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# INFLUENCE OF FLUCTUATIONS IN TEMPERATURE ON LONGEVITY OF CHIP BOARDS

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**Key words and phrases:** chip boards; density; lab and full-scale tests; longevity; temperature.

**Abstract:** Influence of temperature fluctuations on the longevity of chipboards has been studied. The correction value that allows going from laboratory tests (at constant temperatures) to full-scale tests (at temperature fluctuations) has been determined. This correction allows predicting the strength and longevity of chipboards at temperature fluctuations.

In the course of usage the wood laminates work under constantly changing temperature conditions. Thus the temperature can change on average 7-10 °C within a day and during a year it varies from –30 to +35 °C. This has caused the necessity of studying the influences of fluctuations in temperature on the longevity of materials.

Chip boards of 800 kg/m$^3$ density were tested in natural conditions under prescribed constant transverse stresses. Specimens 17×10×130 mm in size were used for the experiments. The time period until failure (the life time) was noted with the help of a timer. Since moisture has a profound effect on the working capacity of wood laminates, the chip boards were insulated from its direct effect.

The experimental data in $\lg\tau$–$\sigma$ coordinates are shown in Fig. 1a. Every point on the graph is an average result of 6 measurements. The graphs shows that the strength of the given material under natural conditions has dependence on straight linear longevity logarithm. The resulting straight line was plotted on the stress graph of the life time dependence on constant temperature (Fig. 1b) described by the following equation:

$$\tau = \tau_* \exp\left(\frac{U}{RT}\right)\exp\left(-\beta\sigma\right), \qquad (1)$$

where $\tau_*$ – empirical constant; $U$ – effective energy of failure activation; $\beta$ – structural-mechanical factor; $R$ – universal gas constant; $\tau$ – longevity; $\sigma$ – strength; $T$ – heat resistance [1].

The empirical and physical constants were determined by graphic-analytic method [2]. Their values for chipboards of 800-kg/m$^3$ density are the following:

$\tau_* = 10^{9,4}$ (c); $U = 70$ (kj/mol); $\beta = 2{,}25$ (1/MPa).

From Fig.1b it is evident that the influence of fluctuation in temperature in the interval between (-7 до +13 °C) corresponds to elevated temperature 65-70 °C. Equation (1) is true only at constant temperatures, consequently the correction was determined for calculations of the longevity under variable temperature conditions. Theoretical values of the longevity for predetermined stresses and temperatures were found from formula (1) and experimental values from the diagram (Fig. 1a). Then the difference between the longevity values ($\Delta\tau = \tau_т - \tau_э$) in every point was calculated. The correction value is determined as an arithmetical means of those values.

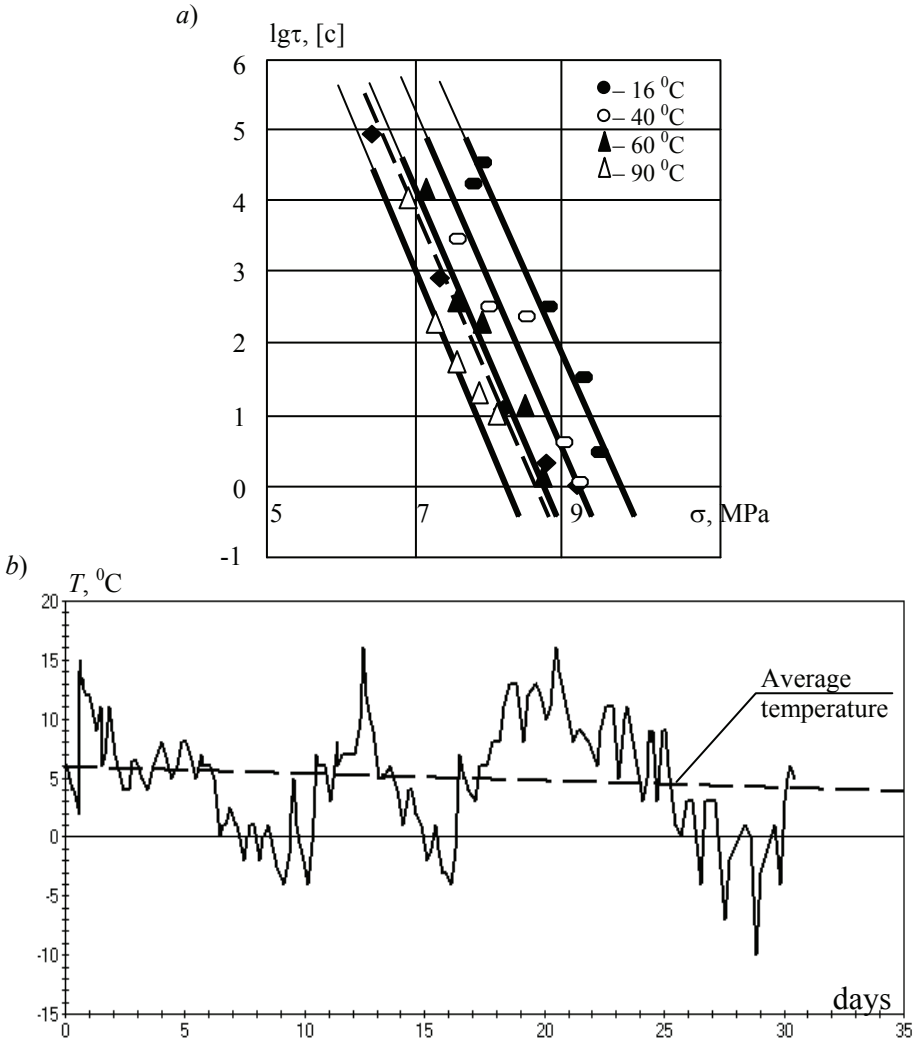


**Fig. 1**
*a*) transverse stress dependence of longevity of chipboards of 800 kg/m$^3$ density:
——— at constant temperature; – – – – at fluctuations in temperature;
*b*) diagram of daily temperature variations

Table

**Calculation of correction value to pass from laboratory tests to full-scale tests**

| Stress σ, MPa | Average temperature T, K | Longevity from formula (1) $\tau_т$, c | True longevity $\tau_э$, c | $\Delta\tau = \tau_т - \tau_э$, c | Correction $\Delta\tau_{ср}$, c |
|---|---|---|---|---|---|
| 8,8 | 280 | $10^{3,59}$ | $10^{-0,05}$ | $10^{3,64}$ | $10^{2,71}$ |
| 8,4 | 278 | $10^{4,15}$ | $10^{0,85}$ | $10^{3,3}$ | |
| 7,4 | 281 | $10^{5,1}$ | $10^{3,1}$ | $10^{2}$ | |
| 6,4 | 278 | $10^{6,28}$ | $10^{5,3}$ | $10^{0,98}$ | |
| 9 | 287 | $10^{3,15}$ | $10^{-0,5}$ | $10^{3,65}$ | |

The obtained data allow predicting the strength and longevity of chipboards not only in the vast range of constant temperature but at fluctuations at temperature as well. For this purpose one can find the longevity of chipboards under predetermined stress and at average temperature with formula (1) and then subtract the correction value.

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## Влияние колебания температуры на долговечность древесностружечных плит

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**Ключевые слова и фразы:** долговечность; древесностружечные плиты; лабораторные и натурные испытания; прочность; температура.

**Аннотация:** Исследовано влияние колебания температуры на долговечность древесностружечных плит. Определена величина поправки, позволяющая переходить от лабораторных испытаний (при действии постоянных температур) к натурным (при колебании температур). Данная поправка позволяет прогнозировать прочность и долговечность древесностружечных плит при колебаниях температуры.

## Einfluß der Temperaturschwingung auf die Haltbarkeit der Holzspanplatten

**Zusammenfassung:** Es ist der Einfluß der Temperaturschwingung auf die Haltbarkeit der Holzspanplatten untersucht. Es ist die Größe der Ausbesserung, die von den

Labortesten (bei der Wirkung der konstanten Temperaturen) zu Naturtesten (bei der Schwingung der Temperaturen) übergehen zuläßt, bestimmt. Die gegebene Ausbesserung erlaubt, die Haltbarkeit und die Dauerhaltbarkeit der Holzspanplatten bei den Temperaturschwingungen vorherzusagen.

## Influence des variations de la température sur la longévité des plaques à copeaux de bois

**Résumé:** On a étudié l'influence des variations de la température sur la longévité des plaques à copeaux de bois. On a défini la grandeur de la correction permettant de passer des essais de laboratoire (avec l'action des températures constants) aux essais naturels (avec les variations des températures). Cette correction permet de prévoir la rigidité et la longévité des plaques à copeaux de bois pendant les variations de la temperature.