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Investigations on the properties of solvent and dispersion adhesives for upholstered furniture. Part II. Thermoresistance of glue lines in PUR foams

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Abstract: *Investigations on the properties of solvent and dispersion adhesives for upholstered furniture. Part II. Thermoresistance of glue lines in PUR foams*. Thermal resistance of chosen binding agents applied to the production of upholstery furniture was determined. Samples were prepared and investigations of the thermoresistance of glue lines across the cyclic temperature rise acc. to the procedure described in literature. The density of applied PUR foams did not exert the meaning influence on thermoresistance of glue lines, both from solvents, as well as dispersion adhesives. It was stated, that glue lines from dispersion adhesives, both in the 1C version, as and 2C showed decidedly higher thermoresistance, than solvent systems. Highest thermoresistance of glue lines placing on the level 130^{o}C, one found for the Jowatac 414.50 adhesive dispersion.

Keywords: solvent adhesive, waterborne adhesive, upholstery furniture, thermoresistance

INTRODUCTION

In our previous part of that study Krystofiak et al. (2013) was determined the wettability and the hardness of solidified adhesive layers, stating among other, that in the function of conditioning time had followed the increase of the cohesion forces. Heat exerts the essential influence on the strength of adhesive connections. The increase of temperature causes the changes of physical state of adhesives, thanks to what deliver the information on their interior structure. In case of solvent adhesives the strength of glue lines at room temperature is satisfying. However under heats they are gathered flexible properties, and then become plastic state. Thereby is the express fall of the strength of glue lines under loadings (Proszyk & Pajdosz 1995). The foresight of the resistance of glue lines on the basis of melting temperatures is fallible, because this resistance is dependent on the property of glued together materials, and especially the thermal dilatation, the relation within the range of the cohesion forces of the connection and the stresses values (Anonymous 1991, Proszyk, Krystofiak & Weihrauch 2002, Krystofiak, Proszyk & Sedliačik 2003, Proszyk, Krystofiak & Szczęsnowski 2005, Krystofiak et al. 2012). In the aspect of the quality of furniture producers must suitably select the adhesives in respect of their thermal resistance. Recognition of this property of glue lines is a very important factor from the point of view of the functionality and the durability of upholstery furnitures. Being supposed this on the attention was decided to execute investigations, whose aim was the evaluation of the thermal resistance of chosen binding agents applied to the production of upholstery furniture.

EXPERIMENTS

For investigations PUR foams specimens at dimension 100 x 100 x 100 mm was prepared, being characterized with the different apparent density with markings T-20, T-25 and T-30. The gluing process with the use of solvent binding agents (Jowatac 456.34 conventional and Jowatac 456.54 HS) was carried out in the MEBLOMAR Comp. with the seat in Siedlec, however of dispersion (2C product – appropriate Jowatac 414.10 applied with the hardener 414.80 and 1C Jowatac 414.50) in the laboratory of the JOWAT Poland Comp. in Sady/near Poznań. On surfaces of foams was applied with the spraying method solvent adhesives glues one- and bilaterally in the quantity 130±5 g/m^2, however of dispersion

products in the quantity 180 g/m^2. Samples were prepared and investigations of the thermoresistance of glue lines across the cyclic temperature rise acc. to the procedure described in the work Proszyk, Bródka & Krystofiak (2001) were executed. Thermoresistance of tested glue lines was expressed with the degree of their percentages delamination (PUZ).

RESULTS

In the Table 1 the comparison of thermoresistance of adhesive connections joined with solvent adhesives at two-sided application was presented.

Tab. 1 Comparison of the thermoresistance of glue lines from solvent adhesives at two-sided application

Temperature [^{o}C]	**Kind of adhesive**					
	456.34			456.54		
	Kind of foam					
	T-20	**T-25**	**T-30**	**T-20**	**T-25**	**T-30**
	PUZ [%]					
30	0	0	0	0	0	0
40	0	0	0	0	15	15
50	0	0	0	15	50	45
60	50	100	90	100	100	100
70	80	-	100	-	-	-
80	100	-	-	-	-	-

From the general analysis of results follow, that from among solvent systems highest thermoresistance showed glue lines from the Jowatac 456.34 adhesive. Samples from foam T-20 showed 100% thermoresistance in the 50^{o}C, and only in 80^{o}C surrendered to the total stratification. With the smaller resistance were characterized joints of the same adhesive, however at one-sided application, for which already in the temp. 60^{o}C was noted down the total delamination. In case of the solvent 456.54 adhesive was obtained the full resistance only in the temp. 30^{o}C, and at the further progression the glue lines gradually surrendered of delamination and in temp. 60^{o}C followed total disconnections. In the Table 2 values of the PUZ coefficient for solvent 456.34 and dispersion adhesives were compared.

Tab. 2 Comparison of PUZ coefficient for solvent 456.34 and dispersion 1C and 2C adhesives

Temperature [^{o}C]	**Kind of adhesive**								
	456.34			**1C**			**2C**		
	Kind of foam								
	T-20	**T-25**	**T-30**	**T-20**	**T-25**	**T-30**	**T-20**	**T-25**	**T-30**
	PUZ [%]								
30	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0
60	50	100	90	0	0	0	0	0	10
70	80	-	100	0	0	0	15	0	100
80	100	-	-	0	0	0	100	0	-
90	-	-	-	0	0	0	-	10	-
100	-	-	-	0	0	0	-	35	-
110	-	-	-	0	15	0	-	100	-
120	-	-	-	0	50	0	-	-	-
130	-	-	-	0	70	0	-	-	-

Highest thermoresistance was noted down for the 414.50 adhesive dispersion, in case of which even in the temp. 130ºC was did not observe the damage of the glue lines. However in case of the dispersion adhesive in the 1C version within the range of temperatures 70-80^{o}C was found partial delamination, what further led to total delamination in the temp. 90-110^{o}C.

CONCLUSIONS

1. The density of applied PUR foams did not exert the meaning influence on thermoresistance of glue lines, both from solvents, as well as dispersion adhesives.
2. Glue lines from dispersion adhesives, both in the 1C version, as and 2C showed decidedly higher thermoresistance, than solvent systems. Highest thermoresistance of glue lines placing on the level 130^{o}C, one found for the Jowatac 414.50 adhesive dispersion.
3. Among solvent systems higher thermoresistance was shown Jowatac 456.34 adhesive applied two-sided.

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Streszczenie: *Badania właściwości klejów rozpuszczalnikowych i dyspersyjnych przeznaczonych do produkcji mebli tapicerowanych. Cz. II. Termoodporność spoin w piankowych tworzywach PUR.* Badania termoodporności spoin z klejów tapicerskich typu rozpuszczalnikowego i dyspersyjnego w piankowych tworzywach PUR o różnej gęstości pozornej, przeprowadzono w procedurze cyklicznego podwyższania temperatury, z odstopniowaniem co 10^{o}C. Na podstawie uzyskanych rezultatów stwierdzono, że gęstość zastosowanych pianek PUR nie wywierała znaczącego wpływu na termoodporność testowanych spoin, zarówno z klejów rozpuszczalnikowych, jak i dyspersyjnych. Spoiny klejów dyspersyjnych, zarówno w wersji 1C, jak i 2C wykazały zdecydowanie wyższą termoodporność aniżeli z systemów rozpuszczalnikowych. Najwyższą termoodporność spoin plasującą się na poziomie 130^{o}C, stwierdzono dla kleju dyspersyjnego Jowatac 414.50.

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