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Zvýšenie adhéznych vlastností polyuretánových adhezív po modifikácii v hmote

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SÚHRN:

Cieľom práce bolo štúdium možností modifikácie polyuretánových disperzií používaných ako adhezíva na trojrozmerné lepenie polymérnych fólií s vysokým leskom pri lepení nábytku. Boli použité hydrofobizačné aditíva, aby sa zvýšilo zmáčanie lepeného drevného substrátu - strednohustotnej drevovláknitej dosky (MDF). Vplyv aditív bol odskúšaný meraniami kontaktných uhlov, šmykovej pevnosti adhéznych spojov MDF-PUR disperzia-MDF v ťahu, pevnosti v ťahu pri roztrhnutí filmu adhezíva a povrchovej kvality adhézneho spoja. Na porovnanie účinku modifikácie PUR v hmote bol tiež odskúšaný vplyv modifikácie MDF povrchu bariérovou plazmou. Experimentálne výsledky ukázali, že prídavok hydrofobizačných aditív zlepšuje zmáčanie MDF s PUR disperziami a má pozitívny účinok na povrchovú kvalitu adhézneho spoja.

Increase of polyurethane adhesive surface properties after modification in mass

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ABSTRACT:

The aim of the work was the study of modification polyurethane-based (PUR) dispersions used as adhesives for 3D bonding of high glossy foils in the furniture industry. The hydrophobization additives were used in order to improve the wetting of bonding substrate –

middle density fiberboard (MDF). The influence of additives was examined by the measurement of contact angle, shear strength of adhesive joint, tensile strength at break of adhesives films and surface quality of adhesive joint. In relation to modification of PUR dispersion was examined also the influence of modification MDF surface by the barrier plasma. The experiment showed that the addition of hydrophobization additives improves the wetting properties of MDF with PUR dispersions and has positive effect on surface quality of adhesive joint.

1. Introduction

Polyurethane dispersions generally consist of urethane urea polymers dispersed in water in preference based on aliphatic poly(isocyanates) and therefore offer good resistance to discoloration [1]. Heat-activated adhesives based on polyurethane dispersions have become established for joining processes in which synthetic materials need to be adhesively bonded and are gradually displacing conventional solvent-based adhesives [2]. Examples include laminating PVC foils on MDF sheets. For 3D laminating PVC foils on MDF sheets the polyurethane dispersion adhesives can be applied either as two-component materials, i.e. in combination with modified isocyanate, or in the form of a latent-reactive dispersions with a surface-deactivated solid isocyanate which are applied by spraying on the surface of profiled MDF [3] . The wetting properties of examined system are possible to change not only by the modification of adhesive, but also by the treatment of bonded substrates. When the plasma treatment is used the significant changes on the surface are observed.

Because the surface of evaluated MDF is non-polar - hydrophobic, when the polar component of surface energy MDF is significantly lower than polar component of surface energy of films prepared from Dispercoll U 53, we studied in our work two kinds of modifications: The addition of oleic acid which is non-polar to polyurethane dispersion in order to reach the better wetting properties on the MDF as a basic presumption for smoother surfaces of adhesive joints and also was studied the treatment of MDF sheets by the coplanar barrier plasma and its influence on wetting and bonding characteristics.

2. Experimental

In this study was used the commercial polyurethane dispersion Dispercoll U 53 produced by Bayer, Germany. The properties of Dispercoll U 53 are described in the table 1.As a hydrophobization additive was used oleic acid in pure quality. The content of oleic acid in PUR dispersion was given as weight % calculated on polymer content of PUR dispersion.

MDF was type Antine, density 800 kg/m^3, produced by Bipan, Italy, PVC foil was Darkar HG, thickness 0, 5 mm produced by Riken Technos, Japan.

The wetting properties were evaluated by measurement of contact angles with selected testing liquids set using SEE (Surface Energy Evaluation) device completed with a web camera (Advex, Czech Republic) and necessary PC software.

The adhesive joints for measurement of shear strength were prepared by pressing at the temperature 60 °C on the hydraulic press Fontijne SR 100 and evaluated by dynamometer Instron 4301. Plasma modification was implemented in static conditions by diffuse coplanar barrier surface discharge (DCSBD) plasma source in air at atmospheric pressure and room temperature.

3. Results and Discussion

The contact angles of modified PUR adhesive Dispercoll U 53 with oleic acid on treated surface MDF by plasma are shown in Fig 1. After treatment of MDF surface by plasma the contact angles of modified Dispercoll U 53 significantly decreased. The addition of non-polar oleic acid causes better wetting although the treatment by plasma causes higher polarity of MDF surface.

The shear strengths of adhesive joints given in Fig. 2 are significantly affected by the exposure time of treatment surface MDF by plasma and addition of oleic acid. The values of shear strengths increase with the exposure time, only when unmodified PUR adhesive Dispercoll U 53 is used. The addition of oleic acid causes the decrease of shear strengths. It can be explained by different effect both types of modifications. With longer exposure time of plasma treatment is surface of MDF more polar and with higher content of oleic acid is dried PUR film more non-polar.

4. Conclusion

The addition of oleic acid to polyurethane dispersion improves the wetting properties of PUR dispersion and has positive effect on surface quality of adhesive joint and also improves the shear strengths up to 2 weight % of oleic acid. When the plasma treatment of surface MDF was applied the significant decrease of contact angles and an increase of the shear strengths were observed when the oleic acid was added to PUR adhesive. Using the both kind of modifications together is not the right way how to modify and apply the PUR dispersions.

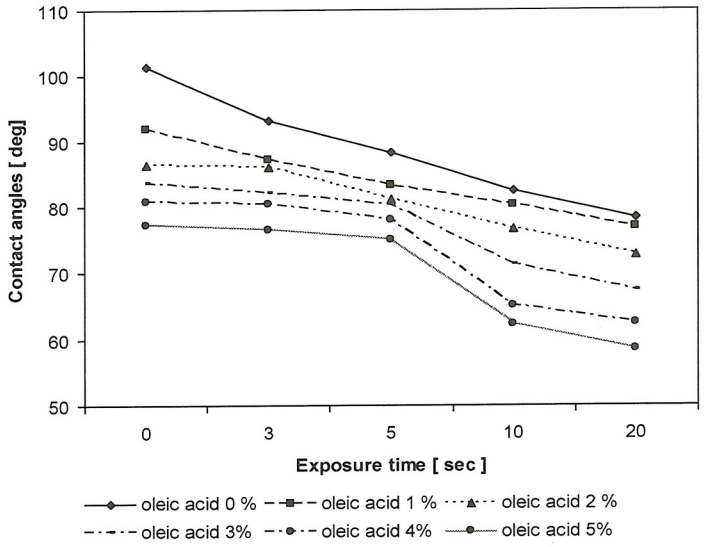

Fig. 1. The contact angles modified Dispercoll U 53 by oleic acid vs. exposure time of MDF plasma treatment.

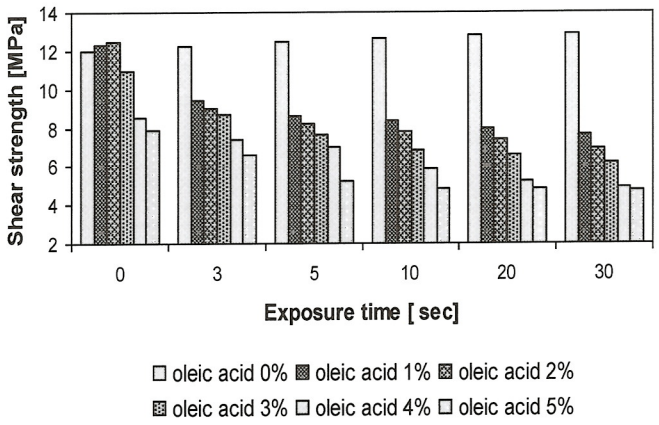

Fig. 2. Shear strength of adhesive joint MDF-PUR adhesive containing oleic acid vs. exposure time of plasma treatment.

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