

SYNTHESIS AND INVESTIGATION OF FLAME RETARDANCY OF PHOSPHORYLATED MALONIC ESTER DERIVATIVES

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Earlier various phosphorylated derivatives of malonic ester, in particular, diamide of phosphonomalonic acid were synthesized by us and its flame retardancy was investigated [1]. In order to synthesize new flame retardants and estimate their flame retardant efficiency, the diamide of malonic ester was introduced into the classical Kabachnik-Fields reaction. It is known that this reaction is widely used in preparative organic chemistry of phosphorus to produce a wide variety of compounds [2]. The reaction was carried out by equimolar mixing of malonic ester diamide, dialkylphosphite and paraform in a benzene medium.

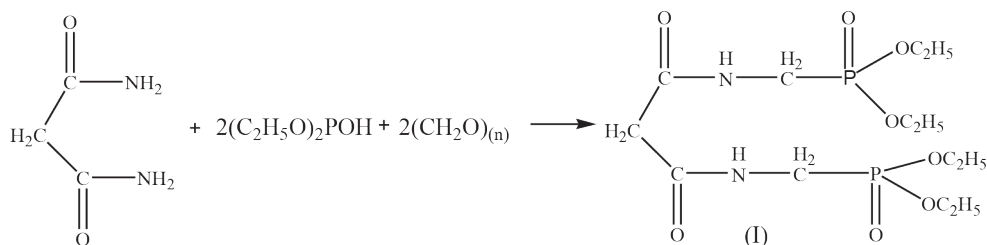
Further the acid hydrolysis of the diphosphate derivative (I) has been carried out and there has been obtained the corresponding diamidodiphosphonic acid (II), which potentially possesses flame

retardancy, since phosphonic acids are widely used as substances that reduce flammability [3].

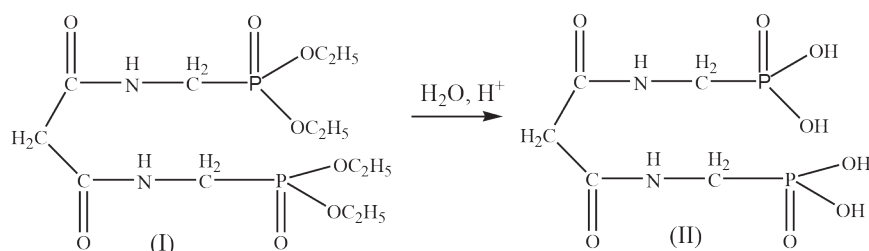
The structure of synthesized compounds (I) and (II) was proved by the data of IR and NMR spectroscopy.

The flame retardant efficiency was estimated according to the State Standard P 50810-95 [4]. After the flammability test, such parameters as the afterflame time and afterglow time were recorded and the char length was measured. Flammability tests were carried out for five samples for each type of determination. The average flammability test data is presented in Table 1. After the fire treatment, fabric samples that were not impregnated with the test solutions burned to the edge.

As can be seen from Table 1, fabric samples treated with 2.5% and 10% solutions of deriva-



Scheme 1.



Scheme 2.

Table 1. Flammability test data

Fabric	Add-on %	Afterflame time, sec	Afterglow time, sec	Char length, mm
Control sample	–	26.8±0.3	75.9±0.2	>22
A sample treated with a 2.5% solution of the derivative (II)	5%	9.5±0.7	0	4.2±0.3
A sample treated with a 10% solution of the derivative (II)	19%	4.0±0.1	0	3.5±0.1

tive (II) have lower values of afterflame time and the char length. There is no afterglow time for the studied fabric samples, as compared to the control sample. According to the results of the flammability

tests carried out, the derivative (II) belongs to the class of hardly flammable substances, but is most effective in the form of an impregnating solution with a concentration of 10%.

References

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4. State Standard P 50810-95// *Pozharnaya bezopasnost' tekstil'nykh materialov. Tkani dekorativnye metod ispytaniya na vosplamnyaemost' i klassifikatsiya.*