UDK 614.8

K.A. Afanasenko, teacher, NUCPU

INFLUENCE OF POLYEPOXY BINDER EXPLOITATION FOR FIBERGLASS REINFORCED PLASTIC ON IGNITION TEMPERATURE UNDER CONDIOTION OF AUTOCLAVE-VACUUM FORMING

(presented by DSc Klyuchka Y.P.)

Forming process polymers epoxynaphtyl binders is researched. It was established that the ignition temperature of FRP based on examination of the relationship, taking into account the intensity of pyrolytic reactions of the binder during heating depends on the molding parameters.

Keywords: pyrolytic conversion, coke, ignition temperature, forming conditions.

Problem formulation. Proceeding from service conditions of fiberglass reinforced plastic (FRP) products, it is putting out requirements to their working capacity, concerning, including their combustibilities.

As raw materials (components) when receiving binding for the (FRP) most often use epoxies resin owing to their technological effectiveness during receiving, high rates of adhesion, thermo – and heat resistance, a possibility of comprehensive modification.

It is known that in case of FRP production by method of autoclave-vacuum formation temperature and pressure of formation varies that significantly influences physical and chemical characteristics of final products [1].

So, in works [2, 3] relation of FRP production ways and parameters and their indicators of fire danger is specified. It is shown what is possible to receive material with significantly lowered indicators of fire danger not only with inclusion fillers and fire-retarding agents in polymeric binding at production of FRP – chemical modification of binding also gives positive effect.

One of problems in the fire danger indicators decrease sphere with application of various sorts polymeric binders in FRP systems has an depends on conditions of their production.

Analysis of the recent researches and publications. The received results on combustibility definition of polymers and composites on their basis demonstrate significant influence of a coke production share and intensity on their ignition [4].

It is known that intensity pyrolytic transformations (coke production process) in polymeric binding depend on its structure and composition, that influences on FRP characteristics. However, such influence of binding is mutual with the reinforcing material (fiberglass, glasscloth, glass fibre fabric, etc.). So, in work [5] it is specified influence of FRP structure and manufacture conditions on heatexchange processes and intensity of pyrolytic transformations in bind-

ing, and, therefore, on his inflammability and combustibility indicators. At the solution of FRP fire danger indicators decrease problems, there is a need for consideration of FRP production parameters influence on their fire danger.

Statement of the problem and its solution. The purpose of this work is determination of FRP on the epoxidized dinaphthols basis formation optimum parameters for assessment of their influence on ignition temperature.

For prepreg manufacturing it was applied glasscloth of the T-10 brand (State standard 17653-88) which before application was previously annealed at the temperature 350°C in a thermocase within at least one hour.

The impregnated layers of glasscloth were cut along the direction of preferential reinforcing by the sizes of the industrial equipment, gathered in a packet and placed in a vacuum cover.

FRP manufacturing (formation) process is described in [6].

For determination of composite formation input parameters for receipt of ignition temperature optimum values it is performed planning of complete factorial test with the following parameters (tab. 1).

Tab. 1. Experiment factors coding

Variation interval and factors levels	Pressure (x_1), MPa	Temperature (x_2), ^oC
Zero level $x_i = 0$	0,4	140
Variation interval δ_i	0,2	20
Low level $x_i = -1$	0,2	120
High level $x_i = +1$	0,6	160
Star points max	0,6	160
Star points min	0,2	120

Ignition temperature value was determined according to State standard 12.1.044-89* “Occupational safety standards system. Fire and explosion hazard of substances and materials. Nomenclature of indices and methods of their determination” by consecutive approximations method (tab. 2). Ignition temperature value was determined as the average between two sizes in what lower value ignition didn't occur, and in upper – occurred.

Tab. 2. Iterations sequence of determining ignition temperature of FRP samples

№ опыта	1	2	3	4	5	6	7	8	9	10	11	12
1	300	400	500	600	550	525	515	515	515	525	525	-
9	300	400	500	600	550	575	565	555	555	555	565	565

On the basis of the obtained experimental data the regression model of dependence of ignition temperature of FRP on the epoxidized dinaphthol basis from formation parameters (fig. 1) is constructed.

On result of performed researches it is made the regression equations of ignition temperature of FRP on the epoxidized dinaphthol basis from formation pressure and temperature dependence

$$T_{ign.} = -465{,}391 + 452{,}5 \cdot P + 13{,}442 \cdot T + \\ + 0{,}875 \cdot PT - 716{,}667 \cdot P^2 - 0{,}0492 \cdot T^2 \quad . \tag{1}$$

Graphic interpretation of the regression equation is presented in the fig. 1.

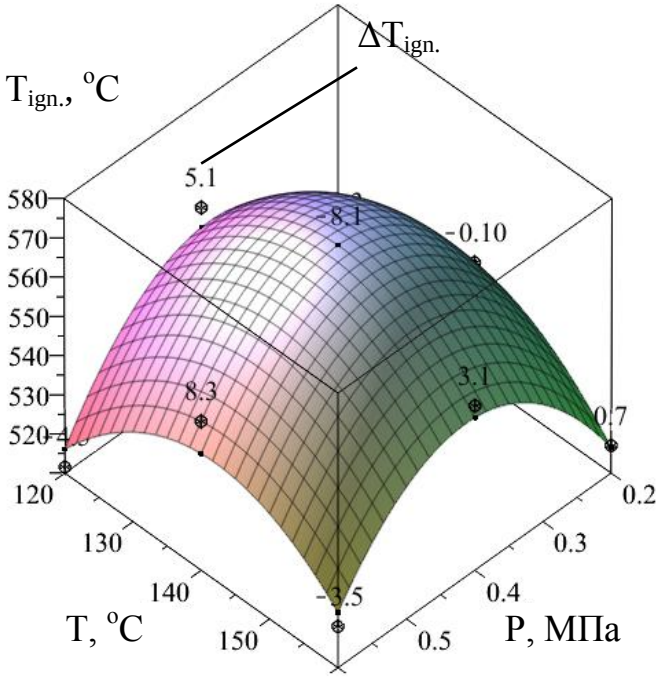

Fig. 1. Dependence of ignition temperature of FRP on the epoxidized dinaphthol basis from formation conditions

Solving of private derivatives equations system $\frac{\partial T_{ign.}}{\partial P}$ and $\frac{\partial T_{ign.}}{\partial T}$ (2) the function extremum is found.

$$\begin{cases} \frac{\partial T_{ign.}}{\partial P} = 452{,}5 + 0{,}875 \cdot T - 716{,}668 \cdot P = 0; \\ \frac{\partial T_{ign.}}{\partial T} = 13{,}441 + 0{,}875 \cdot P - 0{,}049 \cdot T = 0. \end{cases} \tag{2}$$

As a result of the solve of equations system the function extremum is found in a point of $T_{ign.max|P\ =0{,}4013;\ T=140{,}3}$=568,1 °C.

The analysis of fig. 1 shows that value $\Delta T_{ign.}$, which characterizes distinction between experimental values and values according to regression model doesn't exceed 8,1 °C or 1,5%.

Conclusions. On the example of FRP on the epoxidized dinaphthol basis influence of temperature and pressure at an method of autoclave-vacuum formation (production) upon change of FRP ignition temperature value is shown.

REFERENCES

1. Mihaylin Yu. A. Constructional polymeric composite materials / Yuriy Aleksandrovich Mihaylin. – M.: Scientific basis and technologies, 2008. – 822 c.

2. Afanasenko K.A. Decline of polymeric composition materials fire hazard indexes by application of connective, inclined by carbonating / K.A. Afanasenko, P.A. Bilim, A.P. Mikhailuk // Fire safety issues. – Kharkiv.: NUCPU, 2013. – V. 34. – P. 12-17.

3. Grassi N. Destruction and stabilization of polymers / N. Grassi, G. Scott. – M.: Pease, 1988. – 446 c.

4. Tuzhikov O.I. Elastomers and plastics with redused. / O.I. Tuzhikov, T.V. Khohlova, S.N. Bondarenko. – Volgograd: VolgGTU, 2005. – 214 c.

5. Vorobev V.A. Polymeric constructional materials flammability. / V.A. Vorobrv, R.A. Andrianov, M.A. Ushkov. – Striyizdat, 1978. – 224 c.

6. Afanasenko K.A. Research of influence of coke polyepoxy binder for fiberglass's on oxygen index under autoclave-vacuum forming is. / K.A. Afanasenko, A.P. Mikhailuk // Fire safety issues. – Kharkiv.: NUCPU, 2016. V. 39. – P. 19-23.

Received by editorial Board 15.10.2016

К.А. Афанасенко

Вплив застосування поліепоксидних зв'язуючих на температуру спалахування склопластиків в умовах автоклавно-вакуумного формування

Досліджений процес формування полімерів на прикладі эпоксінафтілових зв'язуючих. Установлено, що температура спалахування склопластиків на основі вивчених зв'язуючих, з урахуванням інтенсивності піролітичних перетворень зв'язуючого під час нагріву, залежить від параметрів його формування. Розроблена регресійна модель.

Ключові слова: піролітичні перетворення, коксовий залишок, температура спалахування, умови формування.

К.А. Афанасенко

Влияние использования полиэпоксидных связующих на температуру воспламенения стеклопластиков в условиях автоклавно-вакуумного формования

Исследован процесс формования полимеров на примере эпоксинафтиловых связующих. Установлено, что температура воспламенения стеклопластиков на основе изученных связующих, с учетом интенсивности пиролитических превращений связующего во время нагрева, зависит от параметров его формования. Разработана регрессионная модель.

Ключевые слова: пиролитические превращения, коксовый остаток, температура воспламенения, условия формования.