GUIDEBOOK

to MAN-MADE TEXTILE FIBERS and TEXTURED YARNS OF THE WORLD

- FILM-to-YARN
- NON-WOVENS

Third Edition | ADELINE A. DEMBECK

THE UNITED PIECE DYE WORKS

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By THE UNITED PIECE DYE WORKS

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IN THIS THIRD EDITI
Textured Yarns of the
section. Continued h
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In this edition we pres
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In addition, severa
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two flow charts whic
of man-made fibers a

We wish to acknowle
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with information acc
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other data about pro
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supplementary data

We also extend than
much valuable inform

While the information
available, we cannot
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implied with respect
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adopted, are solicite
trust this book will b

A

trademark	FTC generic class	description	source
RUSTANYL	Nylon	West German 66 false-twist textured yarn	ZUE Untereggingen *processor*
RUVEA	Nylon	USA nylon yarn can be twisted plied bulk-textured and heat set 250 900 2500 denier luggage covering shoe uppers golf and bowling bags	DuPont *Marketing* Plastics Div
---S	Glass	USA high tensile strength single fiber 700 000 psi for high strength applications	Owens Corning
S-3	Nylon	USA staple fiber	Sno-
S 26	–	Japanese [illegible] filament yarn of nylon or polyester [illegible] modified modules of nylon application [illegible]	Teijin
SAABA	–	USA [illegible] textured stretch yarn of twist untwist type [illegible] heat treated (FLUFLON) or SUPERLOFT false twist yarns modified one knit woven fabrics licensees pg 250	Leesona *licensor of process*
SAFA SAFACROM	Rayon Rayon	Spanish filament yarn Spun-dyed staple	SAFA
SANDERIT	Nylon	West German foam-form monofil	Sander Yacht
SAOLON	Triacetate	Japanese see SCALON	
SARAN	Saran	USA resin for filament yarn tow monofil round flat oval sheeting	Dow
		Japanese filament yarn staple tow monofil -N Saran and nylon mixed fishnets	Asahi-Dow
			USA licensees
		Monofil extruder weaver of narrow webbing	Dew Plastics
		Fil yarn tow for dolls hair wigs monofil	Enjay Fibers
		SPARK-LITE VECTRA	
			Foreign licensees
		Argentine monofil TEJIDO	Plasti-Febril
		Australian monofil	Sarlon
		British multifil yarns round flat monofil garden furniture awnings filters auto seat covers	Bakelite
		Canadian monofil	Grace Fibres
		Rep of China monofil	Lien Yu
		French monofil CLORÈNE	Rhovyl
		West German monofil BOLTA	Bolta-Werk
		Israeli monofil UNITED	United Saran
		Japanese fil yarn monofil, KREHALON	Kureha Chem.
		Mexican monofil dolls hair wigs	Fibrasomni
		Russian vinylidene chloride vinyl chloride polymer SOVIDEN SOWIDEN SOVINOL	USSR

saran . . . A manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 80% by weight of vinylidene chloride units (–CH_2–CCl_2–).

trademark	description	source
BOLTA	West German monofil for textile fabrics	Bolta-Werk
CLORÈNE	French monofil	Rhovyl
ENJAY	USA filament yarn and tow for dolls' hair wigs. 550 dr monofil for draperies	Enjay Fibers
KREHALON	Japanese filament yarn monofil	Kureha
SARAN	USA resin for fil yarn tow monofil round flat oval sheeting	Dow
	Japanese fil yarn staple tow monof	Asahi-Dow
	-N Saran and fy of monofilaments	
		USA Licensees
	Monofil	Dew Plastics
	Fil yarn and tow for dolls' hair wigs ENJAY monofil SPARK-L-ITE	Enjay Fibers
		Foreign Licensees
	Argentine monofil TEJIDO	Plasti-Fabril
	Australian monofil	Sarlon
	British multifil yarns round flat monofil garden furniture awnings filters auto seat covers	Bakelite
	Canadian monofil	Grace Fibres
	Rep of China monofil	Lien Yu
	French monofil CLORÈNE	Rhovyl
	West German monofil BOLTA	Bolta-Werk
	Israeli monofil UNITED	United Saran
	Japanese fil yarn monofil KREHALON	Kureha
	Mexican monofil dolls hair wigs	Fibras Omni
	Russian polymer SOVLIDEN or SOVINOL SOWIDEN	USSR
SOVIDEN	Russian vinylidene chloride vinyl chloride polymer or SOVINOL SOWIDEN	USSR
SPARK-L-ITE	USA high luster monofil outdoor furniture webbing	Enjay Fibers
TEJIDO	Argentine monofil	Plasti-Fabril
UNITED	Israeli monofil	United Saran

spandex .

trademark
CORESPUN
DORLASTAN
DuPONT
DURASPAN
EASTHAMPTON
ENKASPAN
ENKASWING
ESPA
ESTANE V C.
FUJIBO
GLANZSTOFF ELASTOMER
GLOSPAN
HECOSPAN
INTERSPAN
LASTRALENE

sources . . addresses, affiliations, trademarks

Eastman Chemical Products, Inc., P O Box 431, Kingsport, Tennessee 37662
Subsidiary of Eastman Kodak Co
Marketing for Tennessee Eastman Company, Texas Eastman Company, Carolina Eastman Co (Divisions of Eastman Kodak Company)
Regional Marketing
Rep for Western USA Wilson & Geo Meyer & Co., 270 Lawrence Ave., South San Francisco, Calif 94080
Far East and Australasia Eastman Chemical Products, Inc., P O Box 14050, Hong Kong
Europe, Africa, Middle and Near East Eastman Chemical International AG, (sub of EK Co) ZVB-Haus an der Aa, 6301 Zug, Switzerland, 246 High Holborn, London W C 1, England
Latin America and Canada Eastman Chemical Inter-American Ltd 164 Eglinton Avenue East, Toronto M12, Canada

Anish (Ac) Crystal (Ac) Estalill (P) Kodacel (C) Lofture (Ac) Tomte (O)
Chromspun (Ac) Eastman (Ac, (M), (O), (P) Estron (Ac) Kodel (P) Sculptured (Ac) Verel (M)

Ectona Fibres, Limited, P O Box 20, Siddington, Macclesfield, Cumberland, England (Ac)
Owned jointly by Eastman Chemical International AG 60% Bunzl Pulp & Paper Ltd 40%

Elastomeric Fibres Company Ltd., 345 Foleshill Road, Coventry, England Spanzelle (S)
Affiliate of Courtaulds Ltd 100% interest *Sales* Courtaulds Ltd

(N) Elastover, 5 Avenue Perdier, Paris 8e, France (G)
Owned jointly by Compagnie de St Gobain and Compagnie Industrielle de Textiles Artificielles, affiliate of Rhône Poulenc S A

ation Emeca S A I C , Calle Tte Gral Eustoquio Frias 254, Buenos Aires, Argentina *processor* Sum-Pal

Ems-Gelsenberg AG , Domat Ems, Switzerland Grilene (P)
Owned jointly by Chemie Holding Ems AG, Domat Ems, Switzerland *ITM of Ems Industries Ltd.*, and Gelsenberg Benzin AG, Johannesstrasse 2-8, Gelsenkirchen-Horst, W Ger

es (N) Ems Industries, Ltd, Domat Ems, Switzerland Grilamid (N), Grilan (N), Grilene (P), Grilon (N), Grilon-Crimpset (N)
(O) *Formerly* Fiberfil, S A
Sales Grilon S A , affiliate of Ems Industries Ltd
Joint ownership Ems Gelsenberg A G with Gelsenberg Benzin A G
il (O) Worldwide licensing of processes developed by Ems Industries Ltd by Inventa AG (affiliate of Chemie Holding Ems AG)

ENI—Ente Nazionale Idrocarburi (state-owned oil company) *See* ANIC

Enjay Fibers & Laminates Co., Odenton, Maryland 2113 Enjay (N), (Sa), Escon (O), Spark-Lite (Sa), Vectra (O)
Division of Enjay Chemical Co, 60 West 49th Street, N Y 10020
Licensee of Spunize, Saran

Enka de Colombia, S.A., Aptdo Aéreo 5233, Medellin, Colombia Enkalon, (N), Terlenka (P)
Plant Girardota, Colombia
Joint venture of AKU (51% interest), Colombian textile mills (39%), Corporaciones Financieres (International Finance Corp 13%)

Erste Österreichische Glanzstoff-Fabrik AG ..... Austriacord (R), Rayonaustria (R)
Reichsratsstrasse 11, 1010 Vienna, Austria
Plant Herzogenburgerstrasse 69, St Poelten, Lower Austria, Austria
Member of AKU Group, AKU interest 76%

Esbjerg Ropeworks, Ltd., Esbjerg, Denmark . . . . . (O)

ESCO—Ets. Industriels Pour La Soie et Le Coton S.A., 15 Rue Gawad Hosni, ESCo + device (R)
Cairo, Egypt, UAR

sources * *continued*

sources . . . addresses, affiliations, trademarks

Fibras Omni S.A., Calle 6 #135 Colonia Granjas San Antonio, Ixtapalapa Mexico D F Mexico — **Politen-Omni (O), Unnamed (Sa)**
Licensee of Dow Chemical Company (Saran)

Fibras Quimicas do Brasil, Ltda *See* Cellbras do Brasil Ltda

Fibras Químicas de Venezuela, C.A., Apartado 3631 Caracas Venezuela — **Celanese (N), Celtron (P)**
Affiliate of Celanese Venezolana S A (handle marketing) *Plant* Valencia.

Fibras Quimicas, S.A., Calz Dolores y Av Ruiz Cortines Monterrey N L Mexico — **Cydsa (N), Enkalon (N), Terlenka (P)**
Exclusive Sales Rep Cydsa Comercial S A
Member of Grupo [illegible] Cydsa Chemical Group
Joint Venture of AKU—[illegible] interest [illegible] Cydsa [illegible] S A

Fibras Sintéticas S A [illegible] Sánchez No 126 [illegible] Arequipa Lima Peru — **(Ac) (P)**

Fibras Sintéticas S A R L [illegible] *See* [illegible]

Fibras Sintéticas Venezolanas C A [illegible] — **Venecron (P)**
[illegible]
[illegible] CA and G P Kahan [illegible] Compañía [illegible] Venezuela

FIBRASIR [illegible] — **Siron (P)**
Affiliate of S.F—[illegible] S A

Fibreglass Ltd, St Helens Lancashire England — **Fibreglass (G)**
Also Reinforcements Div Birkenhead Cheshire England Textile Div Glasgow Scotland

Fibreglass Pilkington Ltd *See* FGP

Fibreglass South Africa (Proprietary) Ltd, P O Box 9335 Johannesburg South Africa — **Fibreglass (G)**
Affiliate of Owens-Corning Fiberglas Corp of America 24 1 2% interest

Fibremakers Ltd 95 Collins Street Melbourne Australia — **Bri-Nylon, Terylene (P)**
Plant Bayswater Victoria Australia
Formerly British Nylon Spinners Australia Pty Ltd
Owned by ICIANZ—ICI of Australia and New Zealand Ltd
Subsidiary Fibremakers N Z Ltd New Zealand
Acquisition Allied Chemical (Australia) Pty Ltd

Fibremakers (N Z.) Ltd., Wiri (near Auckland) New Zealand — **Bri-Nylon, Terylene (P)**
Subsidiary of Fibremakers Ltd Australia

Fibres de Verre S A., 3 Chemin de Mornex 1001 Lausanne Switzerland — **Vetroflex (G), Vetrotex**

Fibriver, S A, 8 rue Christophe Colomb Paris 8e France — **Fibriver (G)**

Fibron, Inc., 2403 Lyndon Av Chattanooga Tenn 37415 — **(O)**

Fibron S A., Switzerland *See* Ems Industries Ltd

Fibro Quimica Chilena Ltda., Casilla 1935 Santiago Chile — **Trevira (P)**
Subsidiary of Farbwerke Hoechst AG

Filatura dei Cascami di Seta, S.p.A. *See* Cascami di Seta S p A

Filatures et Moulinages de L'Ardeche S.A. *See* FIMOLA

Fillattice S p A, Via Piave 4 Muggio 20053 Milan Italy — **Eurothreads (Ru), Fieltex (Ru), Lattitex (Ru)**

FIMOLA-Filatures et Moulina[illegible]
15, Quai Jean Moulin Lyon 2 [illegible]
Licensee of Helanca, Taslan, [illegible]

Fine Spinners, Ltd., Blackfriars [illegible]
Formerly Fine Spinners & Dou[illegible]
Merged into Courtaulds Ltd [illegible]

FINICISA-Fibras Sinteticas, [illegible]
Marketing IC [illegible] (Portugal) SAR[illegible]
Owned jointly by ICI Ltd [illegible]

Firestone Industrial Rubber [illegible]
Div of The Firestone Tire & R[illegible]
Formerly [illegible] Firestone R[illegible]

Firestone Rubber & Latex Pr[illegible]

Firestone Synthetic Fibers & [illegible]
Div of The Firestone Tire & R[illegible]
Marketing 45 Rockefeller P[illegible]

Firestone Textiles Ltd, W[illegible]
Affiliate of The Firestone T[illegible]

Firestone Tire & Rubber Co[illegible]
Affiliate The Firestone Text[illegible]
Joint ownership Polyfibres [illegible]

Fish Net & Twine Co., 927 [illegible]

FISIBA—Fibras Sinteticas [illegible]

Fitzpatrick Robert F & Co [illegible]
USA Distributor for Kaneg[illegible]

Fluflon, Ltd., 7 St James S[illegible]
Licensee of Permatwist C[illegible]
UK Licensors of processes [illegible]

FMC Corp., American Visc[illegible]
Chemical R. D Center, Princ[illegible]
Subsidiary VISCHISCA, M[illegible]

Avceram (I) Avloc (R)
Avicolor (Ac),(R) Avisco (Ac),(R)
Avicron (R) (V)
Avigrimo (R) Avistrap (O),(R)

Formosa Chemical & Fibr[illegible]
Republic of China *Plan*[illegible]

Formosa Plastics Corp.

Fothergill & Harvey, Ltd

Franchi, Fratelli, Manifat[illegible]

Frost's Yarns Ltd., [illegible]
P O Box No 11, Park Gre[illegible]
Subsidiary of Wm Frost [illegible]
Licensee of Agilon [illegible]

Exhibit 2

Here is a translation of the attached letter:

Dear Lucia:

Your telephone calls are a real pleasure.. I am very eager to meet you personally.

To get the wig was not easy, but to send it to you will be almost as difficult. The messenger companies (DHL, Fedex, etc.) are a little reticent about accepting the package, the will be approximately 19x19x24 centimeters and will weigh about 1 &1/2 pounds, or a bit more; besides that, one of the companies tell me, over the phone, that it will cost $200. In view of this situation, I think the most sensible thing is for me to give it to you personally when you come to Mexico.

In the meanwhile I am enclosing a few of the strands of the "hairs", such as you suggested to me.

When you have your travel itinerary, please let me know so that I can organize my agenda accordingly and be free, or at least less busy, when you are here. How long do you think you can stay in the city?

Until soon,

Affectionately,

Jaume

JAUME RIBAS
Dulce Olivia 83,
Coyoacán•04000
Tel. 554•1153

México. D.F 8 de Noviembre de 1993.

Ms. Lucia Bartoli.
24176 Holly Oak Lane, Dept. 6,
Laguna Hills, CA. - 92656.

Dear Lucia;

Tus llamadas telefónicas son un verdadero placer. - Tengo muchisimos deseos de conocerte personalmente.

Conseguir la peluca no fué nada fácil, pero mandartela, resulta casi igual de dificil. Las compañias de mensajerias (DHL, Federal Express, etc.) se resisten un poco a recibir el paquete, que tendrá, aproximadamente unos 19x19x24 cm. y pesará 1-1/2 lb, o un poco más; además, una de las Cias, me dice, por telefóno, que costará unos US$200, -. Ante esta situación, creo que lo más sensato es que te la de a tí personalmente cuando vengas a México.

Mientras tanto te adjunto unos recortes de los cabellos, tal como tu me sugeriste.

Cuando tengas tu programa de viaje, por favor avisamelo para que yo pueda organizarme y estar libre, o menos ocupado, cuando tú estes por aqui. ¿ Cuantos dias piensas quedarte en la ciudad?

Hasta pronto.

Afectuosamente

Jaume

Exhibit 3

Analytical Answers, Inc.
The information you need...when you need it

November 19, 1993

Mr. Harvey Silverglate
Silverglate & Good
The Batterymarch Building
89 Broad Street 14th Floor
Boston, MA 02110-3511

Report No: 24898 **P.O. No:** 3766

PURPOSE OF ANALYSIS:

To identify a black wig fiber and compare it to a polyvinylidene chloride (PVDC).

SAMPLES:

One black braided wig provided by Lucia Bartoli 11/93 (source: Mexican Anthropology Museum)

METHOD OF ANALYSIS:

Micro-Fourier Transform Infrared Spectroscopy (FTIR)

RESULTS:

The fibers from the black braided wig are made of polyvinylidene chloride (PVDC). These are the same type of fibers as those from the Asahi Chemical Company analyzed during AAI Job # 24579. The Asahi Chemical Company fibers are also PVDC. These fibers are both the same type of polymer known under the trade name Saran.

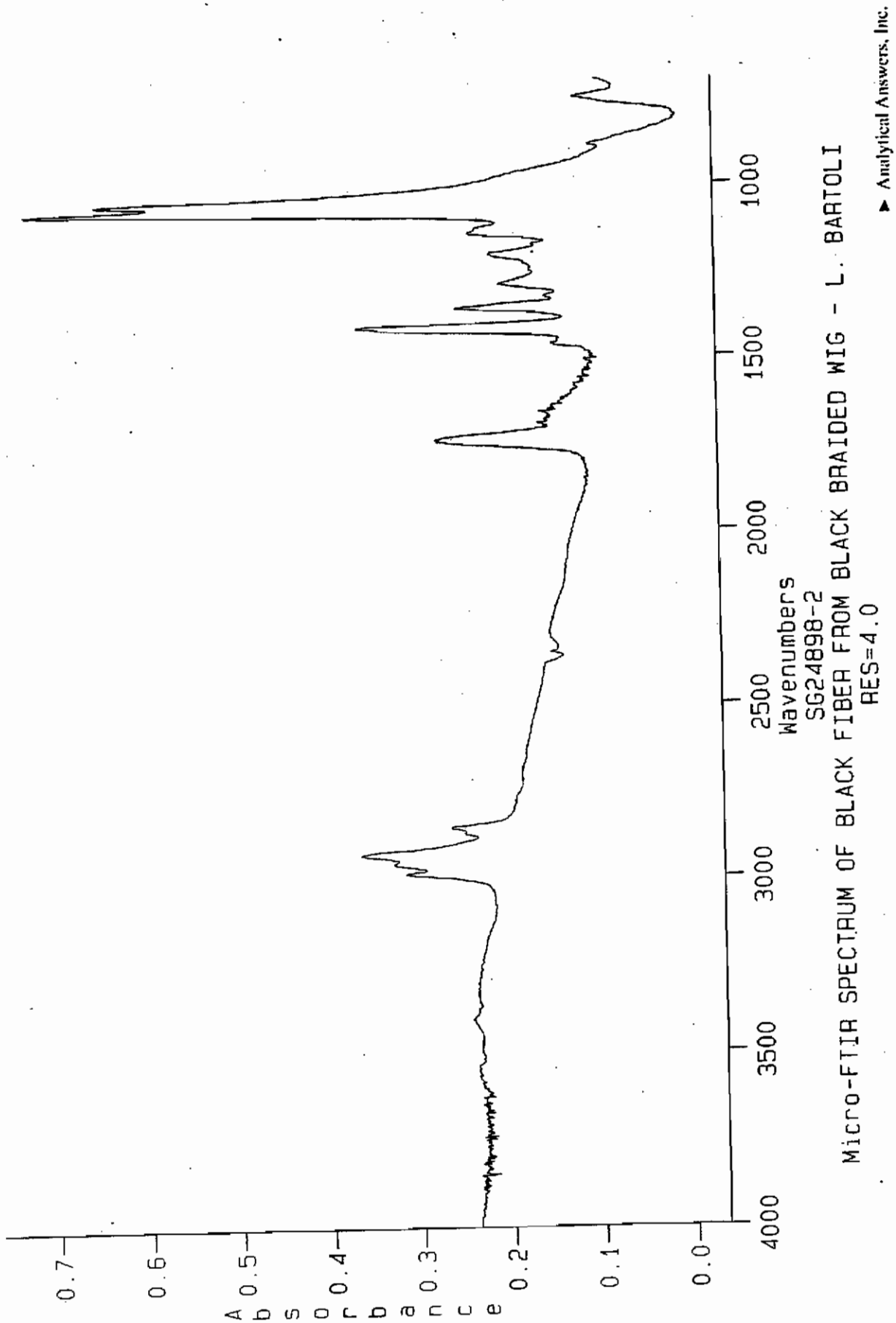
The enclosed data sheet further describes the FTIR analytical technique.

John D. Lennhoff, Ph.D.
Senior Scientist

JDL:ks

Enclosures: Micrographs: 1
Spectra: 6
Data Sheet

4 Arrow Drive, Woburn, Massachusetts 01801 ▲ Telephone: (617) 938-0300 ▲ Fax: (617) 935-5087


Micro-FTIR SPECTRUM OF BLACK FIBER FROM BLACK BRAIDED WIG - L. BARTOLI
RES=4.0
SG24898-2
Wavenumbers
4000
3500
3000
2500
2000
1500
1000
Absorbance
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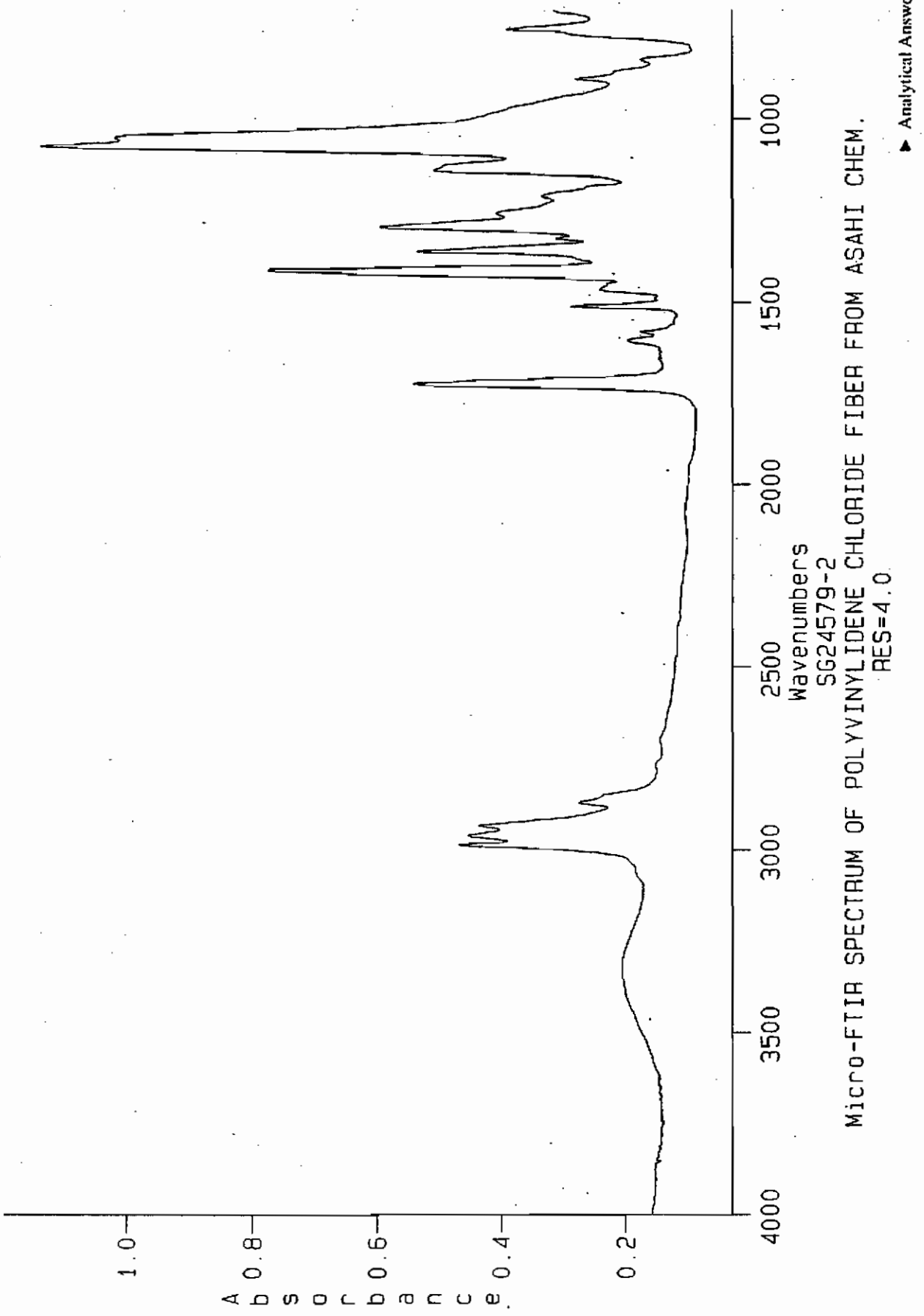
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Analytical Answers, Inc.


Micro-FTIR SPECTRUM OF POLYVINYLIDENE CHLORIDE FIBER FROM ASAHI CHEM.
RES=4.0
SG24579-2
Wavenumbers
4000
3500
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Absorbance
0.2
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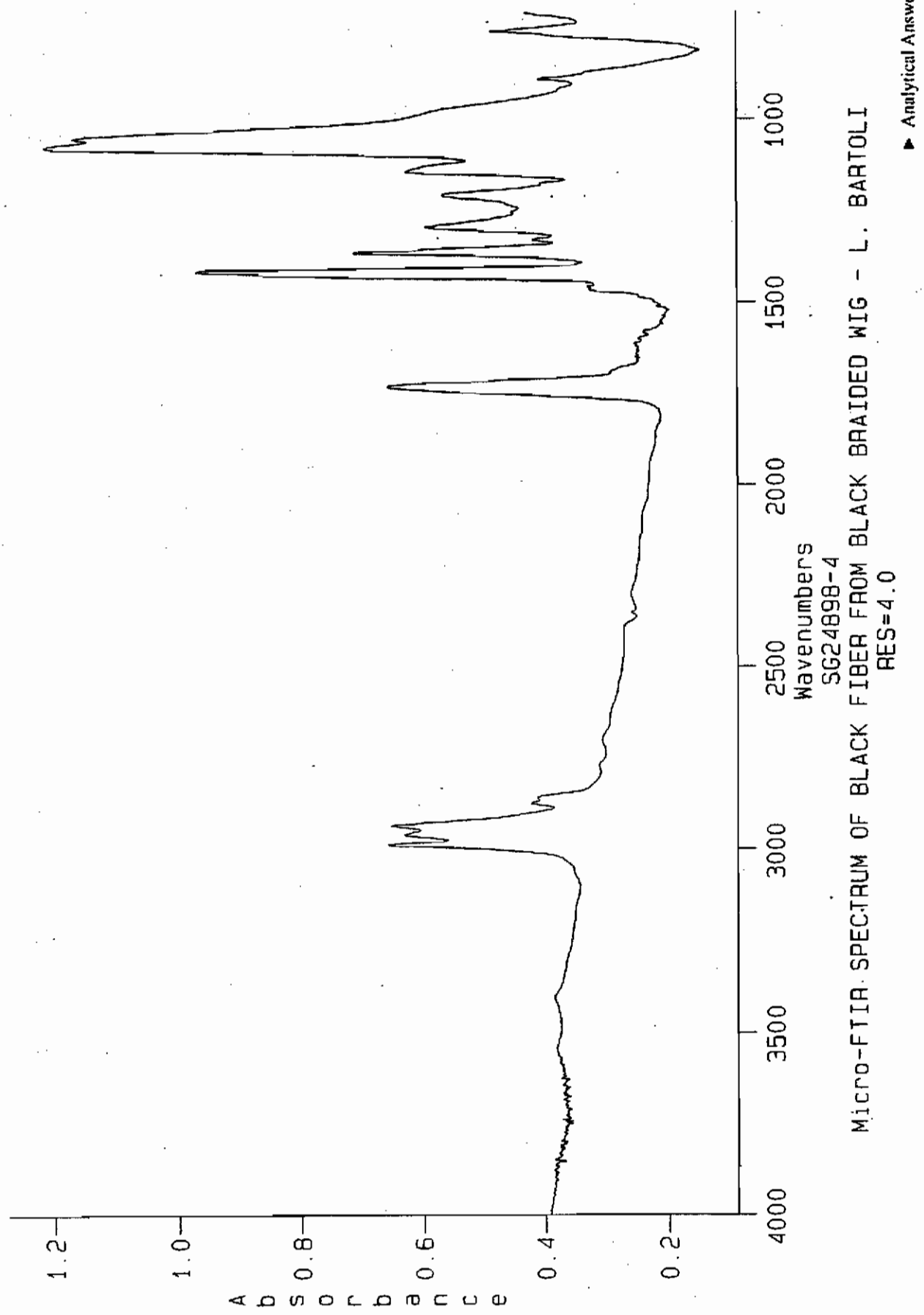
0.8
1.0
Analytical Answers, Inc.


Absorbance
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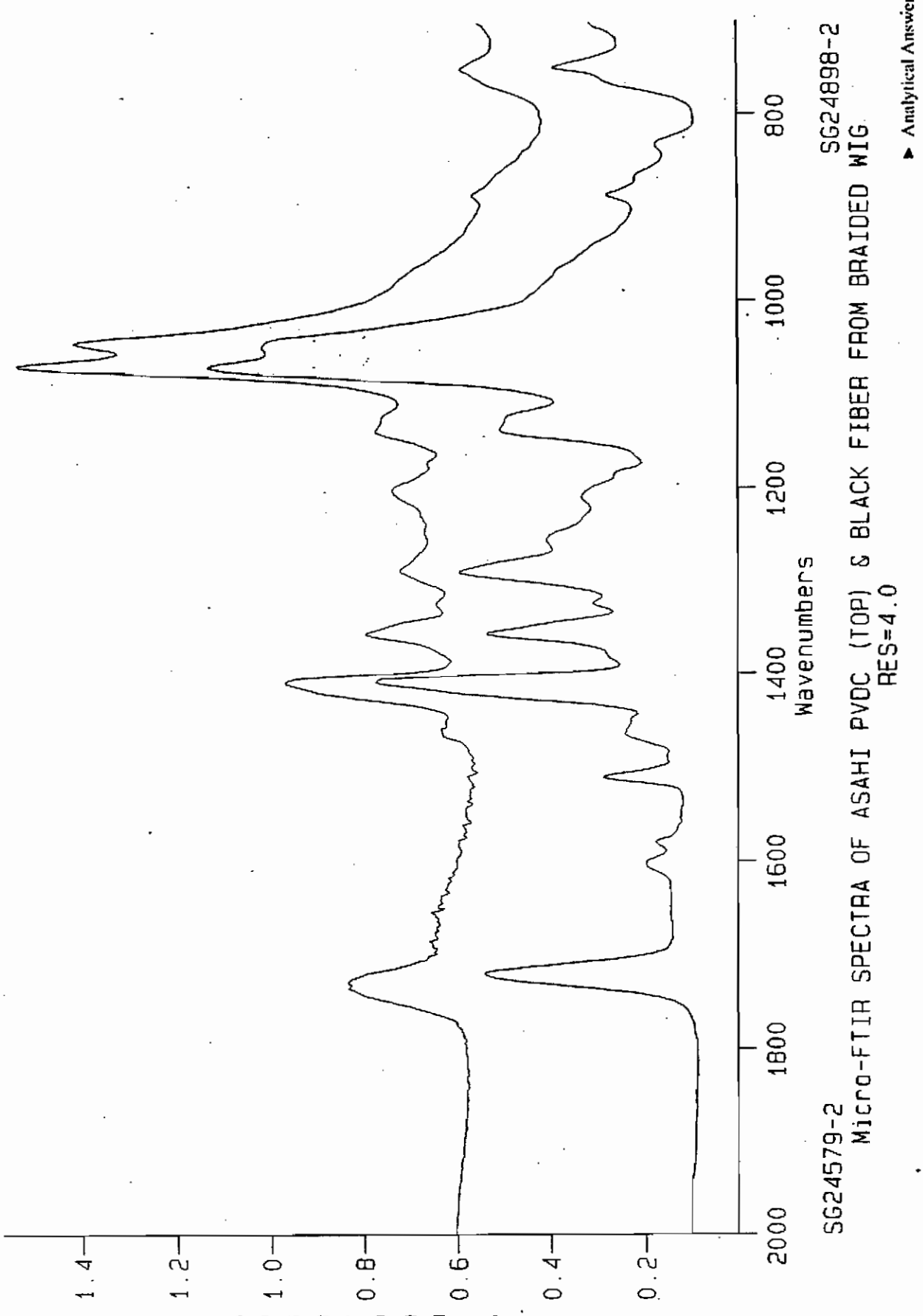
Wavenumbers
SG24898-4
RES=4.0
Micro-FTIR SPECTRUM OF BLACK FIBER FROM BLACK BRAIDED WIG - L. BARTOLI
► Analytical Answers, Inc.


Absorbance
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1.2
1.0
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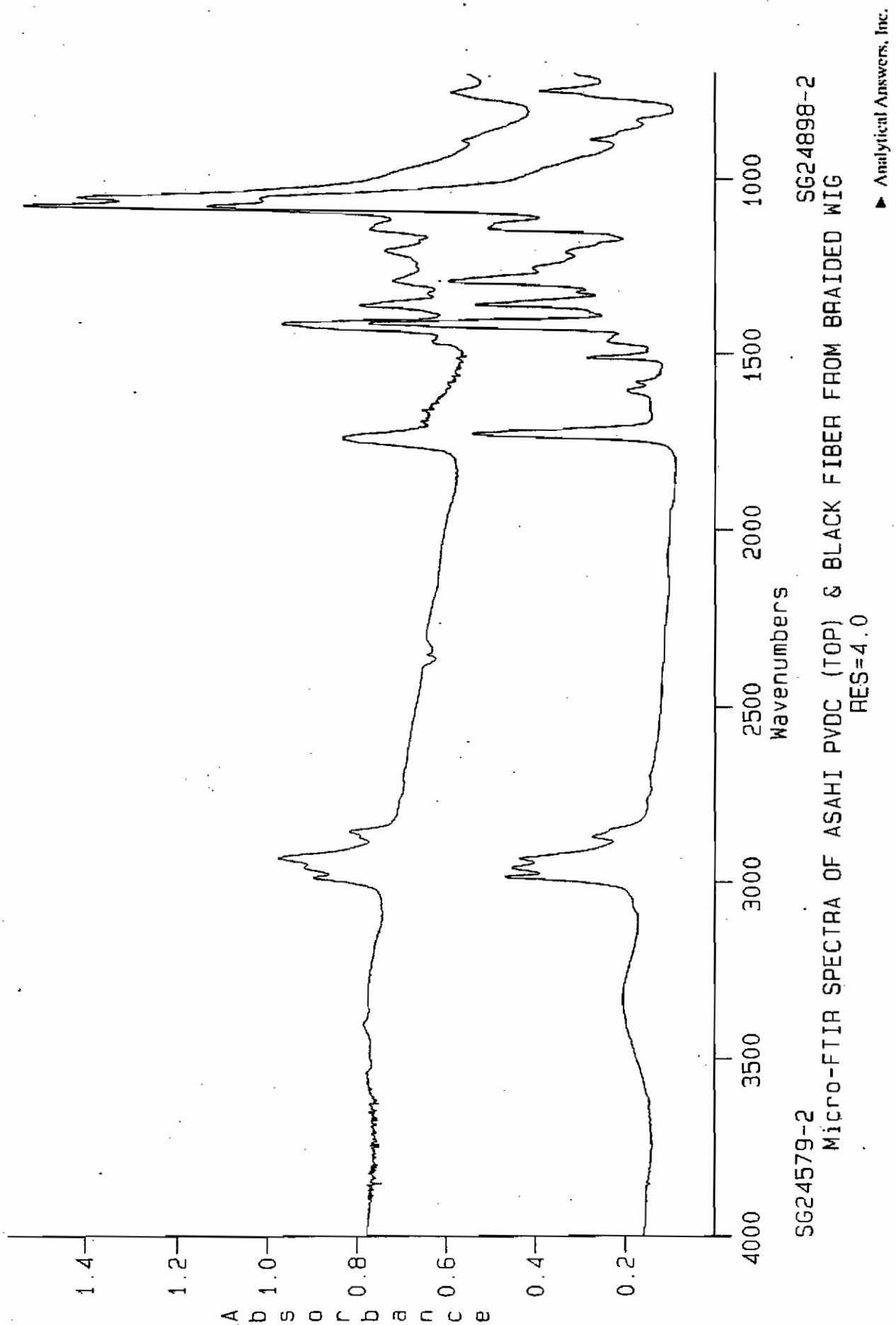
1800
1600
1400
1200
1000
800
Wavenumbers
SG24579-2
Micro-FTIR SPECTRA OF ASAHI PVDC (TOP) & BLACK FIBER FROM BRAIDED WIG
RES=4.0
SG24898-2
Analytical Answers, Inc.


SG24579-2
Micro-FTIR SPECTRA OF ASAHI PVDC (TOP) & BLACK FIBER FROM BRAIDED WIG
RES=4.0
SG24898-2
Absorbance
Wavenumbers
4000
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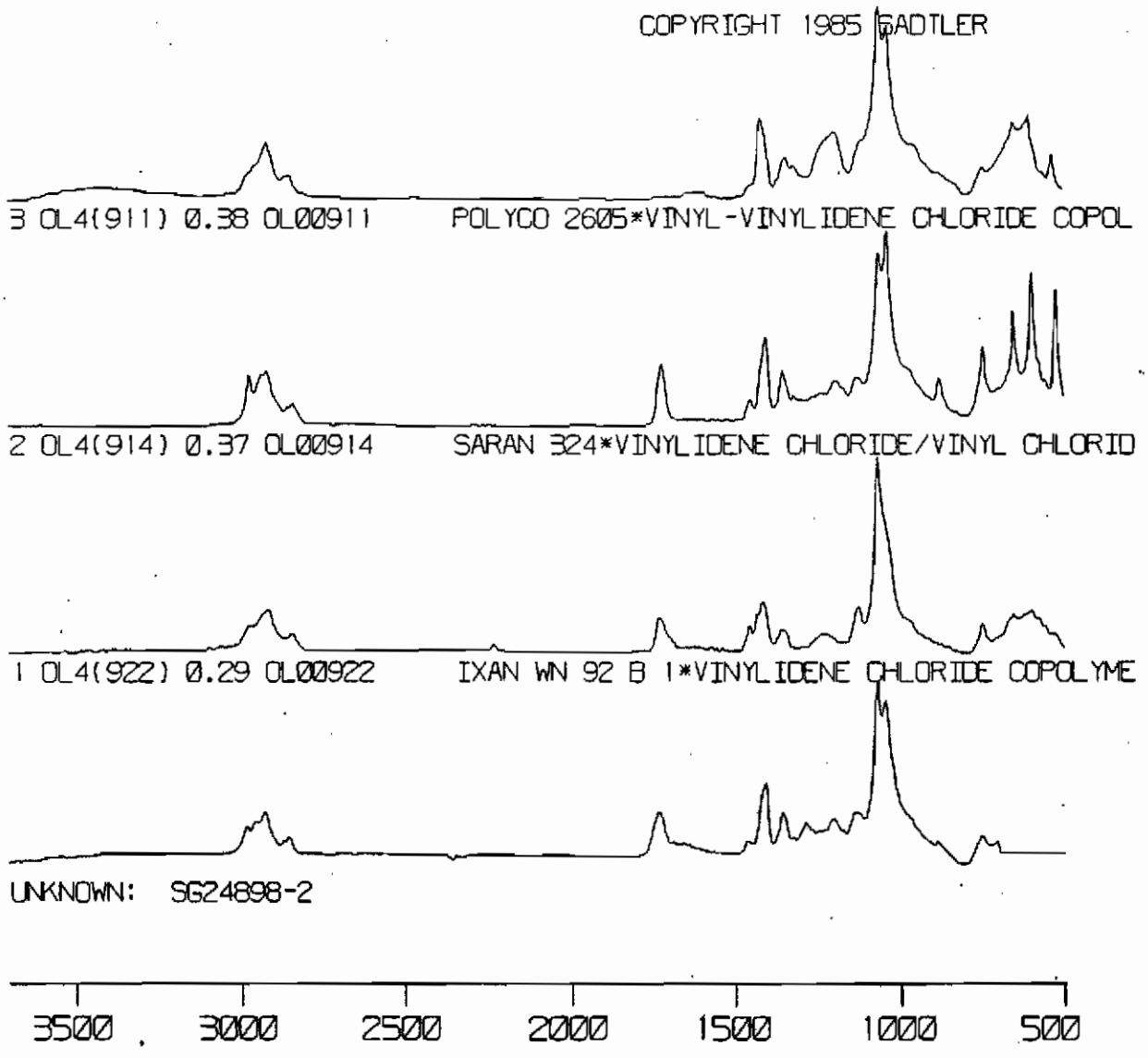
▲ Analytical Answers, Inc.



UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF NORTH CAROLINA
FAYETTEVILLE DIVISION

UNITED STATES OF AMERICA,	)	
	)	Nos. 75-26-CR-3
v.	)	90-104-C.V.-3-D
	)	
JEFFREY R. MacDONALD	)	

AFFIDAVIT OF SAMUEL WALTER UMANSKY

I, Samuel Walter Umansky, being first duly sworn, state under oath the following:

1. I reside at 5310 Zelzah Avenue, Encino, California 91316.

2. From 1952 to 1958, I was employed by Saran Yarns Company, located in Odenton, Maryland. Saran Yarns Company also conducted business under the name National Plastics Products. For purposes of this affidavit, I will refer to this company as "Saran Yarns Co."

3. During my employment at Saran Yarns Co., I was a technical sales associate in the Sales and Marketing department from 1952 to 1958. Saran Yarns Co. manufactured and sold saran fiber.

4. During the course of my employment at Saran Yarns Co., I became familiar with the processes used to manufacture saran fibers. The chemical name for saran is polyvinylidene chloride.

5. Saran Yarns Co. manufactured saran fibers using a melt spinning process which involves the following steps:

(a) First, saran resin, stabilizers, and

colorants are fed into a heated screw extruder. With these colorants, saran fibers can be produced in virtually any color.

(b) Second, from the heated screw extruder, the resin is then fed into a spinarette, a type of die which contains a number of round holes positioned in distinct groups or units. The melted saran is extruded through each of these holes in the spinarette to create saran filaments or fibers, all of which remain grouped together in their separate unit. Each of these units constitutes what is known as "continuous multifilament," i.e., a bundle of untwisted fibers that are often referred to as a "tow."

(c) Third, after extrusion through the spinarette, each multifilament bundle enters a cooling tank filled with water, and then the bundle is fed through a series of rollers known as "draw rolls." As the fibers pass through the draw rolls, they are heated and stretched four to six times their original length to orient the molecules in the filaments. This process significantly increases the fibers' strength. After being drawn, the filaments are put through another strengthening process called "heat setting."

(d) Finally, each of the multifilament

bundles or tow are wound onto a spool. A number of these spools are packaged in a box that is sent to the end user.

6. During the course of my employment at Saran Yarns Co., in addition to learning how saran fibers were manufactured, I also became familiar with the many end uses for saran fibers, including the use of saran fibers in human cosmetic wigs.

7. During the period that I worked at Saran Yarns Co. (1952-1958), Saran Yarns Co. sold saran in continuous multifilament ("tow") form, in a variety of colors, including blond, to a number of wig manufacturers for use in human cosmetic wigs, including Grand Wigs, Ben Wigs, Artistic Wig, Myer Jacoby, the Dawbarn Brothers, and A & B Wig, which also conducted business under the name A & B Artistic Wig. I do not know whether any of these companies are still in business.

8. During the course of my employment at Saran Yarns Co., I became familiar with some of the wigmaking processes that utilized the saran fibers manufactured by my company. The saran wigs were made by sewing the saran fibers onto "buckram", a cloth cap with a number of holes in it which forms the "scalp" of the cosmetic wig. The wig manufacturers would sometimes curl the saran multifilament by placing it on quills and then putting the quills in an oven to "bake" a curl into the saran fibers.

9. In addition to selling saran fibers directly to the wig manufacturing companies listed in paragraph 7 above, Saran Yarns Co. also sold saran multifilament to intermediary manufacturers who pre-treated and curled the saran and then sold it to wigmakers for use in cosmetic wigs to be worn by humans. I recall that one such intermediary manufacturer was Willard George of Annapolis, Maryland.

10. I have read the Supplemental Affidavit of FBI Special Agent Michael P. Malone, dated May 21, 1991, attached hereto as Exhibit 1. In ¶ 7 of Agent Malone's Supplemental Affidavit, he states:

> Further, based upon my own investigation and research in this case, I can state that saran has the following physical characteristics which make it unsuitable for use in cosmetic wigs, in which the objective is to have the wig hair appear indistinguishable from natural hair. Saran is very straight, is only manufactured as a continuous monofilament, and does not lay or drape like human hair, and is also too shiny to resemble human hair. Lastly, saran can not be manufactured as a "tow" fiber [footnote*], which is essential to the cosmetic wig manufacturing process.
>
> * A "tow" is a large group of continuous filaments, without any definite twist, which is cut into definite lengths.

11. Based on my experience, the statements made by Agent Malone in ¶ 7 of his affidavit are simply not true.

(a) First, Agent Malone states that saran "is only manufactured as a continuous monofilament," and "can not be manufactured as a 'tow' fiber [footnote omitted] which is essential to the

cosmetic wig manufacturing process." These statements are untrue. While saran can, and is, manufactured as a monofilament, it is not true that saran can be manufactured "only" as a monofilament. As noted in ¶¶ 3-9 above, Saran Yarns Co. manufactured saran fiber in a variety of forms, including continuous multifilament ("tow") form, and it sold saran in continuous multifilament form to wigmakers that used it to manufacture human cosmetic wigs. I have seen human cosmetic wigs made with saran fibers in a variety of styles and colors.

(b) Second, Agent Malone states that "[s]aran is very straight." As noted in ¶¶ 8 and 9 above, saran fibers very readily take and retain a permanent curl. In fact, the invention of saran cosmetic wigs to be worn by humans was largely predicated upon the ease with which saran fibers can be curled and styled.

(c) Third, Agent Malone states that saran "does not lay or drape like human hair, and is also too shiny to resemble human hair." This statement is inaccurate. As noted above in ¶¶ 6-9, saran fibers have been used in the manufacture of human cosmetic wigs, and they can be curled to resemble human hair. Saran fibers are used also for doll

hair, which is likewise intended to resemble human hair.

Samuel Walter Umansky

Signed and sworn to before me on this 27th day of March, 1997, at Pottstown, California.

Notary Public, State of California

My commission expires Feb. 9th 2001.

[seal]

DENNIS F. OGLE
Commission # 1126703
Notary Public — California
Los Angeles County
My Comm. Expires Feb 9, 2001

Exhibit 1

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF NORTH CAROLINA
(FAYETTEVILLE DIVISION)

UNITED STATES OF AMERICA	:	Crim. No. 75-26-Cr.-3
	:	
v.	:	
	:	
JEFFREY R. MACDONALD	:	

SUPPLEMENTAL AFFIDAVIT OF MICHAEL P. MALONE

I, Michael P. Malone, being first duly sworn, state under oath the following:

1. I am the senior examiner of the Hairs and Fibers Unit (HFU) of the Federal Bureau of Investigation (FBI) Laboratory which is located in Washington, D.C.

2. I am the same Michael P. Malone who executed an affidavit in the above-captioned case, on February 14, 1991.

3. I have read the Reply Brief of the petitioner in this case which was filed on May 14, 1991.

4. With respect to the numerous references in the Reply Brief to "the 22-inch synthetic blond wig hairs" allegedly found in the clear handled hair brush (Exhibit K, E-323), by Army Chemist Janice Glisson, I can state with certainty that no 22-inch synthetic blond wig hairs were found in Exhibit K, E-323, or in any other exhibit which I examined in this case (see my previous Affidavit). In this regard, my use of the term "wig" unless otherwise specified, means a head covering made of synthetic fibers or human hair, which substitutes for the wearer's own hair, and which is worn by a human being, usually female, for cosmetic purposes. It is my understanding based upon reading the pleadings in this case, that the petitioner contends that Helena Stoeckley

owned a blond shoulder length wig (as defined above), which was further described as being "stringy". Further, it is my understanding that there is no record evidence as to whether this wig was composed of specific synthetic fibers or human hair. In any event, to the extent that petitioner contends that the "22-inch blond synthetic" fibers removed from Exhibit K, E-323 are consistent with having originated from a cosmetic blond wig allegedly owned by Helena Stoeckley, there is no factual or scientific basis for this conclusion. I base my statement on the following facts and observations.

5. With respect to Exhibits Q-46, Q-48 and Q-49, the microscopic slides previously identified by Janice Glisson as those now containing the striated blond synthetic fibers made to look like hairs, which she previously removed from Exhibit K, E-323 (see Glisson Affidavit at pp.3-4), I personally determined the lengths of the fibers mounted on these slides. I determined that Exhibit Q-46 contained two blond fibers which were of 24-inch and 9-inch lengths, respectively. Further instrumental analysis by SA Robert Webb of the Materials Analysis Unit (MAU) determined that these fibers were composed of saran. My own microscopic examination determined that these two blond saran fibers were striated, and one matched the FBI Laboratory's known saran doll hair reference exemplar (see photo exhibits 11 and 12 to my previous affidavit) and did not match any wig exemplar in the reference collection[1].

[1] The FBI Laboratory's reference collection of fibers has been maintained for over forty years. Among other items, it contains numerous samples from wigs,all of which I have personally examined

Similar examinations performed on Exhibit Q-49 revealed a single light blond striated saran fiber, which was 22-inches in length, and also did not match any wig exemplar in the FBI reference collection. Lastly, similar examinations performed on Exhibit Q-48, revealed a single grey, delustered, modacrylic fiber which was approximately 5-inches in length, and which matched modacrylic fibers removed from the K-47 hair piece or "fall" worn by Colette MacDonald. Therefore, I can state that the only blond synthetic fibers which are 22-inches or longer and which were removed from Exhibit K, E-323, are saran, which does not resemble human hair, and not modacrylic, which does resemble human hair.

6. In addition to performing physical examinations in this case, I have consulted numerous standard references (see Exhibits 1-6 attached to this affidavit) which are routinely used in the textile industry and as source material in the FBI Laboratory, concerning the industrial applications for fibers, including saran. None of these standard references reflect the use of saran fibers in cosmetic wigs; however, they do reflect the use of saran fibers for wigs for dolls and manikins, in addition to such uses as dust mops and patio screens.[2]

7. Further, based upon my own investigation and research in this case, I can state that saran has the following physical

---

and none of which revealed a known wig exemplar of saran. Rather all of the known wig exemplars are composed of polyvinyl chloride (PVC) , modacrylic or human hair.

[2] Joseph, Introductory Textile Science, 1966, Holt Rinehart and Winston,Inc., at page 185 (attached as Exhibit 1).

characteristics which make it unsuitable for use in cosmetic wigs, in which the objective is to have the wig hair appear indistinguishable from natural human hair. Saran is very straight, is only manufactured as a continuous monofilament, does not lay or drape like human hair, and is also too shiny to resemble human hair. Lastly, saran can not be manufactured as a "tow" fiber[3], which is essential to the cosmetic wig manufacturing process.

8. Based upon these factors described above, and in the absence of any evidence to the contrary, I conclude that the 22 and 24 inch blond saran fibers in this case are not cosmetic wig fibers.

9. Contrary to the statement reflected in the Reply Brief that I compared the saran fibers in this case with dolls which came from the MacDonald crime scene at Fort Bragg, without making an identification, I can state that none of the dolls which I examined came from the MacDonald crime scene at Fort Bragg, N.C. Nor did the dolls I examined belong to the MacDonald children, whose dolls, I understand, were disposed of by petitioner (see Kassab Affidavit at p.3).

10. With reference to the numerous assertions concerning the Transfer Theory of Locard which are contained in the Reply Brief I can state as follows: the Transfer Theory of Locard, an accepted scientific principle and the premise for all forensic trace evidence examinations, has been misinterpreted by petitioner.

---

[3] A "tow" is a large group of continuous filaments, without any definite twist, which is cut into definite lengths.

Simply stated, the theory explains that the hairs and fibers found on an individual are reflective of their most recent and immediate surroundings. This principle is particularly applicable to situations in which a body is in physical contact with an object such as a residential or automobile carpet. Based upon my review of the evidence in this case, including crime scene photos, it is indisputable that Colette MacDonald's body was last in contact with the shag rug in the master bedroom. Based upon my experience and training as a hair and fiber examiner, it is my opinion that rugs are conducive to the transfer and retention of foreign fibers. Further, since woolen fibers possess an outer layer of scales, they are among the fibers most readily transferable to surfaces such as rugs.

Further your affiant sayeth not:

Michael P. Malone

Michael P. Malone
Special Agent
Federal Bureau of Investigation

Subscribed and sworn to before me this 21 day of May 1991.

Notary My Commission Expires on the First Monday of January, 19[illegible].

EXHIBIT 1

MARJORY L. JOSEPH
San Fernando Valley State College

Introductory Textile Science

Holt, Rinehart and Winston, Inc.
New York · Chicago · San Francisco · Toronto · London

Library of Congress Catalog Card Number: 66-16950
03-055870-0
Printed in the United States of America
90123 22 10987654

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Saran in Use

While saran fibers are somewhat dense and therefore may be undesirable for apparel fabric use, they are prized for use in furnishing fabrics such as upholstery and draperies; on outdoor furniture; as automobile upholstery and for similar uses in commercial vehicles. The staple fiber form is preferred for draperies, while filament fiber is more satisfactory for furniture use as it is cleaned quickly and easily and does not provide interstices between fibers for dirt and stains to settle. However, the smooth surface of the fiber enables soil to be removed easily from staple yarns.

The fibers are easily cleaned with detergents and lukewarm water. Stains seldom penetrate.

Other uses for saran fibers include wigs for manikins and dolls, luggage coverings, window and patio screening, dust mops, and a wide variety of industrial fabrics.

VINYON

The first vinyon fibers were made experimentally in 1933. The Carbide and Carbon Corporation made the polymer but it was 1939 before any commercial quantities of the fiber were produced. At that time the American Viscose Corporation began to convert the polymer made by Carbide and Carbon into filament fibers. It is interesting to note that this fiber, a true synthetic, was introduced the same year as nylon.

Since that time, improvements have been made on the original fiber and several foreign fiber manufacturers are producing vinyon. The trade names usually encountered are Vinyon HH, Rhovyl, Pe Ce, PCU, and PVC.

Vinyon fibers are defined by the Federal Trade Commission as:

> a manufactured fiber in which the fiber forming substance is any long chain synthetic polymer composed of at least 85% by weight of vinyl chloride units (—CH_2—CHCl—).

Production

Vinyon fibers are either polymers of vinyl chloride or copolymers of vinyl chloride and a second vinyl compound, usually vinyl acetate. These chemicals are polymerized either under pressure or by means of catalysts; the process is addition polymerization. The polymer is dissolved in a suitable solvent and spun into a coagulating media—water, warm air, or other acceptable environment.

EXHIBIT 2

THE MODERN
Textile Dictionary

FULLY REVISED AND EXPANDED

by

GEORGE E. LINTON, Ph.D.

Duell, Sloan and Pearce
New York

tion

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ONARY
and J. M. Price

TEXTILE TERMS
Richard S. Cox

LAUNDRY INDUSTRY
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William C. Segal

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Affiliate of
MEREDITH PRESS
Des Moines & New York

LIBRARY OF CONGRESS CATALOGUE CARD NO. 62-13518

MANUFACTURED IN THE UNITED STATES OF AMERICA FOR MEREDITH PRESS

VAN REES PRESS • NEW YORK

treatment which results in a parallel molecular structure and a yarn which is regenerated cellulose. Properties include extreme strength and dimensional stability.

SAPPHIRE. A color, greenish-blue in hue, of medium saturation and low brilliance.

SAPPY WOOL. Wool which has a high percentage of yolk and suint; the actual yield will be small because of their presence in the grease wool.

SARABAND RUG. Small or medium size Persian rugs made of cotton warp and filling for the base construction with the short pile-effect made of wool tied with Senna knots. Some of the rugs may have wool filling. The design usually shows a pear or some other fruit, while the narrow ornate borders have approximately seven stripes in red, blue, or green. The filling crosses twice beneath each row of tufts. The rugs are often used as runners since they can be made in long, narrow sizes.

SARACENIC TAPESTRY. See BASSE-LISSE.

SARAKHS RUGS. Carpets or rugs made in this northeastern town in Iran (Persia). These heavy, all-wool rugs have the long, close pile tied in Ghiordian knot formation. The yarn is spun from wool obtained in the vicinity.

SARAN AND VELON. Chemicals are the base of these fibers; after processing, the result is vinylidene chloride. Derived from ethylene, a petroleum product, and chlorine from brine.

Saran is known in popular language as a thermoplastic resin; that is, a plastic which is softened by heat and hardened into shape by cooling. It can be quickly and economically molded, and because it can be softened and reshaped again and again, little waste is occasioned. Saran is made by Dow Chemical Co., and is made into filaments and fabrics under both its own name and others.

Velon is a filament made by the Firestone Tire and Rubber Company. At present it is available only as a monofilament.

Properties of these two fibers include resistance to chemicals, stains, abrasion, corrosion, and moisture; they are nonflammable, tough, flexible as desired. Chief uses are for screen cloth, draperies, luggage, shoes, upholstery.

SARANDAZ RUGS. Trade term for Anatolian- and Persian-knotted wool rugs of various designs. Used for household purposes—floor covering, wall decoration, etc.

SARASHI CARIKO. A 36-inch, bleached cotton fabric used for shirting in Japan.

SARASHI KANAKIN. Japanese term for a plain-weave, bleached cotton shirting.

SARASSES COTTON. An East Indian cotton used locally.

SARAWAMI. An Indian sheep known for its fat tail; its fleece shows both wool fibers and hair. The yield is used chiefly in making rough blankets used by the natives and finds some use as carpet wool.

SARCILIS, SARZIL. During the Middle Ages this very coarse, low-textured woolen cloth was worn chiefly by those who subsisted on charity or were beggars.

SARI, SAREE. Scarf worn by the women in India: a gauzy, long fabric which covers the body and can be used to cover the head. The chief garment of Hindu women, it is, in hot weather, the only article of dress worn by the poorer classes.

SARONG. A shirt-like garment, twice as long as wide. The short ends

are sewn together, then it
tied around the hips. The
sarong is broken by the k
head)—which is a doubl
angular motifs called to
feature floral designs. Th
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(double tie-dyed silk ir
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Dodot—depending upon
rules of court etiquette.

The Slendang (shawl
long small cloth of batik
either to carry a baby on
a shawl, over the should
DANG.

SAROUK RUG. See
INGS, CLASSIFICATION OF.

SARPLAR. 1. A bale
weighs one ton, 2,240 p
equal to 80 tods. 2. Tod.
term sarplar, is a unit
pounds of wool.

SARPLIER. A strong
cotton fabric made in En
for bagging to hold newly
wool being shipped from
consignee. See SARPLAR.

SARSANET. Plain or
fabric noted for its soft
perseded by more practic

EXHIBIT 3

MAN-MADE TEXTILE ENCYCLOPEDIA

Edited by J. J. PRESS
United States Navy Clothing and Textile Research Laboratory

TEXTILE BOOK PUBLISHERS, INC.
A Division of
INTERSCIENCE PUBLISHERS, INC., NEW YORK
Interscience Publishers Ltd., London

DEDICATION

To my good friend, Dr. Herman F. Mark, who inspired the organization of this Encyclopedia, and to my dear wife, whose impotient patience and cooperation helped me see it through to completion.

LIBRARY OF CONGRESS CATALOG CARD NUMBER 59-15700

TEXTILE BOOK PUBLISHERS, INC., *A Division of*
Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, New York
For Great Britain and Northern Ireland:
Interscience Publishers Ltd., 88/90 Chancery Lane, London W. C. 2

PRINTED IN THE UNITED STATES OF AMERICA BY MACK PRINTING COMPANY, EASTON, PENNSYLVANIA

to acrylonitrile. The high moisture regain is reported to minimize or prevent the accumulation of static electricity during mill processing. Verel is fire resistant to the extent that it does not support combustion and is resistant to attack by microorganisms and a wide variety of organic and inorganic chemicals. This fiber can be handled on all spinning systems and blends well with cotton, wool, and other synthetics. The bright and dull staple fiber is available in three types (Regular Verel, Verel-Type I, and Verel-Type II) which differ primarily in heat sensitivity as measured by shrinkage in boiling water and in air at elevated temperatures. Whereas the low shrinkage, regular Verel is used in conventional fabrics, the high shrinkage types I and II are recommended for such applications as backing yarns in pile fabrics and high bulk yarns for sweaters and jerseys. The dyeing properties of Verel are reported to be good with premetalized, disperse, and basic dyes. Best light and wash fastness properties are achieved with the neutral dyeing premetalized dyes. A special dyeing assistant available from the fiber manufacturer is recommended for obtaining deepest shades.

TABLE VII
Properties of Verel

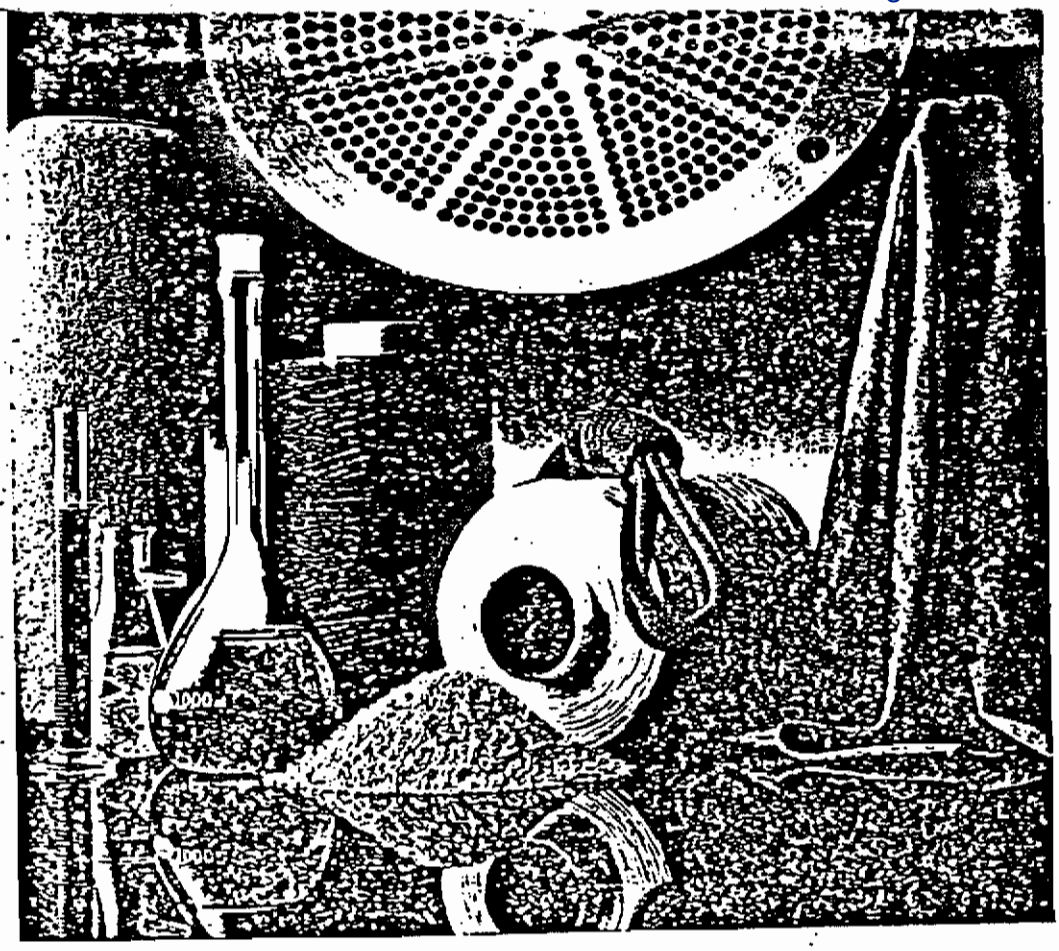
Molecular structure	Partially crystalline
Fiber cross section	Peanut shape
Dry tensile strength, p.s.i.	44,000–49,000
Dry tenacity, g. den.	2.5–2.8
Wet tenacity, g. den.	2.5–2.8
Dry and wet elongation, %	33–35
Initial stiffness, g. den.	40
Elastic recovery	88% from 4% extension
Specific gravity	1.3
Moisture regain, % at 70°F., 65% R.H.	3.5–4.0
Shrinkage, % in boiling water	
Regular Verel in yarn form	1.0–3.0
Type I Verel	9.0–11.0
Type II Verel	19.0–23.0
Shrinkage, % in air at 300°F.	
Regular Verel in yarn form	2.0–5.0
Type I Verel	15.0–17.0
Type II Verel	25.0–28.0
Solvents	Warm acetone, adiponitrile, methyl sulfoxide, acetonitrile
Moth and mildew resistance	Not attacked
Effect of high temperatures	Fabrics can withstand temperatures under a dry iron up to 300°F.; no appreciable strength loss after 128 hr. at 230°F.; some discoloration
Effect of chemicals	Good-to-excellent resistance to acids and alkalies up to 50% concentration, and to solutions of various metallic salts at room temperature; excellent resistance to dry cleaning solvents
Fiber identification test	About 0.2 g. of scoured fiber is placed in a test tube containing 5–6 ml. of pyridine; the mixture is heated on a steam bath for 2–3 minutes. If Verel is present, fiber turns a deep reddish brown and the solution becomes pale pink

Vinylidene Chloride-Vinyl Chloride Copolymer. Polyvinylidene chloride was first observed in France as early as 1838, but little was done in studying the properties and in attempting to exploit the commercial value of this material until about 1930. It soon became apparent that the insolubility and poor heat stability of the homopolymer imposed serious limitations on methods for making useful items of commerce such as fibers and films. Intensive work was therefore directed toward the copolymerization of vinylidene chloride with vinyl monomers as a means of overcoming this problem, and in 1939 copolymers of vinylidene chloride and vinyl chloride were disclosed in a series of patents assigned to Dow Chemical Co. Copolymers containing from 10 to 15% of vinyl chloride, known as saran polymers, are now produced commercially by Dow Chemical Co., and are converted to filament yarns and staple fibers by several manufacturers in America, Britain, Europe, and Japan.

Saran fibers show excellent resistance to soiling and staining. They are also resistant to acids and alkalies and to attack by bacteria and insects. When exposed to a flame, saran fibers soften and char, but do not support combustion. When combined with flammable fibers, saran acts as a fire-retardant. Saran can be dyed with disperse (acetate) dyestuffs, but the light fastness of the dye is a problem. Coloration is usually obtained by pigmentation during the manufacture of the fiber, and a complete range of colored yarns is now available. The principal uses for saran are in screens, upholstery, fabrics, carpets, industrial filter fabrics, and in blends with other fibers for drapery and casement cloth.

Saran yarns are produced in the U.S. by Saran Yarns Co., National Plastic Products Co., Firestone Plastics Co., Dawbarns Bros., Inc., Pierce Plastics, Inc., Southern Lus-Trus Corp., Elmer E. Mills Corp., and Bolta-Saran Inc. Foreign producers of saran yarns include B. X. Plastics Ltd., of England, Kureha Kasei Co., Ltd. of Japan, Bolta-Werk GmbH. of Germany.

EXHIBIT 4



Manufactured Fiber


MADE IN THE
USA

carboxylic acid, including but not restricted to substituted terephthalic units.—

$$p(\text{-R-O-}\overset{\overset{O}{\|}}{\text{C}}\text{-C}_6\text{H}_4\text{-}\overset{\overset{O}{\|}}{\text{C}}\text{-O-})$$

and parasubstituted hydroxy-benzoate units.—

$$p(\text{-R-O-C}_6\text{H}_4\text{-}\overset{\overset{O}{\|}}{\text{C}}\text{-O-}).$$

Basic Principles of Production

Polyester fibers are produced from fiber-forming material made from elements derived from coal, air, water and petroleum. They are melt spun.

Characteristics

- Strong
- Resistant to stretching and shrinking
- Resistant to most chemicals
- Quick drying
- Crisp and resilient when wet or dry
- Wrinkle resistant
- Mildew resistant
- Abrasion resistant
- Able to retain heat-set pleats and creases
- Easily washed

Some Major Uses

Apparel
Every form of clothing

Home Furnishings
Carpets, curtains, draperies, sheets and pillow cases, wall coverings and upholstery

Other
Fiberfill for various products, automobile upholstery, fire hose, power belting, ropes and nets, thread, tire cord, sails, V-belts, floppy disk liners

General Care Tips

1. Most items made from polyester can be machine washed and dried. Use warm water and add a fabric softener to the final rinse cycle. Machine dry at a low temperature and remove articles as soon as the tumbling cycle is completed.
2. If ironing is desired, use a moderately warm iron.
3. Most items made from polyester can be dry-cleaned. (For specific instructions, refer to garment's sewn-in care label.)

SARAN

First U.S. Commercial Production:

1941, Firestone Plastics Company, predecessor of Firestone Synthetic Fibers and Textiles Company.

Federal Trade Commission Definition:

A manufactured fiber in which the fiber-forming substance is any long-chain synthetic polymer composed of at least 80% by weight of vinylidene chloride units.

$$(\text{-CH}_2\text{-CCl}_2\text{-}).$$

Characteristics and Uses

Saran fibers wear well and resist common chemicals, sunlight, staining, fading, mildew and the weather.

Fabrics made from saran fibers can be easily washed with soap and water. They are non-flammable. Saran monofilaments are comparatively stiff and they soften at low temperatures. The fiber is heavy compared with most apparel fibers. Saran fibers are used for upholstery in public conveyances, deck chairs, garden furniture, etc. The weight of saran fibers is too great for wide use as a general textile material.

SPANDEX

First U.S. Commercial Production:

1959, E. I. du Pont de Nemours & Company, Inc.

Federal Trade Commission Definition:

A manufactured fiber in which the fiber-forming substance is a long-chain synthetic polymer comprised of at least 85% of a segmented polyurethane.

EXHIBIT 5

The Condensed Chemical Dictionary

TENTH EDITION

Revised by

GESSNER G. HAWLEY

VNR VAN NOSTRAND REINHOLD COMPANY
New York

Library of Congress Catalog Card Number 80-29636
ISBN 0-442-23244-6

Manufactured in the United States of America

Published by Van Nostrand Reinhold Company Inc.
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1. Chemistry—Dictionaries. I. Hawley, Gessner Goodrich, 1905–
QD5 C5 1981 540'.3'21 80-29636
ISBN 0-442-23244-6

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intermediate for con-
and acetals; sealant;
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nt of lacquers, inks,
ng agent for cements.

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carbons. Attacked by
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n, thermoplastic resin
acetylene with carba-
has excellent dielectric
chemical stability, but
n used principally as a
cal equipment and as an
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-H₂CCHCl—)ₙ. A syn-
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Properties. White powder or colorless granules. Resistant to weathering and moisture; dimensionally stable; good dielectric properties; resistant to most acids, fats, petroleum hydrocarbons and fungus. Readily compounded into flexible and rigid forms by use of plasticizers, stabilizers, fillers, and other modifiers. Easily colored and processed by blow molding, extrusion, calendering, fluid bed coating, etc. Available as film, sheet, fiber and foam.
Derivation: Polymerization of vinyl chloride (q.v.) by free radicals with peroxide initiator. May be copolymerized with up to 15% of other vinyls.
Hazard: Decomposes at 148°C, evolving toxic fumes of hydrogen chloride. See also vinyl chloride, and note.
Uses: Piping and conduits of all kinds; siding; gutters; window and door frames; officially approved for use in interior piping, plumbing, and other construction uses; raincoats, toys, gaskets, garden hose, electrical insulation, shoes, magnetic tape, film and sheeting; containers for toiletries, cosmetics, household chemicals; fibers for athletic supports; sealant liners for ponds and reservoirs; adhesive and bonding agent; plastisols and organosols; tennis court playing surfaces; flooring; coating for paper and textiles; wire and cable protection; base for synthetic turf, phonograph records.
Note: Use of PVC in rigid and semirigid food containers, such as bottles, boxes, etc., is under restriction by FDA, as well as in coatings for fresh citrus fruits. Its use in thinner items such as films and package coatings is permissible. Possibility of migration of vinyl chloride monomer into food products is the critical factor; this tends to increase with the thickness of the material.

polyvinyl chloride-acetate. A vinyl chloride and vinyl acetate copolymer that is more flexible than polyvinyl chloride. The copolymer usually contains 85 to 97% of the chloride. It is generally similar in properties and uses to polyvinyl chloride.

polyvinyl dichloride (PVDC). A chlorinated polyvinyl chloride. Has high strength and superior chemical resistance over a broad temperature range; self-extinguishing. Used for pipe and fittings for hot corrosive materials up to 100°C. Is immune to solvation or direct attack by inorganic reagents, aliphatic hydrocarbons and alcohols.

polyvinyl ether. See polyvinyl ethyl ether; polyvinyl isobutyl ether; polyvinyl methyl ether; polyvinyl methyl ether-maleic anhydride.

polyvinyl ethyl ether (PVE; polyvinyl ether) $[-CH(OC_2H_5)CH_2-]_n$.
Properties: Viscous gum to rubbery solid, depending on molecular weight. Colorless when pure; sp. gr. 0.97 (20°C); refractive index 1.45 (25°C). Insoluble in water; soluble in nearly all organic solvents. Stable toward dilute and concentrated alkalies and dilute acids. Compatible with a limited number of commercial resins, including rosin derivatives and some phenolics.
Derivation. Polymerization of vinyl ethyl ether.
Uses: Pressure-sensitive tape; to improve adhesion to porous surfaces, cellophane, cellulose acetate and vinyl sheet.

polyvinyl fluoride $(-H_2CCHF-)_n$. Polymer of vinyl fluoride. In film form it is characterized by superior resistance to weather, high strength, high dielectric constant, low permeability to air and water, as well as oil, chemical solvent and stain resistance.
Hazard: Not recommended for food packaging. Evolves toxic fumes on heating.
Uses: Protective material for outdoor use; packaging; electrical equipment.

polyvinyl formal. See polyvinyl acetal.

polyvinylidene chloride (saran). A stereoregular, thermoplastic polymer.
Properties: Tasteless, odorless, nontoxic; abrasion-resistant; low vapor transmission; impermeable to flavor. Highly inert to chemical attack; softened by chlorinated hydrocarbons and soluble in cyclohexanone and dioxane. Combustible but self-extinguishing.
Derivation: Polymerization of vinylidene chloride (q.v.) or copolymerization of vinylidene chloride with lesser amounts of other unsaturated compounds.
Forms: Extruded and molded products; oriented fibers; films.
Uses: Packaging of food products, especially meats and poultry; insecticide-impregnated multiwall paper bags; pipes for chemical processing equipment; seat covers, upholstery fibers, bristles, latex coatings.
See also saran fiber; "Cryovac."

polyvinylidene fluoride $H_2C=CF_2$. A thermoplastic fluorocarbon polymer suitable for compression and injection molding and extrusion.
Properties: Crystalline melting point 171°C. Thermally stable from −62 to +148°C. Self-extinguishing and nondripping. Tensile strength 7000 psi at 25°C; yield stress 5500 psi; elongation 300%; compression strength 10,000 psi; thermal conductivity 1.05 Btu/hr/sq ft/°F/in; water absorption 0.04% in 24 hrs; sp. gr. 1.76; refractive index 1.42. Resistant to oxidative degradation, electricity, acids, alkalies, oxidizers, halogens. Somewhat soluble in dimethylacetamide; attacked by hot conc. sulfuric acid or n-butylamine.
Forms: Powder, pellets, solution, and dispersion.
Uses: Insulation for high-temperature wire, tank linings, chemical tanks and tubing, protective paints and coatings with exceptional resistance (30 years) to weathering and U.V.; valve and impeller parts; shrinkage tubing to encapsulate resistors, diodes, and soldered joints; sealant.
See also fluorocarbon polymer.

FILE # 70-51228 KMY

CONTENTS: LAB WORKSHEET ITEMS
01022018S RQ TN Charts

EXHIBIT 6

Matthews'

TEXTILE FIBERS

Their Physical, Microscopic, and Chemical Properties

SIXTH EDITION

Prepared by a Staff of Specialists
under the Editorship of

HERBERT R. MAUERSBERGER

Secretary of Textile Book Publishers, Inc.
Director, Textile Department,
Fairleigh Dickinson College
Textile Consultant

JOHN WILEY & SONS, INC., NEW YORK
CHAPMAN & HALL, LIMITED, LONDON

Utilization. Among the first commercial applications of vinylidene chloride were fishing leaders made of monofilaments and produced by Pierce Plastics, Inc., of Bay City, Mich., under the trade name of Permalon. This company also used Saran for the production of tapes, as well as catheters for surgical purposes. Irvington Varnish & Insulator Company produced filaments in a rattanlike cross-section for use in upholstery fabrics. The success obtained with this material in specialty fields soon led to its adoption for the manufacture of narrow webbing in decorative fabrics such as belts and suspenders, as well as specialty braids and some knitted fabrics. It was found possible to weave the material on metal wire looms through minor loom modifications. A durable insect screen was made for war purposes, which outlasted metal in adverse tropical and humid climates. Among the first extruders producing monofilaments for this use were the Firestone Industrial Products Company, now Firestone Plastics Company, of Pottstown, Pa., under the trade name Velon. Shortly after the work on metal wire looms was started, it was found possible to weave this fabric on slightly modified standard textile looms. The use of vinylidene chloride in insect screens is a typical example of the utility of this material for military applications. Other companies have taken up the manufacture of Saran monofilaments and brush bristles: Las-Tras Extruded Plastics, Inc.; Bolta-Saran, Inc., and Dawlarn Brothers, Inc.

Process. Petroleum and brine are the basic raw materials. Ethylene, made by cracking petroleum, and chlorine, obtained by the electrolysis of brine, combine to form trichloroethane, which is converted to vinylidene chloride as shown in Fig. 23.

Monomeric vinylidene chloride is a clear, colorless liquid having a boiling point of 31.7° C. (89° F.). The structural formula is $CH_2 - CCl_2$. It can be readily polymerized to form a long, linear, straight-chain polymer. By selection of copolymers and control of the polymerization conditions, polymers can be formed which have softening points ranging from 70° C. (156° F.) to at least 180° C. (350° F.). An average commercial polymer has a molecular weight of approximately 20,000 and a softening point of 120 to 140° C. (248 to 284° F.). The basic vinylidene chloride resin is practically odorless and tasteless, and is nontoxic.

The fabrication method of particular interest in the textile field consists of extrusion with subsequent mechanical or heat treatment for improved properties. The extrusion of vinylidene chloride produces a long, continuous-length monofilament, either of circular cross-section

UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF NORTH CAROLINA
FAYETTEVILLE DIVISION

UNITED STATES OF AMERICA,	
v.	Nos. 75-26-CR-3 90-104-CIV-3-D
JEFFREY R. MacDONALD	

AFFIDAVIT OF FRANK APPLEBAUM

I, Frank Applebaum, being first duly sworn, state under oath the following:

1. I currently reside at 3 Pomona West, Apt. 3, Pikesville, Maryland 21208.

2. Between 1939 and 1987, I was employed at a company in Odenton, Maryland, which conducted business under the following names: National Store Fixtures, National Plastics Products, Enjay Fibers and Laminates Co., Amtech Co., and Ametek Co.

3. While working for said company, I held positions in the following departments approximately during the years indicated: Research and Development, 1939 to 1946; Manufacturing, 1946 to 1968; Sales and Marketing, 1968-1987. From 1976 to 1987, I was the Vice-President of Marketing.

4. During the course of my employment at National Plastics Products Company and its successors, I became familiar with the production of saran fibers, including development work on the use of saran fibers for cosmetic wigs worn by humans. The chemical name for saran is polyvinylidene chloride.

5. Saran can be manufactured in a number of different forms, including solid, film, monofilament and continuous

multifilament forms. While I was employed by National Plastics Products Company and its successors, we manufactured saran fibers in both monofilament and continuous multifilament forms.

6. "Monofilament" consists of an individual fiber which can vary in length depending on the end use. A rather simple example of a monofilament fiber is fishing line. "Continuous multifilament" is a bundle of numerous individual saran fibers that have all been extruded and processed as a group. Continuous multifilament can be made in any length desired and can be many feet in length. At the end of the production line, the continuous multifilament gets wound onto a spool, paper tube, or a 62-inch bundle form, which is then shipped to the end user who can cut it to any length desired for the end use.

7. National Plastics Products Company manufactured saran fibers in continuous multifilament form in a full range of hair colors, including light or "platinum blond." From the late 1950s to 1987, National Plastics Products Company and its successors worked with companies including Globe Wig, World Wig, and A & B Wig (which also conducted business under the name A & B Artistic Wig), in the development of saran continuous multifilament for use in human cosmetic wigs. All of these companies were located in New York City. To the best of my knowledge, none of these companies are currently in business.

8. During the course of my employment at National Plastics Products Company and its successors, I saw human cosmetic wigs being developed for commercial use with the

saran fiber products. The saran wigs I saw were manufactured by Globe Wig and A & B Wig (which also conducted business under the name A & B Artistic Wig).

9. National Plastics Products Company and its successors also supplied saran continuous multifilament in bundle form to a wigmaker named Myer Jacoby, who made white Santa Claus wigs and beards with it. To the best of my knowledge, Jacoby worked out of New York and is now deceased.

Frank Applebaum

Signed and sworn to before me this 20 day of April, 1996, at Pikesville, Maryland.

Notary Public, State of Maryland

My commission expires _____.

The Police Chief

THE PROFESSIONAL VOICE OF LAW ENFORCEMENT

JUNE 1993

"FATAL VISION" REVISITED

Kristen and Kimberly MacDonald at play at the home of their maternal grandparents, Mr. and Mrs. Alfred G. Kassab, in Long Island, New York, in the summer of 1969. This photo—a print made from an 8mm home movie taken by Mr. Kassab—proved that the MacDonald girls had at least one blond-haired doll, and thus helped to account for the "blond synthetic hair" found in a hairbrush at the crime scene. *Inset*, the Army booking photo of Jeffrey MacDonald taken following his arrest for the murder of his wife and two daughters.

The PoliceChief

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"FATAL VISION" REVISITED:

The MacDonald Murder Case

By Brian M. Murtagh, Assistant U.S. Attorney, Washington, D.C., and Supervisory Special Agent Michael P. Malone, Senior Examiner, Hair and Fibers Unit, FBI Laboratory, Washington, D.C.

Editor's note: Mr. Murtagh was the prosecuting attorney in the 1979 MacDonald murder trial. Mr. Malone has been a central figure in the hair and fiber analysis required throughout the post-trial appeals process.

The trial of *United States v. Jeffrey R. MacDonald* commenced on the morning of July 19, 1979, in U.S. District Court for the Eastern District of North Carolina, in Raleigh, and was to continue until his conviction on August 29, 1979. The prosecution's theory was that MacDonald's exculpatory account of the murder of his wife and two small daughters by intruders was false and was therefore evidence of his consciousness of guilt. In particular, the prosecution focused on MacDonald's own account of his movements in the crime scene after the "intruders" had allegedly fled into the night. Here, the purpose was to demonstrate that MacDonald's alibi that he was in the living room when his family was being attacked in the bedrooms was false.

Ultimately, it was proven beyond a reasonable doubt that the crime scene had been rearranged and that only MacDonald could have rearranged it. In effect, the jury was asked to determine whether to give credence to MacDonald's account or to the story told by the physical evidence.

MacDonald's defense involved several themes:

1. the intruders did it;
2. the crime scene's integrity was destroyed by the military police;
3. physical evidence that cannot be linked to the household or its occupants proves the presence of intruders;
4. unlike the government experts, the defense experts have correctly examined the physical evidence; and
5. there is no evidence to prove that MacDonald was other than a loving husband and "a wonderful Daddy."

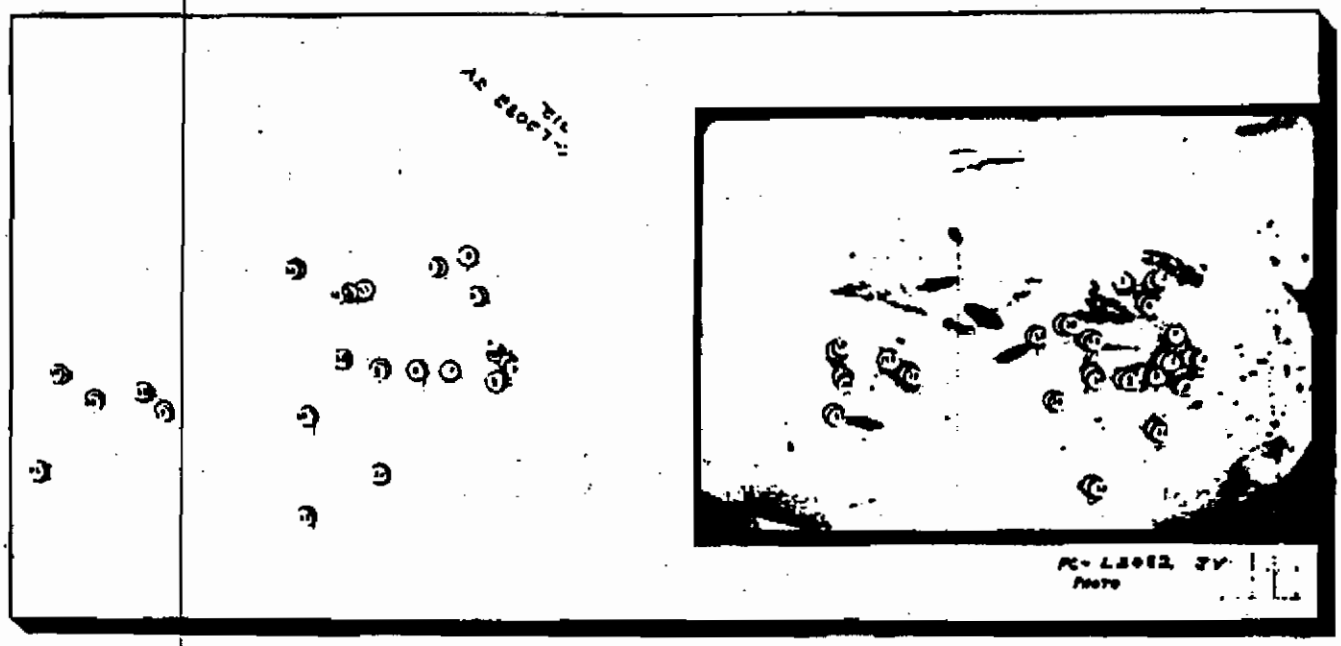
Fortunately for the prosecution, MacDonald's account was well documented and consisted principally of a tape-recorded interview on April 6, 1970, and his subsequent testimony before the Army's Article 32 investigating officer and the federal grand jury.

The case focused on Jeffrey MacDonald's torn and bloody blue pajama top, found on top of Colette MacDonald's body, which was lying in a supine position on the shag rug of the master bedroom. When Colette's body was lifted off the rug, a CID agent spotted a dark thread in a blood clot on the rug in the area where her head had been. The agent's hunch that the thread might have come from the blue pajama top (later confirmed by laboratory examination) prompted an immediate search for threads in the body outline, as well as in the living room where MacDonald said he had been attacked and his pajama top torn.

The results of this search were informative: a total of 60 threads and yarns were found in the master bedroom. Thirty-four were found under Colette's body, and one was found on the floor beneath the headboard that bore the word "PIG" written in Colette's blood type. Nineteen were found inside bedding in which Kimberly's body was wrapped, and three were found on Kristen's bedspread. Significantly, neither threads nor yarns from MacDonald's pajama top were found in the area of the living room where he claimed to have been attacked.

What was found in the living room was a blood-stained *Esquire* magazine containing an account of the recent Tate-LaBianca murders perpetrated by Charles Manson's

Contrary to Jeffrey MacDonald's assertion that the unidentified dark woolen fibers found at the scene could not have belonged to anyone in his family—and must have come from the dark clothes of the "hippie intruders"—this family photograph shows Colette (with baby Kristen) in a dark coat and knit hat.



Although Jeffrey MacDonald contended that the 48 ice pick holes in his pajama top were the result of a violent struggle with an ice pick-wielding assailant, he sustained no such wounds himself. In fact, when the pajama top was folded right sleeve inside out, as it had been found on Colette's chest, it was possible to insert 21 probes simultaneously through the 48 ice pick holes in the pajama top. The resulting pattern (above, left) corresponds exactly with the two groupings of the 21 ice pick wounds in Colette's chest (above, right).

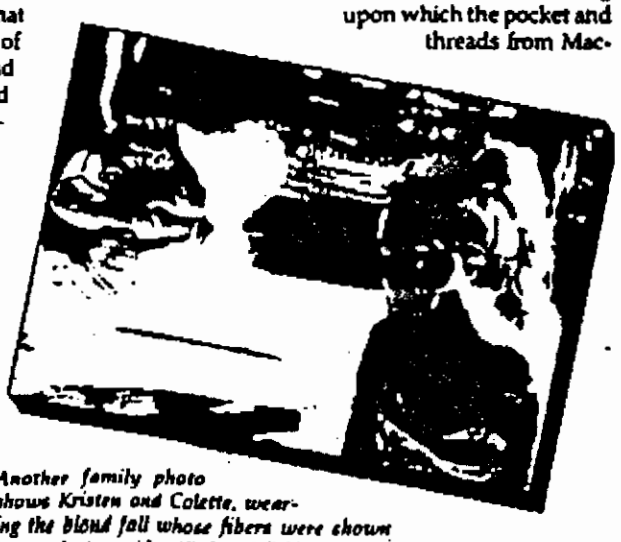
hippie family. In addition, MacDonald's eyeglasses, which he claimed not to have been wearing during or subsequent to "the struggle," were found in the living room, with Kristen's blood group on the side of the lens that was in contact with the floor.

The pocket from MacDonald's blue pajama top was found on the upturned corner of a multicolored throw rug adjacent to Colette's feet. When CID agents questioned MacDonald about the disparity between the lightly bloodstained pocket and the blood-soaked top from which it had been torn, MacDonald provided the following explanation: Upon regaining consciousness in the living room, and still wearing his pajama top (which had been torn in the struggle with an ice pick-wielding assailant), he had gone directly to the master bedroom and shed his pajama top. He then described how he had covered his wife with his pajama top and a "towel" to treat her for shock. Attempting to explain how the pajama pocket could have been torn in the living room, but fallen off in the master bedroom, MacDonald was emphatic that he had not made a "circuit" of the other rooms before removing his pajama top.

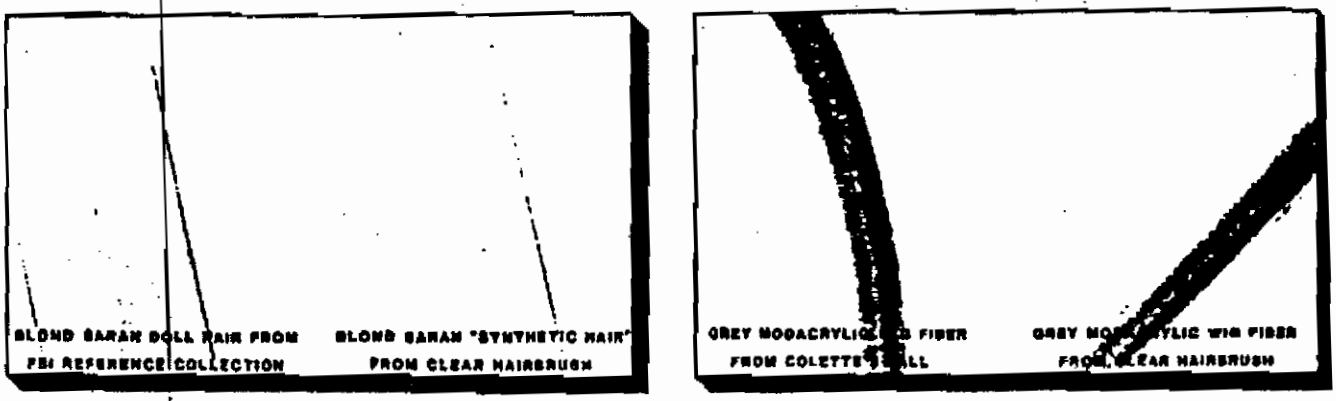
This statement kept MacDonald from explaining away the results of subsequent laboratory examinations, which revealed the following: some of the blood stains in Colette's blood type on MacDonald's pajama top were bisected by tears on the front of the pullover-type pajama top. This indicated that Colette's blood, which by MacDonald's account could only have gotten on the pajama top when he placed it on her body, was there before it was torn. The location where the pajama top was torn, according to MacDonald, was the living room. However, this was controverted by the profusion of pajama top threads in the master bedroom. Furthermore, the pocket was stained with Colette's blood type as the result of direct contact before it was ripped from the pajama top.

The compelling blood evidence further demonstrated that MacDonald's assault on his wife and older child, Kimberly, had originated in the master bedroom. Due to the fact that each of the four members of the MacDonald family had a different ABO blood group,[1] and all had bleeding injuries, it was possible to reconstruct, to a degree, the locations where the assaults had taken place. The presence of contact blood stains in both Kimberly's and Colette's blood types on the master bedroom rug, on splinters from the club (which was found outside the utility room door) and other blood spatters showed that both Kimberly and Colette had been assaulted with the club in the master bedroom.

In Kimberly's room, spatters in Kimberly's and Colette's blood groups on the wall adjacent to the bed where her body was found indicate that Kimberly was assaulted with the club a second time, after it had been stained with Colette's blood. MacDonald is linked to these assaults by the presence of a stain in Kimberly's blood type on his pajama top, which—according to his account—he was not wearing when he went into Kimberly's room. In addition, threads from his pajama top were found on the club, which also bore fibers from the throw rug upon which the pocket and threads from Mac-



Another family photo shows Kristen and Colette, wearing the blond fall whose fibers were shown to match the unidentified "wig" fibers that supposedly linked Helena Stoeckley to the crime scene.



The defense scenario alleged that at some point during the crimes, Helena Stoeckley, wearing a blond wig, had answered the kitchen telephone in the MacDonald residence and left a clear-handled hairbrush on a sideboard near the phone. The "wig" fibers found in this hairbrush were analyzed with the following results. The blond synthetic hair was found to be a saran fiber often used for doll hair; at far left is a blond saran doll hair from the FBI reference collection for purposes of comparison. The grey modacrylic wig fiber found in the hairbrush (far right) was found to match a grey modacrylic wig fiber from the blond fall Colette was known to wear.

Donald's pajama top had fallen. As the club was stained with both Colette's and Kimberly's blood groups, the logical inference is that the club came in contact with the throw rug and acquired the rug's fibers, as well as other foreign fibers (such as the pajama top threads) that were present on the rug.

According to MacDonald's account, the only place he was in contact with the club was in the living room, where no splinters, pajama top threads or blood spatters were found. As MacDonald claimed that he had brought the pajama top into the master bedroom after the club had been dropped outside the utility room door, it follows that the club, the throw rug and threads torn from MacDonald's pajama top could never have been in the master bedroom at the same time.

MacDonald had initially denied owning the club, or any lumber of similar 2" x 2" dimension. However, investigation revealed that the club was not of 2" x 2" dimension, but rather had been cut from a 2" x 4" used as a bed slat for Kimberly's bed. As demonstrated by the configuration of paint stains of identical chemical composition, the club had been used to support a leg of Kimberly's bed when the bed was painted. Furthermore, the club was similar in dimension to homemade shelf supports that MacDonald had constructed for the master bedroom.

Whether Colette MacDonald went to Kristen's bedroom to rescue her baby or because MacDonald was already in the room will never be known. However, it has been proven that Colette was assaulted with the club by Jeffrey MacDonald in Kristen's room while he was still wearing his torn pajama top. These inferences are supported by Colette's blood type spattered on the wall above Kristen's bed, and in large stains on the top sheet of Kristen's bed. In addition, splinters from the club and threads from MacDonald's pajama top were found on Kristen's bedspread. Because Kristen, unlike Colette and Kimberly, sustained no blunt-trauma injuries, it can be inferred that Colette was assaulted in this room with the club by MacDonald, who was wearing the torn pajama top.

As the body of Colette MacDonald was found in the master bedroom, the conclusion that her body was moved after she was assaulted in Kristen's room becomes inescapable. That only MacDonald could have moved her body is equally clear when the interrelation of key pieces of evidence is analyzed. The most probative of these evidentiary items was MacDonald's bare bloody footprint in Colette's blood group, exiting from Kristen's room. The significance of this footprint was initially overlooked, until it was discovered that no other sources of Colette's blood type were present on the floor of Kristen's bedroom.

Since MacDonald had tracked Colette's blood out of—rather than into—Kristen's room, the question arose as to the source of Colette's blood in Kristen's room (on which MacDonald must have stepped before tracking the blood out of the room). Whatever the source of Colette's blood had been, it had been removed before the investigators arrived. Subsequent laboratory examinations were to answer these questions.

On the floor of the master bedroom, investigators had found a pile of bedding from the master bed. The bedspread was found inside the top sheet; both items bore numerous bloodstains, predominantly in Colette's blood group. The sheet also had spatters in Kimberly's blood group, which was consistent with the sheet having been present when Kimberly was assaulted in the master bedroom. In addition, the sheet bore numerous fabric impressions in Colette's blood group. Some of these fabric impressions matched the sleeves of both Colette's and Jeffrey MacDonald's pajama tops, each of which also had corresponding bloodstains in Colette's blood group. Further, purple cotton seam threads from MacDonald's pajama top were removed from the bedspread, one of which was entangled with a crushed head hair that matched Colette's hair.

Taken together, this evidence refuted MacDonald's denial of any contact with the bedding or with having moved Colette's body from Kristen's room. Additionally, as was argued to the jury, the presence of MacDonald's footprint in Colette's blood type, exiting from Kristen's room, can be explained by the following scenario: After assaulting Colette and rendering her unconscious in Kristen's room, MacDonald—still wearing the torn pajama top stained with Colette's blood type—obtained the bedding from the master bedroom. Placing the bedspread on the floor to shield it from Colette's blood, he then placed Colette's body, covered with the sheet, on the spread. The quilt-like bedspread absorbed a large quantity of Colette's blood and also picked up the pajama top thread entangled with Colette's hair.

As the result of contact between the sheet and the sleeves of Colette's and Jeffrey's pajamas, fabric impressions in Colette's blood were transferred to the sheet. In the process, MacDonald's bare foot became coated with Colette's blood, most probably from the bedspread. MacDonald then tracked the blood out of Kristen's room. Colette's body was then deposited on the master bedroom shag rug, where the majority of threads from his pajama top had been previously deposited when the pajama top was first torn.

Thus viewed, the bloody footprint could only have been left by MacDonald during the removal of Colette's body from Kristen's room.

The pajama top, rather than the footprint, was still the most probative evidence in disproving MacDonald's account. In addition to refuting his account of where the pajama top was torn, laboratory examinations demonstrated the falsity of his explanation for the presence of 48 puncture holes in the pajama top. MacDonald had given a vivid "blow-by-blow" description of his attack by intruders, one of whom was allegedly armed with an ice pick. MacDonald described how his pajama top was pulled over his head and on to his arms, which he then used to absorb the thrusts of the ice pick.

However, none of the resulting 48 puncture holes exhibited any evidence of tearing, which indicated that the garment had been stationary at the time the ice pick holes were made. The defense expert attempted to challenge this conclusion by stabbing a ham wrapped in a similar pajama top, in order to demonstrate that it was theoretically possible to puncture a moving pajama top without tearing.

Because MacDonald's account had the unsupported portion of the pajama top between his arms, sustaining the punctures during a violent struggle, the prosecution responded with an "in-court" demonstration. One prosecutor placed a similar pajama top on his arms while the other stabbed at the moving garment with an ice pick. As was readily apparent to the jury, it was impossible to stab at the unsupported pajama top with an ice pick without tearing it or hitting the arms of the wearer. Since MacDonald had no documented ice pick wounds, and claimed no such wounds on his arms, the credibility of his account was further damaged. Additionally, MacDonald's initial, emphatic denial that the family had owned an ice pick was disproved by the testimony of two witnesses.

Only a single small stain of MacDonald's own blood type was found on his pajama top. This stain conformed to a defect on the left sleeve of the garment, which was consistent with having been made by the dull blade of the Geneva Forge-brand paring knife found on the floor of the master bedroom. It was this knife that MacDonald had spontaneously stated—on three occasions—he had pulled from his wife's chest. However, neither the wounds in Colette's chest nor the cuts in her pajama top were consistent with having been made by the Geneva Forge knife. MacDonald's fingerprints were not on the Geneva Forge knife, but a speck of his wife's blood type was present.

If the knife was not used on Colette or either of the children, what was its role in the crime? The evidence supports the inference that Colette used the knife to defend Kimberly from her father.

Contrary to MacDonald's assertion, the older daughter, Kimberly, suffered from enuresis (involuntary bed-wetting). In addition, as established by the testimony of a classmate from a child psychology course attended by Colette on the night she was murdered, Colette and Jeffrey disagreed on how to deal with the recurrent problem of the children climbing into the parents' bed. MacDonald admitted they talked about the class discussion when Colette returned from class, but claimed that Colette's solution was for the displaced parent to sleep elsewhere. MacDonald claimed that when he finally went to bed that night, Kristen had wet his side of the bed, so he returned to sleep on the living room couch, where he was subsequently attacked. The presence of the antigen A in the urine stain from the master bed is inconsistent with Kristen's blood type, but is consistent with a deteriorated sample from Kimberly's type.

Colette's chest bore a pattern bruise from the end of the club, as if she had been struck at arm's length by a bayonet-type thrust. Given the other evidence, which establishes that MacDonald's pajama top was torn in the master bedroom and that Colette and Kimberly were struck there with the club, it is entirely consistent that the initial focus of the confrontation was Kimberly. As Kimberly screamed in response to her father's blows, Colette picked up the Geneva Forge knife and attempted to stab MacDonald. In response, MacDonald grabbed the club, and in the fray, struck Kimberly and fractured her skull.

In contrast to MacDonald, Colette had sustained 21 ice pick wounds to the upper chest area. The tightly grouped wounds—five on the right side and 16 on the left side—were in addition to the 16 deep, penetrating, elliptical knife wounds to her chest that caused her death. The ice pick wounds had been inflicted in a perpendicular manner, while her body was in a supine position.

When MacDonald's pajama top was folded right sleeve inside out, as it had been found on Colette's chest, it was possible to insert 21 probes simultaneously through the 48 ice pick holes in the pajama top. The pattern that results from the insertion of the 21 probes through the ice pick holes in the pajama top corresponds exactly with the two groupings of the 21 ice pick wounds in Colette's chest (see photo on page 16). This graphically demonstrates that Colette MacDonald was stabbed through Jeffrey MacDonald's pajama top while it lay on her chest.

It was argued to the jury that MacDonald had initially put the pajama top on Colette to provide an explanation for the presence of her blood type on his garment. Subsequent to the infliction of the fatal knife wounds, MacDonald stabbed his wife through his pajama top with an ice pick in order to suggest, by the use of different weapons, the presence of multiple assailants inflicting ritualistic-type wounds. Further forensic examinations established that the ice pick and steel paring knife had been wiped clean on a Hilton bathmat, which was found draped across Colette's abdomen, and which bore stains in Kimberly's and Colette's blood groups. This was the "towel" that MacDonald had claimed to have placed over Colette to prevent shock.

Other attempts to make the crime scene appear Manson-esque also implicated MacDonald. The word "PIG" in Colette's blood type on the headboard appeared, due to the absence of ridge lines, to have been written by a person wearing rubber gloves. This was supported by the presence of fragments of latex glove bearing Colette's blood type that were found on the floor and in the pile of bedding in the master bedroom. MacDonald's blood

type was found on the kitchen floor leading to a cabinet in which packages of disposable surgeon's latex gloves were found. Examinations of the glove fragments and the exemplar gloves revealed the presence of similar trace elements.[2] A thread from MacDonald's pajama top was also found on the floor beneath the headboard where "PIG" had been written.

In addition to glowing character testimony and an attack by defense experts on the government's forensic evidence, the defense presented the testimony of Helena Stoeckley in an attempt to corroborate MacDonald's account.[3]

Initially, the defense had sought to get Stoeckley's various admissions admitted through the testimony of third parties to whom she had made various conflicting statements over the years. The trial judge ruled that the under the Federal Rules of Evidence, such exceptions to the hearsay rule are not admissible unless corroborating circumstances clearly indicate the trustworthiness of the statement. Far from being corroborated, Stoeckley's conflicting admissions and denials of involvement were, in the court's view, about as untrustworthy as they could get. Consequently, Stoeckley's out-of-court statements were ruled inadmissible.

However, the prosecution had sought a material witness warrant for Stoeckley, who was arrested by the FBI and brought to the courthouse. The trial judge recessed the trial, and made Stoeckley available to the defense. In their subsequent interview, the defense showed Stoeckley the crime scene photos in an attempt to refresh her recollection.

Called to the witness stand by the defense, Stoeckley testified, in the presence of the jury, to her extensive consumption of opiates and cannabis on February 16, 1970. After consuming a "hit of mescaline" around midnight, Stoeckley could not recall her whereabouts until she returned to her apartment early on the morning of February 17, after the news of the murders had been announced on a local radio station. Contrary to earlier statements in which she "thought" she might have been involved, at trial Stoeckley testified that she didn't believe that she had participated in or witnessed the murders. Stoeckley did admit that she owned a floppy hat and boots, and sometimes wore a blond wig, although she was not wearing it on the night of the murders.[4] Stoeckley subsequently destroyed the hat and wig. During the Army Article 32 Hearing, and in subsequent interviews by the CID, MacDonald had not identified Stoeckley's photographs, nor did he identify Stoeckley during his trial testimony.

The defense also sought to demonstrate the existence of intruders by pointing to the presence of unidentified fingerprints, unmatched fibers and candle drippings found in the crime scene. However, as the critical evidence involving the pajama top stained with Colette's blood, the puncture holes matching the pattern of Colette's ice pick wounds, the pajama top fibers on the club and elsewhere, the bloody footprint and the fabric impressions on the sheet could only be accounted for by MacDonald's rearrangement of the crime scene, the jury rejected his intruder defense. After six and one-half hours, the jury found Jeffrey MacDonald guilty of the second-degree murders of Colette and Kimberly, and murder in the first degree of Kristen. He was immediately sentenced to three consecutive terms of life imprisonment.

The Direct Appeal

In July 1980, the U.S. Court of Appeals for the Fourth Circuit reversed MacDonald's conviction on the grounds of denial of his right to a speedy trial and cited as trial prejudice Helena Stoeckley's loss of memory of her whereabouts. The government petitioned the U.S. Supreme Court for writ of certiorari, which was granted. On March 31, 1982, after briefing and oral argument on the merits, the Supreme Court found no denial of speedy trial rights, reversed the Fourth Circuit and reinstated MacDonald's conviction. The case was remanded for disposition of remaining issues, and MacDonald was returned to prison the same day. A subsequent appeal on the conduct of the trial, including the exclusion of Stoeckley's out-of-court statements, was rejected by the Fourth Circuit and the Supreme Court.

While MacDonald's conviction had theoretically become final by 1984, several collateral attacks on the conviction were mounted.

The 1984 Collateral Attack

In 1984, MacDonald filed a motion for a new trial on the grounds of newly discovered evidence in the form of detailed post-trial confessions by Helena Stoeckley. Also filed at this time were petitions for writ of habeas corpus, challenging the conviction on the grounds of alleged suppression of exculpatory physical evidence. The "exculpatory" evidence had been obtained by the defense under the Freedom of Information Act, and included laboratory bench notes from both the FBI and the CID. These claims were also rejected by the trial court, appellate court and Supreme Court.

The 1990 Collateral Attack

In 1990, MacDonald's third set of lawyers filed a third petition for habeas corpus, based exclusively on "critical new"

evidence from "previously unreleased" documents that had been purportedly obtained under the Freedom of Information Act in 1989-90. In fact, the FBI and CID laboratory bench notes involved had been released in 1983-84 to MacDonald's prior habeas counsel, who had raised other matters from the same releases. The actual physical evidence had been made available for examination by defense experts prior to trial.

This subsequent habeas petition, based upon information that was available but not raised in the first habeas petition, was held to be an abuse of the writ. The final portion of this article, however, will address only the forensic aspects of this petition, and will demonstrate that not only was the evidence not new, but it wasn't exculpatory. Furthermore, these items in no way altered the evidence upon which MacDonald had been originally convicted.

The newly discovered "exculpatory" evidence would fall into three main categories: (1) unidentified blond and grey "wig" fibers, (2) unidentified dark wool fibers and (3) unidentified hair found on or near Colette's body and in both children's bed clothing.

The unidentified "wig" fibers were crucial to MacDonald's defense because of where they were found and because they supposedly "linked" Helena Stoeckley, now deceased, to the crime scene. Two hairbrushes, a clear-handled hairbrush found on a sideboard near the kitchen phone and a blue-handled hair brush found under Colette's body, became important.

The defense scenario alleged that at some point during the crimes, Helena Stoeckley, wearing a blond wig, had answered the kitchen telephone in the MacDonald residence. If actual unidentified human "wig" fibers, which did not originate from the MacDonald household, were found in these hairbrushes, this would tend to corroborate Stoeckley's presence and would be "exculpatory" to the government's case.

The "blond synthetic hair" and "grey synthetic hair" had been originally discovered in the clear-handled hairbrush early in the CID investigation by an Army CID laboratory examiner. The presence of these blond synthetic fibers was noted in the CID examiner's bench notes; however, they were never mentioned in the final CID laboratory reports. They had never been disclosed to the defense prior to the 1979 trial.

The first step in the re-examination of these "wig" fibers was to determine if they were, in fact, true wig fibers and then to attempt to determine their source. The grey "wig" fibers were examined using

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the standard light microscope, the polarizing light microscope and two of the most discriminating techniques that can be used with synthetic fibers—the microspectrophotometer[5] and the Fourier Transform Infrared analyses.[6] They were identified as modacrylic fibers, the most common type of synthetic fiber used in the manufacture of human hair goods.

Investigation revealed that a blond fall, once owned and worn frequently by Colette MacDonald, was still available for analysis. When the fall was examined, it was found to be composed of a combination of human hair and modacrylic wig fibers. It was also found that the grey modacrylic wig fibers from the hairbrush matched the grey modacrylic wig fibers found in the composition of the fall. Accordingly, these grey wig fibers were consistent with having originated from Colette's fall (see photos on page 18).

Therefore, while "true" wig fibers were found at the crime scene, the source of these modacrylic wig fibers could be accounted for—they came from Colette MacDonald's fall.

The source of the "blond synthetic hair" from the clear-handled hairbrush posed more of a problem. Again, the same microscopic, optical and instrumental techniques were used, ultimately determining that the "blond synthetic hairs" were composed of saran fibers. Due to problems in manufacturing and the physical properties of saran fibers, they are not suitable for human wigs. They do not look like or "lay" like human hair; therefore, they are not used to make human hair goods.

One of the main uses of saran fibers during the time frame of the murders was for doll hair. These "blond synthetic hairs" were very similar to blond doll hair in the FBI reference collection (see photos on page 18). In fact, the early "Barbie"™ dolls made by Mattel had hair made of saran fibers.

Since the MacDonald girls were known to have owned dolls with blond hair, and since little girls are known to brush the hair of their dolls, it can be inferred that the "blond synthetic hair" found in the hairbrush probably came from a doll belonging to the MacDonald girls or one of their friends. Unfortunately, none of the dolls originally belonging to Kimberly or Kristen are available today for testing purposes.

A second area of "exculpatory" evidence as noted in the defense petition concerned unidentified woolen fibers found on Colette MacDonald's body and on the club. These fibers had been noted in an early FBI examination, but not included in the FBI report. These consisted of dark-colored woolen fibers and white woolen fibers. The dark-colored fibers were important to MacDonald's defense in order to fit the latest defense scenario, which alleged that the "intruders" were wearing dark-colored clothing.

The bluish-black woolen fiber from the biceps area of Colette was determined, by means of microspectrophotometry, to be different from the bluish-black woolen fiber removed from the club. Additionally, both of these fibers were different from the two dark purple woolen fibers found on the mouth area of Colette's body. The white woolen fibers found on Colette's bicep and on the club were eventually matched back to the white shag wool rug upon which Colette's body was lying.

This fact was very important to the prosecution's theory of the case. According to the Transfer Theory of Locard,[7] upon which all hair and fiber work is based, an individual is constantly exchanging both hairs and/or fibers with his environment, so that the hairs and fibers found on an individual at any one time are reflective of his latest environment. Since the white woolen fibers on Colette's body were reflective of her latest environment—the master bedroom rug—it follows that the dark-colored woolen fibers probably were also from the rug.

As for the original source of the woolen fibers, it is a known fact that Colette owned many dark-colored clothing items, such as sweaters, coats and knit hats. These items had been returned to MacDonald in 1970 and were no longer available for testing.

The final area of "exculpatory" evidence, as noted by the defense, concerned unidentified human hairs found under Colette's body and in the bed clothing of all three victims. These hairs had been originally discovered by the CID laboratory examination and had been noted in the bench notes. This information was not disclosed to the defense.

If a suitable pubic hair is matched to a particular individual, this leads to a strong association to that individual.[8] A brown Caucasian pubic hair was found under the body of Colette MacDonald. This hair remained unmatched for over 20 years. Finally, as a result of a recent FBI Laboratory examination, this hair was matched to the pubic hairs of Jeffrey MacDonald; and accordingly, is consistent with having originated from Jeffrey MacDonald.

The unidentified hairs from the master bedding, Kristen's bedspread and Kimberly's quilt were also re-examined and were found to be either limb hairs or body

hairs. Accordingly, they did not possess sufficient characteristics to be of value for significant comparison purposes.

In summary, as a result of numerous re-examinations, all of the alleged "exculpatory" evidence deemed so important to the latest defense scenario probably originated from ordinary, everyday items found in the MacDonald household, and in no way suggests the presence of outside "intruders." Had Colette MacDonald's parents not retained their daughter's blond fall, however, MacDonald could have successfully argued that "blond wig hairs," unmatched to any item from the MacDonald household, were found at the crime scene. While this would have been "literally" true, the inference that the "blond wig hairs" established the presence of "intruders" would have been false.

The Outcome

On Monday, July 8, 1991, U.S. District Judge Franklin T. Dupree, Jr., who presided over MacDonald's original trial in 1979, denied Jeffrey MacDonald's petition for a new trial, stating: "[T]he fiber evidence presented here for the first time would have been insufficient to alter the result at trial, and if a new trial were held, the jury would again reach the almost inescapable conclusion that [Jeffrey MacDonald] was responsible for these horrible crimes."

On June 2, 1992, the U.S. Court of Appeals for the Fourth Circuit again denied MacDonald's petition and upheld Judge Dupree's prior ruling. Commenting on the "newly discovered" evidence in its lengthy opinion, the Appeals Court stated, "The most that can be said about the evidence is that it raises speculation concerning its origin. Furthermore, the origin of the hair and fiber evidence has several likely explanations other than intruders." The court goes on to state, "We have carefully reviewed the voluminous record of evidence in this case, beginning with the original military Article 32 proceedings through the present habeas petition, which contains over 4,000 pages. Yet we do not find anything to convince us that the evidence introduced here, considered with that previously amassed, would have raised reasonable doubts in the minds of the jurors."

In October 1992, the U.S. Supreme Court denied Jeffrey MacDonald's petition for writ of certiorari to review the appellate court's decision.

At this writing, MacDonald is serving his sentence at the Federal Corrections Institution in Sheridan, Oregon. He is currently eligible for parole. ★

[1] Jeffrey MacDonald has blood group B, Colette MacDonald had blood group A, Kimberly MacDonald had blood group AB and Kristen MacDonald had blood group O. The chances of this occurring in a family are extremely low.

[2] A neutron activation analysis revealed that the trace elemental composition of the finger section of the latex surgical glove was similar to the trace elemental composition of the packets of latex surgical gloves found in the MacDonald kitchen cabinet.

[3] Helena Stoeckley was a known drug addict and member of a local hippie community who emerged shortly after news of the MacDonald murders became known locally.

[4] MacDonald stated that when he initially awoke in the living room, he saw a blond girl wearing a floppy hat and boots, carrying a candle and chanting "acid is groovy, kill the pigs."

[5] K.K. Laing and M.D. Isaacs, "The Examination of Paints and Fibers by Microspectrophotometry," Home Office Central Research Establishment, Report Number 359, British Crown Copyright, 1980.

[6] Mary W. Tungol, Edward G. Bartick and Montaser Akbar, "Analysis of Single Polymer Fibers by Fourier Transform Infrared Microspectrophotometry: The Results of Case Studies," *Journal of Forensic Sciences*, vol. 36, pp. 1027-1043, July 1991.

[7] Edmond Locard, "The Analysis of Dust Traces," *The American Journal of Police Science*, vol. 1, pp. 276-298, 1930.

[8] B.D. Gaudette, "Probabilities and Human Pubic Hair Comparisons," *Journal of Forensic Sciences*, pp. 514-517, July 1975.