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DETERIORATION OF FIBROUS MATERIALS BY ULTRAVIOLET LIGHT

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Directorate of Materials and Processes
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Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

45 YEARS OF MATERIALS PROGRESS
SAPPHIRE ANNIVERSARY

Project No. 7320, Task No. 73203

(Prepared under Contract No. AF 33(616)-7701
by the Southern Research Institute, Birmingham, Alabama;
Charles V. Stephenson, William S. Wilcox, Henry T. Crenshaw,
Hassel L. Hancock, and Edward B. Dismukes, authors.)

NOTICES

FOREWORD

This report was prepared by Southern Research Institute, Birmingham, Alabama, under Contract AF 33(616)-7701, Project No. 7320, "Fibrous Materials for Decelerators and Structures," Task No. 73203, "Organic and Inorganic Fibers." This is the third annual report. The work was administered under the direction of the Directorate of Materials and Processes, Aeronautical Systems Division, Deputy for Technology, Wright-Patterson Air Force Base, Ohio, with Mr. Lewellyn G. Picklesimer as project engineer.

This report describes work conducted from December 15, 1961, through December 15, 1962.

ACKNOWLEDGMENT

Chemical analyses were made by Dr. W. C. Coburn, Jr., and Miss Virginia Jackson. The thiazole polymer was prepared under the direction of Dr. W. C. Sheehan.

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ABSTRACT

This report discusses primarily the effects of ultraviolet light on the tensile properties of four polymeric materials — polyethylene terephthalate (Dacron), polybenzimidazole, a thiazole polymer, and a du Pont experimental material designated as HT-1.

Among these materials, exceptions were found to the usual trend that degradation is more severe the shorter the wavelength of light. These exceptions are discussed in terms of an absorption of light near the surface of the material that, in effect, prevents the interior from being irradiated.

Among materials studied, those that are known to contain hydrogen are more susceptible to irradiation damage in an oxygen atmosphere than in a nitrogen atmosphere or in a vacuum.

This technical documentary report has been reviewed and is approved.

C. A. Willis

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Fibrous Materials Branch
Nonmetallic Materials Laboratory
Directorate of Materials and Processes

TABLE OF CONTENTS

DETERIORATION OF FIBROUS MATERIALS BY ULTRAVIOLET LIGHT

I. INTRODUCTION

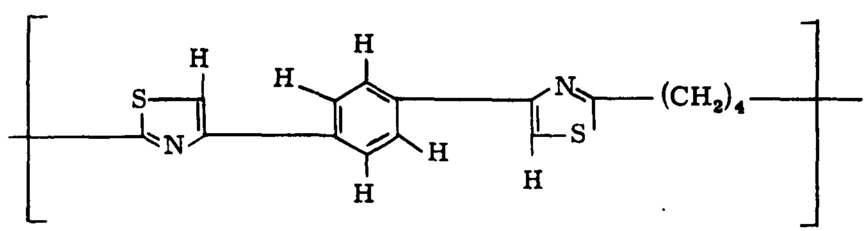
This is the third annual report of research on the effects of ultraviolet light on fibrous materials.† Preceding reports, which have been published as WADD-TR-60-510 and ASD-TR-61-730, discussed work on the following materials: polyethylene, nylon, Mylar, Teflon, Acrilan, Dacron, Fiberglas, fused silica, and HT-1.

The materials discussed in this report are described in Table 1.

Table 1. Materials Irradiated with Ultraviolet Light

Polymer	Form	Source
Polyethylene terephthalate (Dacron)	Fiber, 4.4 denier	du Pont
HT-1 (experimental material)	Fiber, 2.0 denier	du Pont
Polybenzimidazole	Fiber, 8.0 denier	du Pont
Thiazole polymer*	Film, 0.5 mil	Southern Research Institute
Thiazole polymer*	Fiber, 8.3 denier	Southern Research Institute

* This material was prepared by the polymerization of p-bis(bromoacetyl) benzene and adipodithioamide. In the polymer, the repeating unit is



† Manuscript released by the authors December 1962, for publication as an ASD Technical Documentary Report.

The experimental conditions under which these materials were irradiated were varied with respect to the wavelength of the light, the amount of incident energy, and the atmospheric environment. After the materials were irradiated, the following tensile properties were determined: tensile strength, Young's modulus, and elongation at break. The chemical effects produced by irradiation were studied for some of the materials by determining the amount of gel and by analyzing the volatile products that were formed.

II. EXPERIMENTAL APPARATUS AND PROCEDURES

The experimental apparatus and procedures were described in detail in WADD-TR-60-510 and ASD-TR-61-730 and are described only briefly here.

Two types of radiation sources were used. One was a G30T8 lamp which is a low-pressure mercury arc that emits 90% of its radiant energy at 253.7 mμ and is, in effect, a monochromatic source. The other source was an A-H6 lamp, which is a high-pressure mercury arc that emits a broad continuum of wavelengths. Bands of light centered at 244, 314, and 369 mμ were isolated from the A-H6 emission and used for irradiation of the polymers. The G30T8 lamp permitted the irradiation of large polymer samples and was used when chemical effects of irradiation were to be studied.

Tensile properties were determined with an Instron Tensile Tester. Tensile strength, as given in this report, is based upon the original cross-section of the sample. The elongation is the percentage by which the original length has increased at the breaking point. Young's modulus pertains to 4% elongation. As in ASD-TR-61-730, tensile strength and elongation data are presented graphically and are found in the main body of this report. All of the data on tensile properties are in the tables of the Appendix.

Gel formation was studied by determining the fraction of a polymer that was insoluble in a selected solvent. Volatile decomposition products were analyzed by gas chromatography.

Special sampling techniques were used with the polybenzimidazole and the thiazole polymer, both of which varied a good deal in uniformity from fiber to fiber and from segment to segment along an individual fiber.

All specimens of a fiber used for an irradiation experiment (consisting, for example, of irradiation for a specified time) were taken from a single fiber. This fiber was cut into a number of segments; every second segment was reserved for the control sample, and the others were irradiated. In preparing samples of film of the thiazole polymer, specimens were taken from the several sheets of material available for a control sample, and specimens were taken from different areas of a single sheet for a sample to be irradiated. Despite these efforts to minimize the effects of nonuniformity in the starting material, an unfortunate lack of reproducibility was encountered in tensile data within individual irradiation experiments. Also, data for several irradiation experiments showed considerable scatter from any consistent trend with the time of irradiation.

III. EXPERIMENTAL RESULTS

A. Dacron Fibers

Dacron fibers that were exposed in nitrogen to radiation at wavelengths of 244, 314, or 369 mμ from the A-H6 lamp showed the greatest deterioration in tensile properties for equal amounts of incident energy at the intermediate wavelength, 314 mμ, as shown by the data given in Figure 1. Most of the polymers that have been studied heretofore (including Mylar film, a polyethylene terephthalate material as Dacron fibers are) were degraded more extensively by irradiation with shorter wavelength energy.

At wavelengths below 314 mμ, absorption in Dacron fibers must increase greatly as it does in the chemically similar Mylar film (see WADD-TR-60-510). In the 4.4-denier (1.0-mil) Dacron fibers, the material at the interior of the fiber should be shielded from 244-mμ light more than from longer wavelength light and should be less degraded. On the other hand, in the comparatively thin 0.25-mil Mylar film that was studied previously, material at the interior would not be as well shielded from 244-mμ light. Therefore, the difference observed between Dacron fibers and Mylar film as the wavelength was varied might be expected. Similarly, the lesser deterioration of Dacron fibers than of Mylar film with the 253.7-mμ wavelength of the G30T8 lamp, which was discussed in ASD-TR-61-730, might be expected.

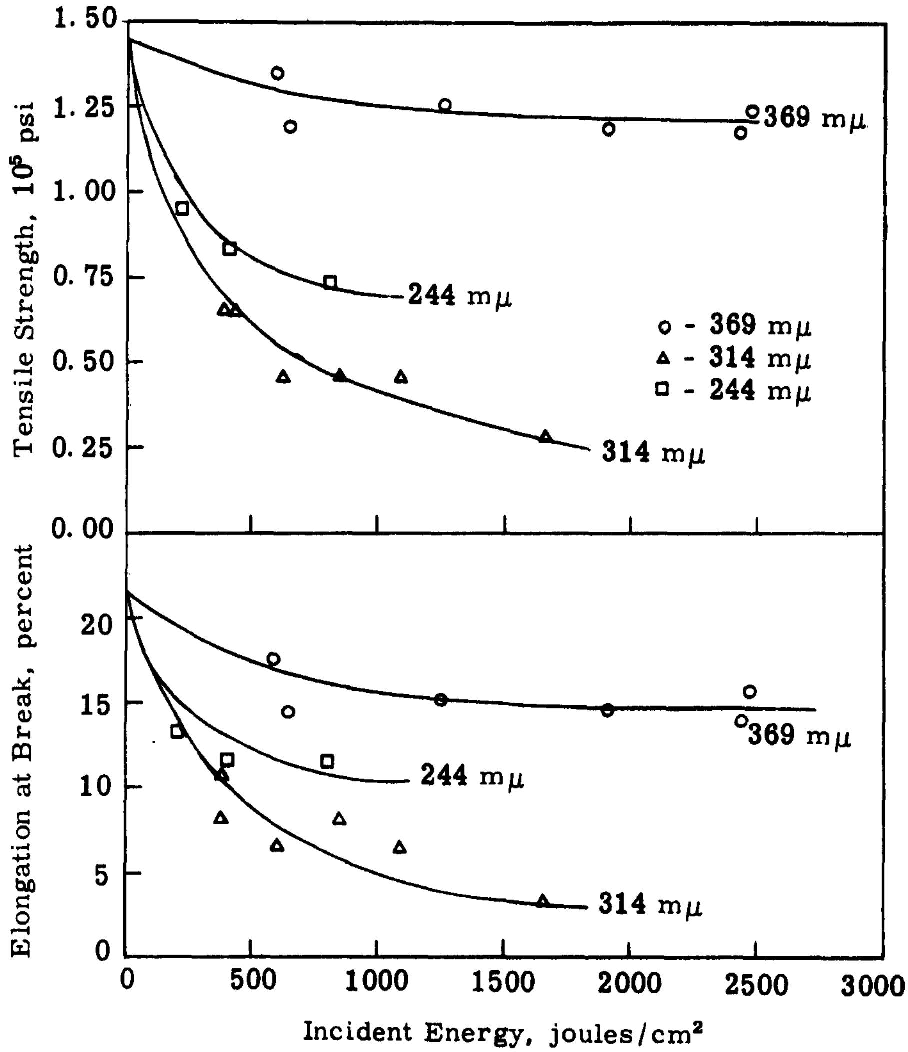


Figure 1. Effects on Tensile Properties of Dacron Fibers by Irradiation in Nitrogen with Light of Various Wavelengths.

No experiments were done to determine the effects of atmospheric environments on radiation damage to the tensile properties of Dacron fibers. However, Mylar was found to be much more rapidly degraded in oxygen than in nitrogen or vacua (see ASD-TR-61-730), and Dacron probably is affected in a similar way.

The chemical effects of the irradiation of Mylar and Dacron were discussed in ASD-TR-61-730.

B. HT-1 Fibers

It has been shown previously (see ASD-TR-61-730) that HT-1 fibers are degraded more rapidly by exposure to comparable amounts of incident energy at 369 mμ than at 314 or 244 mμ. Perhaps some type of absorption phenomenon similar to that noted for Dacron occurs, but no accurate absorption spectrum for HT-1 is available to support this argument.

HT-1 fibers that were irradiated at 253.7 mμ with the G30T8 lamp apparently were not affected differently in their tensile properties in atmospheres of nitrogen and oxygen and in vacua of 10^{-3} and 10^{-6} mm, as shown by Figure 2. HT-1 is the first polymer studied in our program that has not been degraded to different degrees as the environment was changed. No volatile products were detected during irradiation of the HT-1.

C. Polybenzimidazole Fibers

Polybenzimidazole fibers were deteriorated more rapidly by exposure to energy at a wavelength of 369 mμ than at 244 or 314 mμ. The data obtained at the different wavelengths are given in Figure 3. The transmission spectrum shown in Figure 4 tends to indicate that surface absorption at the shorter wavelengths affords self-protection of the type discussed for Dacron and HT-1.

Irradiation of polybenzimidazole fibers with 253.7-mμ light from the G30T8 lamp produced greater deterioration of tensile properties in oxygen than in nitrogen or in vacua, as shown by Figure 5. Irradiation in nitrogen produced effects in elongation that were intermediate between those in oxygen and in vacua.

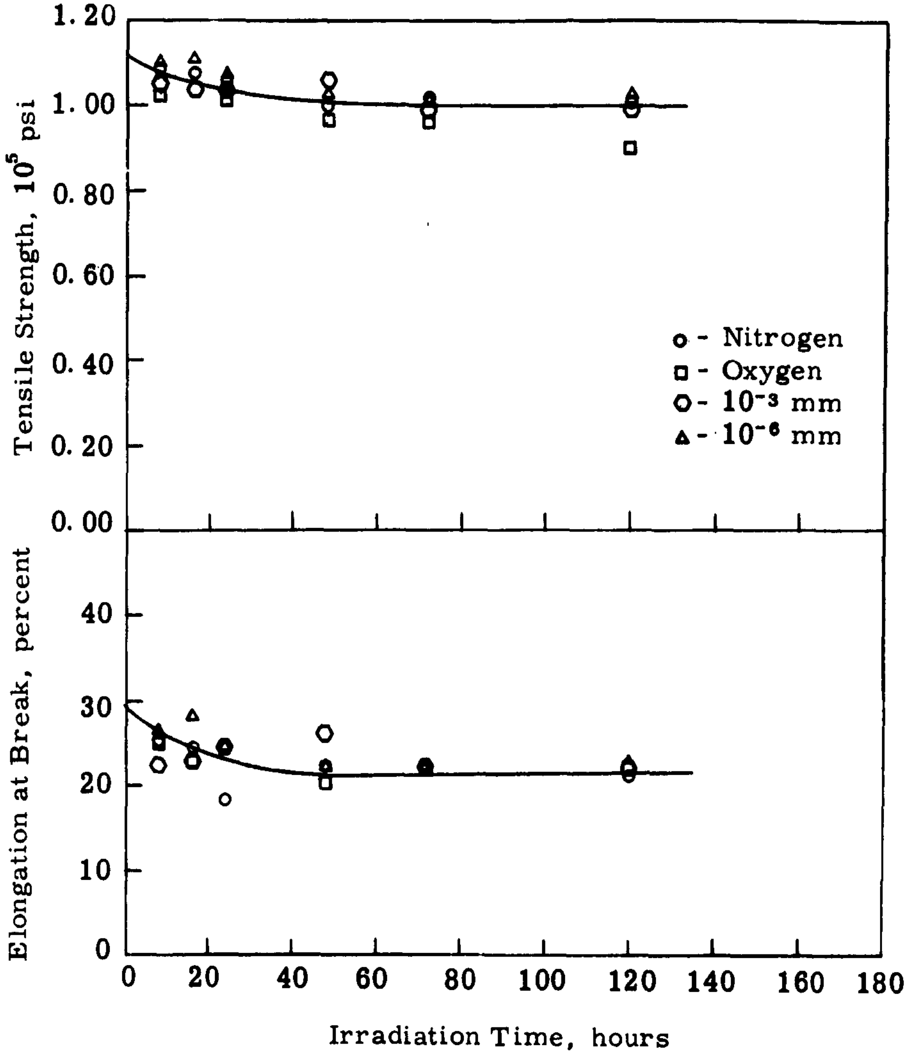


Figure 2. Effects on Tensile Properties of HT-1 Fibers by Irradiation in Various Environments with 253.7-mμ Light.

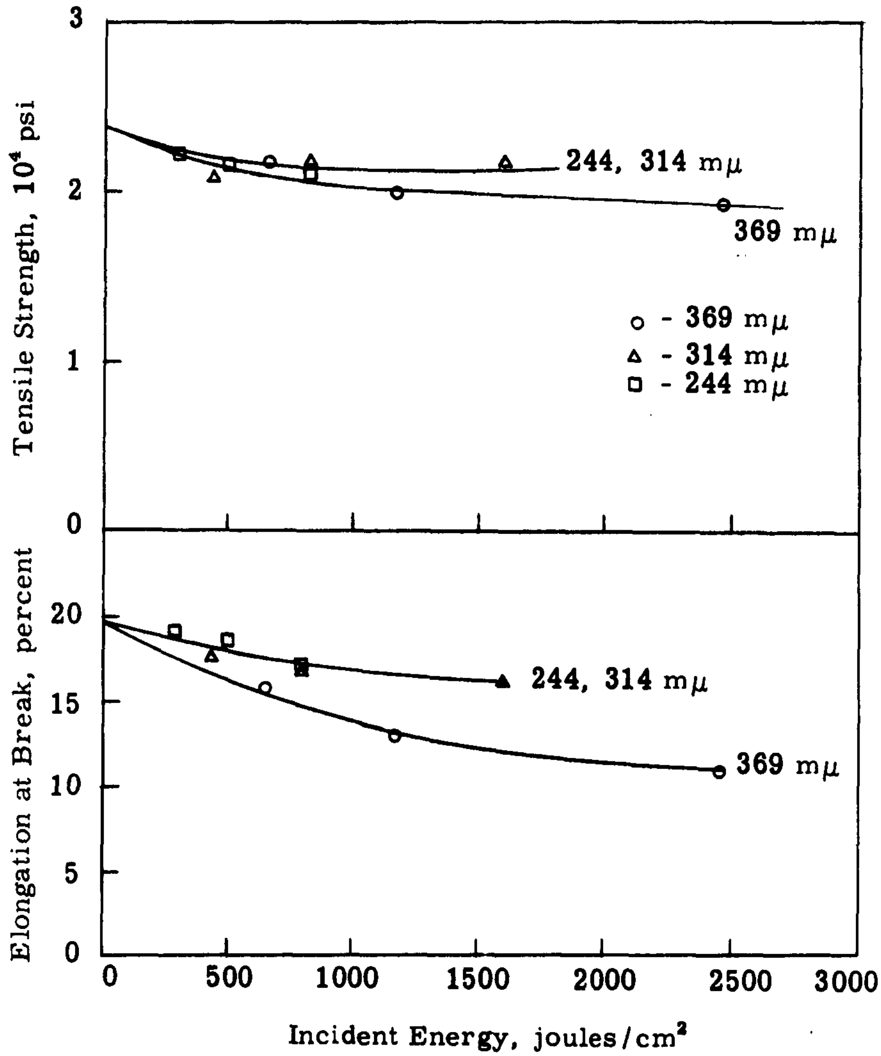


Figure 3. Effects on Tensile Properties of Polybenzimidazole Fibers by Irradiation in Nitrogen with Light of Various Wavelengths.

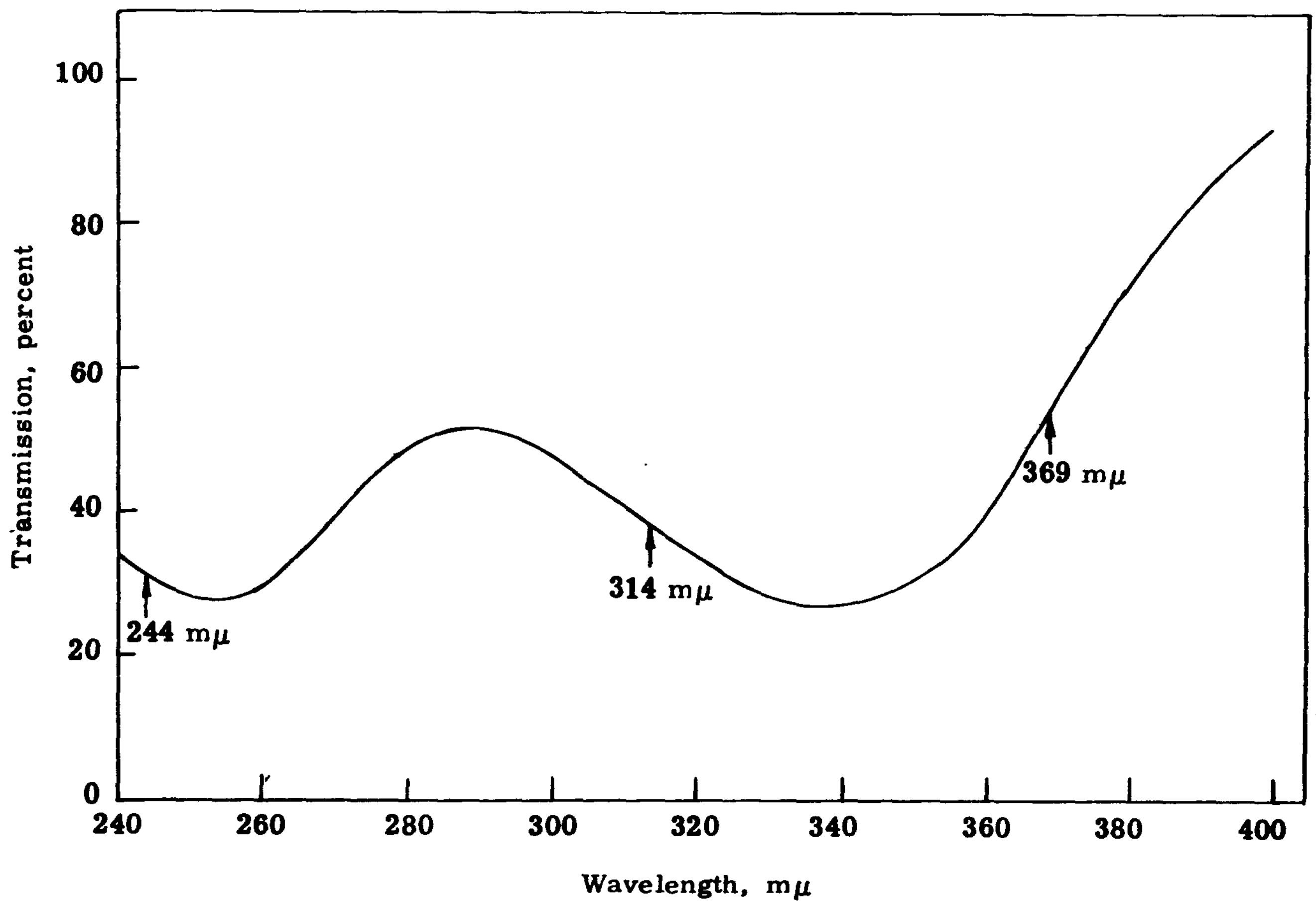


Figure 4. Transmission Spectrum of Polybenzimidazole at an Unknown Concentration in Dimethylsulfoxide and Ethanol.

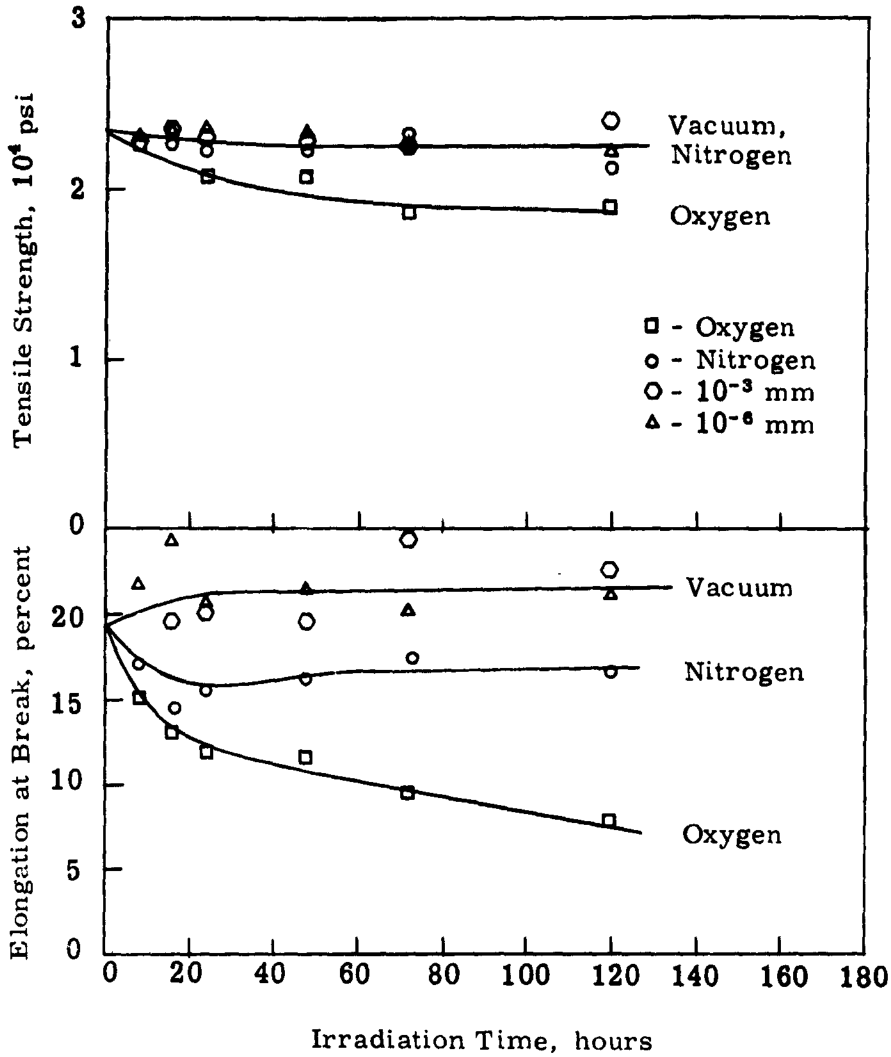


Figure 5. Effects on Tensile Properties of Polybenzimidazole Fibers by Irradiation in Various Environments with 253.7-mμ Light.

Some evidence for crosslinking in polybenzimidazole during irradiation is shown by the gel-formation data given in Table 2. These data were obtained by dissolving the polymer in dimethylsulfoxide, washing the insoluble portion or gel with dimethylsulfoxide and then methanol, and drying and weighing the residue. There was some gel or crosslinked material before irradiation, but there also was appreciably more gel formed during irradiation. Inconsistencies in the trend of gel formation with the time of irradiation can be attributed partly to nonuniformity of the original material. It is not possible to analyze these data in terms of the scission-to-crosslinking ratio, but there was little indication of chain scission during irradiation.

Table 2. Gel Formation in Polybenzimidazole Irradiated in Vacuo with 253.7-mμ Light

Irradiation time, hours	Percent gel*
0	3.1 ± 1.0
8	14.6 ± 2.0
16	11.3 ± 0.6
24	16.2 ± 1.8
48	35.5 ± 3.6
72	12.4 ± 3.6
120	21.8 ± 7.8

* Each value is the average of two or more determinations. Experimental deviations are indicated.

Definite information on volatile products of irradiation was not obtained. Oxygen was detected, but it cannot be attributed definitely to decomposition of the polymer rather than to an initial impurity in the system.

D. Thiazole Polymer

With this material, the only work to be reported is based upon irradiation of fibers and films in different atmospheres with the 253.7-mμ light from the G30T8 lamp. Tensile-property data are given, but no information on chemical effects of irradiation was obtained.

1. Fibers

Within the precision of the data obtained, which unfortunately left a great deal to be desired, fibers of the thiazole polymer appeared not to be affected differently in nitrogen, oxygen, and vacua. As shown by Figure 6, no loss of tensile strength due to irradiation was apparent, but some decrease in elongation appeared to take place.

2. Films

Films of the thiazole polymer, for which tensile-property data are given in Figure 7, showed a greater deterioration due to irradiation than did the fibers. From the greater damage that is produced in the film, it can be seen with fair certainty that deterioration of the thiazole polymer is most rapid in an oxygen atmosphere.

From the transmission spectrum of thiazole polymer that is presented in Figure 8, it seems possible to explain the greater deterioration in 0.5-mil film than in 1.2-mil (8.3-denier) fibers. The wavelength of the G30T8 lamp, 253.7 mμ, is highly absorbed by the polymer. Therefore, the thicker fibers should afford themselves more self-protection by surface absorption and should be less extensively affected by the radiation.

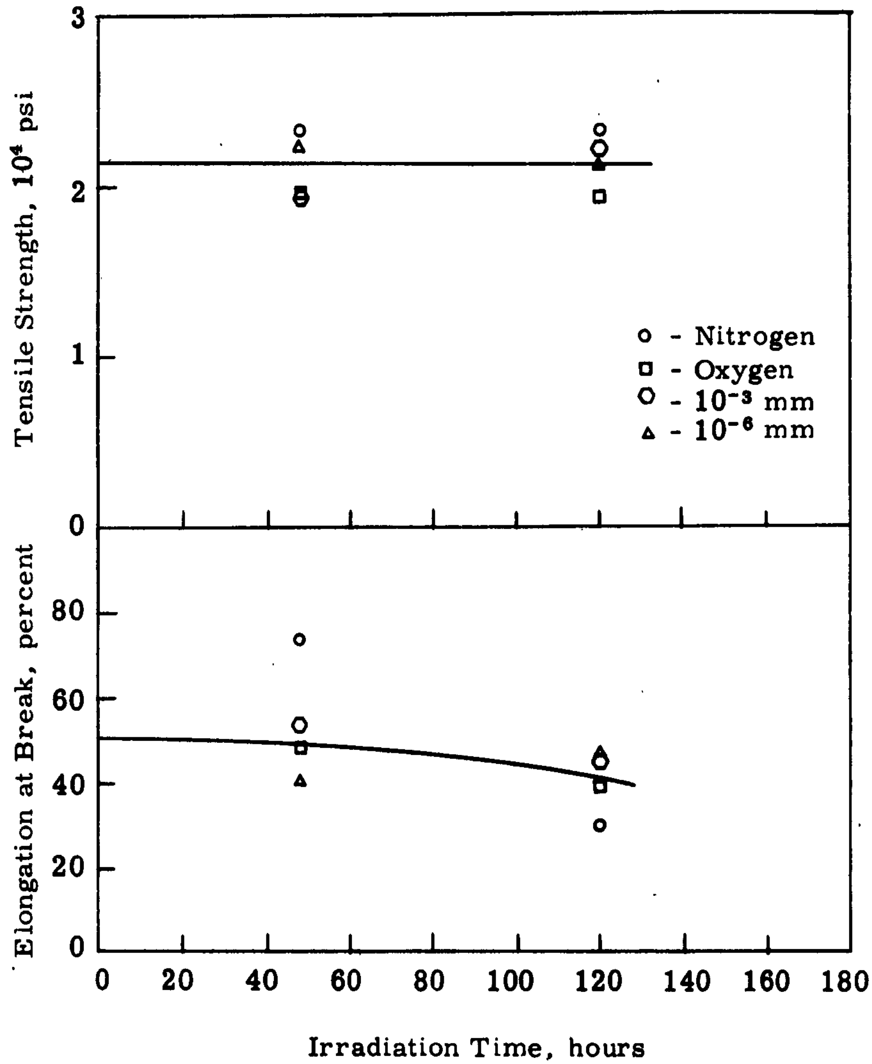


Figure 6. Effects on Tensile Properties of Fibers of Thiazole Polymer by Irradiation in Various Atmospheres with 253.7-mμ Light.

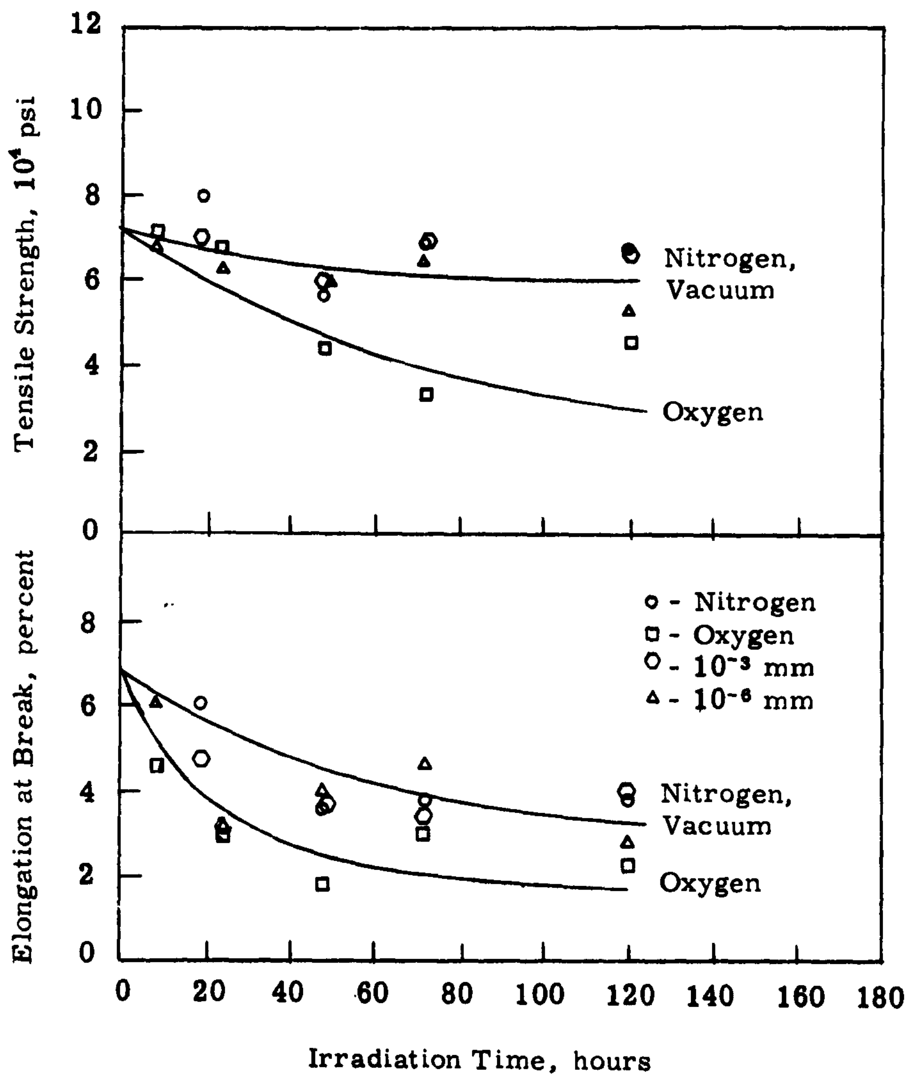


Figure 7. Effects on Tensile Properties of Films of Thiazole Polymer by Irradiation in Various Atmospheres with 253.7-mμ Light.

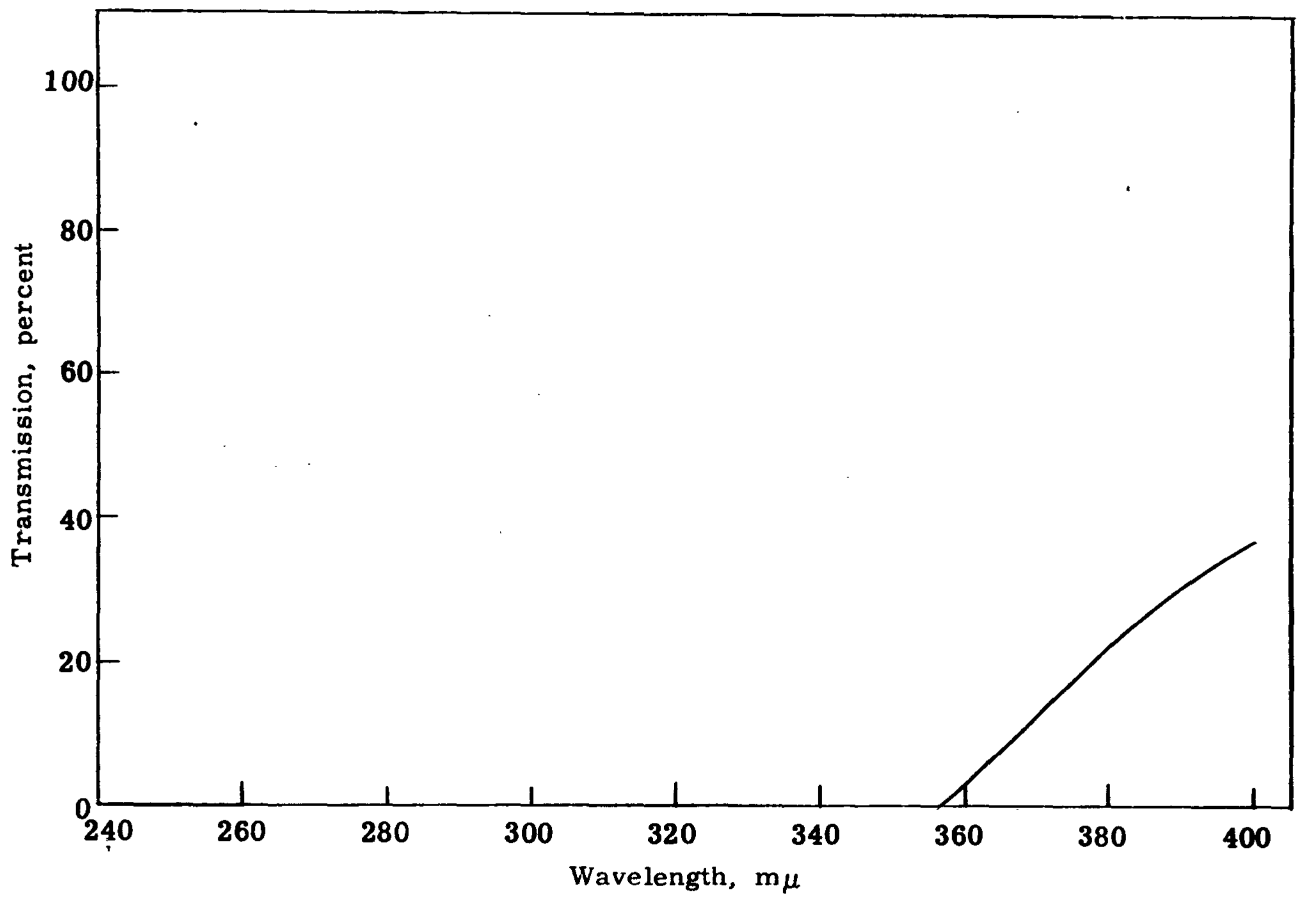


Figure 8. Spectrum of a 0.4-Mil Film of Thiazole Polymer.

IV. DISCUSSION

With three of the materials covered in this report, there are deviations from the trend of increasing deterioration on exposure to equal amounts of incident energy of decreasing wavelength that the polymers studied heretofore have shown. These deviations were encountered with Dacron fibers, HT-1 fibers, and polybenzimidazole fibers. The wavelength effect was not determined with the fourth material, a thiazole polymer. Lesser deterioration at shorter wavelengths can be interpreted as the result of self-protection when the fibers absorb the light in surface layers and remain unaffected at the interior.

The materials known to contain hydrogen — Dacron, polybenzimidazole, and thiazole polymer — have all shown greater deterioration in oxygen than in nitrogen or in a vacuum. This effect is consistent with the effects observed with other hydrogen-containing polymers, as discussed in WADD-TR-60-510 and ASD-TR-61-730. HT-1, for which the composition is not known, did not show a dependence upon the atmosphere present during irradiation.

APPENDIX

TABULATION OF THE TENSILE PROPERTIES OF IRRADIATED MATERIALS

Table 3. Effects on Tensile Properties of Dacron Fibers by Irradiation in Nitrogen with Light of Different Wavelengths

Wavelength, mμ	Incident energy, joules/cm²	Tensile strength, 10^5 psi	Young's modulus, 10^5 psi	Elongation at break,%
-	0	1.45 ± 0.04	8.7 ± 0.5	21.5 ± 1.3
369	596	1.35 ± 0.04	8.6 ± 0.2	17.5 ± 1.3
	630	1.19 ± 0.03	8.8 ± 0.2	14.4 ± 1.0
	1220	1.26 ± 0.04	8.5 ± 0.3	15.0 ± 2.3
	1910	1.19 ± 0.04	8.5 ± 0.1	14.7 ± 1.2
	2420	1.18 ± 0.03	8.6 ± 0.2	13.9 ± 1.3
	2480	1.24 ± 0.04	8.5 ± 0.6	15.7 ± 1.1
314	360	0.67 ± 0.05	8.1 ± 0.5	8.3 ± 1.6
	380	0.67 ± 0.22	7.5 ± 0.3	10.8 ± 2.4
	610	0.47 ± 0.04	7.6 ± 0.2	6.6 ± 1.0
	830	0.47 ± 0.10	7.3 ± 0.5	8.2 ± 1.8
	1080	0.46 ± 0.04	7.7 ± 0.4	6.5 ± 0.9
	1660	0.28 ± 0.03	8.0 ± 0.2	3.4 ± 1.0
244	200	0.94 ± 0.06	8.1 ± 0.6	13.3 ± 1.3
	400	0.83 ± 0.04	7.7 ± 0.6	11.5 ± 1.9
	800	0.73 ± 0.01	7.4 ± 0.3	11.4 ± 0.2

Table 4. Effects on Tensile Properties of HT-1 Fibers by Irradiation in Various Atmospheres with 253.7-mμ Light

Atmosphere	Irradiation time, hours	Tensile strength, 10^5 psi	Young's modulus, 10^6 psi	Elongation at break,%
-	0	1.13 ± 0.04	1.41 ± 0.06	29.5 ± 2.7
Nitrogen	8	1.09 ± 0.03	1.49 ± 0.06	25.5 ± 2.5
	16	1.08 ± 0.01	1.40 ± 0.03	24.8 ± 2.1
	24	1.06 ± 0.03	1.93 ± 0.27	18.4 ± 2.1
	48	1.00 ± 0.02	1.37 ± 0.06	22.4 ± 2.6
	72	1.04 ± 0.02	1.39 ± 0.09	24.4 ± 2.3
	72	1.05 ± 0.03	1.42 ± 0.07	21.9 ± 4.8
	72	0.96 ± 0.06	1.37 ± 0.06	21.5 ± 5.1
	120	0.94 ± 0.01	1.31 ± 0.02	22.6 ± 1.3
	120	1.03 ± 0.02	1.38 ± 0.06	20.5 ± 2.2
	120	1.05 ± 0.04	1.38 ± 0.06	21.3 ± 1.7
Oxygen	8	1.02 ± 0.03	1.32 ± 0.05	25.0 ± 2.5
	16	1.02 ± 0.04	1.34 ± 0.02	23.0 ± 2.3
	24	1.02 ± 0.03	1.25 ± 0.09	24.8 ± 3.1
	48	0.97 ± 0.01	1.32 ± 0.07	20.2 ± 2.1
	72	0.98 ± 0.03	1.33 ± 0.05	23.2 ± 2.5
	72	0.93 ± 0.01	1.25 ± 0.04	21.8 ± 1.9
	120	0.96 ± 0.02	1.27 ± 0.06	21.4 ± 2.7
	120	0.84 ± 0.08	1.08 ± 0.08	23.0 ± 3.4
10^{-3} mm	8	1.06 ± 0.02	1.45 ± 0.07	22.7 ± 3.4
	16	1.04 ± 0.01	1.29 ± 0.05	23.0 ± 1.4
	24	1.04 ± 0.04	1.37 ± 0.04	24.4 ± 4.7
	48	1.06 ± 0.02	1.35 ± 0.05	26.5 ± 2.0
	72	1.00 ± 0.03	1.34 ± 0.08	20.9 ± 1.9
	72	1.01 ± 0.03	1.38 ± 0.07	22.4 ± 2.7
	120	1.01 ± 0.04	1.25 ± 0.10	22.8 ± 2.3
	120	1.00 ± 0.02	1.29 ± 0.05	21.8 ± 0.6
	120	0.97 ± 0.04	1.30 ± 0.04	21.4 ± 3.1
10^{-6} mm	8	1.10 ± 0.02	1.36 ± 0.02	26.7 ± 1.4
	16	1.11 ± 0.02	1.32 ± 0.03	28.3 ± 4.2
	24	1.07 ± 0.05	1.35 ± 0.04	24.9 ± 3.7
	48	1.03 ± 0.03	1.35 ± 0.09	22.4 ± 2.1
	72	1.02 ± 0.04	1.32 ± 0.09	24.0 ± 2.9
	72	0.99 ± 0.02	1.31 ± 0.04	20.4 ± 1.6
	120	1.02 ± 0.03	1.31 ± 0.04	21.4 ± 2.9
	120	1.03 ± 0.02	1.31 ± 0.05	24.7 ± 1.6

Table 5. Effects on Tensile Properties of Polybenzimidazole Fibers by Irradiation in Nitrogen with Light of Various Wavelengths

Wavelength, mμ	Incident energy, joules/cm²	Tensile strength, 10^4 psi	Young's modulus, 10^5 psi	Elongation at break,%
-	0	2.35 ± 0.15	3.72 ± 0.25	19.4 ± 2.8
244	285	2.23 ± 0.23	3.49 ± 0.30	18.2 ± 3.7
	500	2.15 ± 0.29	3.12 ± 0.64	17.7 ± 1.1
	810	2.10 ± 0.17	3.44 ± 0.23	17.1 ± 2.0
314	430	2.08 ± 0.15	2.82 ± 0.36	17.5 ± 1.2
	810	2.14 ± 0.11	3.28 ± 0.32	16.9 ± 1.6
	1610	2.17 ± 0.16	3.50 ± 0.19	16.3 ± 2.3
369	640	2.17 ± 0.20	3.36 ± 0.31	15.9 ± 2.4
	1180	1.99 ± 0.11	3.21 ± 0.25	13.1 ± 2.6
	2470	1.92 ± 0.15	3.21 ± 0.20	10.7 ± 1.2

Table 6. Effects on Tensile Properties of Polybenzimidazole Fibers by Irradiation in Various Atmospheres with 253.7-mμ Light

Atmosphere	Irradiation time, hours	Tensile strength, 10^4 psi	Young's modulus, 10^6 psi	Elongation at break,%
-	0	2.35 ± 0.15	3.72 ± 0.25	19.4 ± 2.8
Nitrogen	8	2.33 ± 0.07	3.70 ± 0.14	17.1 ± 1.2
	16	2.25 ± 0.11	3.65 ± 0.11	14.5 ± 2.4
	24	2.23 ± 0.16	3.52 ± 0.20	15.4 ± 2.1
	48	2.23 ± 0.11	3.58 ± 0.16	16.2 ± 1.4
	72	2.32 ± 0.16	3.62 ± 0.19	17.6 ± 2.2
	120	2.14 ± 0.14	3.59 ± 0.22	16.5 ± 2.3
Oxygen	8	2.26 ± 0.18	3.61 ± 0.39	15.0 ± 2.1
	16	2.28 ± 0.29	3.92 ± 0.40	13.0 ± 1.8
	24	2.08 ± 0.11	3.68 ± 0.13	11.8 ± 1.7
	48	2.08 ± 0.06	3.60 ± 0.14	11.4 ± 0.9
	72	1.86 ± 0.11	3.45 ± 0.20	9.4 ± 1.3
	120	1.89 ± 0.08	3.52 ± 0.18	7.8 ± 1.2
10^{-3} mm	16	2.32 ± 0.18	3.57 ± 0.14	19.7 ± 3.5
	24	2.29 ± 0.23	3.52 ± 0.23	20.2 ± 2.9
	48	2.25 ± 0.15	3.57 ± 0.20	19.6 ± 2.7
	72	2.25 ± 0.16	3.52 ± 0.18	24.5 ± 3.6
	120	2.39 ± 0.12	3.55 ± 0.19	22.7 ± 3.3
10^{-6} mm	8	2.30 ± 0.11	3.47 ± 0.17	21.8 ± 3.2
	16	2.33 ± 0.12	3.50 ± 0.14	24.2 ± 3.4
	24	2.35 ± 0.13	3.65 ± 0.19	20.7 ± 2.4
	48	2.33 ± 0.16	3.54 ± 0.13	21.5 ± 4.0
	72	2.24 ± 0.14	3.58 ± 0.14	20.3 ± 2.6
	120	2.22 ± 0.21	3.39 ± 0.22	21.1 ± 2.9

Table 7. Effects on Tensile Properties of Fibers of Thiazole Polymer by Irradiation in Various Atmospheres with 253.7-mμ Light

Atmosphere	Irradiation time, hours	Tensile strength, 10^4 psi	Young's modulus, 10^5 psi	Elongation percent,%
-	0	2.15 ± 0.24	3.74 ± 0.17	50 ± 16
Nitrogen	48	2.34 ± 0.26	3.51 ± 0.76	74 ± 26
	120	2.34 ± 0.33	4.21 ± 0.20	25 ± 9
Oxygen	48	1.96 ± 0.36	3.74 ± 0.38	48 ± 29
	120	1.96 ± 0.21	3.51 ± 0.54	39 ± 20
10^{-3} mm	48	1.96 ± 0.23	3.27 ± 0.42	54 ± 20
	120	2.24 ± 0.22	3.97 ± 0.51	45 ± 19
10^{-6} mm	48	2.24 ± 0.31	3.51 ± 0.54	40 ± 14
	120	2.15 ± 0.19	3.74 ± 0.19	47 ± 14

Table 8. Effects on Tensile Properties of Films of Thiazole Polymer by Irradiation in Various Atmospheres with 253.7-mμ Light

Atmosphere	Irradiation time, hours	Tensile strength, 10^4 psi	Young's modulus, 10^6 psi	Elongation percent, %
-	0	7.22 ± 1.89	1.77 ± 0.42	6.80 ± 2.8
Nitrogen	19	8.02 ± 1.27	2.00 ± 0.25	6.20 ± 2.7
	48	5.72 ± 0.64	1.58 ± 0.09	3.60 ± 1.0
	72	6.90 ± 0.63	1.81 ± 0.06	3.80 ± 0.8
	120	6.76 ± 0.85	1.92 ± 0.16	3.80 ± 1.0
Oxygen	8	7.18 ± 0.63	1.78 ± 0.17	4.60 ± 0.8
	24	6.77 ± 0.61	1.66 ± 0.00	3.00 ± 0.5
	48	4.37 ± 1.34	-	1.80 ± 0.6
	72	3.35 ± 0.52	0.96 ± 0.06	3.00 ± 0.7
	120	4.59 ± 2.87	-	2.20 ± 0.6
10^{-3} mm	19	7.05 ± 1.93	2.10 ± 0.21	4.80 ± 1.3
	48	5.99 ± 0.33	-	3.60 ± 0.6
	72	6.88 ± 0.40	1.68 ± 0.00	3.40 ± 0.5
	120	6.67 ± 0.73	1.69 ± 0.30	4.00 ± 0.9
10^{-6} mm	8	6.84 ± 0.40	1.66 ± 0.09	6.00 ± 1.8
	24	6.33 ± 0.64	1.53 ± 0.02	3.20 ± 0.6
	48	6.04 ± 0.56	1.54 ± 0.13	4.00 ± 0.8
	72	6.49 ± 1.35	1.75 ± 0.19	4.60 ± 1.4
	120	5.33 ± 2.56	-	2.80 ± 0.8

Aeronautical Systems Division, Dir/ Materials and Processes, Nonmetallic Materials Lab, Wright-Patterson AFB, Ohio
Rpt No. ASD-TDR-63-57. DETERIORATION OF FIBROUS MATERIALS BY ULTRA-VIOLET LIGHT. Third annual report, Feb 63, 22 pp. incl illus., tables.

Unclassified Report

This report discusses primarily the effects of ultraviolet light on the tensile properties of four polymeric materials – polyethylene terephthalate (Dacron), polybenzimidazole, a thiazole polymer, and a du Pont experimental material designated as HT-1.

(over)

1. Degradation under ultraviolet light
2. Dacron
3. Polybenzimidazole
4. Thiazole polymer

I. AFSC Project 7320, Task 73203
II. Contract No. AF 33(616)-7701
III. Southern Research Institute, Birmingham, Alabama
IV. Charles V. Stephenson et al
V. Not aval fr OTS
VI. In ASTIA collection

Among these materials, exceptions were found to the usual trend that degradation is more severe the shorter the wavelength of light. These exceptions are discussed in terms of an absorption of light near the surface of the material that, in effect, prevents the interior from being irradiated.

Among materials studied, those that are known to contain hydrogen are more susceptible to irradiation damage in an oxygen atmosphere than in a nitrogen atmosphere or in a vacuum.