Annals of Warsaw University of Life Sciences – SGGW
Forestry and Wood Technology No 72, 2010: 37-41
(Ann. WULS-SGGW, For and Wood Technol. 72, 2010)

The influence of long-lasting permanent load with pulling out force on pin displacement in locally strengthened elements of furniture joints

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Abstract: *The influence of long-lasting permanent load with pulling out force on pin displacement in locally strengthened elements of furniture joints*. Current research of elements of modern furniture joints show appearance in them of intensive rheological phenomena. The paper concentrates on experimental evaluation of influence of local strengthening with PUR 555.6 nanopreparation of the area of joint in particle board on pin movement. It was loaded with constant pulling out force – rheological approach. The paper shows methodology and results of the experiment. The analysis of data with special consideration of modelling aspect of observed phenomena was conducted.

Keywords: furniture joints, creeping, particle board, local strengthening

INTRODUCTION

Assurance of better construction joints` properties is strictly connected with furniture quality improvement [2].To achieve it one should eliminate defects of the weakest element of joints which is particle board. Achievement of such effects without changes in production technology can be obtained via strengthened particle board in the area of attachment elements of a joint. It can be done by application of strengthening preparations in wholes performed to fix other elements of joint. One of such preparations is Kleiberit PUR 555.6 nano. Its beneficial influence on static properties of joints was confirmed by experiments [6]. However the problem of local influence of the nanopreparation on rheological phenomena in joints [5, 7, 8] has not been tested. The aim of this paper is experimental evaluation of the process of pin movement under load with constant pulling out force in joints elements which had previously been locally strengthened.

THE SUBJECT AND METHODOLOGY OF THE RESEARCH

The experiment was conducted on Tinius Olsen H5K-T (Fig. 1a) testing machine. To guarantee set and identical climatically-thermal conditions the testing machine was equipped in temperature chamber (Fig. 1a). The tested specimens were made from Twinstart (Titus) pin and locally strengthened particle board (Fig. 1b). Screwing moment was 2,2 Nm and was obtained by dynamometric screwdriver. The samples were fixed in a holder inside temperature chamber (Fig. 1a) [5,6,7,8]. The average density of particle board used for experiment was $\rho_{avg} = 652 \pm 21$ kg/m^3 and humidity $4 \div 6\%$. The samples were seasoned in temperature chamber. The temperature of measurements was 25 ± 0.3 °C.

Loading used in individual tests series were respectively 30%, 37% and 46% of static load [6]. They were obtained by so called ‘straight load way’, and separate options of tests parameters matched previously made ones [3,7,8]. Only for the biggest load a small adjustment of one of the parameters was made to reach time of assumed force value in testing and its relevant characteristics. (Fig. 2) [7, 8].

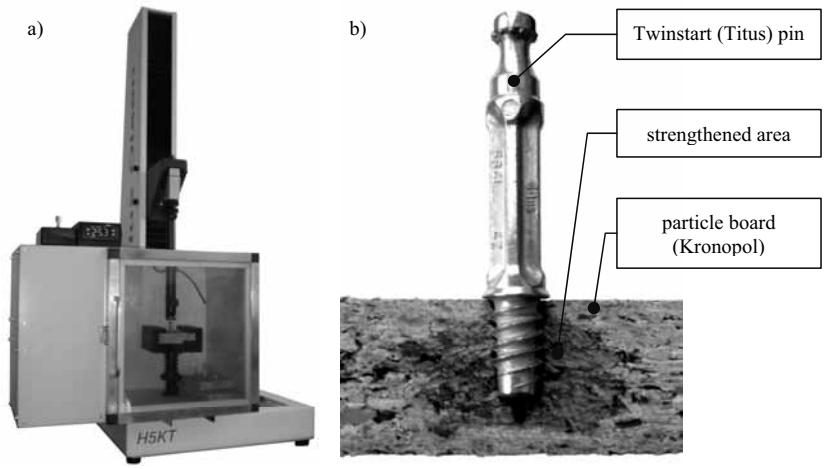
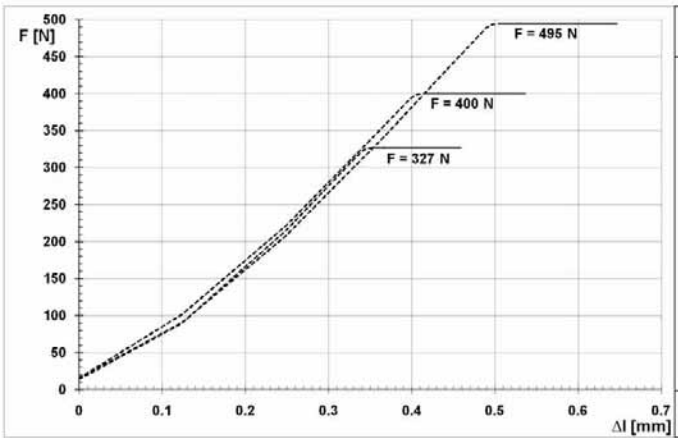


Fig. 1. (a) Tinius Olsen H5K-T universal testing machine with equipment;
(b) tested specimen (dimensions 100x90x18).



Load [N]		327	400	495
Carriage displacement speed	v = 15 mm/min up to force [N]	275	359	375
	v = 4 mm/min up to force [N]	309	387	480.5
Initial stress		10 N		

Fig. 2. The characteristics and parameters of creep tests

Short duration creep tests (60h) were conducted because of limited data acquisition possibilities. Because of limited testing time the research is aimed on the first and partially second creep stage. They are labelled on characteristics as respectively dashed and solid lines (Fig.2).

FINDINGS AND ANALYSIS

The curves referring to two first creep stages were obtained during the experiment (Fig.3a). From the data obtained dependences form load for immediate displacements were calculated (Fig.3b) and average creep speeds in the second stage (between 54 and 60 test hours) (Fig. 4).

a)

b)

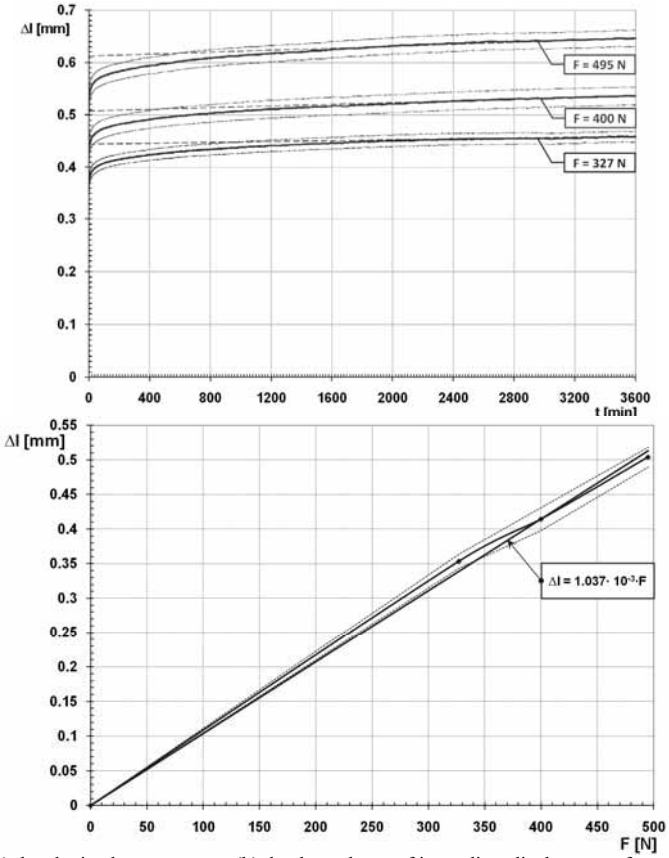


Fig 3. (a) the obtained creep curves; (b) the dependence of immediate displacement from load

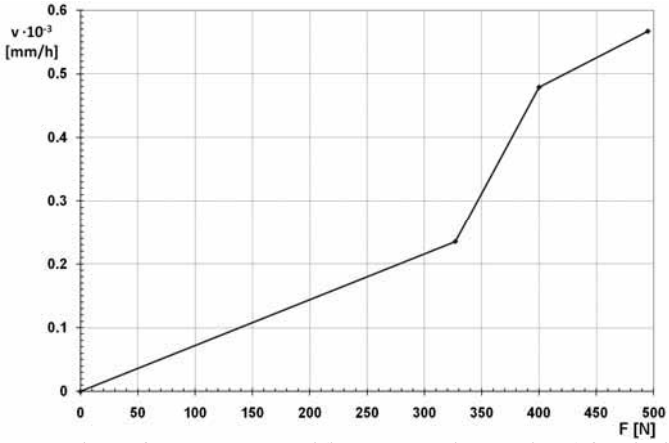


Fig 4. Dependence of average creep speed (between 54 and 60 tests hours) from load

Also linearity in the sense of Boltzmann [1, 3, 4, 5, 9] was verified via constructing isochronous creep curves (Fig.5).

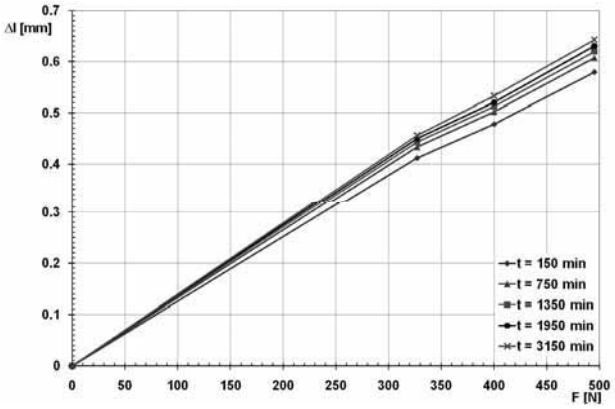


Fig 5. Isochronous creep curves obtained during tests of furniture joints elements

CONCLUSIONS

Locally strengthened joints elements show inclination to creep phenomenon however lower than not strengthened ones. Moreover they show behaviour similar to linear viscoelastic media (Fig. 5) analogically to earlier tested elements of „traditional" joints [8].

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Streszczenie: *Wpływ długotrwałego obciążenia stałą siłą wyrywającą na przemieszczenie trzpienia w lokalnie wzmocnionych elementach połączeń meblowych.* Dotychczasowe badania elementów nowoczesnych połączeń meblowych wykazały występowanie w nich zjawisk reologicznych o intensywnym charakterze. Praca koncentruje się na eksperymentalnej ocenie wpływu lokalnego wzmocnienia nanopreparatem PUR 555.6 okolic złącza w płycie wiórowej na przemieszczenie trzpienia obciążonego stałą siłą wyrywającą w ujęciu reologicznym. Przedstawiono metodykę oraz wyniki eksperymentu. Przeprowadzono analizę wyników ze szczególnym uwzględnieniem aspektu modelowania zaobserwowanego zjawiska.

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