ASPECTS CONCERNING THE ACHIEVEMENT OF SOME ADHESIVE SYSTEMS BY MEANS OF THE FURFURYL ALCOHOL AND SOME FURAN RESINS

ASPECTE PRIVIND REALIZAREA UNOR SISTEME ADEZIVE CU AJUTORUL ALCOOLULUI FURFURILIC ŞI A RĂŞINILOR FURANICE

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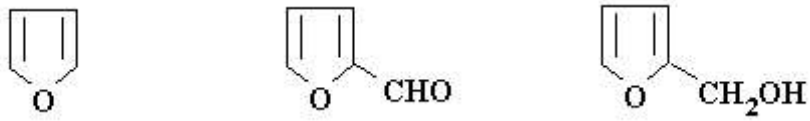
Abstract. *This work is meant to emphasizethe influence of some furan products, namely the influence of the furan resins and the furfuryl alcohol on the cellulose fibers existing in the structure of paper. The main goal is to study the interaction of the individual compounds with the cellulose fibers from the filter paper in the process of immersion bath followed by a thermic treatment. The adhesiveness growth was established as a consequence of the mass increase of the impregnated samples and the level of retention established after the thermic treatment and after the water extractionduring the process of boiling. There has also been studied the power of absorption of the resulting adhesive systems.*

Key words: *adhesive systems, furan resins, furfurylalcohol, filter paper, impregnation, extraction, power of absorbtion.*

Rezumat. *Utilizarea produselor furanice (alcool furfurilic şi răşini furanice), alături de fibrele celulozice din structura hârtiei şi implicit a lemnului, contribuie la realizarea de noi sisteme adezive cu proprietăţi superioare şi cu posibile aplicaţii în domenii diverse. Opţiunea pentru utilizarea prin impregnare a unor benzi de hârtie de filtru în cazul metodei pentru evaluarea capacităţii adezive a structurilor compozite creat are ca justificare necesitatea evidenţierii capacităţii de interacţiune a adezivilor utilizaţi cu fibrele celulozice din structura lemnului. Din datele prezentate, se desprinde ideea că tratamentul termic nu influenţează semnificativ interacţiunea între componentele sistemului adeziv, ceea ce impune utilizarea unor agenţi de reticulare, paralel cu creşterea temperaturii şi implicit realizarea unor „structuri compozite complexe".*

The furan resins represent an important class of synthetic resins which have as a starting point chemical substances having a furan type structure. Among the basic chemical products used for the synthesis of such synthetic resins there can be mentioned: the furan, the furfuryl aldehyde and the furfuryl alcohol (fig. 1) [2].

According to the three types of raw material from where it starts, there can result in synthesis the following furan resins: furan resins of formaldehyde phenol type; furan resins of furfuryl-formaldehyde phenol type; furan resins of simple furfuryl type; furan resins of mixed or modified furfuryl type.



The furan (C_4H_4O) The furfuryl aldehyde ($C_6H_4O_2$) The furfuryl alcohol ($C_5H_6O_2$)

Figure 1 - **Furan chemical products used in the synthesis of synthetic resins**

With respect to the furfuryl alcohol, it is known the fact that it, can be obtained in industry by the hydrogenation of furfuryl in the presence of the selective nikel Ramy catalysers, platinum oxyde, which favours the hydrogenation of the aldehyde functional group and of the furan nucleus.

Here are some of the basic physical-chemical characteristics of the furfuryl alcohol: aspect – oily liqhid; colour – yellowish colourless; density, g/cm^3 – 1,1296; boiling point, ^{0}C/mmHg – 171,750; solubility, g/100 mL solution in water, alcohol, ether - ∞; refraction index, $n^{20}s$ – 1,4845; toxicity – 50 cm^3/m^3 aer.

The largest quantity of furfuryl alcohol is being used at the moment to produce furan resins, commonly named furfuryl resins, for the purpose of creating new adhesive systems and implicitly new composite structures with polyvalent feasability [5]. Assessing the adhesive characteristics of the furfuryl alcohol and of various furan resins, by impregnating support materials followed by the development of some reticular reactions is not a recent technique but rather a permanently developed perfected and up-to-date technique [1, 3, 4].

Choosing to use the impregnation of some slips of filter paper in the case of the method for assessing the adhesive capacity of the resulted composite structures is justified by the necessity of pointing aut the power of interaction of the utilized adhesives with the cellulose fibres from the structure of the wood. In order to dispose of the dificullty concerning the interaction of the substrate with the utilized reagents there have been used in all the cases reference samples of the substrate which have undergone identical treatments excepting the utilized adhesive.

MATERIAL AND METHOD

There have been used:

- furfuryl alcohol 100% concentration;
- Biorez furan resins (Trans Furan Chemicals) of the following types:
  - Biorez 0312019 – 1B x x x, 5,7% humidity } marked R_1
  - Biorez 91 He RZ 0440, 36% humidity } marked R_2
- test-pieces made of filter paper having the size 180 x 80 mm;
- ammonium nitrate;
- distilled water.

The test-pieces made of filter paper have undergone the immersion impregnation in the hydrophilic (R_2) and hydrophobic (R_1) furan resins and in furfuryl alcohol, the boiling water extraction and the preparation for determining the power of absorbtion.

RESULTS AND DISCUSSIONS

The filter paper slips having the size 180 x 80 mm, have undergone the process of impregnation through immersion in an adhesive bath which contains hydrophobic resin (R_1) having the humidtiy 5,7%, hydrophilic resin (R_2) having the humidity 36%, dissolved in distilled water and furfuryl alcohol, for 60 seconds at room temperature. The samples have been weighed before and after impregnation using the analytic scales in order to determine the mass growth (figure 2).

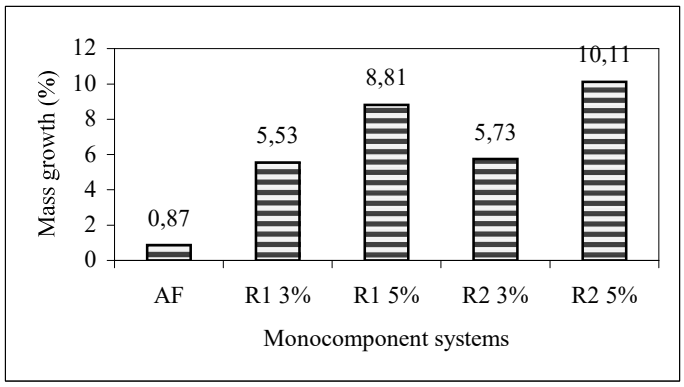


Figure 2 - The influence of the concentration of the immersion bath on the mass growth of the filter paper impregnated with R_1, R_2 and AF
R_1 – hydrophobic resin with U = 5,7%
R_2 – hydrophilic resin with U = 36%
FA – furfuryl alcohol

Figure 2 shows that, as the concentration of the substance in the immersion bath grows, the quantity of retained/fixed product is larger, therefore the level of impregnation is higher.

The retention of the adhesive system by the impregnated slips of flter paper was determined through extracting them in boiling water over a span of 5 minutes. The samples were weighed before and after the extraction just to determine the registered mass loss. The quantity of extracted product was related to the initial mass of the sample (figure 3). There can be noticed shat the loss of mass is higher in the case of the composite structures shat have a higher concentration in the adhesive. Also, as in the case of determining the mass growth (the level of impregnation), there can be noticed that the hydrophilic resin R_2 favours the largest loss of water from the produced adhesive system. From the obtained information it follows that the cellulose fibers from the structure of paper retain enough quantities of adhesive product.

There was also determined the power of absorption of the resulted adhesive system having as standard unimpregnated slips of filter paper. The samples were prepared in an airtight drying stove, for 28 hours, at a temperature of 20^0C and 65% equilibrium humidity achieved by means of a buffer system, oversaturated ammonium nitrate solution respectively (figure 4). From the analysis of the experimental data there can be noticed a uniformity of the value of the power of absorption in the case of all the impregnated samples, value which is not much different from that one registered in the case of the paper which has not undergone any treatment.

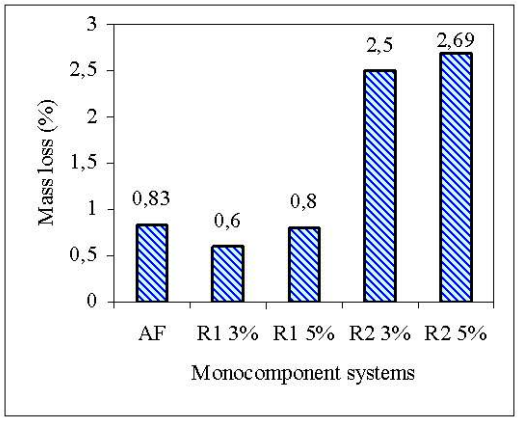


Figure 3 - The quantity of substance extracted from the achieverd adhesive systems

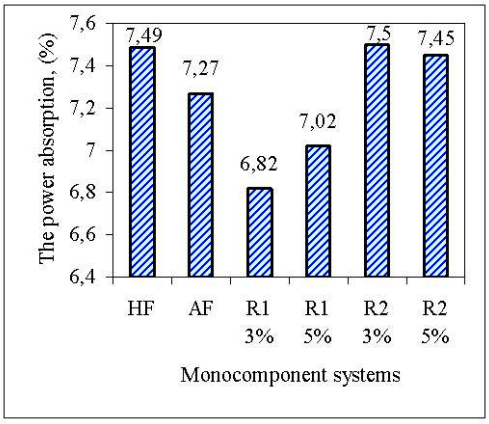


Figure 4 - The variation of the power of absorption of the filter paper impregnated with R_1, R_2 and FA compared to the untreated filter paper

CONCLUSIONS

The use of furan products (furfuryl alcohol and furan resins), together with the cellulose fibers from the structure of paper and implicitly of wood contributes to the achievement of new adhesive system having superior proprieties and which are likely to be applied in various domains.

On the one hand, as the concentraton in the adhesive grows, the level of impregnation improves and on the other hand the level of retention lowers.

The power of absorption of the filter paper treated with various adhesives having various concentrations is not significantly different from the untreated filter paper.

From the information presented, it results that the thermic treatment does not influence significantly the interaction among the components of the adhesive system, this imposing the use of some reticular agents at the same time with the rise of the temperature and implicitly the achievement of some „complex composite structures".

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