

DEVELOPMENT OF A NEW COMPOSITE PRODUCT BASED ON THE FURAN-EPOXIDE BINDING.

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Abstract: *The article highlights the possibilities of synthesizing furan-epoxy binders based on furfural isolated from local raw materials and producing lacquer compositions with their participation. The structural changes of the ED-20+PEPA and 3FAMED+PEPA systems in the 20–140 °C range were evaluated using CHN elemental analysis, X-ray phase analysis, and IR spectroscopic approaches. The results showed that in the 3FAMED+PEPA system, the proportion of nitrogen and hydrogen increases with increasing temperature, reaching values of C 69.59%, H 7.21%, and N 5.78% at 140 °C. The obtained data serve to develop lacquer-grade furan-epoxy compositions based on local furfural, substantiate their structural stability, and determine the directions of their practical application.*

Key words: *local furfural; furan-epoxy binder; lacquer composition; 3FAMED+PEPA; ED-20+PEPA; CHN analysis; X-ray phase analysis; local log.*

Introduction

In recent years, the issue of obtaining high-value-added polymer materials from renewable and local raw materials has become one of the most relevant scientific and practical directions. From this perspective, furfural obtained from agricultural and plant raw materials is considered a promising platform substance for the synthesis of furan-derived resins,

binders, and coating materials. The combination of furan and epoxy components allows for the control of the hardening process, improving adhesion, chemical stability, and coating properties.

The aim of this work is to obtain furan-epoxy binders using furfural obtained from local raw materials, analyze their structural and chemical properties, and evaluate the possibility of creating lacquer compositions. From the perspective of local journal requirements, the practical significance of this study lies in demonstrating the prospects for creating import-substituting lacquer materials using furfural-based binders.

In the studies, the ED-20+PEPA system was studied at 20, 60, and 100 °C, while the 3FAMED+PEPA system was studied at 20, 60, 100, and 140 °C. Elemental analysis was carried out in the laboratory of the Institute of Polymer Chemistry and Physics of the Academy of Sciences of the Republic of Uzbekistan. IR spectra were obtained on a Bruker Invenio-S device, and X-ray phase analysis was performed on a Rigaku MiniFlex-600 device. In X-ray measurements, the 2θ range was taken as 5–70°, the pitch was 0.02°, and the scanning speed was 10°/min. The results of WPPF and peak profiling were used to evaluate the phase composition of the varnish sample.

Table 1. Elemental composition of the studied systems

Sample	T, °C	C, wt%	H, wt%	N, wt%
ED-20+PEPA	20	69.29	4.10	1.50
ED-20+PEPA	60	68.68	3.66	1.21
ED-20+PEPA	100	67.31	4.01	1.74
3FAMED+PEPA	20	67.35	5.70	1.11
3FAMED+PEPA	60	69.35	4.38	1.41
3FAMED+PEPA	100	69.03	3.96	1.41

3FAMED+PEPA	140	69.59	7.21	5.78
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Results and discussion

The results of the elemental analysis showed that the processes of solidification and structural reorganization in the studied systems change significantly under the influence of temperature. The decrease in carbon content from 69.29 to 67.31 wt.% from 20 °C to 100 °C in the ED-20+PEPA system indicates relatively moderate structural changes. At the same time, an increase in nitrogen content from 1.50 to 1.74 wt.% indicates an intensification of bonds in the presence of the hardening component. In the 3FAMED+PEPA system, as the temperature increased from 20 °C to 140 °C, the hydrogen content increased from 5.70 to 7.21 wt.% and the nitrogen content from 1.11 to 5.78 wt.%; this indicates the formation of a network and the more active integration of nitrogen-containing fragments into the system.

X-ray analysis and WPPF results showed the formation of a multiphase structure in the varnish product. The presence of rutile and niobium (55 (4) wt%) as the main phase, as well as the addition of graphite, γ -Al₂O₃, titanium oxide, and carbon oxide, indicates that the composition possesses a complex mineral-organic nature. In the XRD profile, the peaks at 17.7°, 26.48°, 35.01°, 40.19°, 53.316°, and 55.639° confirm the presence of these phases. Such a phase composition can be interpreted as a factor affecting the structural stability and functional properties of lacquer compositions.

Thus, the 3FAMED+PEPA system is more sensitive to temperature effects and can be evaluated as a promising system in terms of lacquer composition formation.

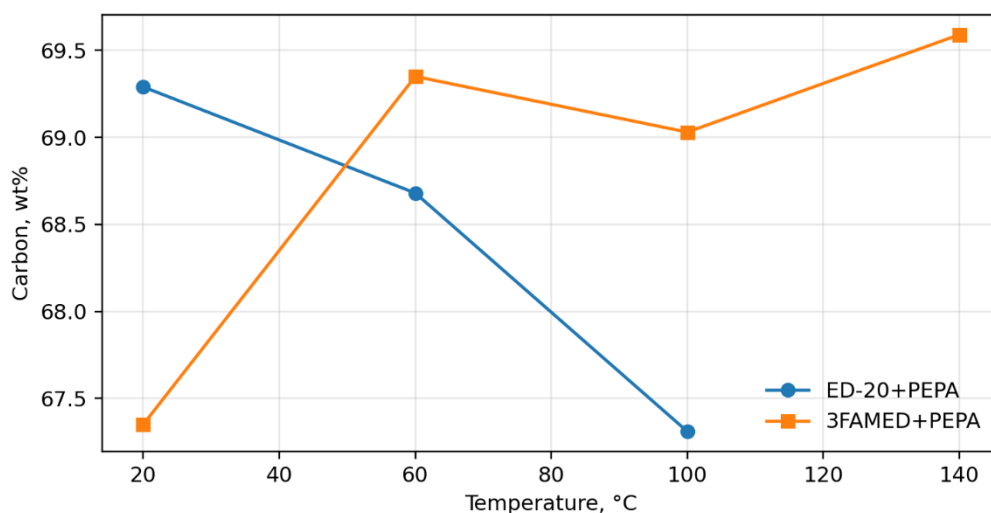


Figure 1. Changes in carbon content depending on temperature.

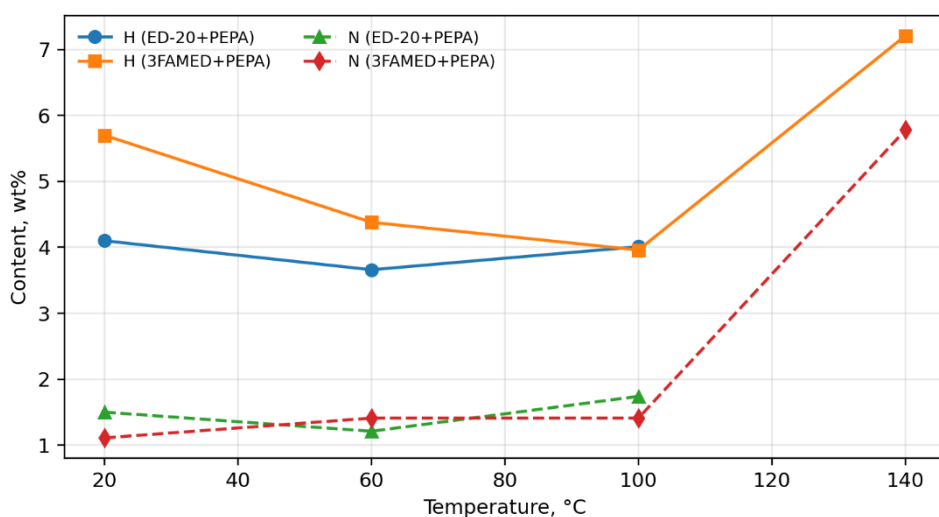


Figure 2. Comparative changes in hydrogen and nitrogen content in the studied systems.

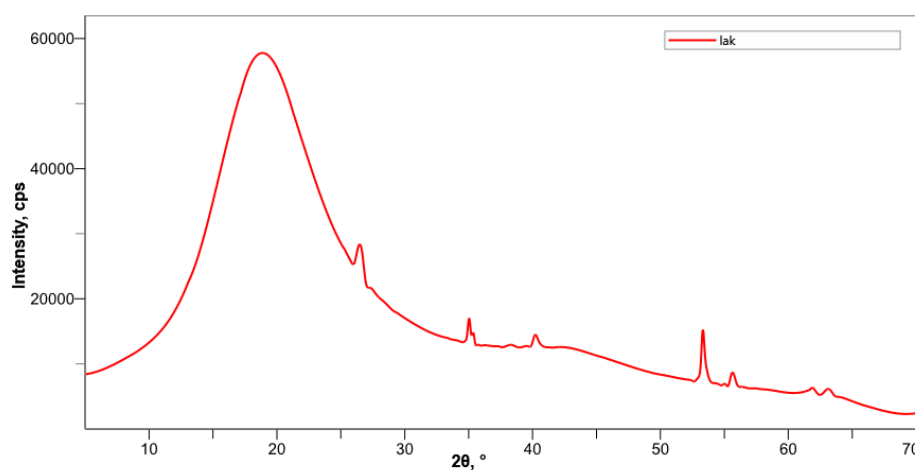


Figure 3. X-ray diffraction pattern of the varnish product.

Conclusion

The possibility of forming furan-epoxy binders and lacquer compositions in the presence of furfural obtained from local raw materials has been experimentally substantiated. CHN-element analysis showed that structural changes occur with increasing temperature in the ED-20+PEPA and 3FAMED+PEPA systems, especially an increase in nitrogen content and more active branching processes in the 3FAMED+PEPA system. X-ray phase analysis confirmed the multiphase structure of the varnish product. The results obtained show that the use of furfural-based binders in local conditions for the production of varnishes and other composite coating materials is promising.

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