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Title

HIGH AND MEDIUM EFFICIENCY FINE GLASS FIBERS FILTRATION MEDIA

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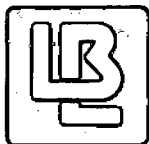
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Author

Kajiyama, Yoichi.

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Lawrence Berkeley Laboratory

UNIVERSITY OF CALIFORNIA

Engineering & Technical Services Division

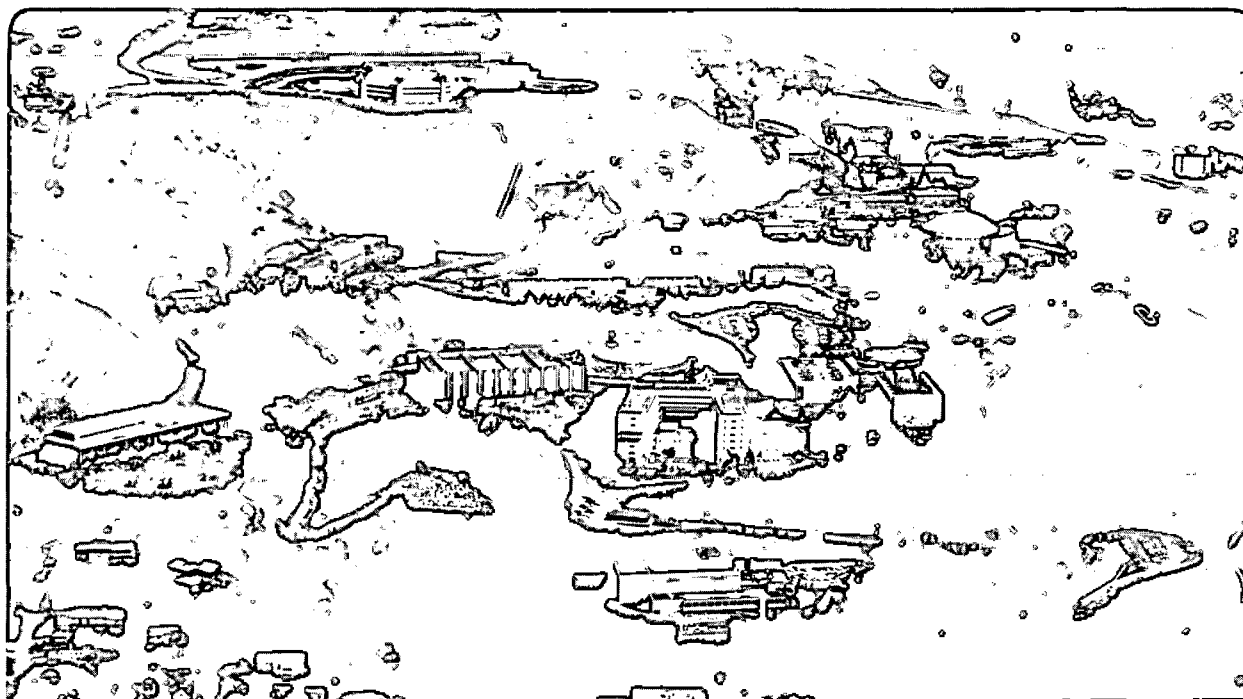
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ENGINEERING NOTE

| | | | |
|---------------------------|--------------------------------------|----------------------|------------------------|
| AUTHOR Yoichi Kajiyama | DEPARTMENT Mechanical Engineering | LOCATION Berkeley | DATE March 15, 1976 |
|---------------------------|--------------------------------------|----------------------|------------------------|

PROGRAM - PROJECT - JOB
ESCAR

REFRIGERATION SYSTEM

TITLE
HIGH AND MEDIUM EFFICIENCY FINE GLASS FIBERS FILTRATION MEDIA

The efficiency of a filtration product is determined by:

- 1) The diameter of the fiber used as the filtration medium;
- 2) The size and number of the interstices among these fibers.

The smaller the fibers, and the smaller and more numerous the interstices in the filter, the smaller the particles that can be trapped--hence, the more effective the filter.

Characteristics of FM series Filtration Media (1):

- 1) Fiberglass*FM series filtration media are blankets composed of fine glass fibers bonded with thermosetting resin.
- 2) The material can be easily cut, slit, stapled, die-cut, sewn, rolled, adhered, faced, and compressed to suit a variety of applications.
- 3) High temperature resistance - will remove pollutants effectively in ambient temperature up to 450 deg. F.
- 4) Chemically inert and non-combustible; will not accelerate corrosion on steel, copper, or aluminum.
- 5) Dimensional stability - resists slumping and thickness loss under severe temperature and moisture conditions, or vibrations.

PRODUCT PROPERTIES: (1)

FM series products are identified by the nominal glass fiber diameter. Example: FM-003 has a fiber diameter of 0.00003"-- three hundred-thousandths of an inch (nominal).

| Product number | Fiber dia. (microns) | Available thickness | Surface Density (lb.sq.ft.) | thickness (inches) | Binder content (% by wt.) | Color |
|----------------|----------------------|---------------------|-----------------------------|--------------------|---------------------------|--------|
| FM-003 | .762 | 1/4 in. | .010 | .27 ± .05 | 12.5 ± 2.5 | Yellow |
| FM-004 | 1.016 | 1/4 in. | .010 | .25 ± .05 | 12.5 ± 2.5 | pink |
| FM-004 | 1.016 | 5/16 in. | .015 | .30 ± .06 | 12.5 ± 2.5 | yellow |
| FM-004 | 1.016 | 1/2 in. | .025 | .50 ± .10 | 17.5 ± 3.0 | pink |
| FM-010 | 2.540 | 1/4 in. | .009 | .25 ± .05 | 12.0 ± 3.0 | green |
| FM-011 | 2.794 | 1/4 in. | .015 | .25 ± .05 | 10.5 ± 2.5 | orange |
| FM-011 | 2.794 | 1/2 in. | .021 | .50 ± .12 | 15.0 ± 2.5 | orange |

PRODUCT PERFORMANCE: (1)

| Product number | Price (\$) | Air resistance, water gauge (in.) | AFI Initial Efficiency, (%) | ARI Dust holding Cap'y (%) |
|----------------|---|-----------------------------------|-----------------------------|-----------------------------|
| FM-003 | (~ 34¢/LB. 36 LB ROLL \$122.40 6' W X 50' L X 1/4" THICK FROM VELCON FILTER SAN JOSE, CA.) | .48 ± .06 | 82 | TBD (TO BE DETERMINED) ↓ |
| FM-004 | | .20 ± .03 | 66 | |
| FM-004 | | .55 ± .06 | 85 | |
| FM-004 | | .80 ± .10 | 93 | |
| FM-C10 | | .07 ± .02 | TBD | |
| FM-011 | | .05 ± .02 | 33 | |
| FM-011 | | .085 ± .02 | 42 | |

| | | | |
|-----------------|------------------------|----------|----------------|
| AUTHOR | DEPARTMENT | LOCATION | DATE |
| Yoichi Kajiyama | Mechanical Engineering | Berkeley | March 15, 1976 |

PRODUCT DIMENSIONS:

Standard Rolls:

Widths (inches 1/8 in.) 24 in., 36 in., 72 in.
 Lengths (feet 1%, -0) 100 ft., 200 ft.

Made to Order:

Widths, trimmed-- 6 in. thru 72 in. 1/8 in. increments (1/4 in.)
 Widths, untrimmed-- 75 in., billed as 72 in.
 Lengths, 100 ft. thru 400 ft., 1ft. increments (1%, -0)

Cut to Size Pieces:

Widths -- 6 in. thru 72 in. in 1/8 in. increments (1/8 in.)
 Lengths -- 24 in. thru 60 in. in 1/8 in. increments (1/4 in.)

Identification: Each roll or package is identified with the following information.

Product name and thickness (i.e., FM-003, 1/4 in.)
 Product Code Dimensions
 Sq. ft. package Shift Code

(1) ##Ref.: Above information is from Owens/Corning FIBERGLAS Co.'s pamphlet (1975)

ADDITIONAL INFORMATION:

Additional information concerning other commonly use filter media materials were investigated by Mr. R. Lindberg. (Bldg. 62) and results are as follows:

| Name: | LBL Cat. No. | Fiber dia.* (microns) | Price(\$) |
|---|--------------|--------------------------|-----------|
| PYREX WOOL (Filtering Fibers) Cat. No. 3950 | 6640-19239 | 9.80 ± .85 | 6.50/lb. |
| ** { PF 105 "B" Stage Epoxy Unset (EQIV. TO FM004) | | 1.63 ± .92 | |
| PF 105 "B" Stage burnt out at 600 deg. F. (= = =) | | 1.38 ± .83 | |

*The statistical average dimension of the material was measured from the photograph which was taken through scanning electron-microscope.

Mr. Lindberg's data and pictures concerning above materials are shown on next three pages of this report.

** \$91.80 FOR 1 ROLL 1" THICK X 72" W X 100' L (PAID \$52.00 ; ORIG. PRICE \$91.80)
 D. HUNT; 10-75 PURCHASE ORDER 4201-01 - 331743

ENGINEERING NOTE

CODE

ES0510

SERIAL

M4914

PAGE

3 OF 6

AUTHOR

Yoichi Kajiyama

DEPARTMENT

Mechanical Engineering

LOCATION

Berkeley

DATE

March 15, 1976

MEASURED OFF FROM PHOTOGRAPHS: Note: 1 micron equals 1/1000 mm

PYREX WOOL (FILTERING FIB.)

CAT. No. 3950

295 X magnification

| E 1 | E 2 |
|-----|-----|
| 3.0 | 3.2 |
| 3.4 | 2.8 |
| 2.9 | 2.8 |
| 2.8 | 2.8 |
| 2.8 | 2.7 |
| 2.7 | 3.0 |
| 2.6 | 2.5 |
| 2.6 | 2.7 |
| 2.5 | 2.4 |
| 2.9 | 2.7 |
| 2.7 | 3.2 |
| 3.0 | 2.7 |
| 3.0 | 2.8 |
| 2.9 | 3.4 |
| 2.8 | 2.8 |
| 3.1 | 3.0 |
| 3.3 | 3.1 |
| 3.0 | 3.0 |
| 2.9 | 3.2 |
| 3.2 | 2.6 |
| 2.7 | 2.9 |
| 2.5 | 2.8 |
| 3.2 | |
| 3.3 | |

Statistical

Average at 295 X
is $2.89 \pm .25$ mm

therefore dia.

is $9.8 \mu \pm .85$

PF 105 "B" stage

Epoxy unset

1000X magnification

| E 4 | E 5 |
|-----|-----|
| .7 | 2.8 |
| 1.6 | .7 |
| 1.9 | 1.2 |
| 2.6 | 1.6 |
| 2.5 | .5 |
| .5 | 1.2 |
| 5.0 | 2.0 |
| 2.3 | 2.8 |
| .7 | .5 |
| 2.0 | 1.7 |
| 1.5 | .4 |
| 1.7 | 2.9 |
| 2.9 | 2.1 |
| 1.2 | .4 |
| 3.5 | 1.7 |
| 1.0 | 1.4 |
| 2.0 | 1.2 |
| .5 | 2.2 |
| 1.3 | .3 |
| 2.3 | 1.2 |
| 2.0 | 2.5 |
| 2.0 | |
| 1.1 | |
| 1.4 | |
| 1.8 | |
| .6 | |
| 1.0 | |
| 1.5 | |
| .7 | |

Statistical Ave.

gives diameter

to be $1.63 \mu \pm .92$

PF 105 "B" stage

Burn out at 600 deg. F

1000X magnification

| E 6 | E 7 | E 8 |
|-----|-----|-----|
| 1.0 | 3.0 | .7 |
| .4 | .3 | 1.5 |
| 1.1 | 1.0 | 1.4 |
| .7 | 2.8 | .5 |
| .5 | 1.7 | .4 |
| 1.0 | 2.7 | 1.2 |
| 1.7 | .6 | 1.5 |
| 2.5 | 1.5 | 4.5 |
| 2.0 | 1.0 | 2.2 |
| .8 | 1.2 | .7 |
| 1.8 | 1.3 | 1.6 |
| 1.5 | 1.2 | .5 |
| 1.3 | 2.1 | .5 |
| 1.2 | .5 | .7 |
| 2.5 | 1.7 | 1.1 |
| 1.0 | 1.5 | 2.5 |
| .6 | .9 | .6 |
| | 2.1 | 1.3 |
| | 1.0 | .5 |
| | 1.2 | .3 |
| | 1.5 | 2.2 |
| | .6 | 1.0 |
| | .9 | 4.0 |
| | 2.2 | 1.0 |
| | | 1.5 |
| | | 1.8 |
| | | 1.5 |

Statistical Ave.

gives diameter

to be $1.38 \mu \pm .83$

ENGINEERING NOTE

ES0510

M4914

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AUTHOR

DEPARTMENT

LOCATION

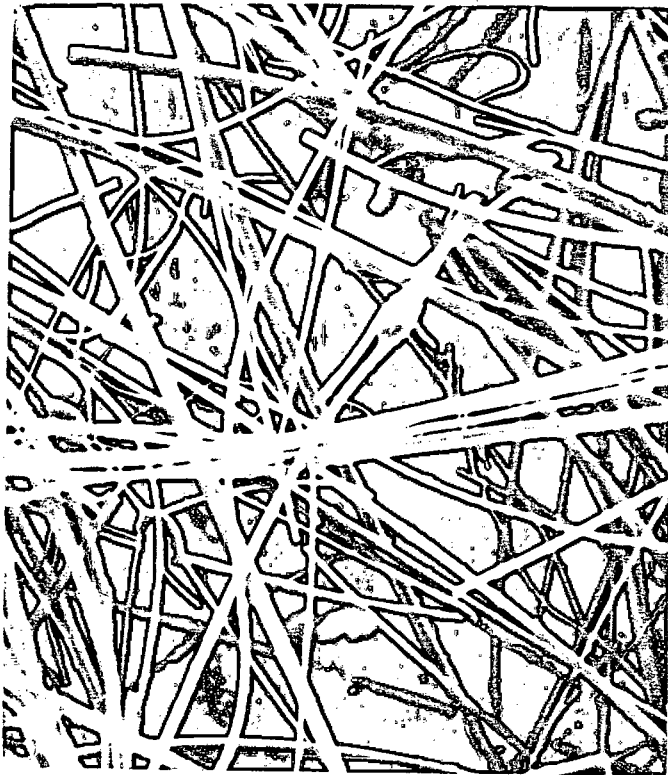
DATE

Yoichi Kajiyama

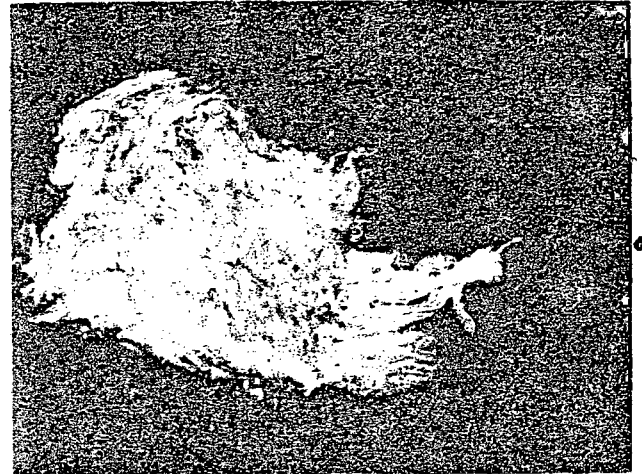
Mechanical Engineering

Berkeley

March 15, 1976

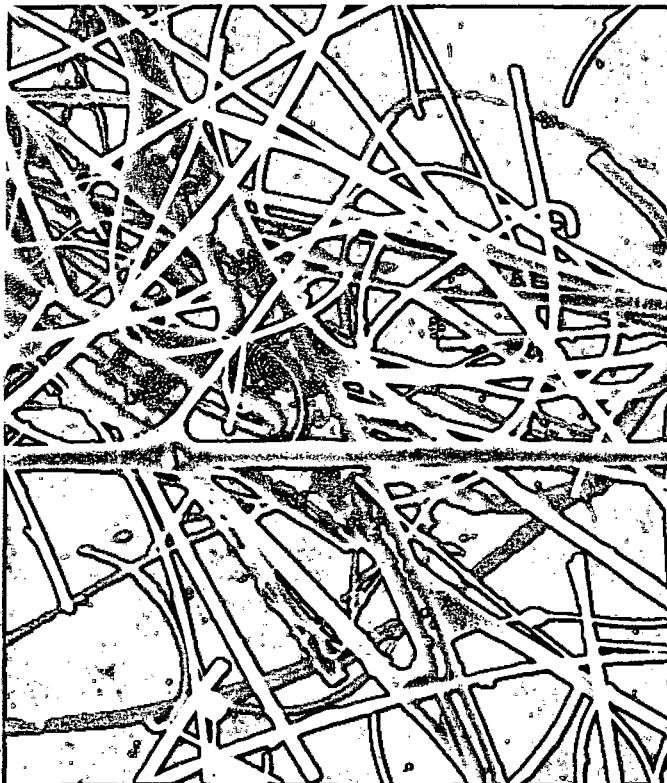


1000X Magnification

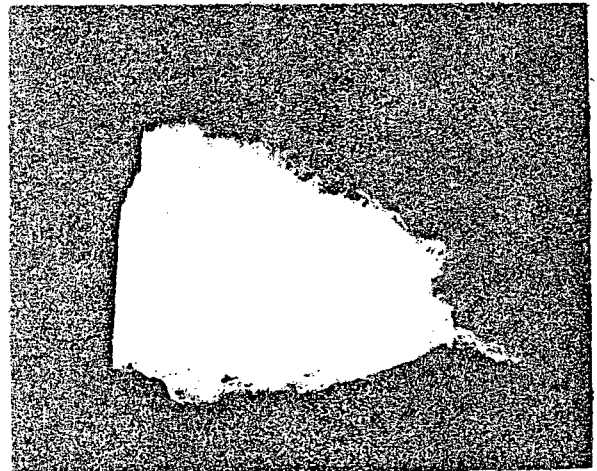


ACTUAL SIZE

PF105 "B" Stage: Burned out
at 600°F

SIZE: $1.38 \mu \pm .83$ DIA.

1000X Magnification



ACTUAL SIZE

PF105 "B" Stage Epoxy Unset

SIZE: $1.63 \mu \pm .93$ DIA.

AUTHOR

Yoichi Kajiyama

DEPARTMENT

Mechanical Engineering

LOCATION

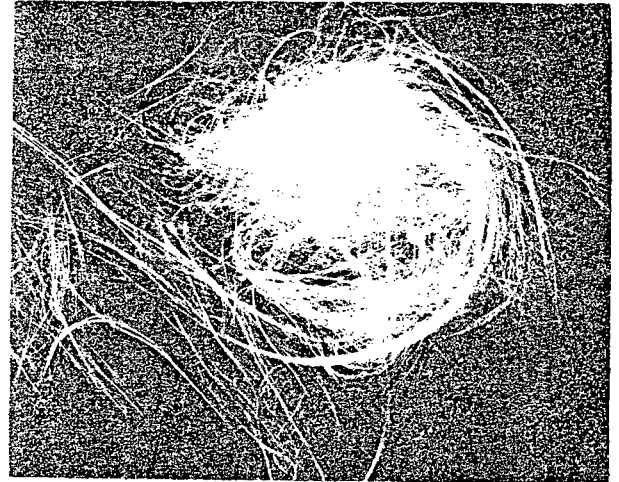
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300X Magnification



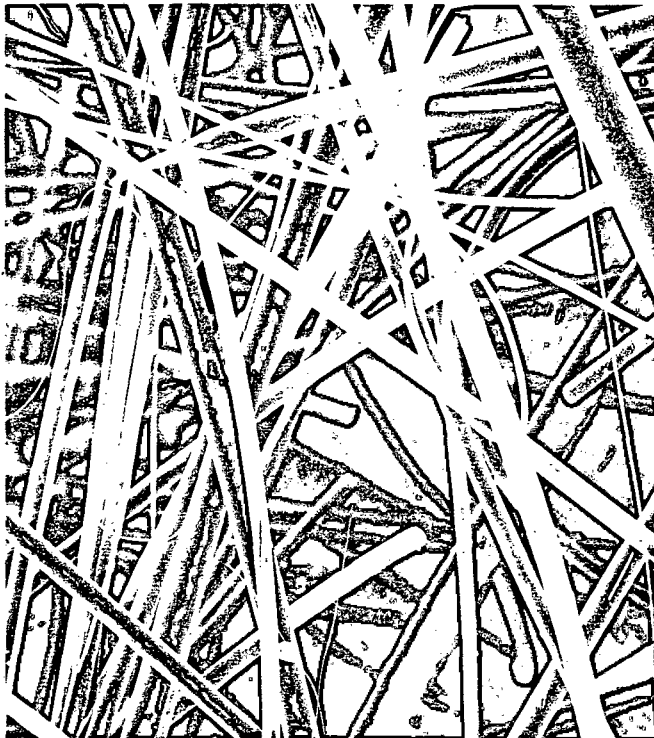
ACTUAL SIZE

PYREX WOOL: Filtering fibers:

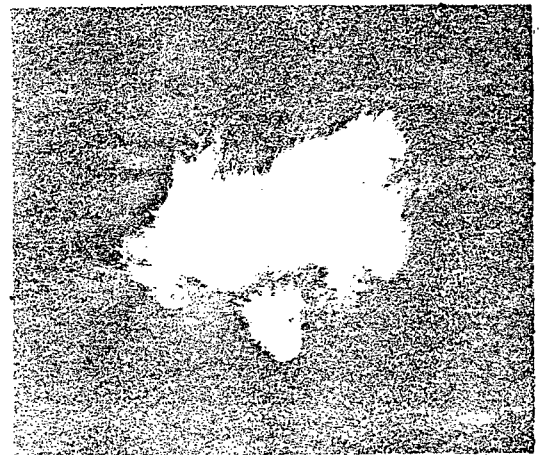
Cat. No. 3950

Size: $9.80 \mu \pm .85$ DIA.

Addendum 3-23-1976



E11 500X Magnification



Actual size

from ~~01-1101-2100~~ compressor package. (USED ~ 8000 HRS)
(Pre-filter pack from charcoal filter)

Size: $5.14 \mu \pm 4.03$ DIA.

*NOTE: IT'S DIA. VARIATION IS GREAT

ENGINEERING NOTE

CODE

ES0510

SERIAL

M4914

PAGE

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AUTHOR

Yoichi Kajiyama

DEPARTMENT

Mechanical Engineering

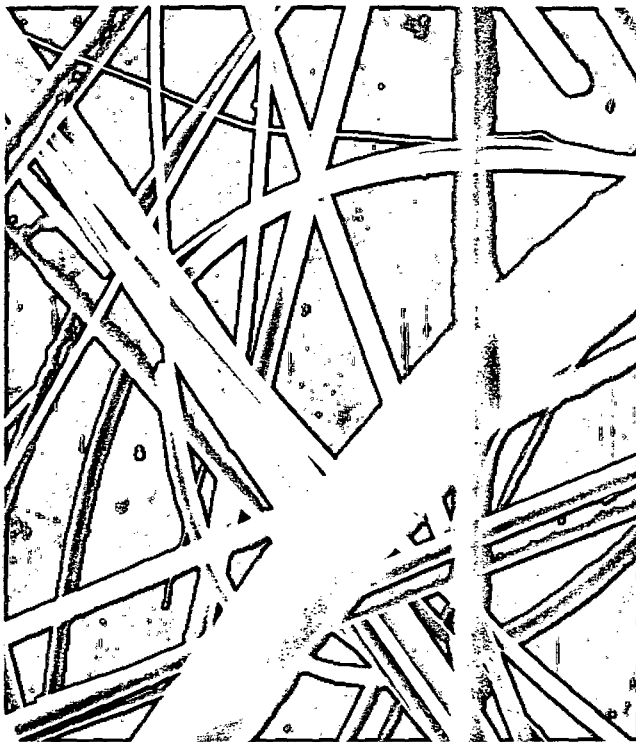
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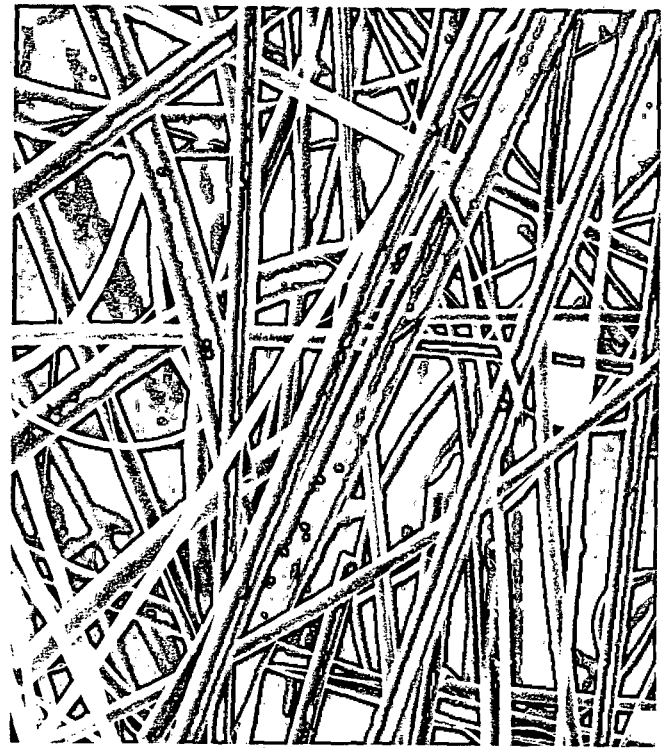
DATE

March 23, 1976

Addendum continue:



E10 500X magnification



E12 500X magnification

For pre-filter pack from charcoal filter of ~~compressor~~ compressor package.

March 17, 1976

From X-ray diffraction the material seems to be completely glass. No crystalline material was detected.

X-ray fluorescence in the scanning electron microscope showed primarily Si but also Na, Al, K, Ca, and Ti. Very small amounts of Mg and Fe may also be present. A small amount of Au is observed, but $\approx 100 \text{ \AA}$ of gold was sputtered on the fibers to make them conductive so that they could be observed in the electron microscope.

observation Richard Lindberg
by: 62-114
phone: X5453

MEASURED OFF FROM PHOTOGRAPHS:

500X magnification

| E10 | E11 | E12 |
|-----|-----|-----|
| 3 | 21 | 18 |
| 50 | 10 | 9 |
| 5 | 32 | 2 |
| 25 | 2 | 18 |
| 11 | 5 | 3 |
| 11 | 45 | 30 |
| 8 | 8 | 55 |
| 15 | 28 | 18 |
| 30 | 46 | 52 |
| 120 | 47 | 28 |
| 55 | 22 | 17 |
| 20 | 28 | 18 |
| | 8 | 8 |

statistical Ave. gives diameter to be $5.14 \mu \pm 4.08$

$5.14 \mu \pm 4.08$

3-22

(statistical Ave. of data on the left is $2.57 \pm 2.04 @ 500X$)

$5.18 \pm 3.66 \mu$

3-16

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