Reduction of combustibility of the polyurethane matrix of microwave-absorbing composite materials

Guzii S.G.[1], Khodakovskyy O.V.[2], Kurska T.M.[3]

[1] *V. Bakul Institute for Superhard materials of NAS of Ukraine, Avtozavodskaya Str., 2, Kyiv-04074, Ukraine.*
E-mail: sguziy2@gmail.com
[2] *National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Peremohy Ave., 37, Kyiv-03056, Ukraine.*
[3] *Odessa Polytechnic State University, Shevchenko Ave., 1, Odessa-65044, Ukraine.*

Introduction

One of the promising areas of modern materials science is the creation of new polymer nanocomposite materials in the form of electromagnetic screens [1] and coatings designed to absorb and scatter electromagnetic waves with a frequency of 10 - 70 GHz from household and industrial appliances and equipment. Given that in such material, as a binder is a polymer, there is a natural question to reduce its combustibility in critical operating conditions, for example, at the time of fire. Therefore, based on the scientific achievements of the authors [2] and the experience of world practice of fire protection, as an object of study was adopted intumescent system (IC) of traditional composition [3].

Experimental results

Based on statistical data processing, regression equations were obtain and isoparametric diagrams of changes in the physical properties of the polymeric binder from changes in variable factors were constructed. The method of superimposition of replicas of isoparametric diagrams (Fig. 1) established the optimal range of concentrations of IC (intumescent coating) additives that meet the requirements of normalized parameters, namely: PFA from 15 to 17%, PE from 9 to 11.5% and MA from 11 to 14%.

On Fig. 2 shows the results of fire tests, and in Fig. 3, the macrostructure of the coating of the optimal composition after fire tests.

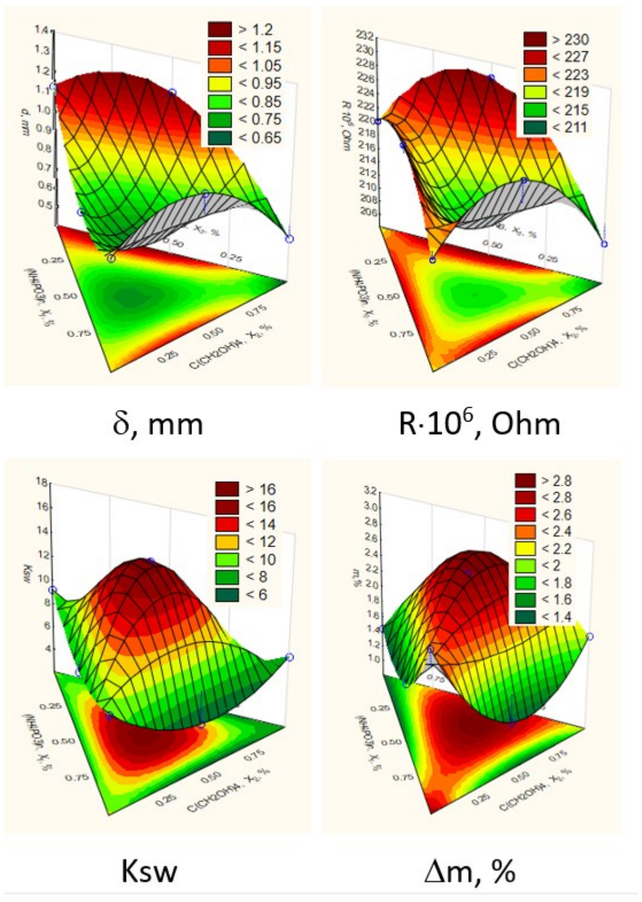

Fig. 1. Isoparametric diagrams of changes in the values of output parameters (coating thickness, resistance, swelling coefficient and mass loss) depending on the concentrations of additives

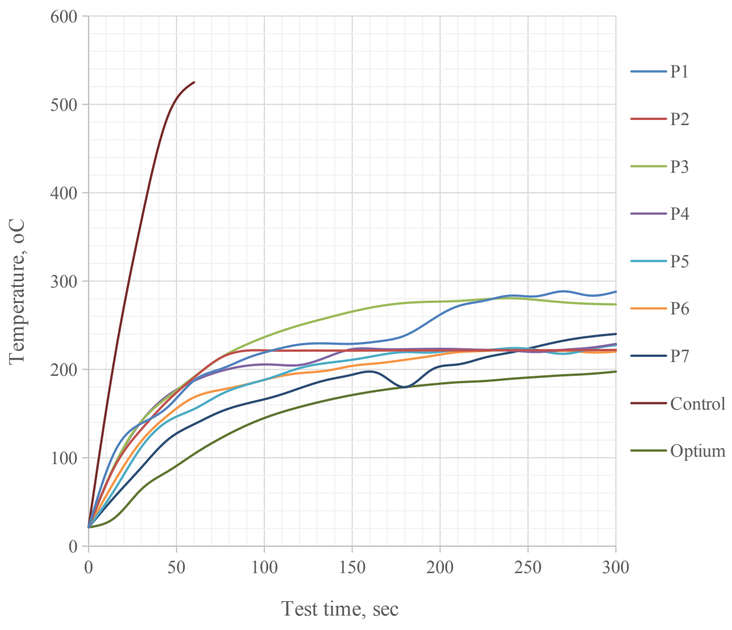

Fig. 2. Results of fire tests (temperatures on the metal substrate under the coating)

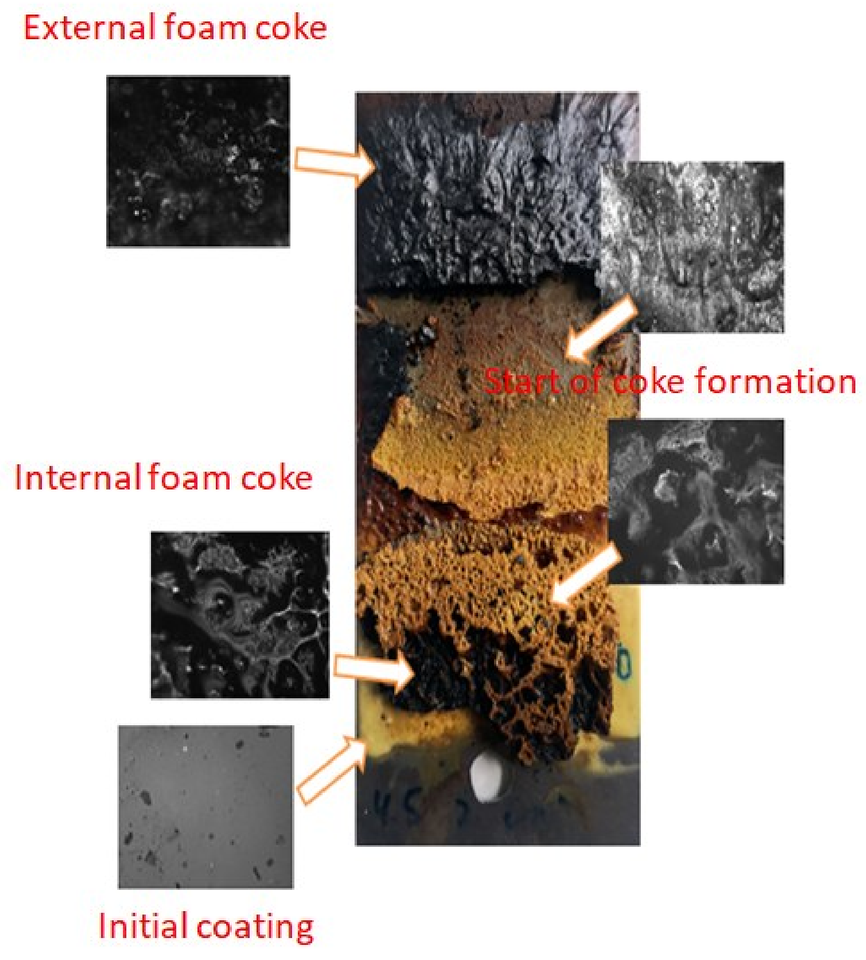

Fig. 3. Macrostructure of the coating of the optimal composition after fire tests

Discussion

As seen from fig. 2, the composition of the optimal composition (PFA=15%, PE=9%, MA=11%) ensures the incombustibility of the polyurethane matrix within the test, which corresponds to fire resistance class R15.

Physical and chemical processes of coke formation will be disclosed in the full version of the article. At the moment, it can be noted that the formed foam mower (Fig. 3) restrains the temperature load both on the polyurethane component of the coating and on the metal substrate, preventing its heating to the critical temperature (500°C).

The introduction of IC components in the specified percentage allows reducing the combustibility of polyurethane varnish by 12.5 times compared to the original.

References

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