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Kochurov D., Fedotov Y., Panov Y. Development of a thermoluminescent dosimetric film based on aromatic polymers for the determination of beta radiation on the skin and radiation equipment

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Abstract. *In article the technology of receiving thermoluminescent films is described. The questions of the choice of polymers as matrixes for thermoluminescent detectors, the choice of optimum concentration of polymer in solution are raised. The way of definition of own background of matrixes is also described, data on measurement of a thermostimulated luminescence are provided. In addition, the gradirovka of detectors on beta radiation is given.*

Keywords: *film, thermoluminescent, thermoluminophor, polyamide, polyester, polyamidoimide*

1. Introduction

For measurement of doses of ionizing radiation in biological fabrics use the radiation detectors allowing to register distribution of doses on a surface and depth. Similar tasks arise also in the radiation equipment at a research of radio sensitivity of separate products. For this purpose detectors on the basis of teflon with addition of fine powder of a thermophosphor which are rather difficult and expensive in production were abroad developed. In our country brand 4A detectors LiF-ftoroplast in the range of thickness of a film from 10 to 100 microns were developed. Detectors were used in the experimental purposes during rather long time, in particular in works at mitigation of consequences of the Chernobyl accidents. As at repeated heating ftoroplast changes the geometrical sizes and optical properties, there was a need of creation of new thermoluminescent films. As such use of heat-resistant polymers with good optical properties of films is possible. Thus, the production technology of a thermoluminescent dosimetric film on the basis of poliimidny PM-1 pitch was developed. Detectors from this film had satisfactory characteristics, however light output decreased due to light absorption by a film. There is a need of development of new matrixes with high thermal stability and the best svetovykhod which would eliminate defects of already existing systems. Thus, there is a need of use of new materials for matrixes of dosimeters of external radiation which have to meet all requirements imposed to dosimeters of external radiation. As alternative in this work films on the basis of aromatic polyamides, polyester, polyamidoimides and polisulfon which allow to eliminate the specified defects are used.

2. Materials and methods

Radiation detectors should simulate energy absorption in sensitive tissue layers and meet the following requirements: tissue energy content, a wide range of recorded doses of beta radiation in the entire "practical" energy range, acceptable for the conditions of chronical and emergency irradiation measurement error, autonomy, ease of wearing during production operations and (depending on the price) multiple use.

As matrices in this study we used heat-resistant polymers: poly-m-phenyleneterephthalamide - Fenelon S2 (TU 6-06-32-274-89); polyarylate FV-1 and polyarylate DV (TU 6-05-2032-87); Torlon.

Solvents of two classes were used: amide solvent (N,N-dimethylformamide according to GOST 20289-74) for polyamides and polyimides; chlorinated solvent (methylene chloride according to GOST 9968-86) for polyarylates.

To dehydration and degreasing of a surface applied C_2H_5OH ethanol in accordance with GOST 9968-86, $(CH_3)_2CHOH$ isopropanol according to TU 2632-015-11291058-95.

Magnesium tetraborate activated by dysprosium $MgB_4O_7 \rightarrow Dy$ was used as a thermoluminophor.

Preparation of thermoluminescent dosimetric films. Preparation of the polymer solution was carried out in a glass reactor with a jacket equipped with a paddle stirrer with a capacity of 500 cm^3. For the preparation of films prepared 50-100 g solution. The polymer was weighed on analytical scales with an accuracy of ±0,002 g. methylene chloride (methylene chloride) was weighed In a glass. The solvent was poured into the reactor, in which the specified temperature (+25°C) was maintained with an accuracy of ±0.5°C using a thermostat. After reaching the required temperature, the polymer was poured into methylene chloride in portions. Dissolution of the polymer took place within 2 hours. Filtration of the solution was carried out through a filter of two layers of coarse calico and cotton wool at a pressure of 0.1 MPa. Add thermolaminated (magnesium tetraborate, activated with dysprosium $MgB_4O_7 \rightarrow Dy$) in an amount of 20-30 mass parts by weight of the polymer was carried out in a beaker while stirring with a glass rod. Airing of the solution was carried out by holding the solution under normal conditions for at least 1 – 1.5 hours. Samples of films were obtained in the fume hood. Watering the solution on the degreased surface of the glass was carried out using a slit die width of 150 mm. For watering the solution, the die was installed on the edge of the glass. With the help of a probe, a gap between the knife of the die and the glass was exposed, which exceeded the required thickness of the resulting film by 3 - 4 times. Then the solution was poured into the die and its uniform movement was applied to the glass solution. The glass with the applied solution was covered with a sealed cap to reduce the rate of evaporation of the solvent. Drying was carried out for 30 minutes at room temperature +20 – 25°C.

Analysis of optical and thermal properties of polymers. The choice of matrix material is mainly determined by its thermal stability and minimal absorption of thermoluminescence in the visible optical range. To analyze the optical characteristics of films without filler, light transmission was used, taken on the SF-26 spectrophotometer according to the standard technique. The samples were placed between two quartz plates of a smooth surface to the light filter; the comparison was a system of two tightly fixed quartz glasses. To exclude the additional effect on the transmission of films of different thicknesses, the samples were cut to the width of the films with a thickness of 100±5 microns. Heat resistance was determined by the behavior of matrices in the measurement of background thermoluminescence, thermal ignition.

Selection of optimal polymer concentrations in the solvent. To obtain a uniform distribution of thermolaminated in the polymer matrix it is necessary to create a system of "solvent-polymer-thermolaminated" with the lowest deposition rate of the latter. To this end, in the solution was determined the sedimentation rate at the time of full sedimentation of the filler (thermolaminated). To determine the sedimentation time of the filler, solutions with a mass fraction of phenylon and torlon from 10 to 25%, and polyaryls from 10 to 15% were prepared.

Irradiation of beta-radiation detectors. Irradiation was carried out by a source based on Sr-90+Y-90 type BIS-40 (according to GOST 26306-84) in accordance with MU 2.6.1.56-2002 [3]. The detector was previously wiped with ethyl alcohol and dried. Then placed on a loading substrate. The time spent by the detector in the radiation source equivalent to the absorbed dose of beta-radiation (30 sec = 0.5 rad).

Measurement of indications of detectors. Measurement of indications of detectors was taken on DVG-01 installation (NPP DOZA) by the technique given in [4]. Before carrying out measurement carefully wiped with a gauze tweezers, quartz glass and also byuksa in which detectors were located. During the work with detectors avoided hit on them direct sunlight and luminescent radiation. The detector was immersed on a nickel substrate covered with quartz glass for more dense contact of the detector with a heating element. Registration of a thermoluminescence was carried out with a linear speed of heating of 4 °C/sec. in the temperature range of 100-270 °C; values of a light output were written down at the following temperatures: 100, 150, 200, 225, 250, 270 °C [4]. Measurement was taken the matrixes both irradiated, and not subjected to radiation for measurement of own background of material. On the obtained data built curve thermohighlightings.

Thermoannealing of matrixes. For reuse of the measured detectors and also for assessment of thermal stability of matrixes thermoannealing is carried out them at a temperature of 290 °C within one hour. Detectors are placed in one layer between plates ftoroplasta-4 brands A 15 mm thick which then are pulled together with small effort by metal plates 5 mm thick and are located in a thermocase. After annealing time detectors cool in a thermocase up to the temperature ≈ 100 °C, then cool them on air to the room temperature (20 – 25 °C), and later take from plates.

3. Results and Discussion

The choice of polymer for the matrix of thermoluminescent dosimeters. The main disadvantage of the currently used polyimide matrices is the insufficient light transmittance of the polymer.

Figure 1 shows the light transmission of the polyimide matrix currently used in LLC NPP "DOSE" [1]. The film transmits light in the range from 480 to 700 nm, and the maximum light transmission does not exceed 75 %. Changes in light transmission after exposure to a dose of 5000 rad is not observed. The temperature resistance of the matrix has been confirmed by long-term tests.

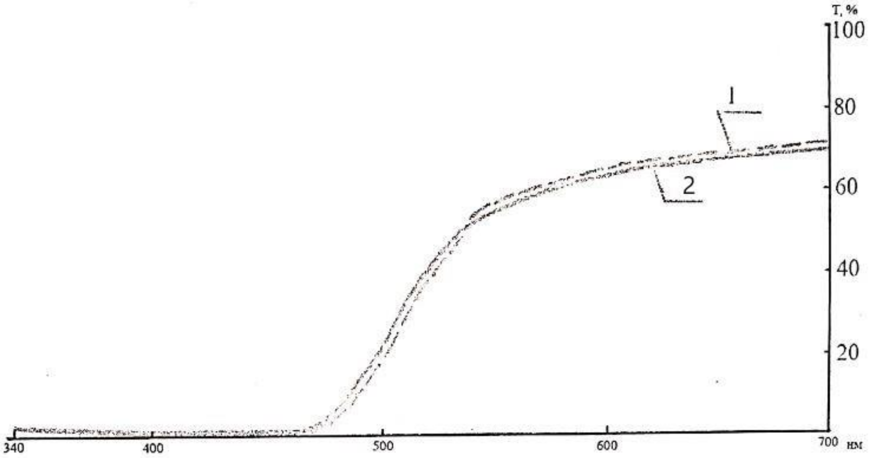

Figure 1. The light transmittance of polyimide films
1 – the original film; 2 – film after irradiation dose of 5000 rad

Therefore, when choosing polymers, the determining criterion is to obtain satisfactory optical characteristics of the polymer.

We should not forget that in conjunction with the optical properties of the matrices are important indicators such as heat resistance and radioactive stability of polymers.

Therefore, the choice of polymer was filmed transmittance of polyimide, polyamidoimide and polyarylate films without thermolaminated in three cases:

- after preparation of films;
- after thermal ignition for two hours;
- after exposure to a dose of 5000 rad

Figure 2 shows the transmittance of poly-m-phenyleneterephthalamide film. As can be seen from the figure, a sharp increase in the transmittance starts at about 360 nm, to 440 nm reaches 70%, after which the coefficient changes practically does not occur. Transmission before and after radiation dose of 5000 rad have the same character. A small decrease (1-5%) in light transmission may be due to ionization of residual amounts of N,N-dimethylformamide in the polymer. A significant increase in the light transmission coefficient after thermal ignition is likely due to the removal of the solvent from the polymer structure.

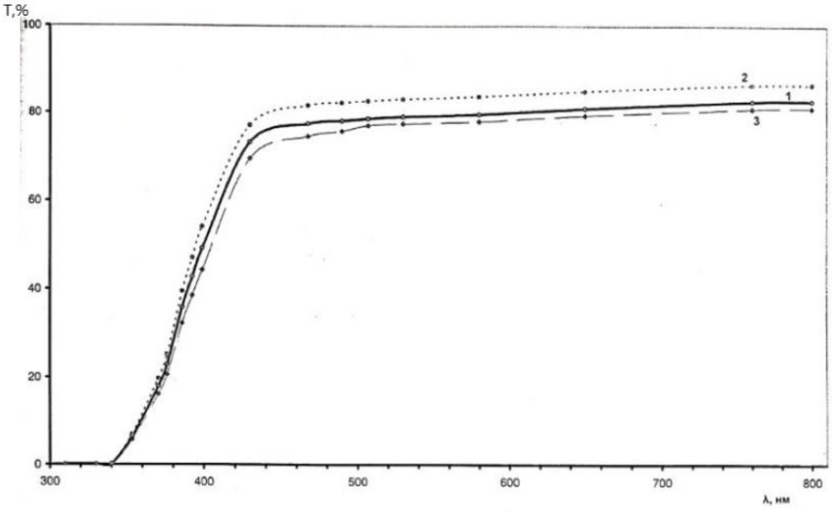

Figure 2. The light transmittance
of poly-m-phenyleneterephthalamide films
1 – the original film; 2 – film after thermal ignition;
3 – film after irradiation dose of 5000 rad

Light transmission of a polyamidimide film of the Torlon brand is shown in figure 3. The increase in transmittance starts at about 450 nm, by 520 nm the change becomes less intense and by 700 nm it becomes constant. As can be seen from figure 3, changes in light transmission before and after irradiation with a dose of 5000 rad are insignificant, which indicates the resistance of the polymer to radiation. The increase in light transmission after termatika is probably for the same reasons as in the poly-m-phenyleneterephthalamide films - removal of solvent from the structure of the polymer.

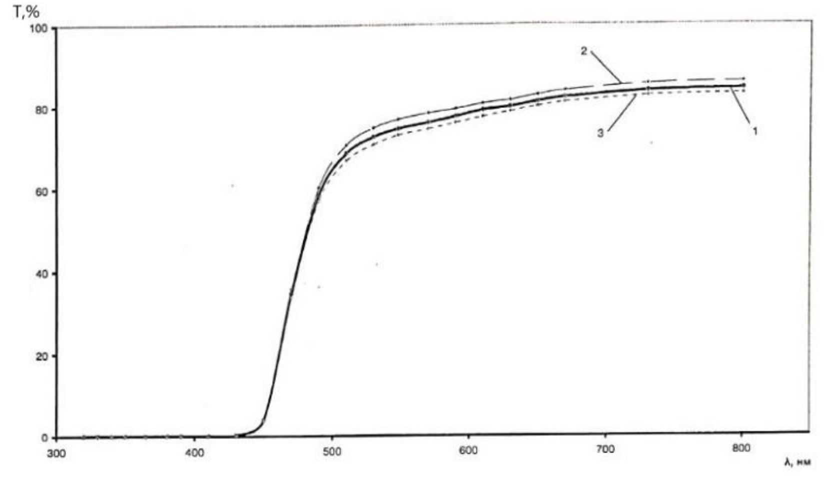

Figure 3. The light transmittance of polyamidimide films of Torlon brand
1 – the original film; 2 – film after thermal ignition;
3 – film after irradiation dose of 5000 rad

Figure 4 shows the light transmission of polyarylate film grade FV-1. Figure 4 shows that a sharp increase in the light transmission coefficient begins at about 330 nm and reaches 80% by 500 nm. This indicates the excellent light transmission ability of the film in the entire visible range of light.

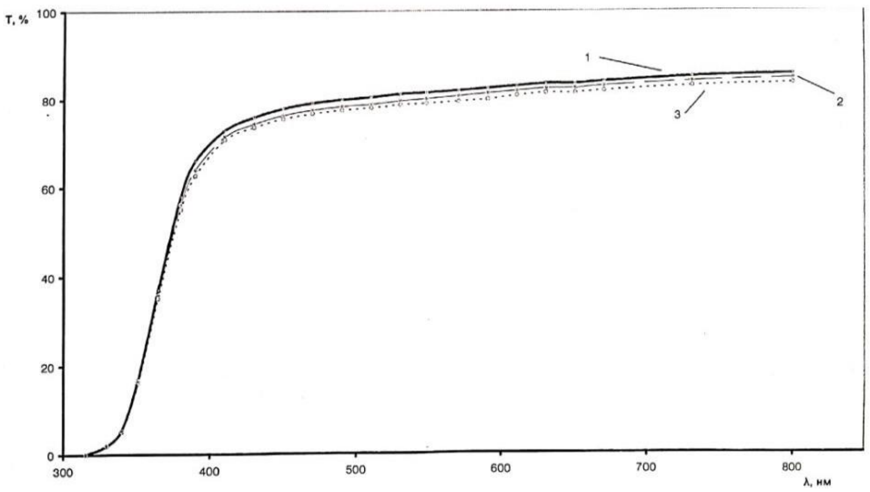

Figure 4. The light transmittance of polyarylate films of FB-1 brand
1 – the original film; 2 – film after thermal ignition;
3 – film after irradiation dose of 5000 rad

Noticeable change in the curves of light transmission after termatika and after irradiation is not detected. Resistance to such harsh conditions makes it possible to use this polymer for matrices of thermoluminescent dosimeters.

Light transmission of polyarylate DV film is shown in figure 5. The intensive increase in the transmittance starts at about 320 nm, to 420 nm reaches 80 %. At 700 nm, 85% light transmission occurs. As can be seen from figure 5, there are no changes in light transmission after irradiation with a dose of 5000 rad, which indicates the resistance of the polymer to radiation. After the thermal ignition of the film, its geometric dimensions changed, a haze appeared, which eventually affected its optical characteristics (see figure 5, curve 2). Insufficient heat resistance of polyarylate of DV makes it impossible to use it as a matrix in the field of thermoluminescent dosimetry.

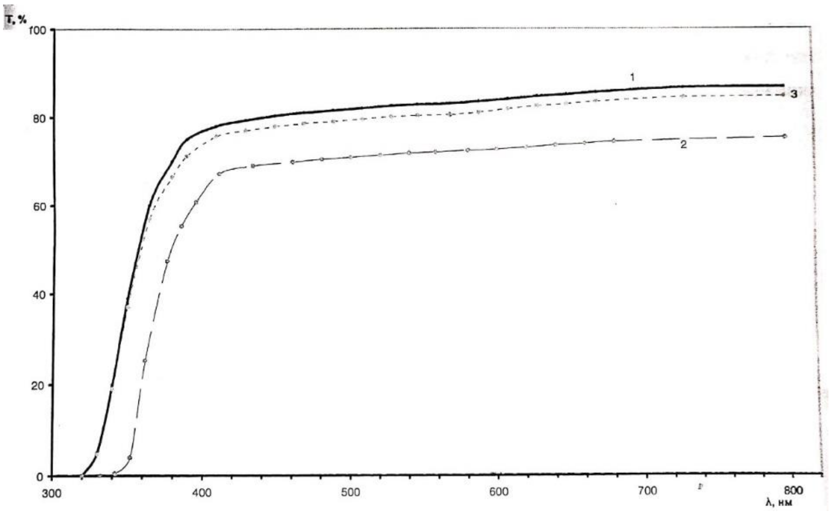

Figure 5. The light transmittance of polyarylate films of DV brand
1 – the original film; 2 – film after thermal ignition;
3 – film after irradiation dose of 5000 rad

When choosing the matrix found that films of poly-m-phenyleneterephthalamide and Torlon are quite resistant to heat treatment and radiation. The change in light transmission after the first heat treatment does not occur in subsequent cycles. Polyarylate films of the FV-1 brand proved to be resistant to radiation and thermal effects, with no noticeable changes in light transmission. Insufficient heat resistance of polyarylate of DV makes it impossible to use it as a matrix in the field of thermoluminescent dosimetry. It is essential that the light transmittance of the above polymer films above polyimide.

The choice of the optimal concentration of polymer in the solution. Selection of optimal concentration of the polymer is associated with the dependence on the viscosity, and as a consequence, different uniformity in the volume of the solution and the time of deposition of thermolaminated. There are two fundamentally different possibilities of finding thermolaminated in the polymer solution [1]. The first is the formation of agglomerates of thermolaminated, despite the long process of homogenization, which leads to wide variation in the sensitivity area of the film. The second case is the formation of a disperse system with a uniform distribution of the filler (thermolaminated). But there are a number of difficulties associated with the deposition of particles thermolaminated during deaeration to remove air bubbles. This process is schematically shown in figure 6.

Ideally, the time of complete removal of air bubbles $\tau_{\text{в}}$ should be much less than the time of complete deposition of the thermoluminophore $\tau_{\text{ТЛ}}$ ($\tau_{\text{в}} << \tau_{\text{ТЛ}}$). Therefore, for the optimal selection of polymer concentrations in the solvent, three factors must be taken into account:

- the time of deposition of the polymer;
- the time of deaeration;
- ability to create agglomerates

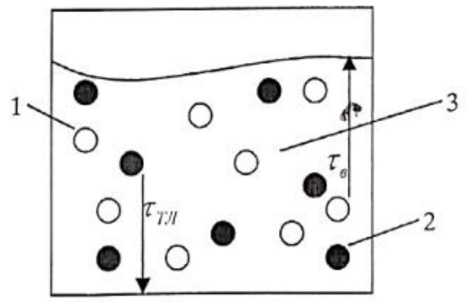

Figure 6. The scheme of processes of aeration and sedimentation thermolaminated in the polymer solution

1 – air bubbles; 2 – particles thermolaminated; 3 - polymer solution;

$\tau_в$ - time of complete removal of bubbles air;

$\tau_{ТЛ}$ - time full deposition thermolaminated

Table 1 shows data on the rate of sedimentation of thermolaminated phosphorus and deaeration of polymer solutions.

Table 1

The sedimentation rate of thermolaminated and de-aeration of polymer solutions

System «polymer/solvent»	Polymer concentration, %	The time of deaeration, h	The deposition time, h
Poly-m-phenyleneterephthalamide/ N,N-dimethylformamide	10	4	10
	16	7	15
	18	9	18,5
	20	12	23
	22	Agglomerates are formed	
	24	Agglomerates are formed	
Torlon/N,N-dimethylformamide	10	4	8
	16	7	14
	18	8	16
	20	9	19
	22	13	25
	24	Agglomerates are formed	
Polyarylate FV-1/ methylene chloride	10	1	12
	11	1,5	13
	12	1,75	17
	13	2	19
	14	Agglomerates are formed	
	15	Agglomerates are formed	

In figures 7-9 shows the dependence of time of aeration air and the time of deposition of thermolaminated on the concentration of polymer in the solution.

The largest difference in the speed of sedimentation processes of thermolaminated and deaeration air in the system poly-m-phenyleneterephthalamide – N,N-dimethylformamide (see figure 7) is observed in the concentration range from 19 to 25 %, and 9.5-11 hours.

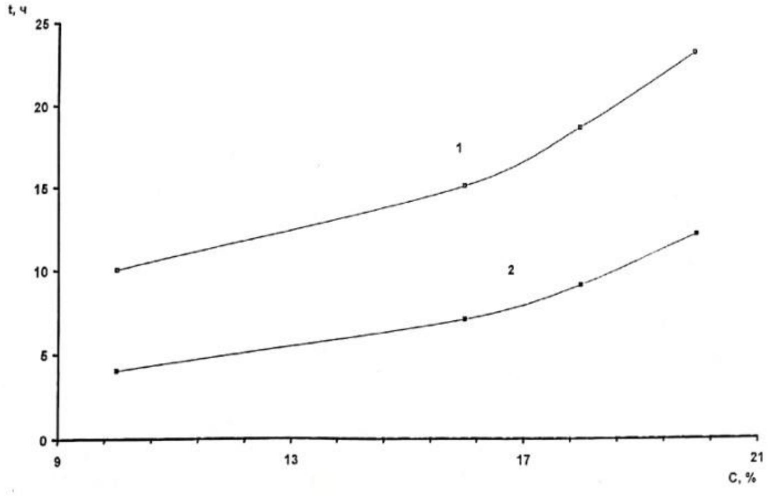

Figure 7. Based on the time of deposition
of thermolaminated (curve 1) and time de-aeration air (curve 2)
on the concentration of poly-m-phenyleneterephthalamide in solution

In the Torlon – N,N-dimethylformamide system (see figure 8), the processes of sedimentation and deaeration are similar to the previous system. Some difference in the speed of these processes is most likely due to the different molecular weight (specific viscosity) of polymers. The greatest difference in speeds is observed in the concentration range from 20 to 22 %, and is 10-12 hours.

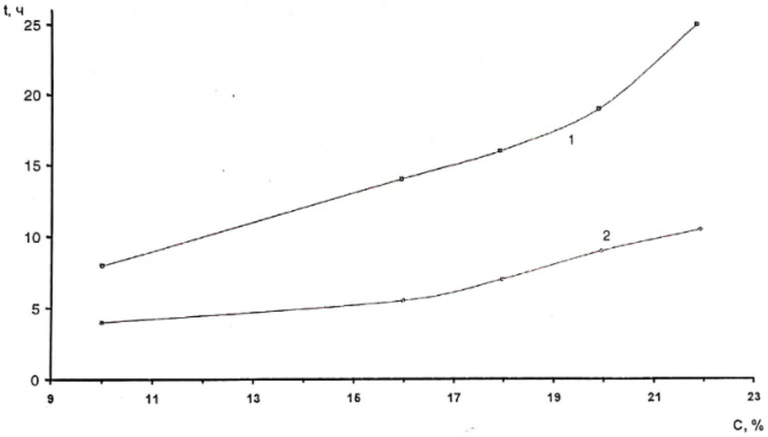

Figure 8. Based on the time of deposition
of thermolaminated (curve 1) and time de-aeration air (curve 2)
on the concentration of Torlon in solution

Slightly different nature of the processes of deposition thermolaminated and deaeration of the solution is observed in the system polyarylate FV-1 - methylene chloride (see figure 9). Polyarylate FV-1 is a more viscous polymer, so the shift of working concentrations occurs in the direction of reduction and is 10-15 %. And after adding to the solution more than 13% of polyarylate FB-1 starts to occur the formation of agglomerates of thermolaminated. The deaeration time in the system of polyarylate FV-1 - methylene chloride is negligible compared to the sedimentation time and can not have a significant effect on the uniformity of the thermoluminophore distribution in the matrix. This is largely due to the nature of the solvent and its low boiling point (boiling point ≈ 40 °C [2]).

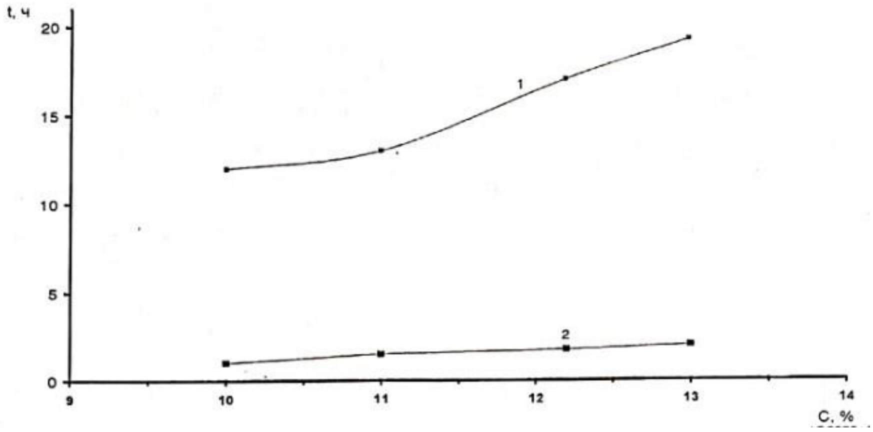

Figure 9. Based on the time of deposition
of thermolaminated (curve 1) and time de-aeration air (curve 2)
on the concentration of polyarylate FV-1 in solution

As a result of the studies, the optimal intervals of polymer concentrations in the solution were established. Both solvents used (methylene chloride and N,N-dimethylformamide) are quite volatile, and the polymer concentration can increase over time. It is, therefore, thermoluminescent detectors were used in the concentration of a slightly smaller maximum possible for these systems: for poly-m-phenyleneterephthalamide - 19 % for Torlon - 21% for polyarylate FV-1 - 12%.

Definition of own background of matrixes. Each substance emits electromagnetic waves in a wide range of wavelengths when heated. In dosimetry, such electromagnetic waves are called the substance's own background.

Determination of own background is an integral part of the development of thermoluminescent detectors, as it is one of the most important characteristics of measurement error. Therefore, several measurements of the pure matrix are carried out to highlight the energy stored by the substance.

To analyze the effect of ionizing radiation on the dosimeter matrix, the background was measured under two conditions:

- after thermal ignition;
- after exposure to a dose of 5 rad

Curves termomassazhnaya poly-m-phenyleneterephthalamide matrix shown in figure 10. The nature of the curve does not change after irradiation of the matrix. The intensity of luminescence before and after irradiation varies markedly, with a maximum difference (≈ 200 relative units) falls on the upper limit of thermoluminescence registration.

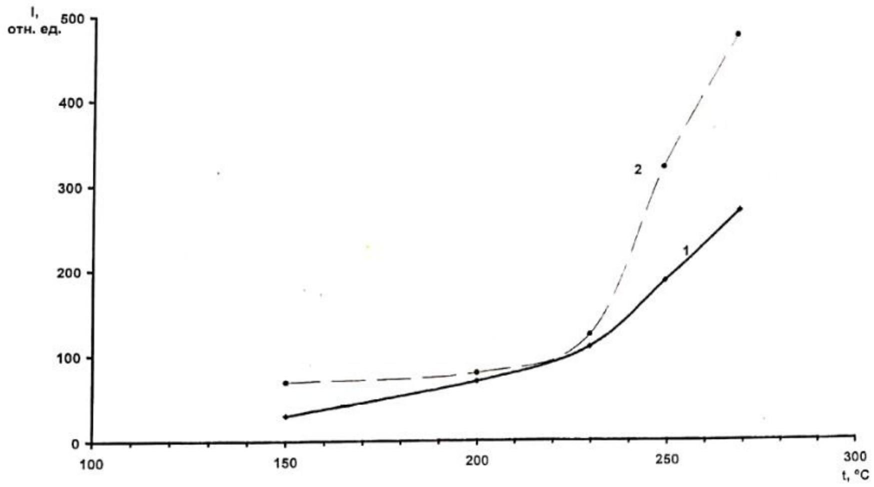

Figure 10. The dependence of their own background matrix
of poly-m-phenyleneterephthalamide temperature
1 – matrix after thermal ignition; 2 – matrix after radiation dose of 5 rad

Curves termomassazhnaya matrix of Torlon shown in figure 11. Own background matrices from Torlon significantly lower polyamide. This is probably due to more resistant polyamidoimide to external radiation and temperature and lower light-transmitting capacity of the matrix. The intensity of thermoluminescence at temperatures above 230 °C does not change after irradiation of the matrix; at temperatures below 230 °C, a noticeable peak appears at a temperature of about 200 °C.

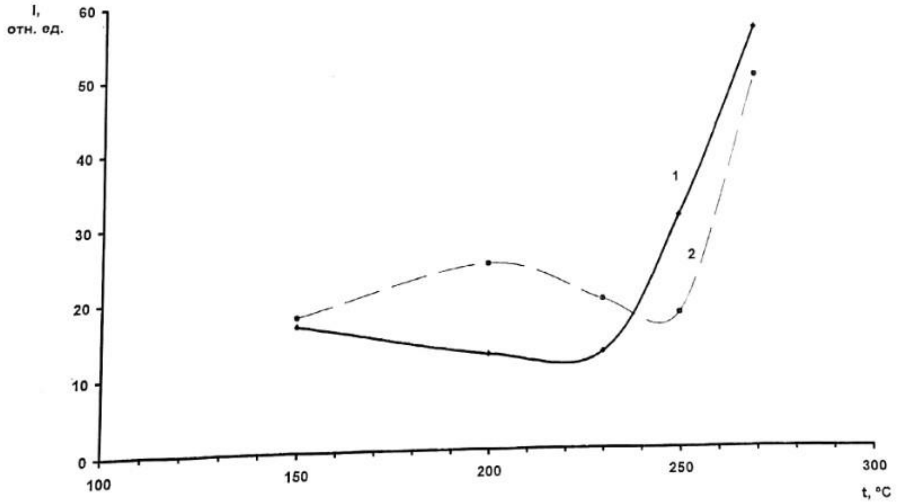

Figure 11. The dependence of their own
background matrix of Torlon temperature
1 – matrix after thermal ignition; 2 – matrix after radiation dose of 5 rad

The curves of thermal radiation of the matrix of polyarylate grade FV-1 are shown in figure 12. Background polyacrylate matrix several of the above matrix from Torlon. A significant difference is the peak at a temperature of 250 °C before and after irradiation of the matrix, and the difference in the intensity of the peak is ≈ 4-5 relative intensity units.

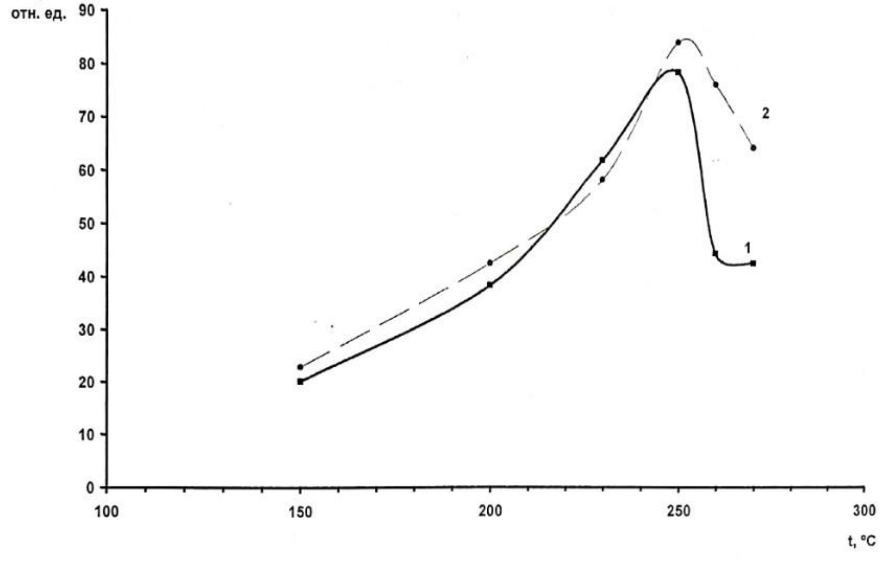

Figure 12. The dependence of their own
background matrix of polyarylate of FV-1 temperature
1 – matrix after thermal ignition; 2 – matrix after radiation dose of 5 rad

Table 2 shows the general data on the light sum of the background intensities of polymer matrices.

Table 2

The light sum of the background polymer matrix

Polymer matrix	Light sum, relative units		The increase of the light sum, %
	After thermal ignition	After irradiation (5 rad)	
Poly-m-phenyleneterephthalamide	479	749	56,3
Torlon	130	131	0,7
Polyarylate FV-1	289	352	21,8

From table 2 it is seen that the lowest sensitivity to irradiation shows a matrix of Torlon. The intensity of the background matrix of poly-m-phenyleneterephthalamide increases by more than half, and the light sum takes quite large values compared to the other matrices, which may affect the accuracy of determining radiation dose. The light sum of the background of the polyacrylate matrix after irradiation increases by 22 %. Presumably, such a change should not significantly affect the detector readings, since the light transmission of the polyarylate film is large enough.

Measurement of thermally stimulated luminescence. The construction of thermal emission curves of the detectors will allow to determine the dependence of the luminescence intensity on the heating temperature, and will also help to determine the role of the matrix in measuring the intensity of thermoluminescence.

The total light sum released during the heating process is a measure of the absorbed dose.

For a more accurate assessment of the absorbed dose, as well as to assess the contribution to the natural background of the thermoluminophor detector, measurements were made of both irradiated detectors and detectors that have passed the stage of thermal ignition.

In figures 13-15 shows the results of measurements of thermally stimulated luminescence detectors based on different polymer matrices and thermolaminated (magnesium tetraborate) after exposure to 5 rad.

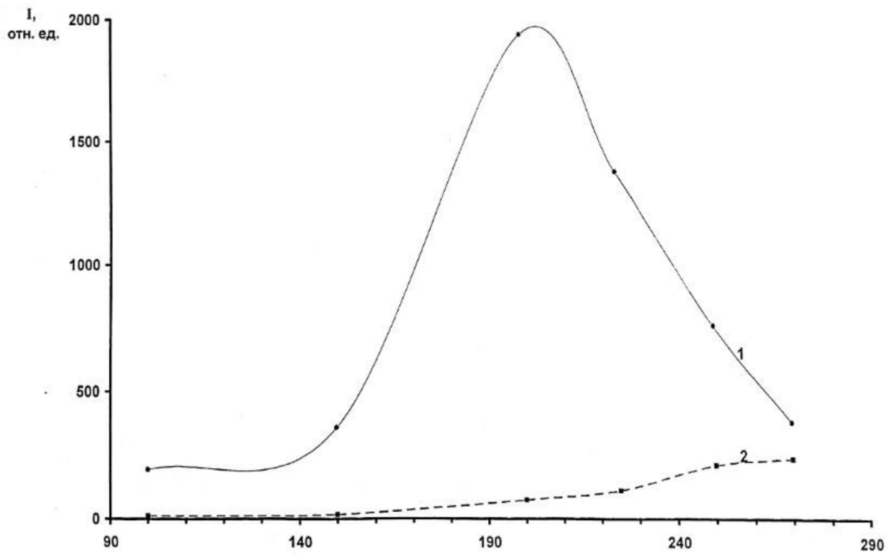

Figure 13. Curves termomassazhnaya (1) and own background (2) detectors based on poly-m-phenyleneterephthalamide and

magnesium tetraborate

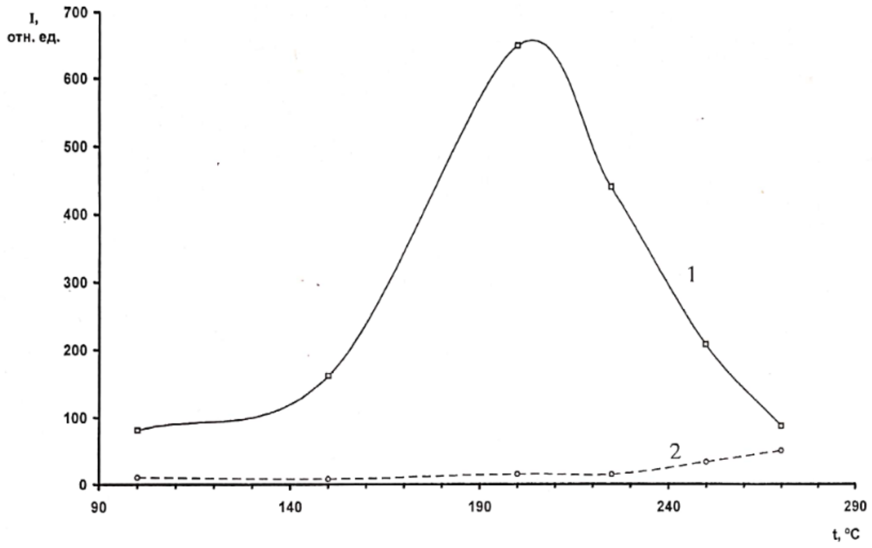

Figure 14. Curves termomassazhnaya (1) and own background (2) detectors based on Torlon and magnesium tetraborate

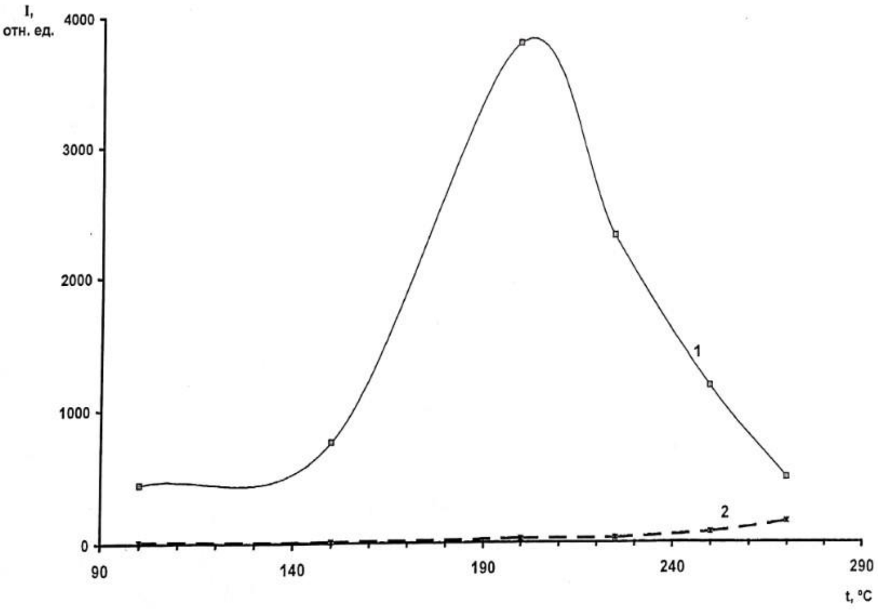

Figure 15. Curves termomassazhnaya (1) and own background (2) detectors based on polyarylate FV-1 and magnesium tetraborate

The thermal curves (curves 1) have the same character. Maximum light output is observed at a temperature of about 210 °C for each polymer matrix. Only its values are different, which is presumably due to the different light transmittance of the matrix. Changes occurred in the nature of the curve in the temperature range from 100 to 150 °C. If the integration of thermolaminated in polyarylate and poly-m-phenyleneterephthalamide matrix is characterized by a decrease of luminescence intensity, when using matrix-based Torlone such a peak is not observed, and the intensity grows slowly. This is probably due to lower sensitivity of the matrix on the basis of Torlon to the emission of light by termocomenergo.

The highest luminescence intensity was shown by detectors based on polyarylate grade FV-1 (table 3). Detectors based on Torlon showed a significantly lower intensity of illumination due to the low transmittance of the matrix, but their advantage is the high reproducibility of the results. After exposure to 5 rad poly-m-phenyleneterephthalamide detectors showed quite high results Svetovid, however, the measurement error is quite high and amounts to 20 %, which is associated with the ability of the matrix to ionization under the action of radiation.

Table 3

Sum light detectors on the basis of polyarylate FV-1 after exposure to 5 rad

Light sum, relative units	№ films	Poly-m-phenyleneterephthalamide	Torlon	Polyarylate FV-1
	1	5300	1610	9050
	2	5500	1635	8960
	3	4640	1652	9240
	4	4550	1643	9080
	5	5300	1637	8900
	average	4998	1635	9046

Table 4 shows estimates of the contribution of own background thermolaminated in the background of the polymer matrix. From table 4 it follows that the own background of thermolaminated negligible and accounts for 9-13 % of the background polymer matrix. This suggests that there is no significant interference with thermoluminescence.

Table 4

Evaluation of the contribution of own background thermolaminated in the background of the polymer matrix

Polymer matrix	Light sum, relative units		Background thermolaminated,	
	clean films	detectors	relative units	%
Poly-m-phenyleneterephthalamide	479	542	63	13
Torlon	130	143	13	10
Polyarylate FV-1	289	315	26	9

Calibration of detectors by beta radiation. For the practical application of detectors in dosimetry of external radiation it is necessary to build based on the readings of the detectors from the radiation dose, which needs to preserve the linear character throughout the range of detected doses.

It is important to note that to determine the minimum dose of radiation must be at least 500 relative units of the light sum. Table 5 shows the dependence of the luminescence intensity on the radiation dose.

Table 5

Dependence of luminescence intensity readings on radiation dose

Radiation dose, rad	Light sum, relative units		
	Poly-m-phenyleneterephthalamide	Torlon	Polyarylate FV-1
0,2	621	203	1122
0,5	1000	326	1975
1	1635	534	2951
5	4998	1633	9021
10	8194	2675	14791
130	56234	18359	123027
300	117489	38357	281838
940	354813	115838	912011
1370	602559	196722	1258925
2150	933254	288403	1905461
3000	1513561	494143	3019952
5000	2454708	801406	5128614
10000	3235936	1202264	6606934

On the basis of the data obtained (see table 5), we construct graphs of the detector readings on the radiation dose (figures 16-19).

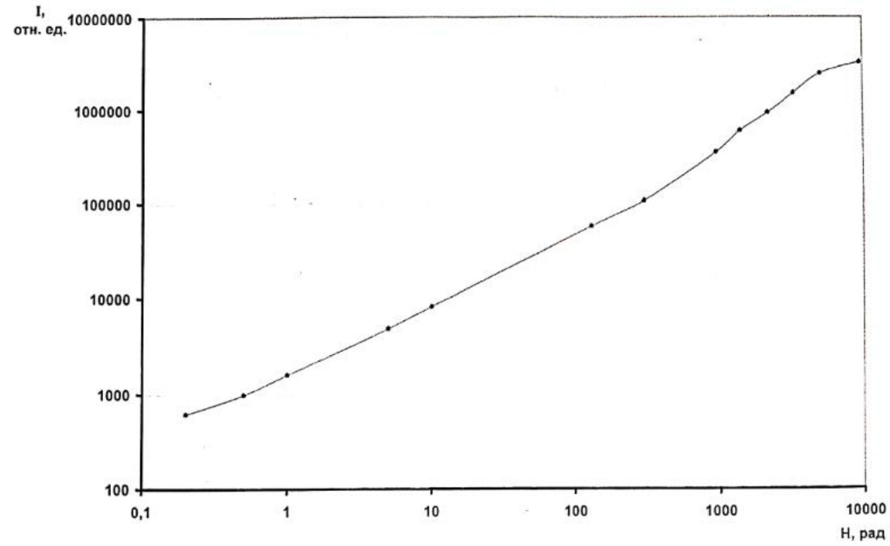

Figure 16. Dependence of detector readings on the basis of poly-m-phenyleneterephthalamide dose radiation

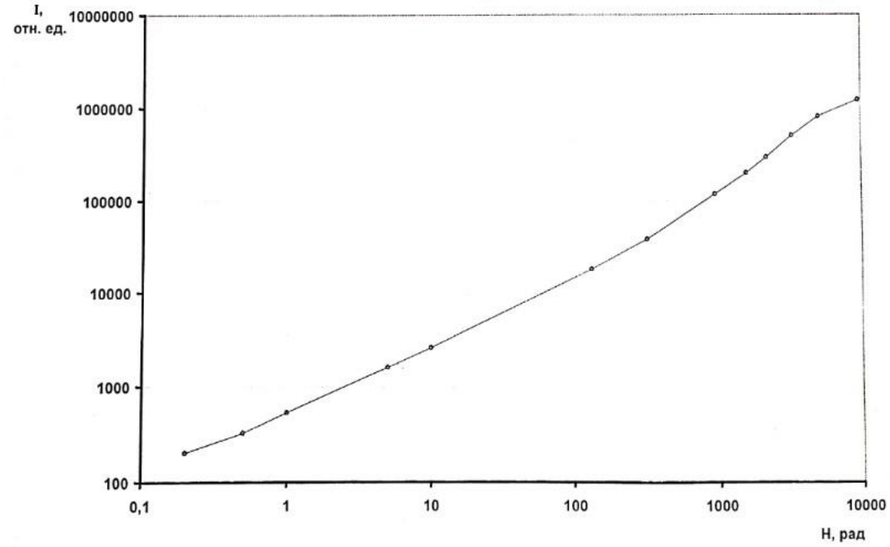

Figure 17. Dependence of detector readings on the basis of Torlon dose radiation

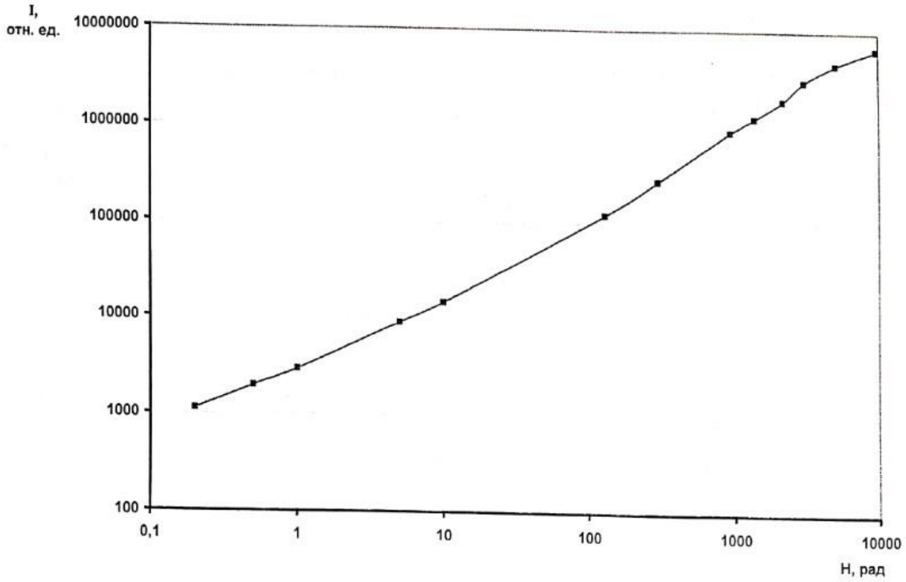

Figure 18. Dependence of detector readings on the basis of polyarylate FV-1 dose radiation

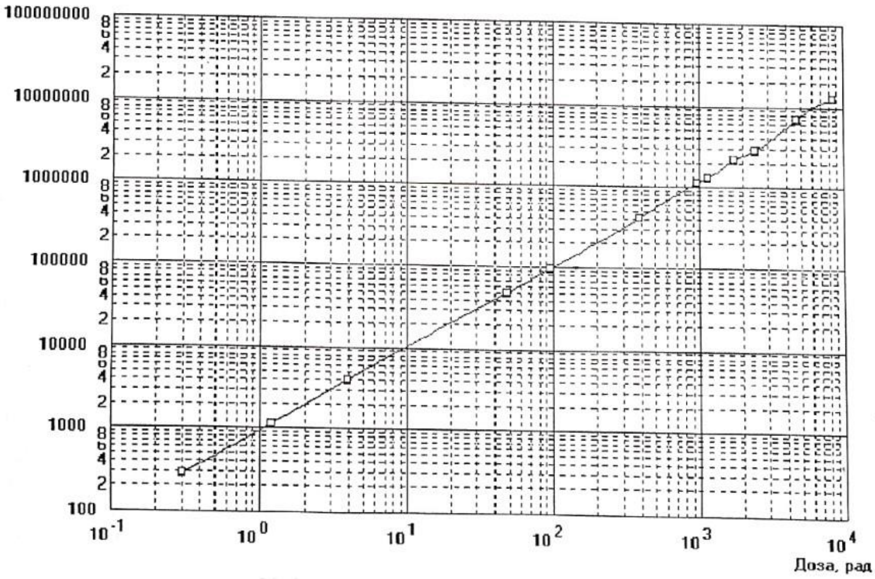

Figure 19. Dependence of detector readings on the basis of polyimide PM-1 dose radiation

From figure 16 it is seen that the minimum detectable dose of detectors with a matrix of poly-m-phenyleneterephthalamide equal to 200 mrad. However, the nature of the curve has deviations from the linear dependence already at a dose of 200-500 rad, which makes such a system unsuitable for large doses of radiation.

The minimum determined dose of detectors based on Torlon does not exceed 1 row (see figure 17), which makes them unsuitable for measuring small doses of radiation. The dependence remains linear in nature over a dose of 3000 rad, which makes it possible to use such detectors in emergency situations at high doses of radiation.

For detectors based on polyarylate grade FV-1 (see figure 18), the minimum determined radiation dose is limited to 150-200 mrad, since there is a risk of overlaying the natural background of the Earth when measuring lower doses [5]. The dependence remains linear up to 2000 rad. This wide range of measuring doses of radiation makes these detectors are best suited for the work on the definition of chronic doses of radiation.

From the above data and reasoning we can conclude the following:

1) In the process was the resulting matrix on the basis of heat-resistant polymers: polyamides, polyarylates, polyamideimides. The contents of thermolaminated (magnesium tetraborate) was 20% by weight of the polymer.

2) The light transmission ability of matrices in the range of wavelengths 300 to 800 nm was Investigated, and the thermal stability of the matrices was estimated. It was found that the highest light transmittance have matrix based on polyarylate FV-1, which reaches 85 %, and there are no changes in light transmission under the influence of temperature and beta-radiation in 5000 rad. Light-transmitting ability of poly-m-phenyleneterephthalamide matrix reaches 83 % and does not change under the action of radiation. Matrix-based Torlone have a lower light-transmitting capacity, however, resistance to irradiation shown them the same polyarylate FV-1. The increase in light-transmitting ability after termatika poly-m-phenyleneterephthalamide and Torlon is due to incomplete removal of solvent from the structure of the polymer. It is important that the light transmission capacity of the obtained thermoluminescent polymer films is higher than that of polyimide films.

3) Study the choice of optimal conctions of polymers with the purpose of uniform distribution of thermolaminated in solution. It was found that when using polyarylate FV-1 of aeration is small and cannot significantly influence the uniformity of thermolaminated. Were selected optimal concentration of the polymers: poly-m-phenyleneterephthalamide 19% and Torlon - 21%, polyarylate FV-1 - 12%.

4) Studies of the own background of polymer materials, as well as the effect of beta radiation on the background change. The curves of thermal radiation before and after irradiation of the polymer matrix with a dose of 5 rad were constructed. It was found that the most significant effect of beta radiation has on the background of poly-m-phenylenterephthalamide matrices (increase in light output exceeds 50 %); and on the background of matrices based on FV-1 (increase in light output of about 22%). Beta radiation has no noticeable effect on the luminescent properties of polymer matrices from Torlon.

5) The thermally stimulated luminescence detectors based on the above matrices (poly-m-phenyleneterephthalamide, Torlon and polyarylate FV-1). It was found that the use of different polymer matrices does not lead to a change in the nature of the thermal radiation curve, but has a noticeable effect on the luminescence intensity due to the different light transmittance of the polymer matrix itself. Most svetoveho showed that detectors based on polyarylate FV-1 after exposure to 5 rad (≈ 9000 relative units). Svetoveho detectors after doses of 5 rad based on poly-m - phenyleneterephthalamide amounted to ≈ 5000 relative units, and detectors based on Torlon - ≈ 1600 relative units.

6) The detectors were calibrated by beta-radiation in a wide range of doses from 200 mrad to 10000 rad. Were set the limits of the designated doses of radiation: detectors based on poly-m-phenyleneterephthalamide they be 0.2 - 200 rad, on the basis of Torlon - 5 and 3000 rad, and on the basis of polyarylate FB-1 from 150 to 3000 rad.

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