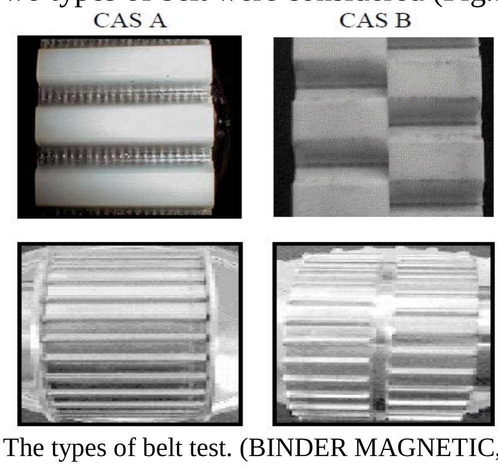

Fig.5 The types of belt test. (BINDER MAGNETIC, 2008)

A trapezoidal profile (20 ° angle, not 10 mm) is combined with teeth of different shape wide.

Note the tooth contact between the belt and the pulley aluminum alloy takes place at the top of the belt and 0.5 mm clearance reaches the hollow zone. 0.4 mm. The clearance between the tooth of the belt and the pulley tooth is also defined, the position of release depends on the relative longitudinal position belt and pulley teeth due to the action of torque. The distance between the pitch line given by the strings and belt after belt tooth is equal to 3.35 mm. further, as the strap is made with steel cords 20 incorporated with the polyurethane (Shore hardness 92), where B is a case of half crossed tooth (Childs T., et al., 1991)

Test Procedure and Measures

Three fitting tension 400, 500 and 600 Newton were considered. These reports are tight enough to avoid the jump in the belt tooth and the resonance period of transverse belt. The input angular speed is varied from 500 to 3000 rpm by steps of 500 rpm by resisting torques range from 25 to 100 Nm by steps of 25 Nm. The tests were made for each combination of test conditions. Only one test is performed for each test condition as preliminary tests showed low dispersion of all results (less than 5%). After the tension break was applied, the belt then resisted to the torque. For an angular velocity, the different values to resist the torque have been applied successively (Merghache S, A. Ghernaout A., 2009).

After the stabilization parameter (the mean of 5 min), measurements were made. Each test condition takes about ten minutes test. The data were stored on a digital data acquisition. It only gives the temperature of the belt and average temperatures of behavior. Temperatures vary slowly with time, but the maximums and the minimums make the average values. For example, T max and T min correspond to the values given by test conditions torsional moments with different resistance and reports tight fitting tension.

Results and discussion

Many data were collected in this article. The temperatures are presented in form of curve According to the angular velocity. The figures summarize 6-7-8-9-10 and 11are the results for both transmission belts considered in this study.

Temperatures are almost unchanged belt by putting a strained relationship, but with increased resistance to torque (Case A and B). They also increase with the angular velocity. It must be designated that the temperature driven pulley is always greater than the drive pully temperature (5-18 ° C). For the case A, the difference of temperature is practically constant when the laying tension increases from 400 to 600 Newton. Thus for the case B values (Case B: 18 ° C), of course, temperatures increase with the angular velocity (between 6-12 ° C).

AT10 Belt (CAS A)

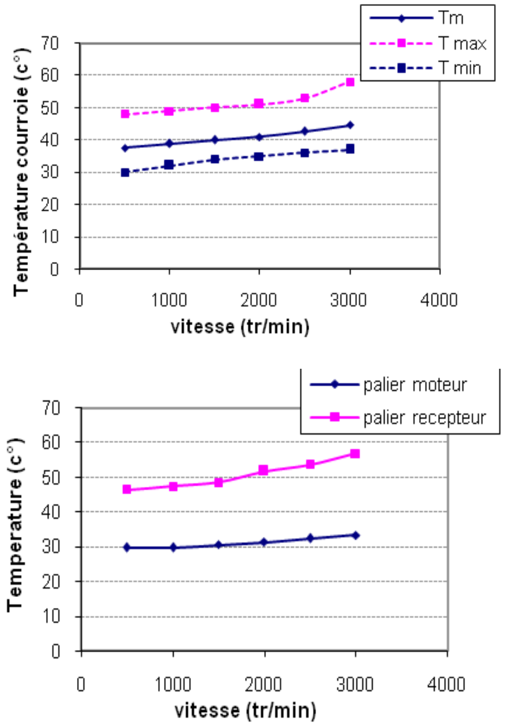

Fig.6 Temperature variation as a function of angular speed "fitting tension 400 N"

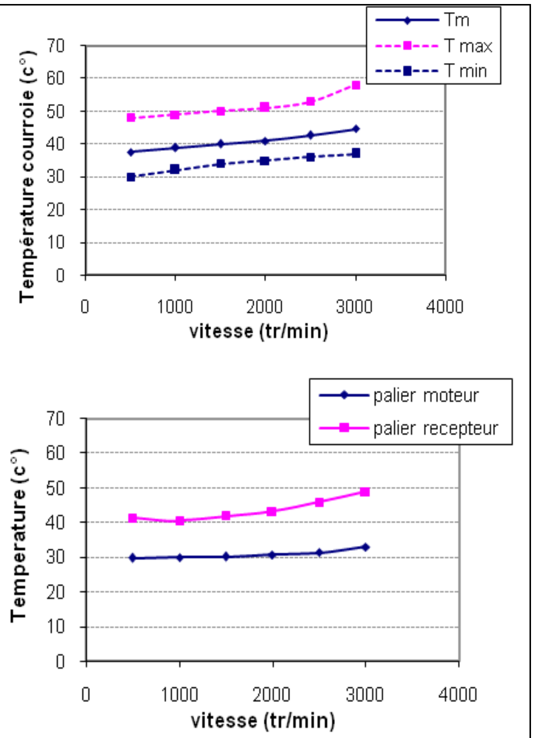

Fig.7 Temperature variation as a function of angular speed "fitting tension 500 N"

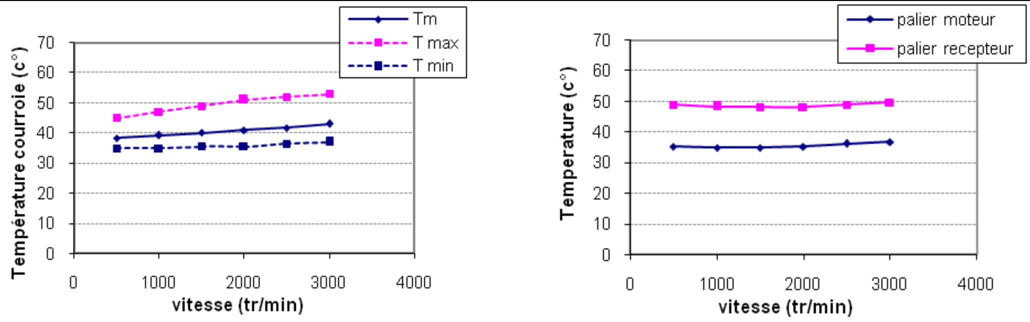

Fig.8 Temperature variation as a function of angular speed "fitting tension 600 N"

SFAT10 Belt (CAS B)

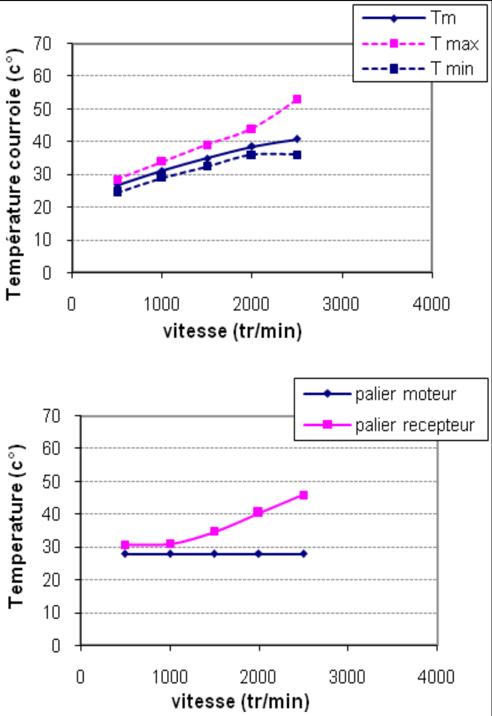

Fig.9 Temperature variation as a function of angular speed "fitting tension 400 N"

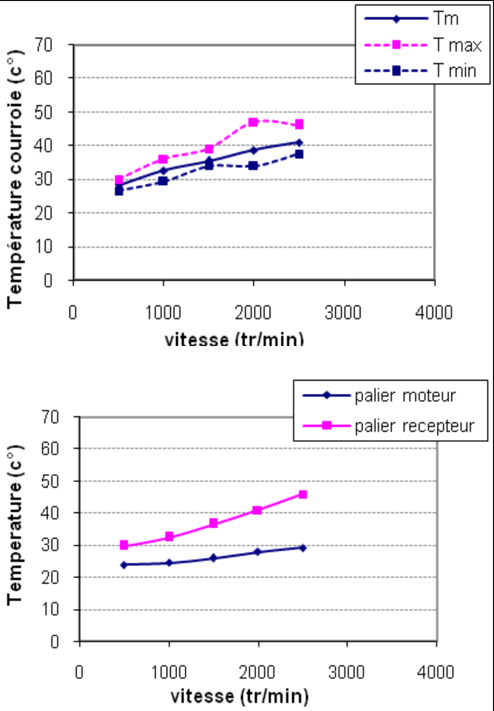

Fig.10 Temperature variation as a function of angular speed "fitting tension 500 N"

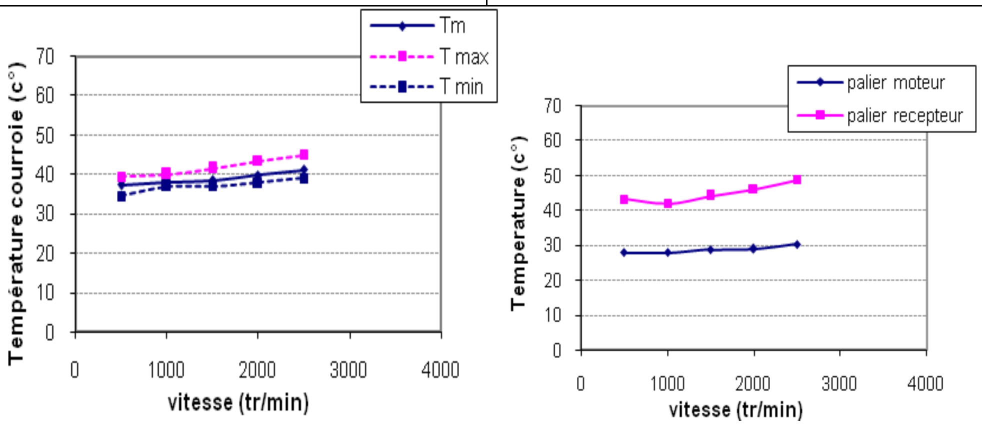

Fig.11 Temperature variation as a function of angular speed "fitting tension 600 N"

Conclusion:

Of more general point of view, it must be designated the output temperature is always greater than the input one. Presumably, the belt temperature is always constant along the length of it. However, we can deduce that the change of the tooth form has an impact on the temperature of the belts; that means the SFAT10 belt bears better the temperature and functions better than AT10 belt.

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