STUDY OF SPECIAL MATERIALS TO MANUFACTURE CAGES USED IN CASE OF HIGH SPEED PRECISION BEARINGS

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Abstract: The cages for high speed precision bearings are mainly achieved from textolite, a material made of cotton fabric impregnated with phenolic resins. In our country, the textolite needed to manufacture the bearings is called stratitex.

Keywords: cage, resin, condensation

1. INTRODUCTION

An important role in the proper functioning of a bearing belongs to the cage, which has the role of maintaining fixed distances between rolling bodies, the cage being characterized both by its constructive shape and also by its material. The constructive shape may be different within the same type of bearing, according to the running conditions imposed on the bearing. Light cages made of phenolic and polyamide resins allow the achievement of high and very high running speed imposed more frequently in the field of industry. Reliability and also durability are two of the most important qualitative features of the product. These features are correlated with the degree of variation in time of the performances and basic proprieties of the product. Another important factor for the proper running of the cage is the materials used.

2. THEORETICAL AND EXPERIMENTAL ASPECTS

Replacing the cages of steel or brass sheet with plastic cages is justified by at least two essential reasons:

- cages made of plastic materials reduce centrifugal force that occurs in bearings, allowing the increase of their speed;
- the second aspect is an economic factor, plastic materials being cheaper.

To manufacture bearing cages with proper features, meaning a wide range of working temperatures (-55 … +130) ^{o}C and high speed, may be used only plastics with high stability in terms of use. Physicochemical and mechanical properties of plastics can be modified in large limits by adding materials of other nature (reinforcement materials).

It was observed that the bearing cages made of stratitex have frequent cracks during the process of bearings storage, chemical instability, and some mechanical strength and chemical agents are below the required values. These shortcomings have required the development of research to improve the quality of the product made of stratitex, starting from raw materials, phenolic resin and the impregnation support, as well as its manufacturing technology. The impregnating resin of C15-68 type, used in the manufacture of stratitex tubes is of phenol formaldehyde type. It was noticed that it could not be diluted with alcohol, which indicates the condensation increasing degree over the limit allowed by the norm of the product [1].

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Figure 1 shows the dependence of gelling time on the temperature used for the studied resin.

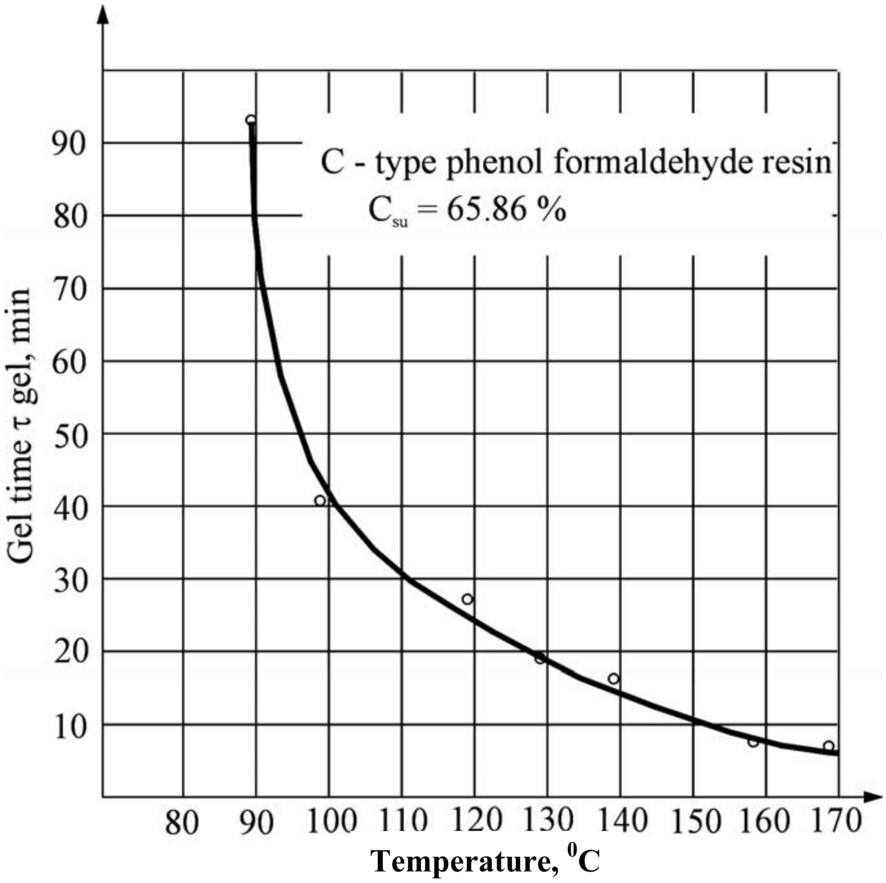

Fig. 1. Dependence of gel time on temperature.

The samples used to determine the time of the C 15-68 resin gelation at different temperatures after curing, were used to assess the degree of resin condensation through acetone resistance. After the examination of samples dissolved in acetone a very weak opalescence occurs, which disappears afterwards, the filtrates obtained are clear, lightly-colored in yellow, and the undissolved residue is hard, with glassy appearance.

Another series of experimental research was conducted on the impregnated drain trap of TI-335 type, the raw material from which are obtained stratitex tubes through mandrel winding and pressing into molds. TI-335 product was used to determine the influence of the variation of pressing parameters of the stratitex tubes on their main characteristics; this way was determined the traction strength of the phenoplasts on two directions specific to fabrics, longitudinal and transversal. The weight of the product TI-335 was determined by weighing samples of rectangular shape.

Experimental samples, similar to those determining traction strength of phenoplasts, have been submitted to the following operations [2]:

- a- condensation for the gel time (Figure 2), $\tau^o{}_C$;
- b- condensation for $\tau^o{}_C$ and thermal treatment for 60 min, at the same temperature $\tau_C = (\tau^o{}_C + 60)$ min., (Figure 3);
- c- condensation for $\tau^o{}_C$ followed by thermal treatment for 120 min, at 130^o C, (Figure 4);
- d- immersion in acetone, for 2 h at 20^oC (Figure 5);
- a/d; b/d- immersion in acetone for the samples of type a and b (Figure 2 and Figure 3).

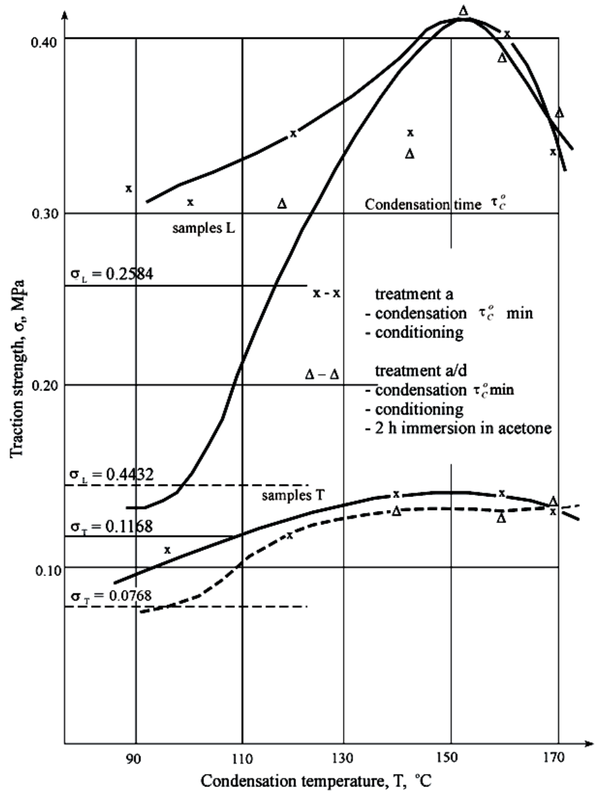

Fig. 2. The influence of condensation temperature on the traction strength and acetone stability.

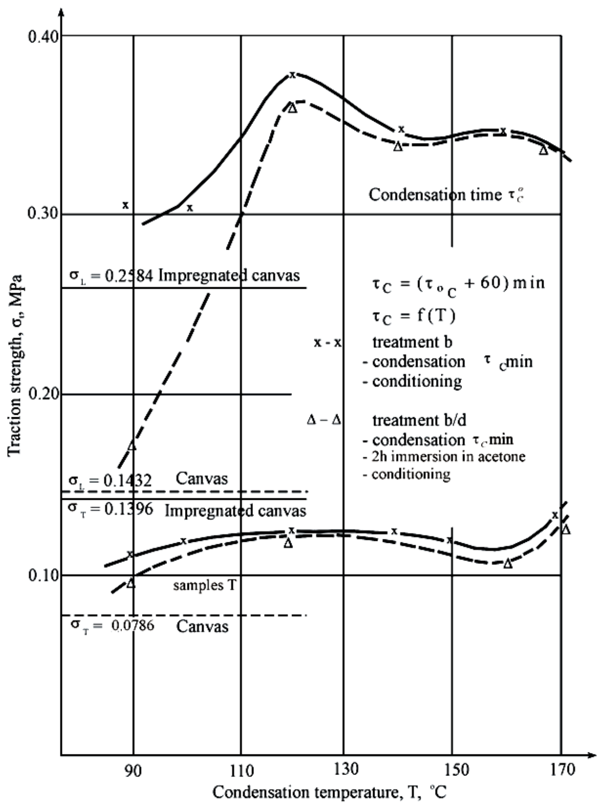

Fig. 3. The influence of condensation temperature on traction and acetone strength.

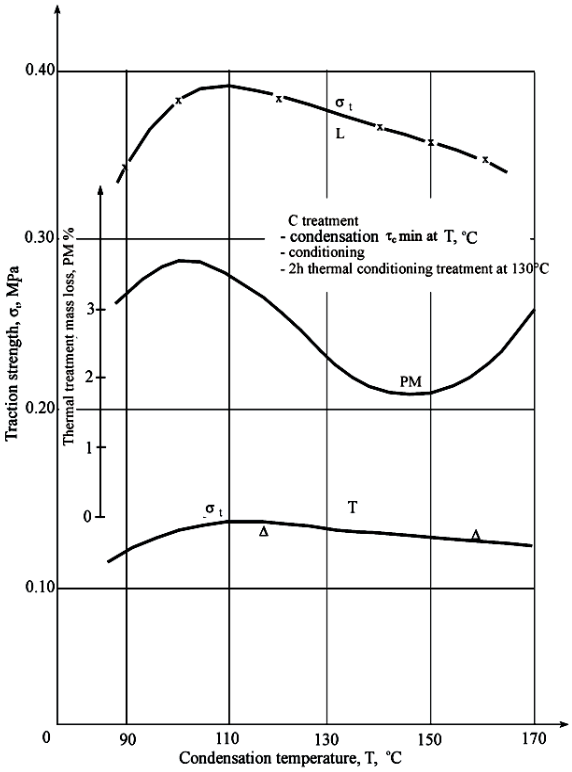

Fig. 4. The influence of initial condensation temperature on traction strength and weight loss after a 2h thermal treatment at 130^{o}C.

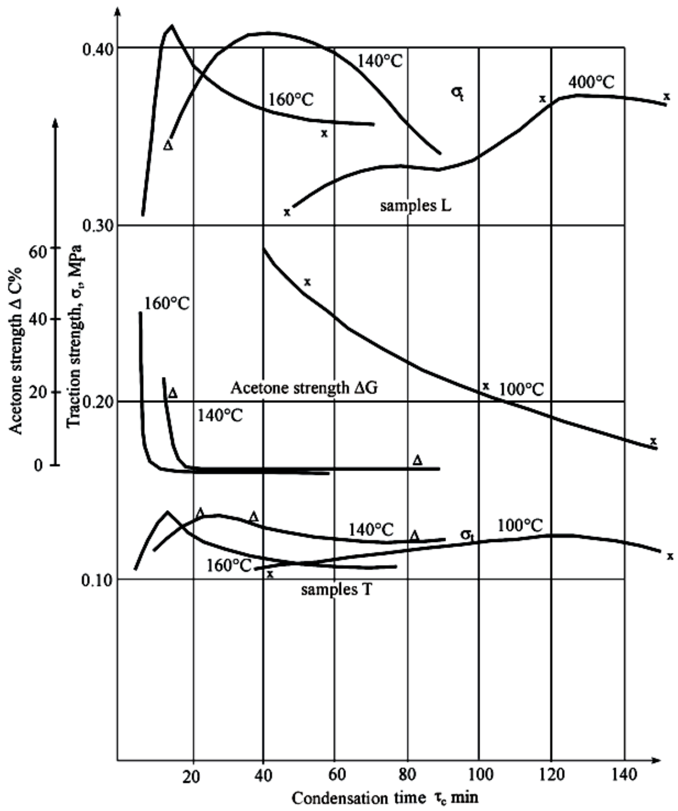

Fig. 5. The influence of condensation temperature on traction and acetone strength.

Fractographies obtained at electron microscope for samples made of stratitex are shown in Figure 6.

Fig. 6. Fractographies.

3. CONCLUSIONS

The assessment of the resin's condensation degree has been done through acetone strength (weight loss ΔG) and that of mechanical characteristics through traction strength, σ_t [MPa]. The outcomes of the experiments carried out, resulting in the graphics from Figures 1-6 allow to be concluded the following:

a- the optimum condensation temperature of the analyzed product TI 335 is between 150-160°C, while the traction strength reaches the maximum of ≈0.4 Mpa, and ΔG is of 0.27% (solubility in acetone is of 0.5%), and the traction strength of the treated samples a/d does not decrease;
b- at condensation temperatures of 100°C, the strength σ_t drops with 25%, ΔG increases to 52.8%, respectively a solubilization of 96% of the resin, being correlated with the traction strength of the treated samples a/d of 0.13 Mpa (a decrease of 57%);
c- it has been noticed that the increase of the time maintaining the samples at variable condensation temperatures does not lead to optimum values for the analyzed values σ_t si ΔG;
d- between 90-100°C, the treatments b and c do not improve the proprieties of the product TI 335;
e- between 120-140°C, a slight improvement of the proprieties can be noticed (Figures 3 and 5), but under the maximum possible values;
f- over 140°C, the increase of condensation time causes thermal degradation of the product (Figure 4);
g- the waving of canvas layers at stratitex is due to tube manufacturing technology, running freely on the mandrel followed by pressing into molds, process in which there is a decrease of the initial winding thickness;
h- it is found that, in terms of chemical composition, the stratitex product is not stable, because it presents a relatively high content in volatile substances.

REFERENCES

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