

#### 4. SUMMARY OF KEY OBSERVATIONS

ICET Test #3 was conducted successfully, maintaining the critical physical and chemical parameters called out in the Test Plan. The test ran uninterrupted for 30 days. The solution chemistry behaved as expected, with the turbidity declining from its early values to steady numbers from Day 1 until the end of the test. TSS was relatively steady near its baseline value, with some increases during the test. The kinematic viscosity was steady for the entire test; and the pH was steady, averaging a value of 8.0.

Samples of the solution were taken daily. The chemical elements present were calcium, magnesium, silica, and sodium. Aluminum, copper, iron, zinc, and nickel were present in trace amounts. Strain-rate viscosity measurements indicated that the solution remained Newtonian throughout the test. No precipitates were observed in the solution, even after it had cooled to room temperature.

The submerged aluminum, IOZ-coated steel, copper, and uncoated steel coupons developed significant amounts of white particulate deposits. The aluminum coupons gained an average of 0.6 g, the IOZ-coated steel coupons 1.8 g, the copper 0.3 g, and the uncoated steel coupon lost 1.1 g. The submerged galvanized steel coupons were covered with a dense, gray particulate deposition, and they gained an average of 15.0 g.

The unsubmerged coupons exhibited light patterns of deposition, and they all experienced uniform weight gains. The aluminum coupons gained an average of 0.4 g, the galvanized steel 0.2 g, the copper 0.2 g, the IOZ-coated steel 2.0 g, and the uncoated steel 1.0 g.

Deposits on the fiberglass samples increased over time, and the deposits appeared to be chemically originated for the samples not lying on the tank bottom. These deposits covered individual fiberglass strands and in some cases formed webs between strands. Based on the SEM and ESEM results, the deposits likely originated from chemical precipitation during the sample-drying process. Comparing Days 4, 15, and 30 fiberglass samples showed deposits that were similar in property and amount. There was no significant difference in the amount of deposits found in the exterior and interior samples. Deposits found on the drain collar fiberglass were likely physically attached, and the exterior samples had significantly more deposits than the interior samples. Two different deposits were identified with EDS, one with a higher percentage of P and one with a higher percentage of Si. The former is likely calcium phosphate particles and the latter cal-sil particles. Deposits on and in the birdcage fiberglass similarly had the two different particulate deposits present. In addition, a pinkish-white gel-like precipitate covered the birdcage and much of the sediment. This gel had a consistency much like face cream, and it was composed primarily of Ca, O, and P, making it likely calcium phosphate.

Sediment on the tank bottom was prevalent, accumulating to depths of over 8 in. The sediment contained crystalline substances and calcite, making it primarily cal-sil, although some fugitive fiberglass was also present.

## REFERENCES

1. "Test Plan: Characterization of Chemical and Corrosion Effects Potentially Occurring inside a PWR Containment Following a LOCA, Rev. 12c," March 30, 2005.
2. J. Dallman, J. Garcia, B. Letellier, and K. Howe, "Integrated Chemical Effects Tests: Data Compilation for Test 1," LA-UR-05-0124, July 2005.
3. "Pre-Test Operations, Test #3," ICET-PI-012, Rev. 1, April 1, 2005.
4. "Test Operations, Test #3 (cal-sil and fiberglass, with TSP)," ICET-PI-014, Rev. 0, April 5, 2005.
5. "Post-Test Operations, Test #3," ICET-PI-008, Rev. 3, May 2, 2005.



## Preface to Appendices

Eleven separate appendices were developed to capture more of the images and information obtained for Test #3. Several appendices are further divided into sub-appendices to better segregate the information according to the time point in the test when the samples were extracted from the test apparatus, the type of samples being evaluated, and the type of examinations performed. With the exception of Appendix L, each appendix represents a separate session of laboratory work that can be traced to a batch of samples that were typically processed in chronological order. Appendix L provides some of the detailed project instructions that were used to initiate Test #3, to conduct routine operations during the test, and to terminate the test with sample recovery and cleaning procedures.

Section 2.4.1.1 of this report reviewed the nomenclature adopted for reporting ICET results. This nomenclature is used in the caption labels for most of the figures presented in the appendices.

As noted in Section 2.4.1.1, the data presented in the appendices are largely qualitative in nature, consisting primarily of SEM and TEM micrographs and EDS spectra. The SEM data are further subdivided into environmental (or low-vacuum) SEM of hydrated samples and microprobe SEM of fully desiccated samples. Microprobe images can be generated using secondary electrons, which are sensitive to attenuation, to reveal fine structural details in a sample or backscatter electrons from the primary beam. Backscatter images indicate in shades of grey with high contrast the relative atomic number of materials across a sample. White or "bright" regions contain high-Z elements; dark regions contain lower-Z elements by comparison.

Transcriptions of the laboratory logbooks are provided for each appendix to document better commonalities that existed among the samples at the time of analysis. Logbook information was developed for most, but not all, of the images presented in the appendices. Interpretation and understanding of the images and their accompanying EDS spectra can be improved by referring frequently to the logbook sample descriptions and sequences.

Typically, a relatively large quantity of a test sample was delivered for SEM or TEM analysis, and then several small subsamples of each item were examined. Note that each subsample was assigned a sequential reference number during the laboratory session. These reference numbers have been cited in the figure captions whenever possible to preserve the connection between the micrographs and the notebook descriptions. Electronic filenames have also been stamped on the images to permit retrieval of the original data files, which are archived elsewhere. Individual data sets for a given sample item have been collated into a typical sequence of (1) visual image, (2) EDS spectra, and (3) semiquantitative mass composition.

Semiquantitative mass compositions are also presented for many of the EDS spectra. These results are obtained from a commercial algorithm that decomposes the spectra into

the separate contributions of each element. Composition estimates should be interpreted with the caveats stated in Section 2.4.1.1 fully in mind.

The appendix titles are listed below.

**Appendix A. SEM and ESEM/EDS Data for Test #3 Day-4 Fiberglass in Low-Flow Zone**

**Appendix B. ESEM and SEM Day-15 Fiberglass**

- B1. ESEM/EDS and SEM/EDS Data for Test #3, Day-15 Fiberglass in High-Flow Zones
- B2. ESEM/EDS and SEM/EDS Data for Test #3, Day-15 Fiberglass in Low-Flow Zones

**Appendix C. ESEM and SEM Day-30 Fiberglass**

- C1. ESEM/EDS Data for Test #3, Day-30 Fiberglass in High-Flow Zones
- C2. ESEM Data for Test #3, Day-30 Fiberglass in Low-Flow Zones
- C3. ESEM/EDS Data for Test #3, Day-30 Drain Collar Fiberglass
- C4. SEM/EDS and ESEM/EDS Data for Test #3, Day-30 Birdcage Fiberglass

**Appendix D. ESEM and SEM/EDS Data for Test #3 Day-30 Corrosion Products**

**Appendix E. SEM Day-30 Coupons**

- E1. SEM/EDS Data for Test #3, Day-30 Aluminum Coupons
- E2. SEM/EDS Data for Test #3, Day-30 Copper Coupons
- E3. SEM/EDS Data for Test #3, Day-30 Galvanized Steel Coupons
- E4. SEM/EDS Data for Test #3, Day-30 Steel Coupons

**Appendix F. SEM/EDS Data for Test #3, Day-30 Flow Meter**

**Appendix G. SEM/EDS and ESEM/EDS Data for Test #3, Day-30 Gel**

**Appendix H. SEM/EDS and ESEM/EDS Data for Test #3, Day-30 Cal-Sil**

**Appendix I. ESEM/EDS Data for Test #3, Day-30 Sediment**

**Appendix J. TEM Data for Test #3 Solution Samples**

**Appendix K. UV Absorbance Spectrum—Day-30 Solution Samples**

**Appendix L. ICET Test #3: Pre-Test, Test, and Post-Test Project Instructions**

## Appendix A

### SEM and ESEM/EDS Data for Test #3, Day-4 Fiberglass in Low-Flow Zone

#### Figures

- Figure A-1. Environmental SEM image magnified 150 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FX1)..... A-5
- Figure A-2. Environmental SEM image magnified 1000 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FX2)..... A-5
- Figure A-3. EDS counting spectrum for the deposits between the fibers on ESEM image shown in Figure A-2. (T3D4FX3)..... A-6
- Figure A-4. EDS counting spectrum (after calibration) for the deposits between the fibers on ESEM image shown in Figure A-2. (T3D4FX4)..... A-6
- Figure A-5. Environmental SEM image magnified 500 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FX5)..... A-7
- Figure A-6. Environmental SEM image magnified 150 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FI6)..... A-7
- Figure A-7. Environmental SEM image magnified 1000 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FI7)..... A-8
- Figure A-8. EDS counting spectrum (after calibration) for the deposits between the fibers on ESEM image shown in Figure A-7. (T3D4FI8)..... A-8
- Figure A-9. SEM image magnified 150 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FibGlsEX001) ..... A-9
- Figure A-10. SEM image magnified 1000 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FibGlsEX002) ..... A-9
- Figure A-11. SEM image magnified 300 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FibGlsEX003) ..... A-10
- Figure A-12. SEM image magnified 50 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FibGlsIN001) ..... A-10

Figure A-13. SEM image magnified 150 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FibGlsIN002) .....	A-11
Figure A-14. SEM image magnified 400 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FibGlsIN003) .....	A-11
Figure A-15. SEM image magnified 1000 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FibGlsIN004) .....	A-12

During ICET Test #3, work was continued for the purpose of identifying the origin and chemical composition of the products that were formed during the test. One objective of ICET tests was to identify the composition of the debris on the fiberglass and of the particulate substances in the test solution. This identification was partially done by examining fiberglass samples located in low-flow-velocity sections of the ICET tank. These samples were removed from the tank on day 4 of the test and examined via Environmental SEM (ESEM)/probe SEM/EDS. The samples were taken both from the exterior and interior locations of the fiberglass package.

Probe SEM was used to examine the fiberglass samples that had been air dried at room temperature and coated with carbon. In addition to probe SEM, ESEM was employed to analyze uncoated, wet fiberglass samples. The ESEM was performed under low vacuum conditions (i.e., 80 Pa) in order to minimize the modification of the fiberglass through the drying process. The EDS results provide a semi-quantitative elemental analysis of the debris attached to the fiberglass.

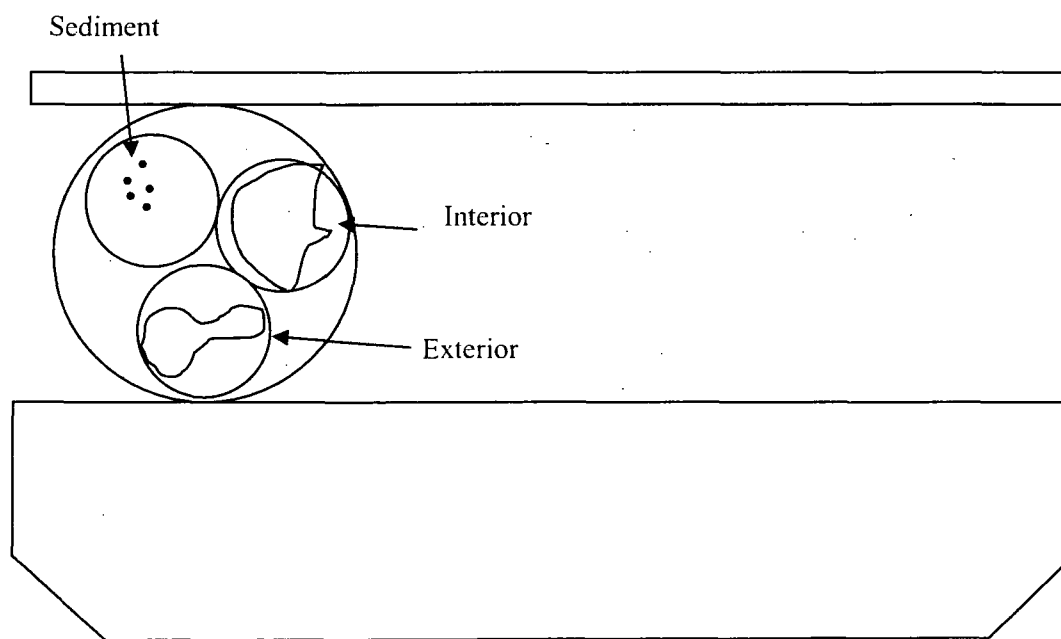
Test #3 Day-4 low-flow fiberglass samples were obtained on April 9, 2005 (4th day for Test #3), and SEM/EDS data presented here were obtained shortly thereafter. Available logbook entries for this laboratory session are included in this appendix as transcribed notes.



## Transcribed Laboratory Log

Laboratory session from April 12, 2005.

ESEM & SEM Test #3, Day-4 Fiberglass.



### ESEM Exterior Low-Flow Submerged Fiberglass Samples

Image:	T3D4FX1	150 ×	ESEM image	Figure A-1
	T3D4FX2	1000 ×	ESEM at higher magnification	Figure A-2
EDS:	T3D4FX3		Particles on Image FX2	Figure A-3
	T3D4FX4		FX2 particles after calibration with primed elemental analysis	Figure A-4
Image:	T3D4FX5	500 ×	ESEM image	Figure A-5

### ESEM Interior Low-flow Submerged Fiberglass Samples

Image:	T3D4FI6	150 ×	ESEM image	Figure A-6
	T3D4FI7	1000 ×	ESEM at higher magnification	Figure A-7
EDS:	T3D4FI8		EDS of particles on FI7	Figure A-8

### **SEM Exterior Low-flow Submerged Fiberglass Samples**

Image:	T3D4FibGlsEX001	150 ×	SEM image	Figure A-9
	T3D4FibGlsEX002	1000 ×	SEM at higher magnification	Figure A-10
	T3D4FibGlsEX003	300 ×		Figure A-11

### **SEM Interior Low-flow Submerged Fiberglass Samples**

Image:	T3D4FibGlsIn001	50 ×	SEM image	Figure A-12
	T3D4FibGlsIn002	150 ×	SEM image	Figure A-13
	T3D4FibGlsIn003	400 ×	SEM image	Figure A-14
	T3D4FibGlsIn004	1000 ×	SEM at higher magnification	Figure A-15



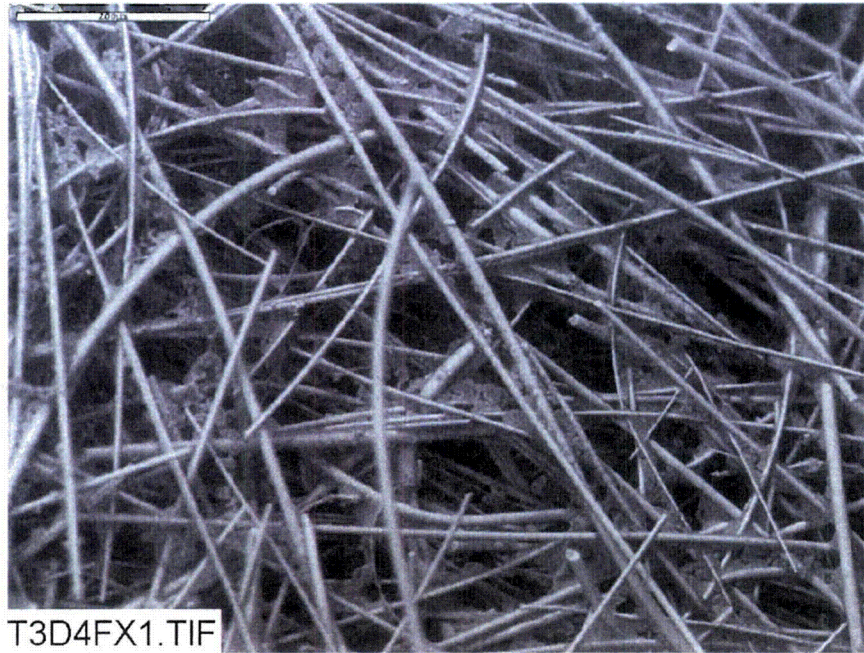


Figure A-1. Environmental SEM image magnified 150 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FX1)



Figure A-2. Environmental SEM image magnified 1000 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FX2)



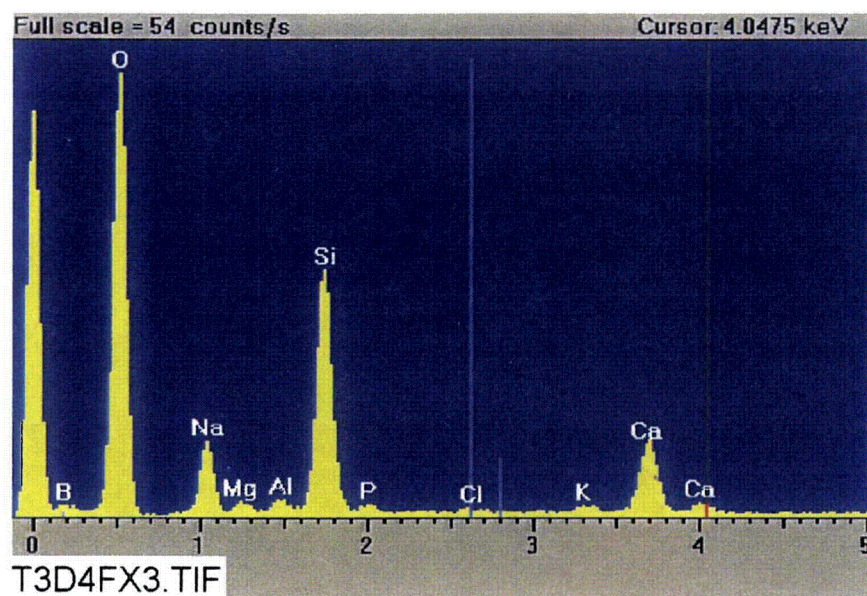


Figure A-3. EDS counting spectrum for the deposits between the fibers on ESEM image shown in Figure A-2. (T3D4FX3)

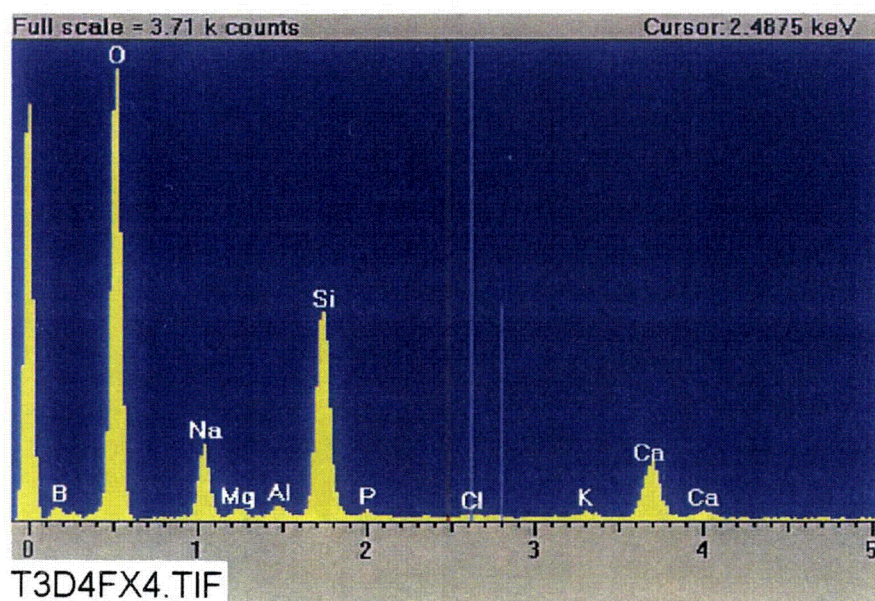


Figure A-4. EDS counting spectrum (after calibration) for the deposits between the fibers on ESEM image shown in Figure A-2. (T3D4FX4)



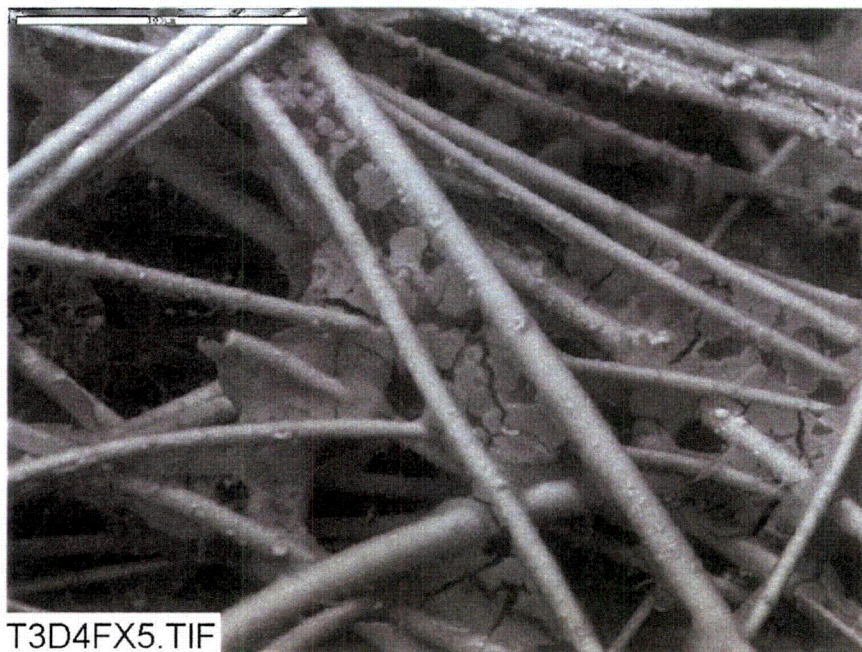


Figure A-5. Environmental SEM image magnified 500 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FX5)



Figure A-6. Environmental SEM image magnified 150 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FI6)





Figure A-7. Environmental SEM image magnified 1000 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FI7)

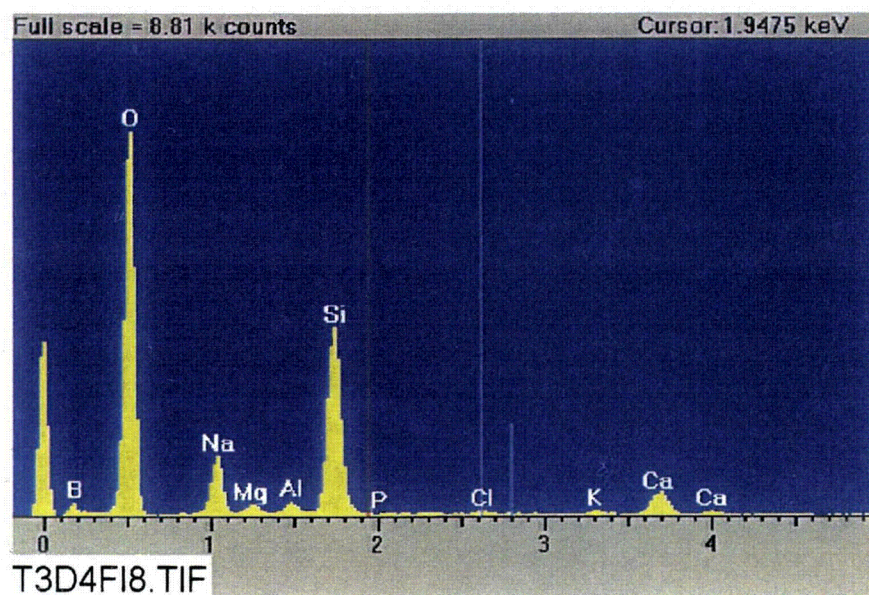
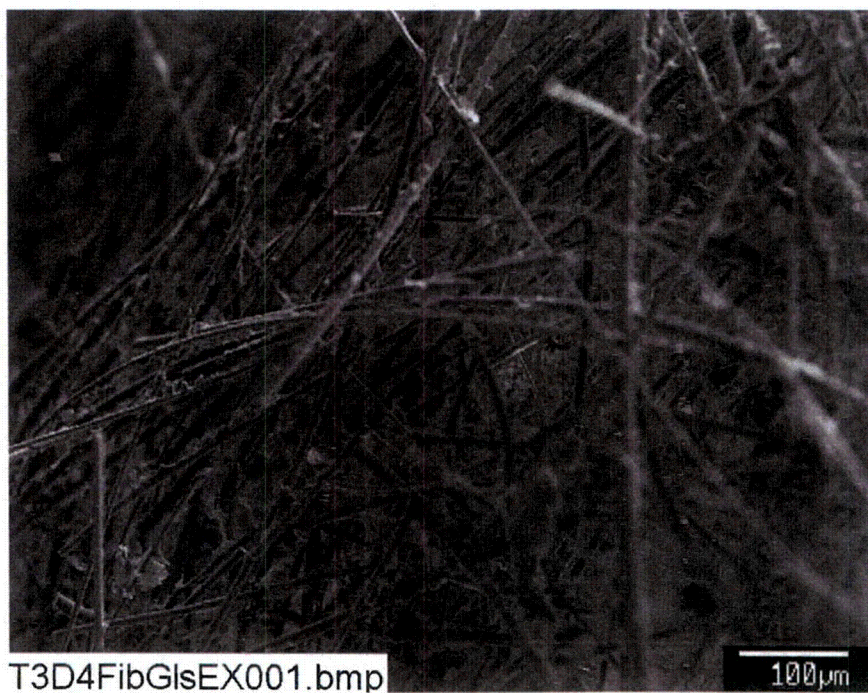
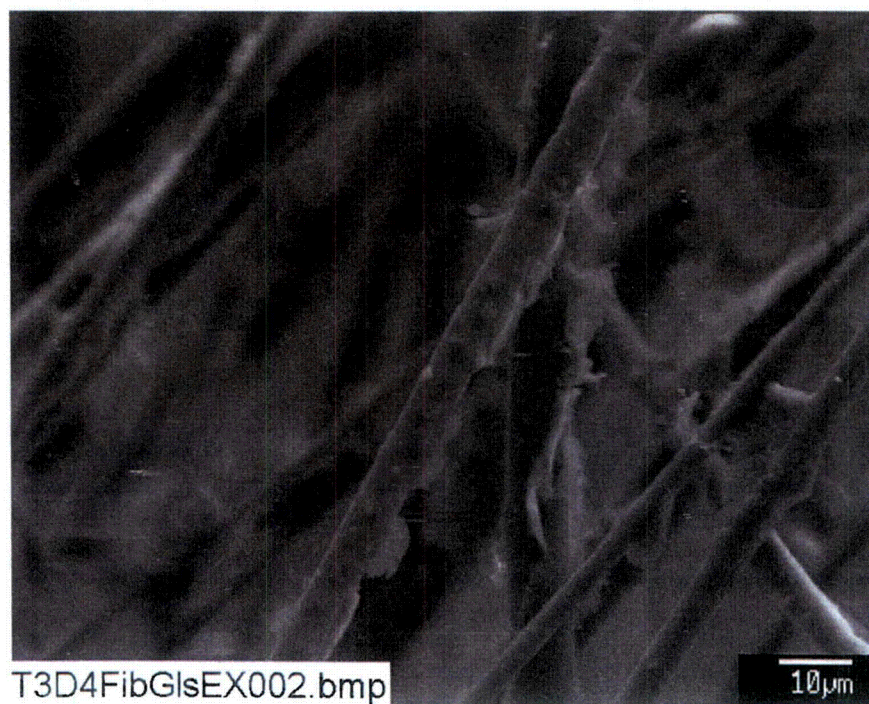


Figure A-8. EDS counting spectrum (after calibration) for the deposits between the fibers on ESEM image shown in Figure A-7. (T3D4FI8)



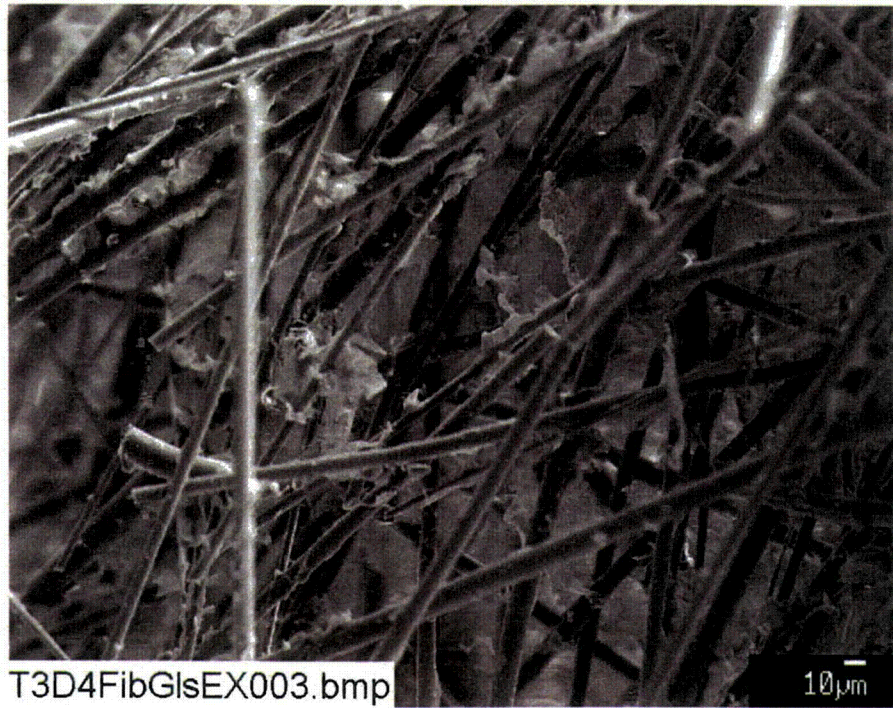


**Figure A-9.** SEM image magnified 150 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FibGlsEX001)

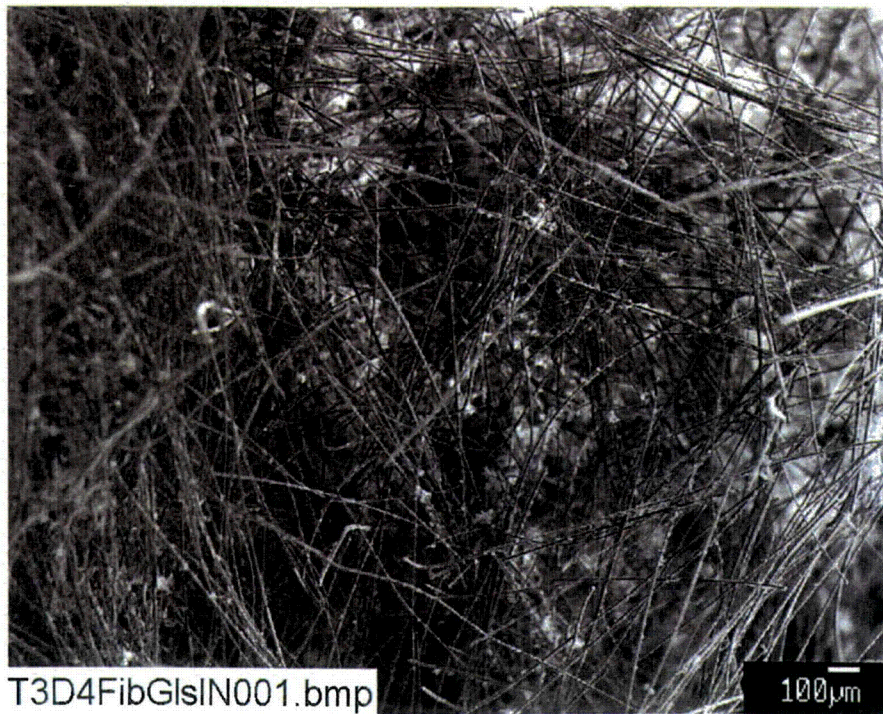


**Figure A-10.** SEM image magnified 1000 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FibGlsEX002)





**Figure A-11.** SEM image magnified 300 times for a Test #3, Day-4 low-flow exterior fiberglass sample. (T3D4FibGlsEX003)



**Figure A-12.** SEM image magnified 50 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FibGlsIN001)



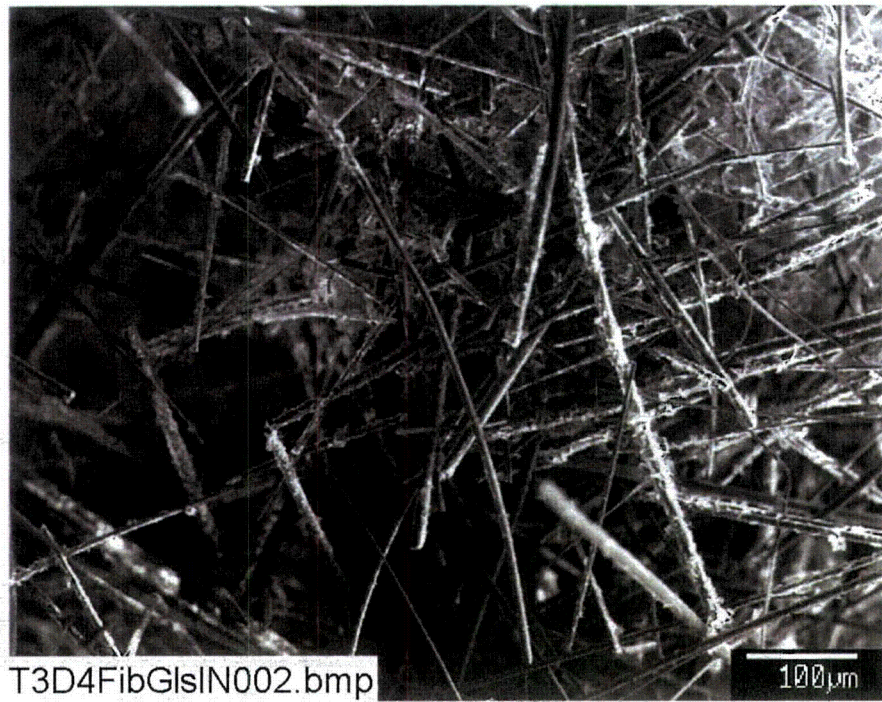


Figure A-13. SEM image magnified 150 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FibGlsIN002)

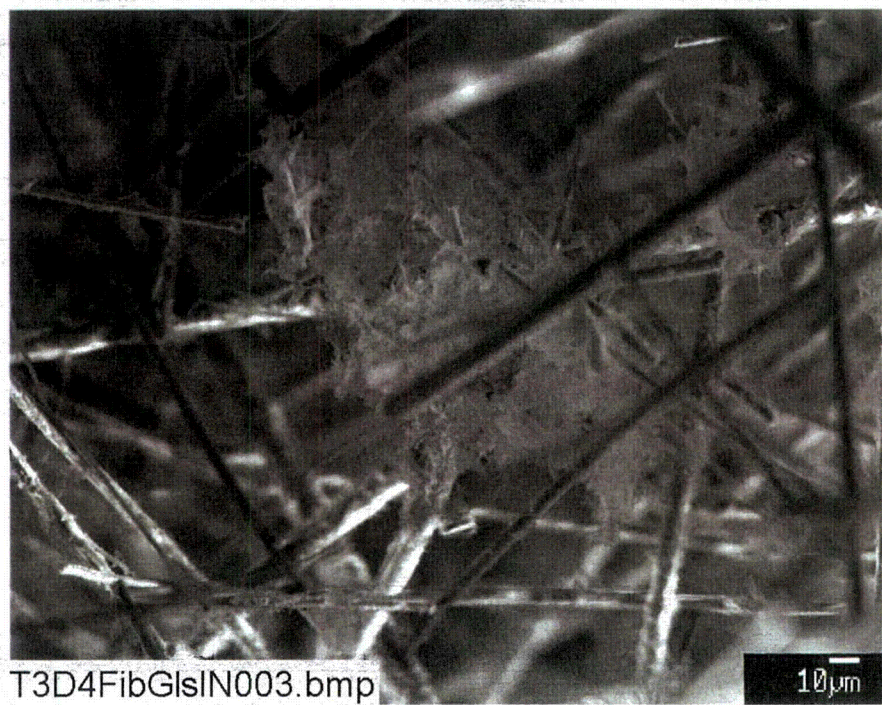
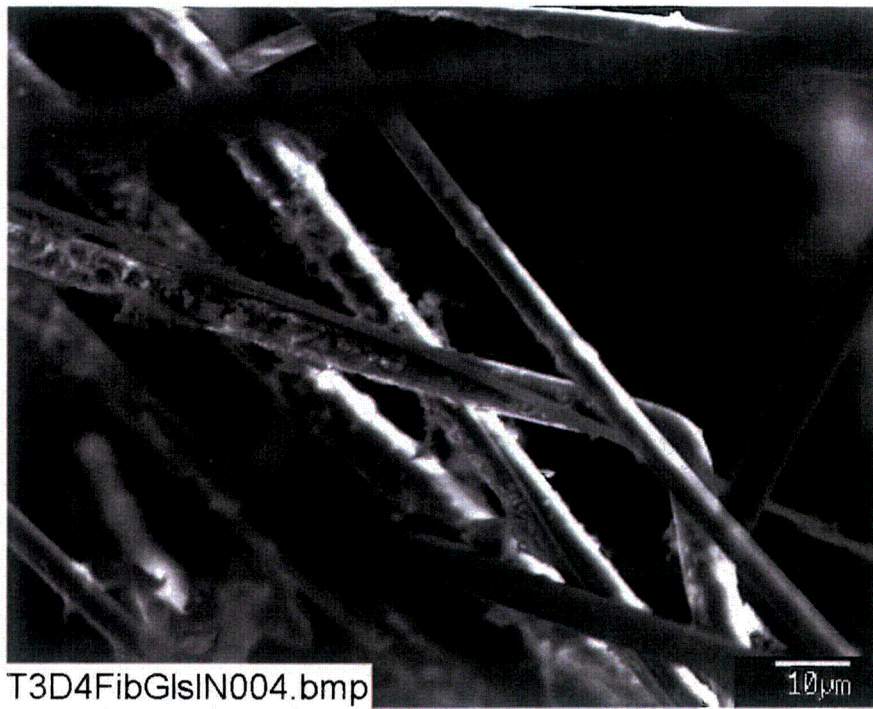


Figure A-14. SEM image magnified 400 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FibGlsIN003)



**Figure A-15.** SEM image magnified 1000 times for a Test #3, Day-4 low-flow interior fiberglass sample. (T3D4FibGlsIN004)



## Appendix B1

### ESEM/EDS and SEM/EDS Data for Test #3, Day-15 Fiberglass in High-Flow Zones

#### Figures

Figure B1-1.	Environmental SEM image magnified 100 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HI1).....	B1-5
Figure B1-2.	Environmental SEM image magnified 1000 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HI2).....	B1-5
Figure B1-3.	Environmental SEM image magnified 2000 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HI3).....	B1-6
Figure B1-4.	EDS counting spectrum for the flocculence deposits between the fibers on ESEM image shown in Figure B1-3. (T3D15HIA).....	B1-6
Figure B1-5.	Environmental SEM image magnified 110 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HX4) .....	B1-7
Figure B1-6.	Environmental SEM image magnified 1000 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HX5) .....	B1-7
Figure B1-7.	EDS counting spectrum for the deposits between the fibers on ESEM image shown in Figure B1-6. (T3D15HXB) .....	B1-8
Figure B1-8.	SEM image magnified 100 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HIFlowInt002).....	B1-8
Figure B1-9.	SEM image magnified 1000 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HIFlowInt003).....	B1-9
Figure B1-10.	SEM image magnified 1000 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HIFlowInt004).....	B1-9
Figure B1-11.	EDS counting spectrum for the flocculence deposits between the fibers on SEM image shown in Figure B1-10. (T3D15HiFlowIntEDS1) .....	B1-10

Figure B1-12. SEM image magnified 100 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HIFlowExt005) .....	B1-10
Figure B1-13. SEM image magnified 1000 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HIFlowExt006) .....	B1-11
Figure B1-14. SEM image magnified 500 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HIFlowExt007) .....	B1-11
Figure B1-15. EDS counting spectrum for the flocculence deposits between the fibers on SEM image shown in Figure B1-14. (T3D15HiFlowExtEDS2) .....	B1-12

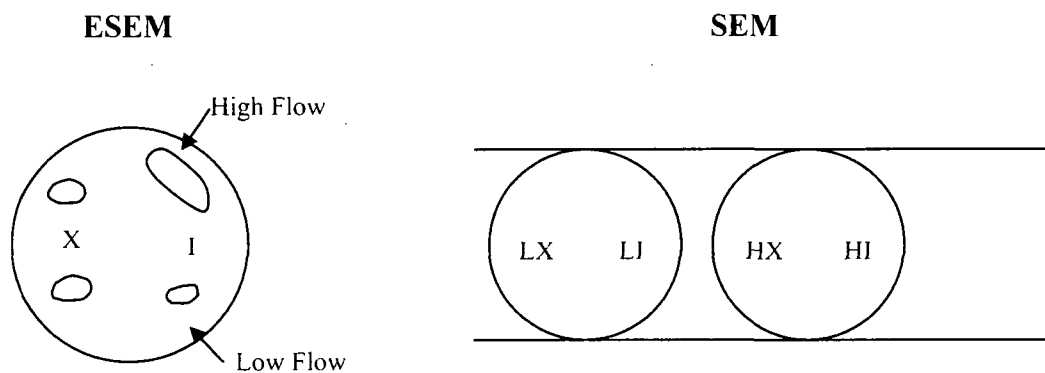
This appendix shows the ESEM/probe SEM/EDS results for ICET Test #3, Day-15 high-flow zone fiberglass samples. Both exterior and interior locations of the fiberglass samples were examined. These fiberglass samples were obtained on April 20, 2005 (15th day of Test #3). For probe SEM examination, the fiberglass samples were air dried at room temperature and then were coated with Au/Pd. Available logbook entries for this laboratory session are included in this appendix as transcribed notes.



## Transcribed Laboratory Log

Laboratory session from April 22, 2005.

Test #3, Day-15 fiberglass in high-flow zones



Instrument Conditions: ESEM, Pressure = 80 Pa

SEM, Electron beam of  $1 \times 10^{-9}$  (A)

### ESEM Fiberglass High-Flow Interior

Image:	T3D15HI1	100 ×	Figure B1-1
	T3D15HI2	1000 ×	Figure B1-2
	T3D15HI3	2000 ×	Figure B1-3
EDS:	T3D15HIA	EDS on particles shown in T3D15HI3	Figure B1-4

### ESEM Fiberglass High-Flow Exterior

Image:	T3D15HX4	110 ×	Figure B1-5
	T3D15HX5	1000 ×	Figure B1-6
EDS:	T3D15HXB	EDS on particles shown in T3D15HX5	Figure B1-7

### **SEM Fiberglass High-Flow Interior**

Image:	T3D15HIFlowInt002	100 ×	Figure B1-8
	T3D15HIFlowInt003	1000 ×	Figure B1-9
	T3D15HIFlowInt004	1000 ×	Figure B1-10
EDS:	T3D15HIFlowIntEDS1	EDS on particles shown in Int004	Figure B1-11

### **SEM Fiberglass High-Flow Exterior**

Image:	T3D15HIFlowExt005	100 ×	Figure B1-12
	T3D15HIFlowExt006	1000 ×	Figure B1-13
	T3D15HIFlowExt007	500 ×	Figure B1-14
EDS:	T3D15HIFlowExtEDS 2	EDS on particles shown in Ext007	Figure B1-15



Figure B1-1. Environmental SEM image magnified 100 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HI1)

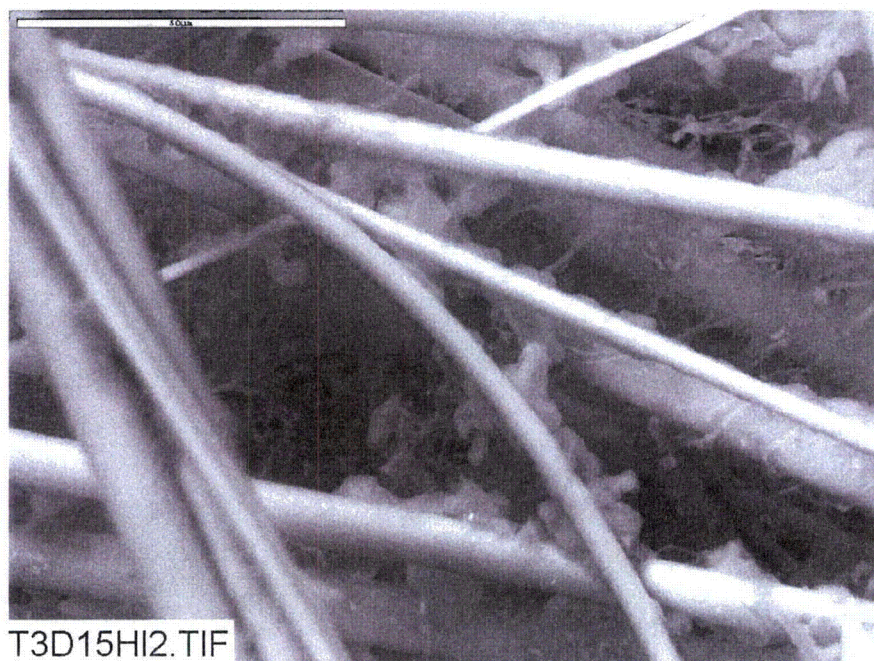
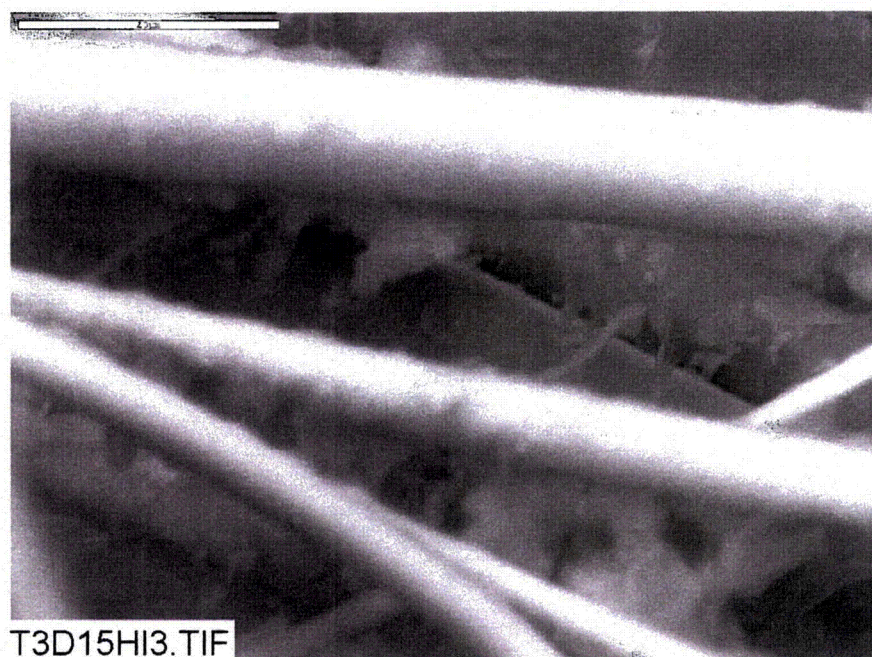
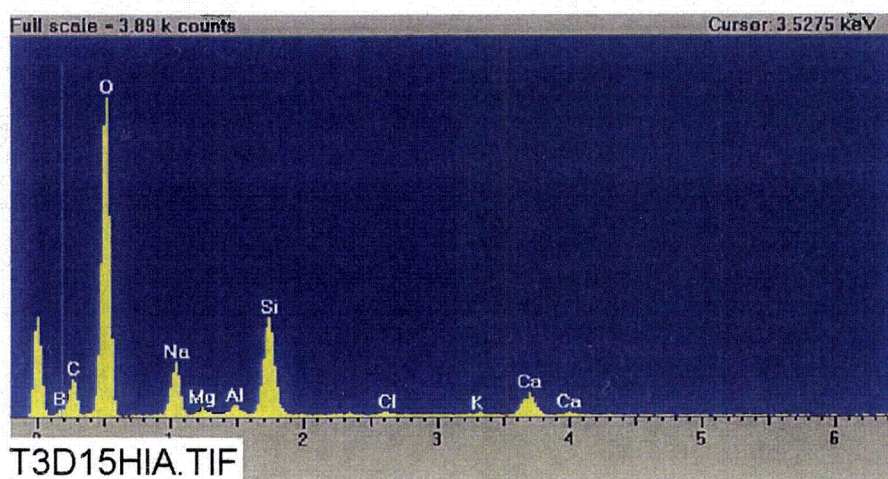


Figure B1-2. Environmental SEM image magnified 1000 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HI2)





**Figure B1-3.** Environmental SEM image magnified 2000 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HI3)



**Figure B1-4.** EDS counting spectrum for the flocculence deposits between the fibers on ESEM image shown in Figure B1-3. (T3D15HIA)





Figure B1-5. Environmental SEM image magnified 110 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HX4)

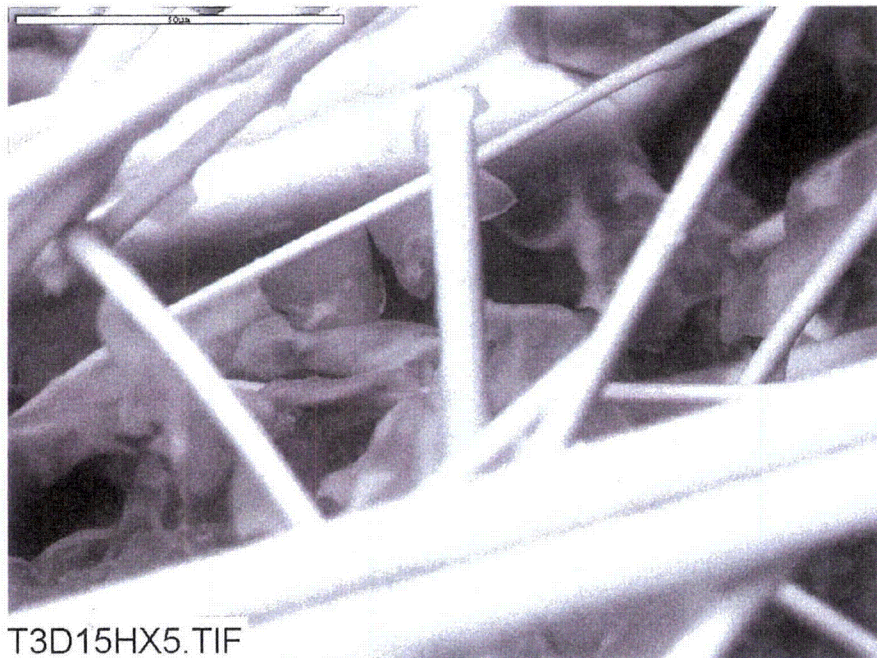


Figure B1-6. Environmental SEM image magnified 1000 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HX5)



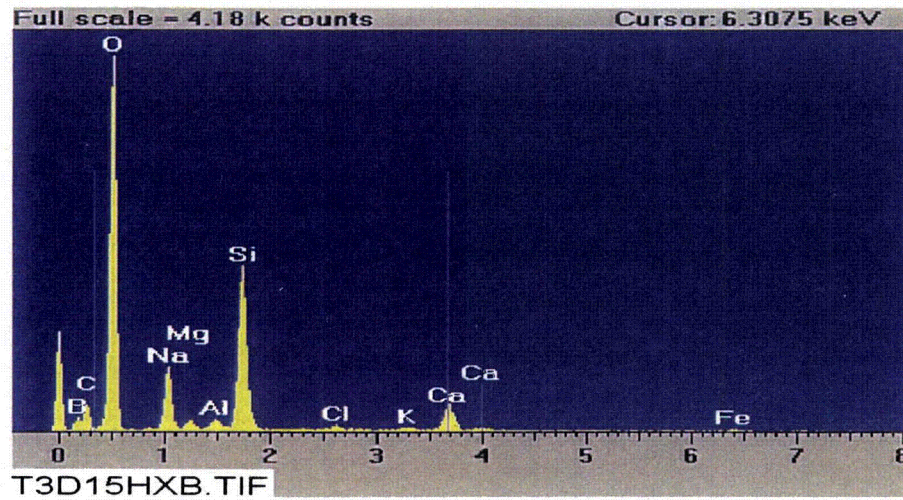


Figure B1-7. EDS counting spectrum for the deposits between the fibers on ESEM image shown in Figure B1-6. (T3D15HXB)

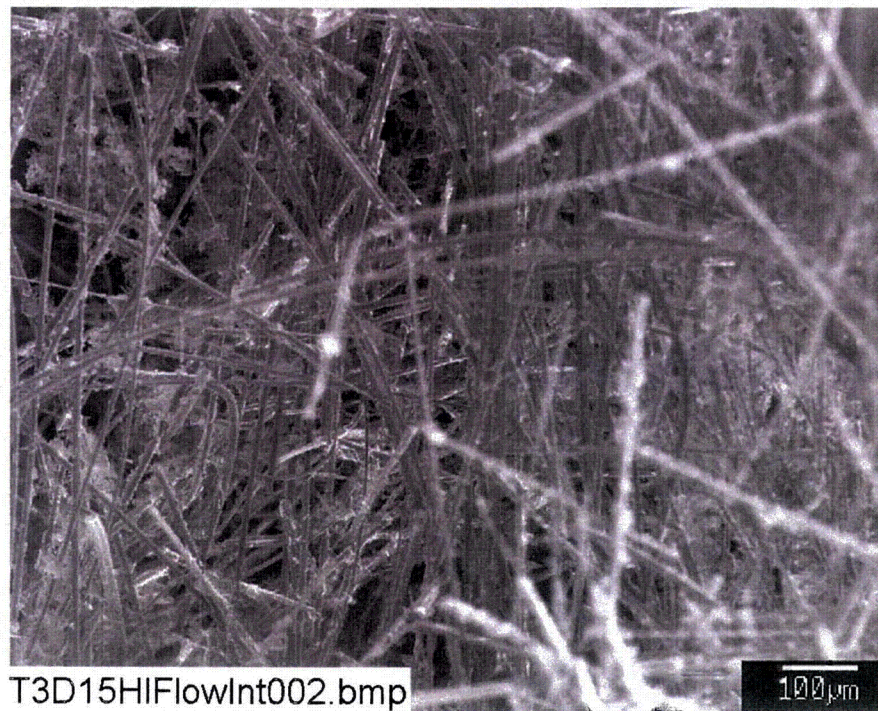
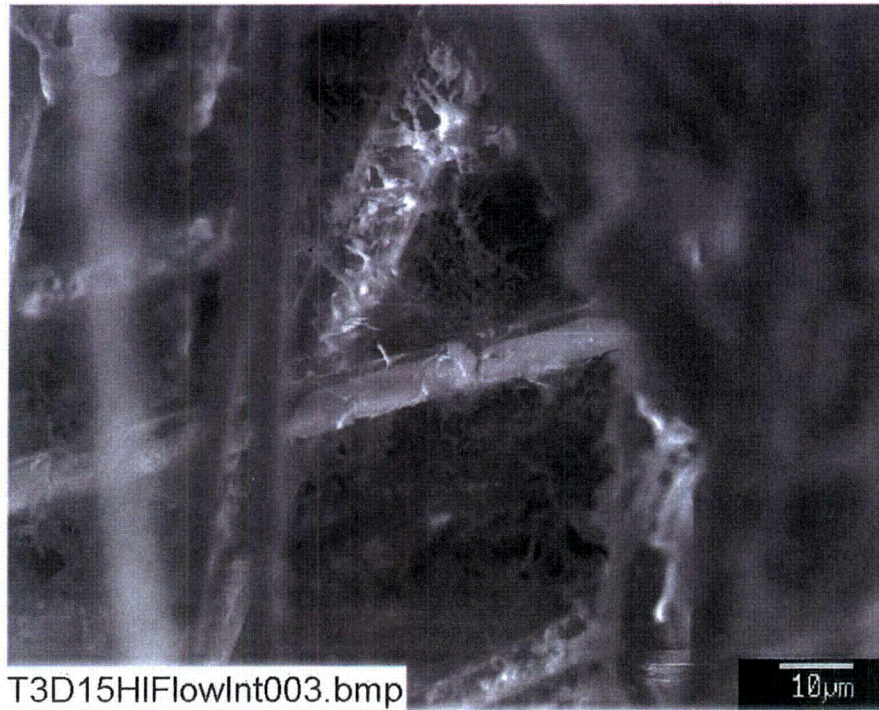
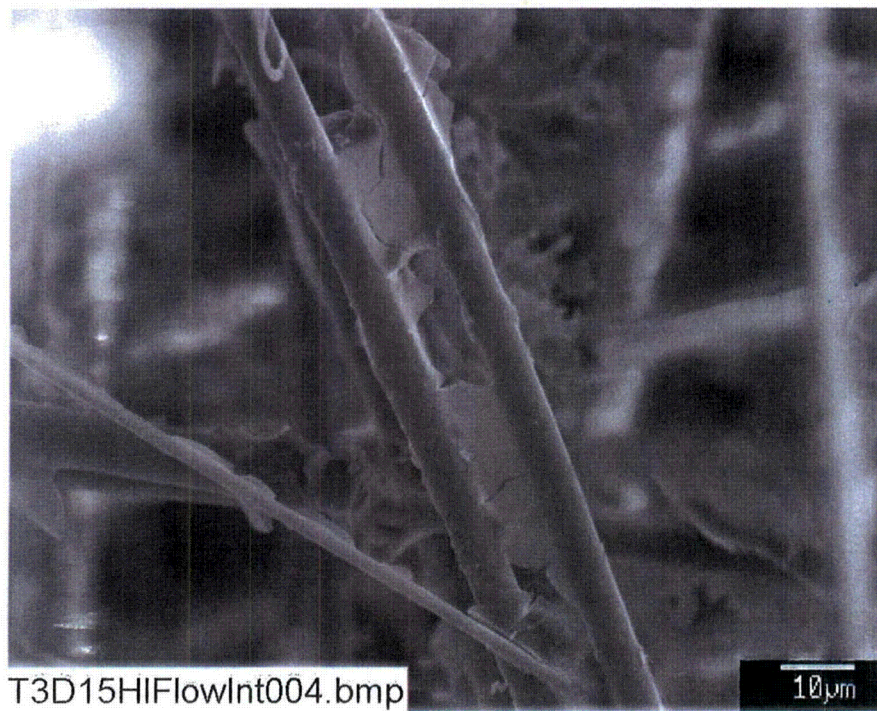


Figure B1-8. SEM image magnified 100 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HIFlowInt002)



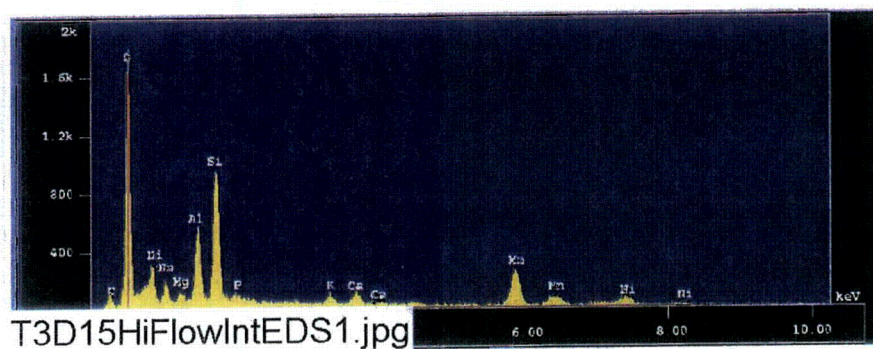


**Figure B1-9.** SEM image magnified 1000 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HIFlowInt003)

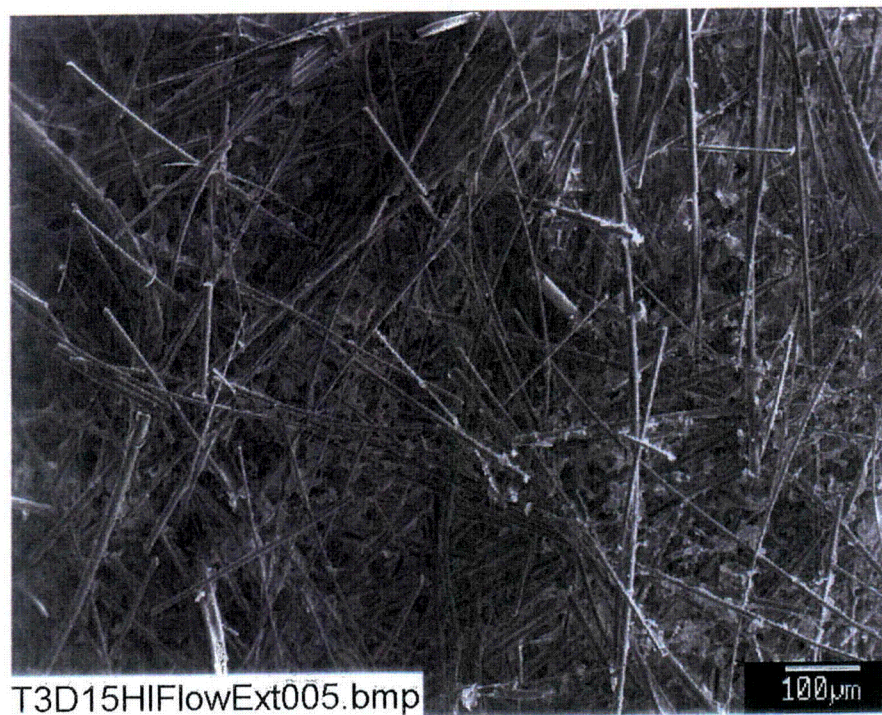


**Figure B1-10.** SEM image magnified 1000 times for a Test #3, Day-15 high-flow interior fiberglass sample. (T3D15HIFlowInt004)



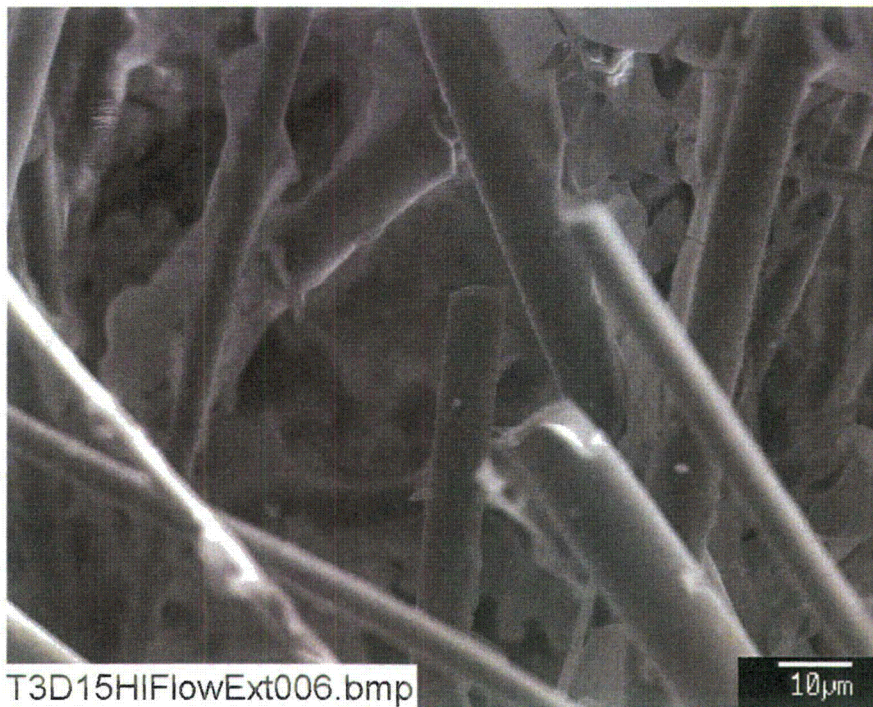


**Figure B1-11. EDS counting spectrum for the flocculence deposits between the fibers on SEM image shown in Figure B1-10. (T3D15HiFlowIntEDS1)**



**Figure B1-12. SEM image magnified 100 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HiFlowExt005)**

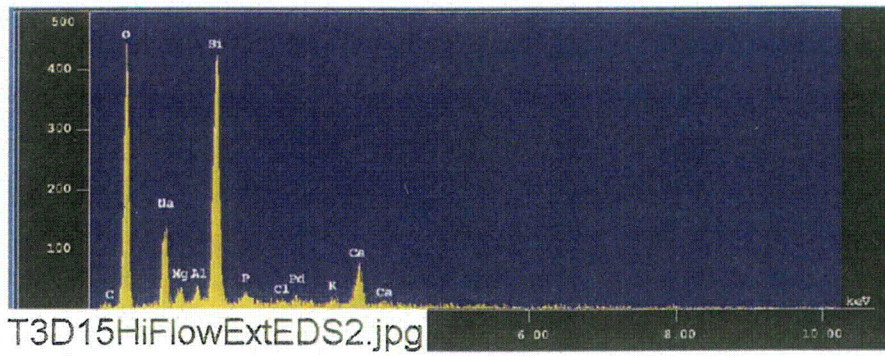




**Figure B1-13.** SEM image magnified 1000 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HIFlowExt006)



**Figure B1-14.** SEM image magnified 500 times for a Test #3, Day-15 high-flow exterior fiberglass sample. (T3D15HIFlowExt007)



**Figure B1-15. EDS counting spectrum for the flocculence deposits between the fibers on SEM image shown in Figure B1-14. (T3D15HiFlowExtEDS2)**

## Appendix B2

### ESEM/EDS and SEM/EDS Data for Test #3, Day-15 Fiberglass in Low-Flow Zones

#### Figures

Figure B2-1.	Environmental SEM image magnified 100 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LI6) .....	B2-5
Figure B2-2.	Environmental SEM image magnified 1000 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LI7) .....	B2-5
Figure B2-3.	Environmental SEM image magnified 1000 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LI8) .....	B2-6
Figure B2-4.	EDS counting spectrum for the flocculence deposits between the fibers on ESEM image shown in Figure B2-3. (T3D15LIC) .....	B2-6
Figure B2-5.	Environmental SEM image magnified 110 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LX9) .....	B2-7
Figure B2-6.	Environmental SEM image magnified 1000 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LX0) .....	B2-7
Figure B2-7.	EDS counting spectrum for the deposits between the fibers on ESEM image shown in Figure B2-6. (T3D15LXD) .....	B2-8
Figure B2-8.	SEM image magnified 100 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LowFlowInt008) .....	B2-8
Figure B2-9.	SEM image magnified 1000 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LowFlowInt009) .....	B2-9
Figure B2-10.	SEM image magnified 1000 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LowFlowInt010) .....	B2-9
Figure B2-11.	SEM image magnified 100 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LowFlowExt011) .....	B2-10
Figure B2-12.	SEM image magnified 1000 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LowFlowExt012) .....	B2-10

Figure B2-13. SEM image magnified 1000 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LowFlowExt013).....	B2-11
Figure B2-14. EDS counting spectrum for the flocculence deposits between the fibers on SEM image shown in Figure B2-13. (T3D15LowFlowExtEDS3).....	B2-11



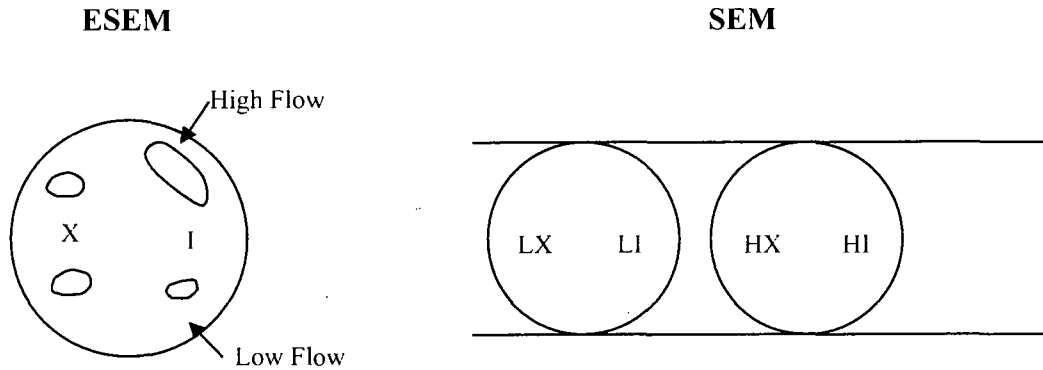
This appendix shows the ESEM/probe SEM/EDS results on ICET Test #3, Day-15 low-flow zone fiberglass samples. The samples were obtained on April 20, 2005 (15th day of Test #3). Both exterior and interior locations of the fiberglass samples were examined. For probe SEM examination, the fiberglass samples were dried in air at room temperature followed by being coated with Au/Pd. Available logbook entries for this laboratory session are included in this appendix as transcribed notes.



## Transcribed Laboratory Log

Laboratory session from April 22, 2005.

Test #3, Day-15 fiberglass in low-flow zones



Instrument Conditions: ESEM, Pressure = 80 Pa  
SEM, Electron beam of  $1 \times 10^{-9}$  (A)

### ESEM Fiberglass Low-Flow Interior

Image:	T3D15LI6	100 ×	Figure B2-1
	T3D15LI7	1000 ×	Figure B2-2
	T3D15LI8	1000 ×	Figure B2-3
EDS:	T3D15LIC	EDS on particles shown in T3D15LI8	Figure B2-4

### ESEM Fiberglass Low-Flow Exterior

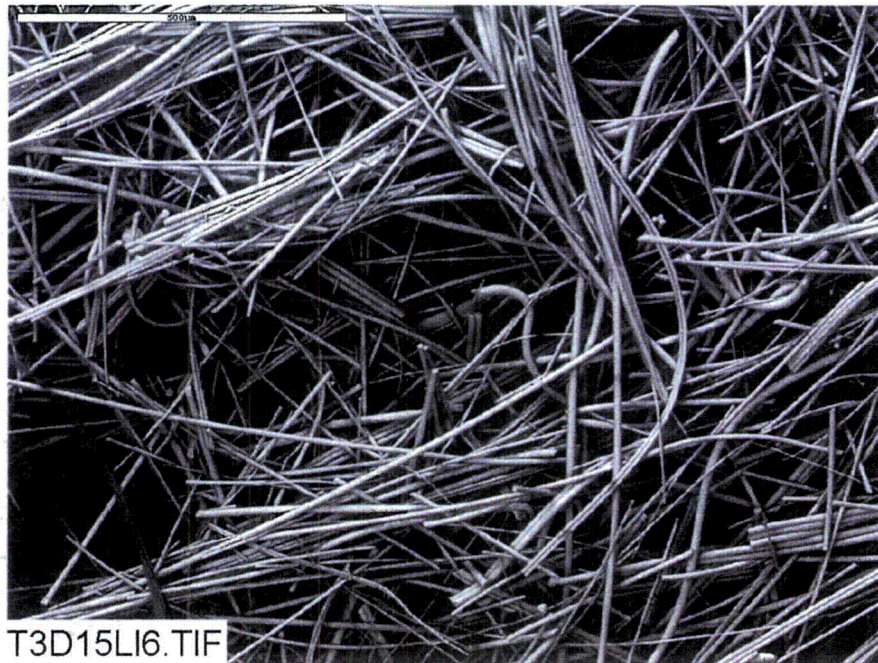
Image:	T3D15LX9	110 ×	Figure B2-5
	T3D15LX0	1000 ×	Figure B2-6
EDS:	T3D15LXD	EDS on particles shown in T3D15LX0	Figure B2-7

### **SEM Fiberglass Low-Flow Interior**

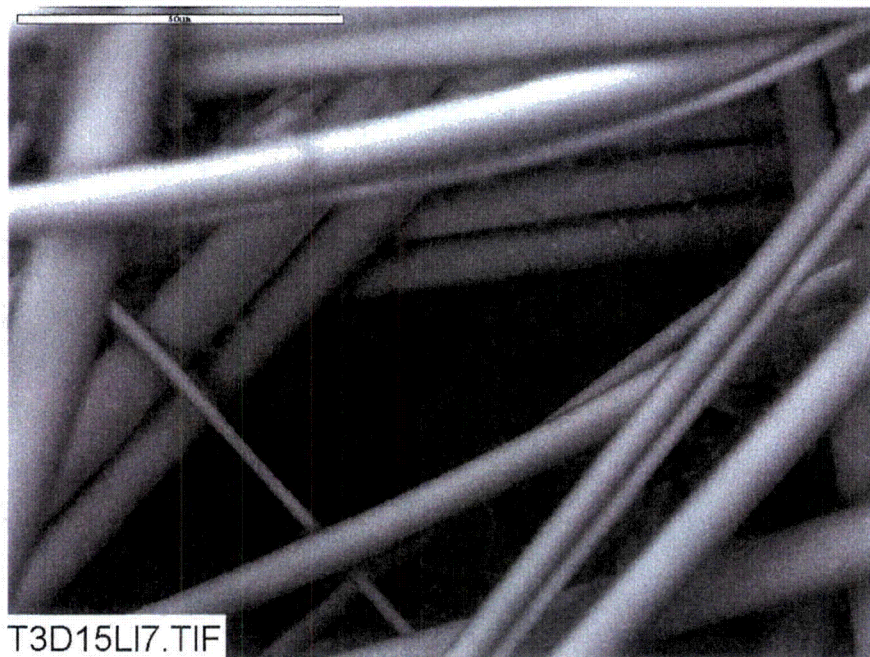
Image:	T3D15LowFlowInt008	100 ×	Figure B2-8
	T3D15LowFlowInt009	1000 ×	Figure B2-9
	T3D15LowFlowInt010	1000 ×	Figure B2-10

### **SEM Fiberglass Low-Flow Exterior**

Image:	T3D15LowFlowExt011	100 ×	Figure B2-11
	T3D15LowFlowExt012	1000 ×	Figure B2-12
	T3D15LowFlowExt013	1000 ×	Figure B2-13
EDS:	T3D15LowFlowExtEDS3	EDS on particles shown in Ext007	Figure B2-14

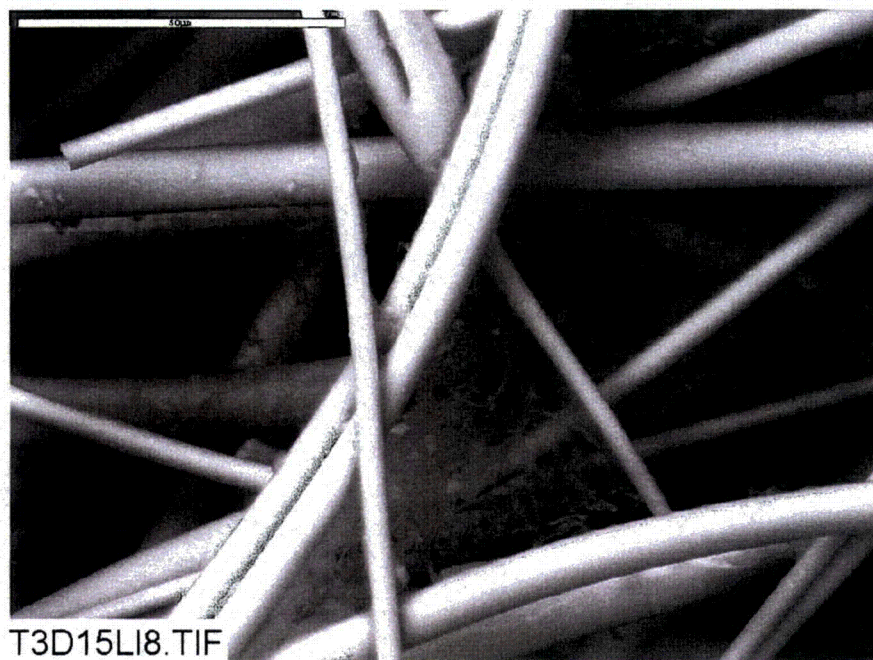


**Figure B2-1.** Environmental SEM image magnified 100 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LI6)

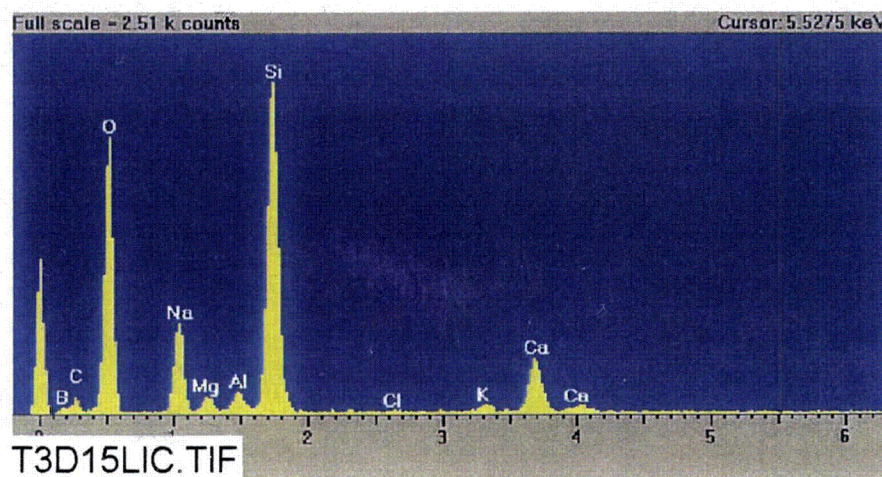


**Figure B2-2.** Environmental SEM image magnified 1000 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LI7)



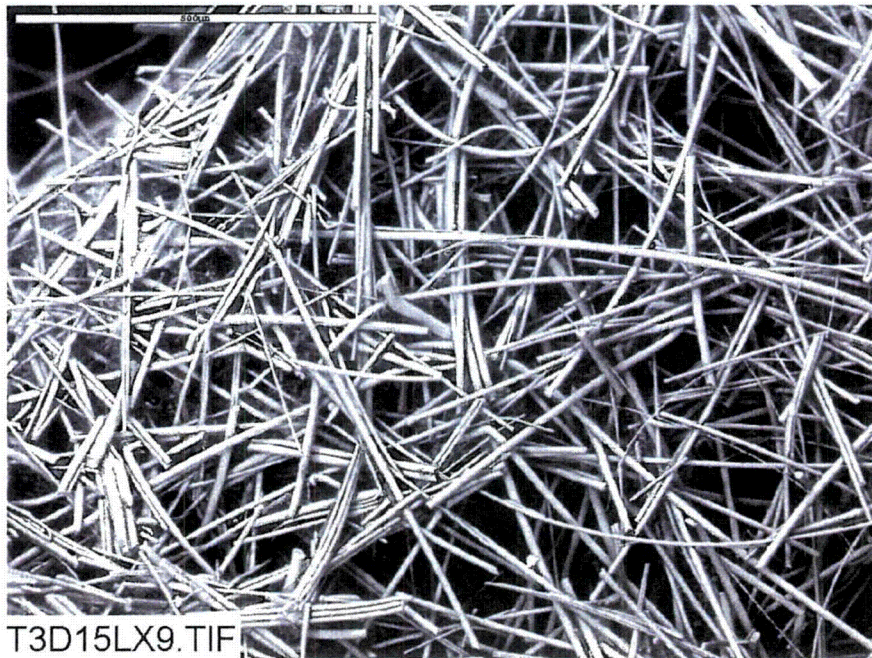


**Figure B2-3.** Environmental SEM image magnified 1000 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LI8)

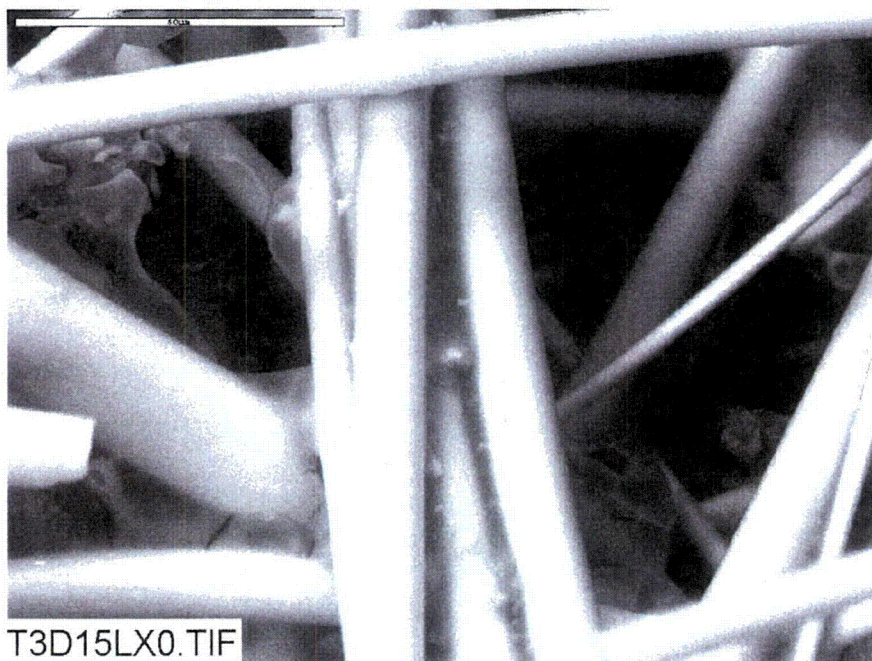


**Figure B2-4.** EDS counting spectrum for the flocculence deposits between the fibers on ESEM image shown in Figure B2-3. (T3D15LIC)





**Figure B2-5.** Environmental SEM image magnified 110 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LX9)



**Figure B2-6.** Environmental SEM image magnified 1000 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LX0)



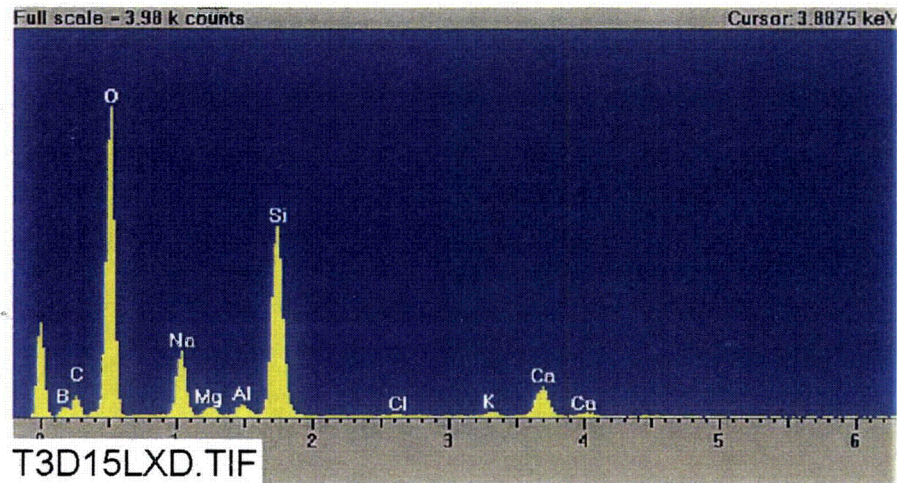


Figure B2-7. EDS counting spectrum for the deposits between the fibers on ESEM image shown in Figure B2-6. (T3D15LXD)

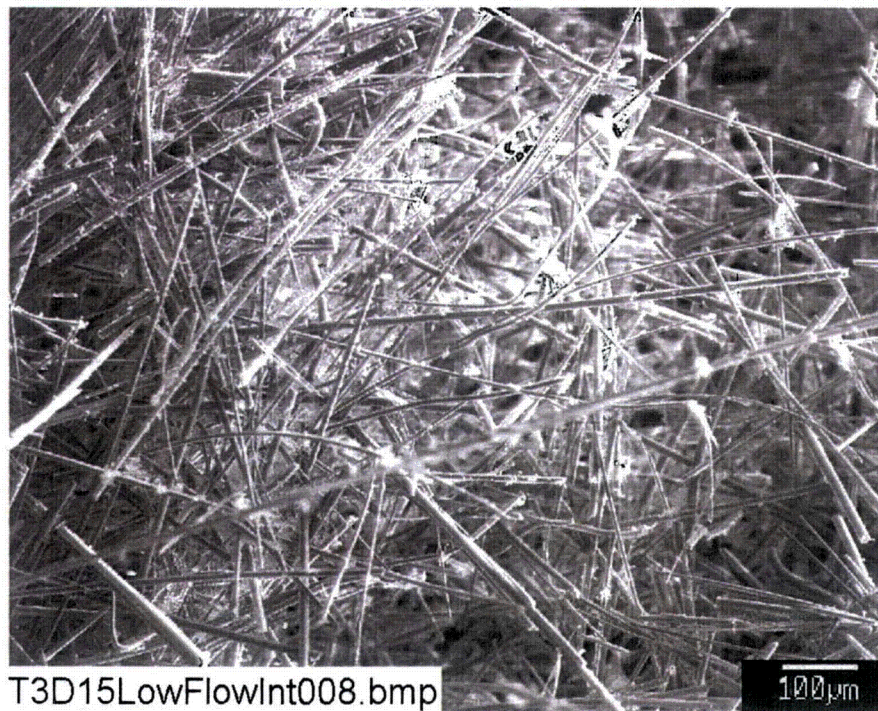
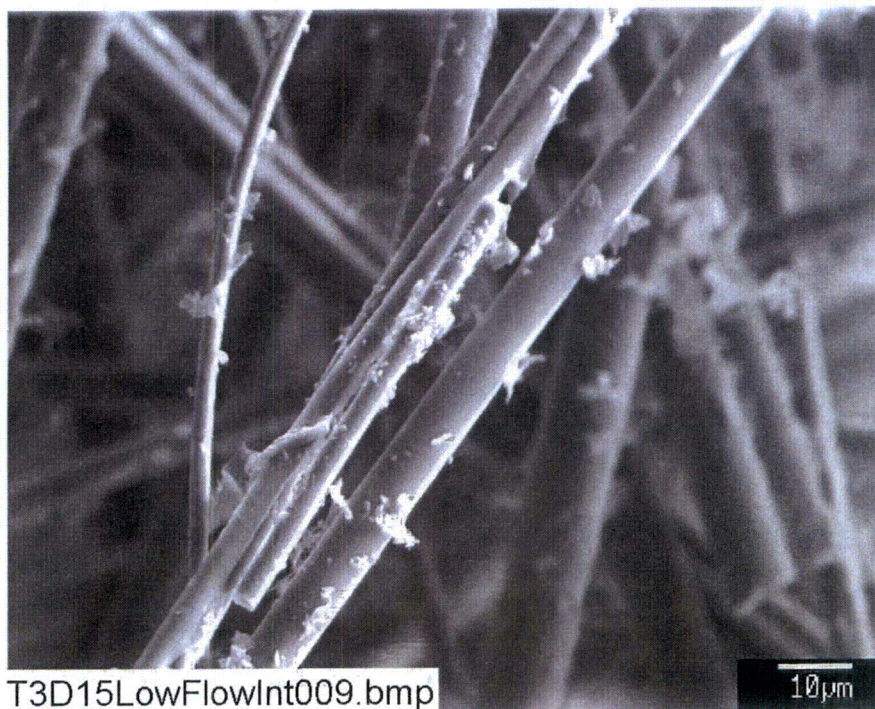
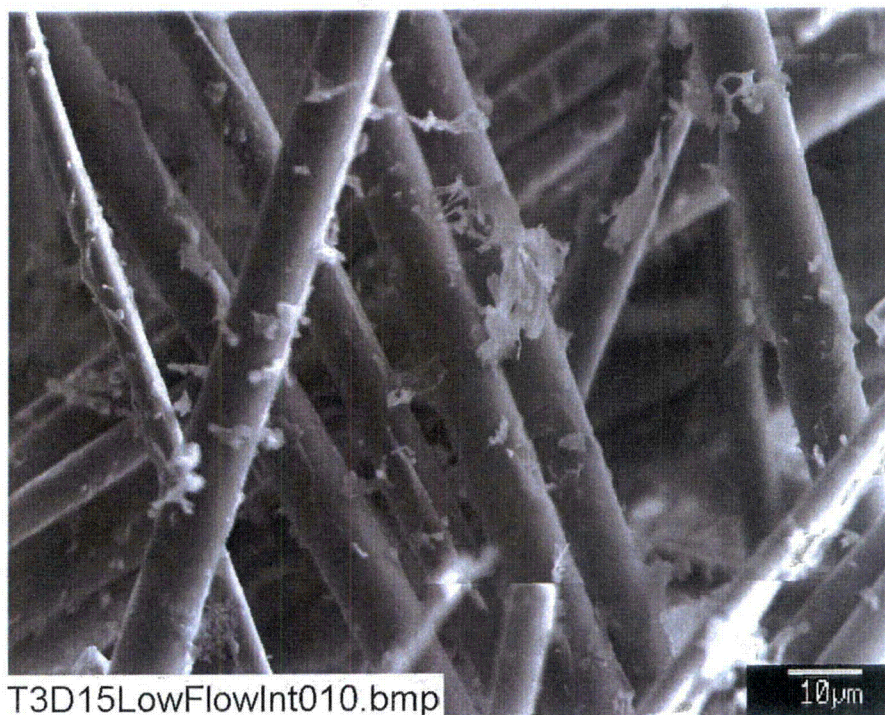


Figure B2-8. SEM image magnified 100 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LowFlowInt008)



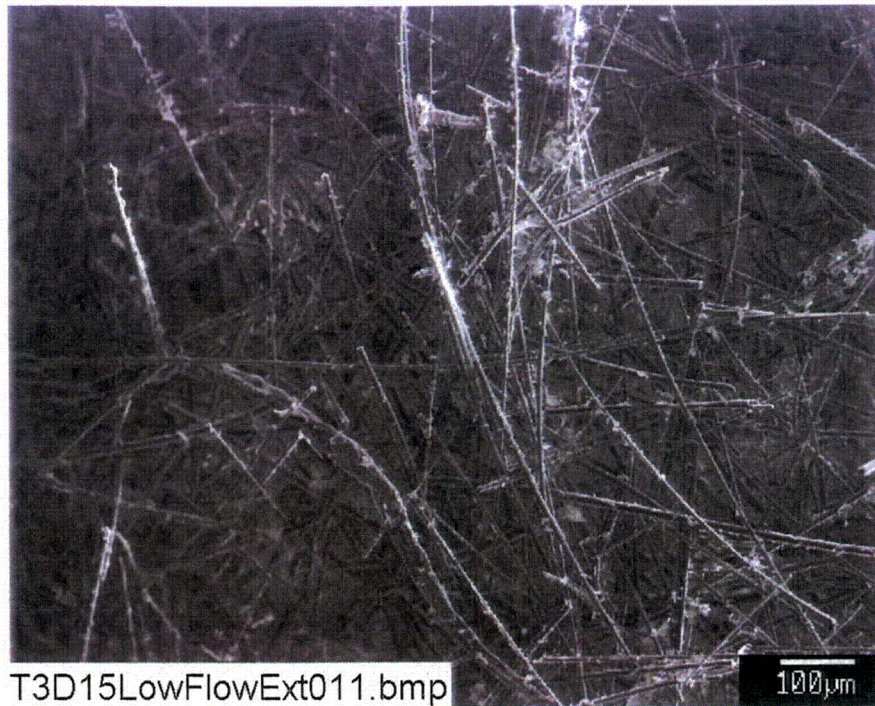


**Figure B2-9.** SEM image magnified 1000 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LowFlowInt009)



**Figure B2-10.** SEM image magnified 1000 times for a Test #3, Day-15 low-flow interior fiberglass sample. (T3D15LowFlowInt010)





**Figure B2-11.** SEM image magnified 100 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LowFlowExt011)

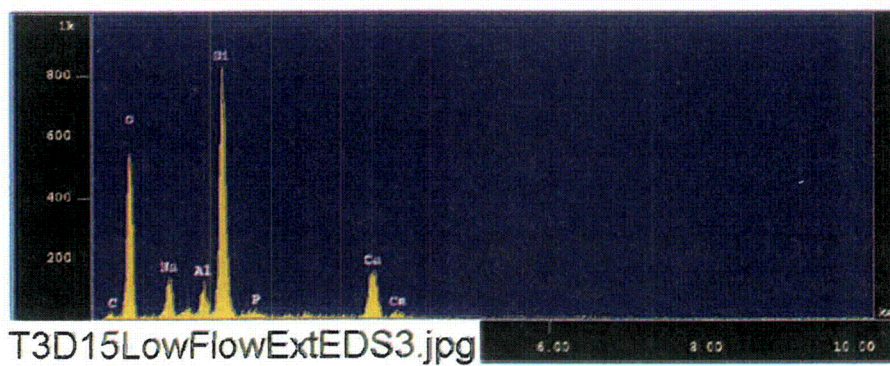


**Figure B2-12.** SEM image magnified 1000 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LowFlowExt012)





**Figure B2-13.** SEM image magnified 1000 times for a Test #3, Day-15 low-flow exterior fiberglass sample. (T3D15LowFlowExt013)



**Figure B2-14.** EDS counting spectrum for the floculence deposits between the fibers on SEM image shown in Figure B2-13. (T3D15LowFlowExtEDS3)



## Appendix C1

### ESEM/EDS Data for Test #3, Day-30 Fiberglass in High-Flow Zones

#### Figures

- Figure C1-1. ESEM image magnified 100 times for a Test #3, Day-30 exterior high-flow fiberglass sample. (T3HiFX31)..... C1-4
- Figure C1-2. ESEM image magnified 1000 times for a Test #3, Day-30 exterior high-flow fiberglass sample. (t3hifx32)..... C1-4
- Figure C1-3. ESEM image magnified 100 times for a Test #3, Day-30 exterior high-flow fiberglass sample. (t3hifx33)..... C1-5
- Figure C1-4. EDS counting spectrum for the large masses of particulate deposits shown in Figure C1-3. (t3hifx34)..... C1-5
- Figure C1-5. ESEM image magnified 600 times for a Test #3, Day-30 exterior high-flow fiberglass sample. (t3hifx35)..... C1-6
- Figure C1-6. ESEM image magnified 100 times for a Test #3, Day-30 interior high-flow fiberglass sample. (T3HiFI36)..... C1-6
- Figure C1-7. ESEM image magnified 1000 times for a Test #3, Day-30 interior high-flow fiberglass sample. (t3hifi37)..... C1-7
- Figure C1-8. ESEM image magnified 100 times for a Test #3, Day-30 interior high-flow fiberglass sample. (t3hifi38)..... C1-7



For ICET tests, the debris accumulated on the fiberglass is of great concern because it may cause significant head loss for the recirculation of the coolant during LOCAs. To evaluate these potential debris accumulations, fiberglass samples submerged in high-flow zones in the test tank were examined by ESEM/EDS.

The fiberglass samples examined in this appendix were extracted on the shutdown date of Test #3 (May 5, 2005). Both exterior and interior locations of the fiberglass samples were examined. Environmental SEM (ESEM) was employed to analyze the wet fiberglass samples under low-vacuum conditions (i.e., 80 Pa) and without any carbon coating, to minimize the possible modification of the fiberglass through the drying process. EDS results provide a semi-quantitative elemental analysis of the debris attached on fiberglass. Available logbook entries for this laboratory session are included in this appendix as transcribed notes.

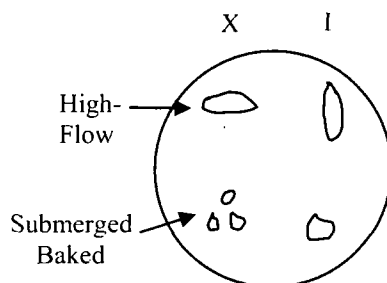




## Transcribed Laboratory Log

Laboratory session from May 11, 2005.

Test #3, Day-30 High-Flow Fiberglass.



### High-Flow Exterior

Image: T3HiFX31	100 ×	ESEM image	Figure C1-1
t3hifX32	1000 ×	ESEM image higher magnification	Figure C1-2
t3hifX33	100 ×	ESEM image	Figure C1-3
EDS: t3hifX34		EDS on particles in T3HiFX33	Figure C1-4
Image: t3hifX35	600 ×	ESEM image on fiberglass	Figure C1-5

### High-Flow Interior

Image: T3HiFI36	100 ×	ESEM image of fiberglass	Figure C1-6
t3hifI37	1000 ×	ESEM image higher magnification	Figure C1-7
t3hifI38	100 ×	ESEM image	Figure C1-8



Figure C1-1. ESEM image magnified 100 times for a Test #3, Day-30 exterior high-flow fiberglass sample. (T3HiFX31)



Figure C1-2. ESEM image magnified 1000 times for a Test #3, Day-30 exterior high-flow fiberglass sample. (t3hifx32)



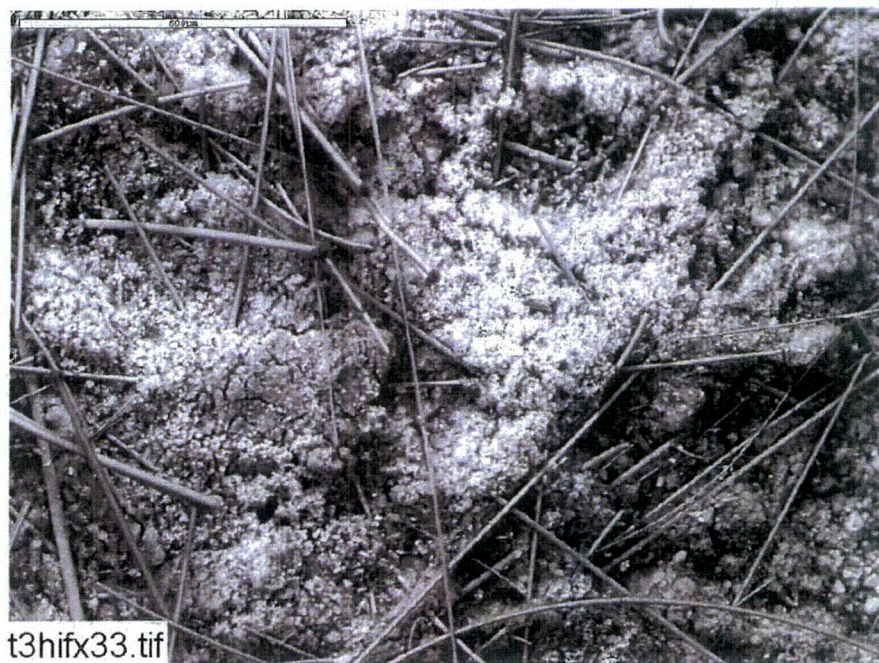


Figure C1-3. ESEM image magnified 100 times for a Test #3, Day-30 exterior high-flow fiberglass sample. (t3hifx33)

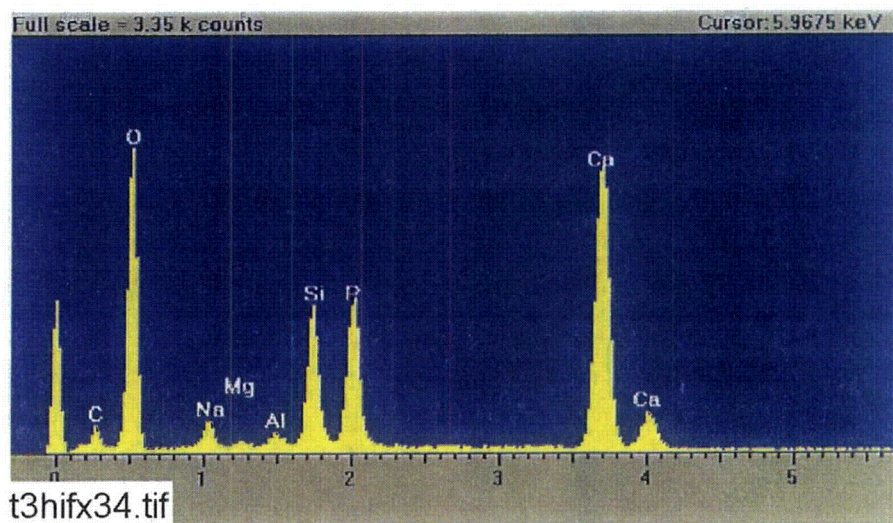


Figure C1-4. EDS counting spectrum for the large masses of particulate deposits shown in Figure C1-3. (t3hifx34)





Figure C1-5. ESEM image magnified 600 times for a Test #3, Day-30 exterior high-flow fiberglass sample. (t3hifx35)

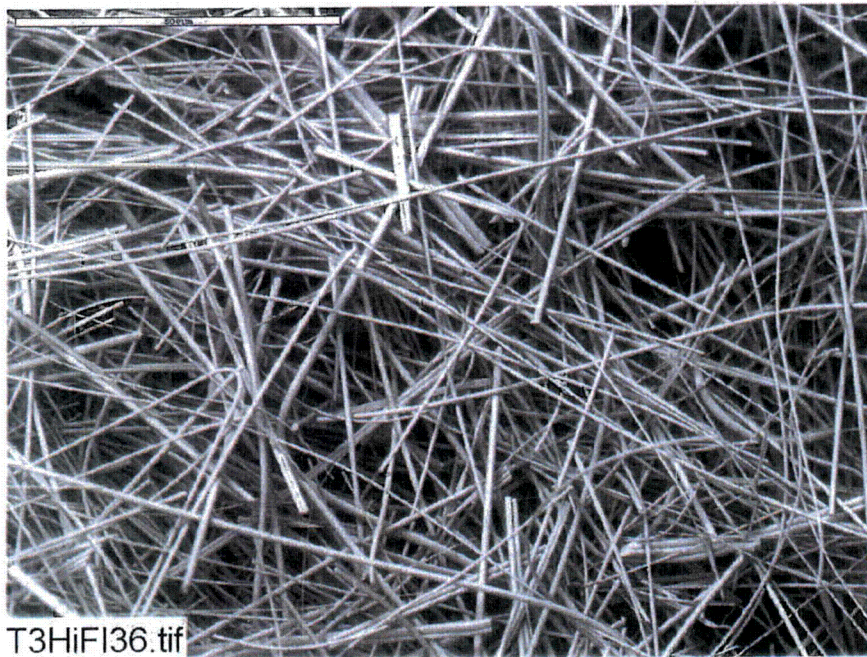


Figure C1-6. ESEM image magnified 100 times for a Test #3, Day-30 interior high-flow fiberglass sample. (T3HiFI36)



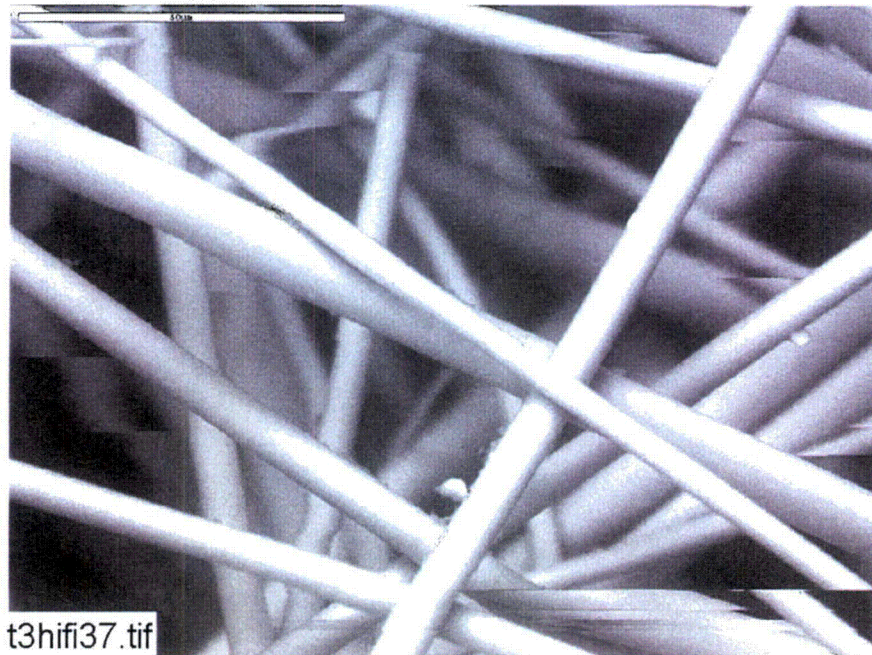


Figure C1-7. ESEM image magnified 1000 times for a Test #3, Day-30 interior high-flow fiberglass sample. (t3hifi37)

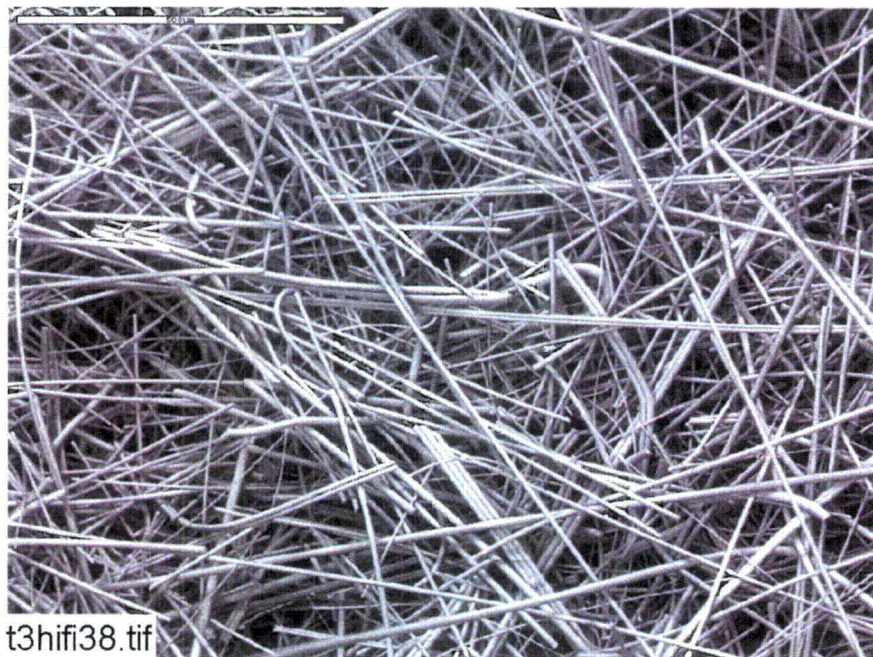


Figure C1-8. ESEM image magnified 100 times for a Test #3, Day-30 interior high-flow fiberglass sample. (t3hifi38)





## Appendix C2

### ESEM Data for Test #3, Day-30 Fiberglass in Low-Flow Zones

#### Figures

- Figure C2-1. ESEM image magnified 70 times for a Test #3, Day-30 exterior low-flow fiberglass sample. (t3lfex09)..... C2-4
- Figure C2-2. ESEM image magnified 1000 times for a Test #3, Day-30 exterior low-flow fiberglass sample. (t3lfex10) ..... C2-4
- Figure C2-3. ESEM image magnified 1000 times for a Test #3, Day-30 exterior low-flow fiberglass sample. (t3lfex11) ..... C2-5
- Figure C2-4. ESEM image magnified 70 times for a Test #3, Day-30 interior low-flow fiberglass sample. (t3lfin12) ..... C2-5
- Figure C2-5. ESEM image magnified 1000 times for a Test #3, Day-30 interior low-flow fiberglass sample. (t3lfin13)..... C2-6
- Figure C2-6. ESEM image magnified 1000 times for a Test #3, Day-30 interior low-flow fiberglass sample. (t3lfin14)..... C2-6
- Figure C2-7. ESEM image magnified 1000 times for a Test #3, Day-30 interior low-flow fiberglass sample. (t3lfin15)..... C2-7



This appendix presents the ESEM results on fiberglass samples submerged in the low-flow zone in the tank. The fiberglass samples were extracted on the date Test #3 was shut down (May 5, 2005). Both exterior and interior locations of the fiberglass samples were examined. ESEM was employed to analyze the uncoated, wet fiberglass samples. Additionally, the ESEM was performed under a low vacuum condition (i.e., 80 Pa) to minimize the modification of the fiberglass that could occur through the drying process. Available logbook entries for this laboratory session are included in this appendix as transcribed notes.

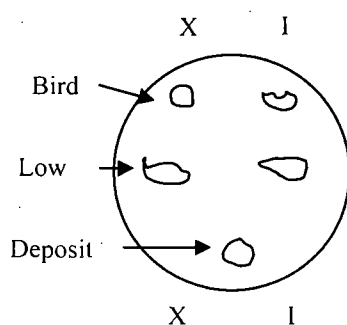




## Transcribed Laboratory Log

Laboratory session from May 6, 2005.

Test #3, Day-30 Birdcage Fiberglass.

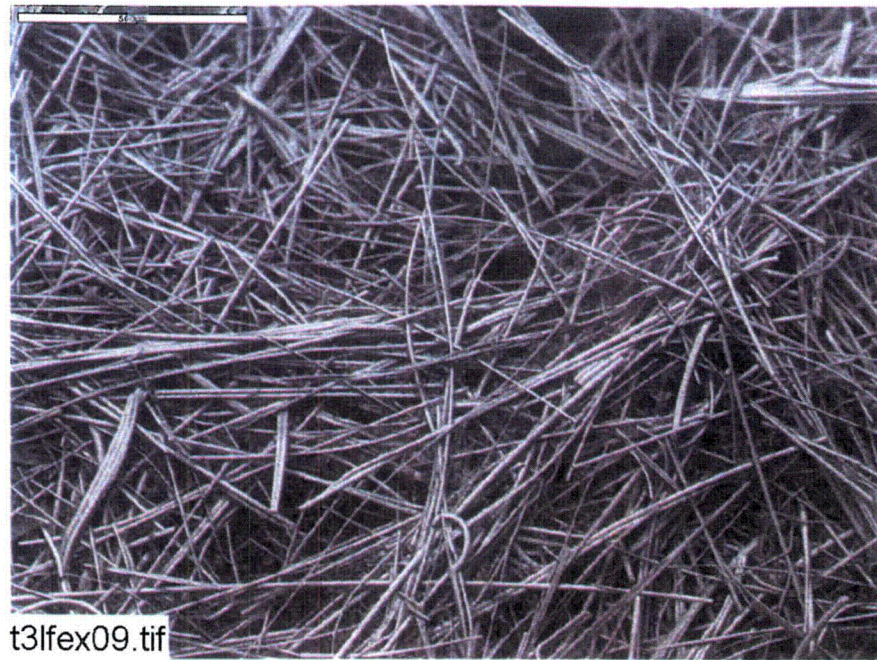


### Low-Flow Exterior

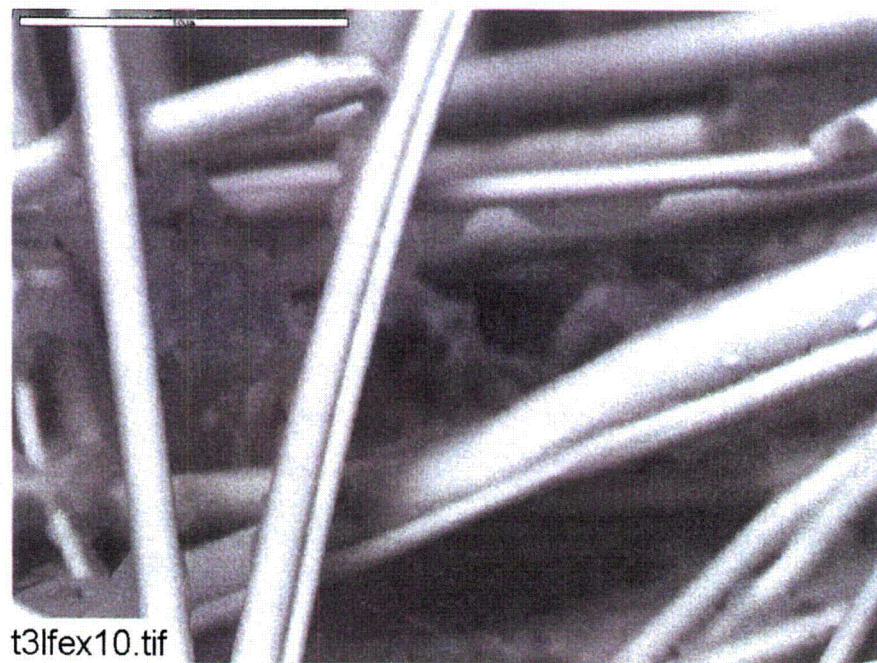
Image: t3lfex09	70 ×	ESEM image of fiberglass sample	Figure C2-1
t3lfex10	1000 ×	ESEM at higher magnification	Figure C2-2
t3lfex11	1000 ×	ESEM image	Figure C2-3

### Low-Flow Interior

Image: t3lfin12	70 ×	ESEM image of fiberglass sample	Figure C2-4
t3lfin13	1000 ×	ESEM image at higher mag.	Figure C2-5
t3lfin14	1000 ×	ESEM image	Figure C2-6
t3lfin15	1000 ×	ESEM image	Figure C2-7

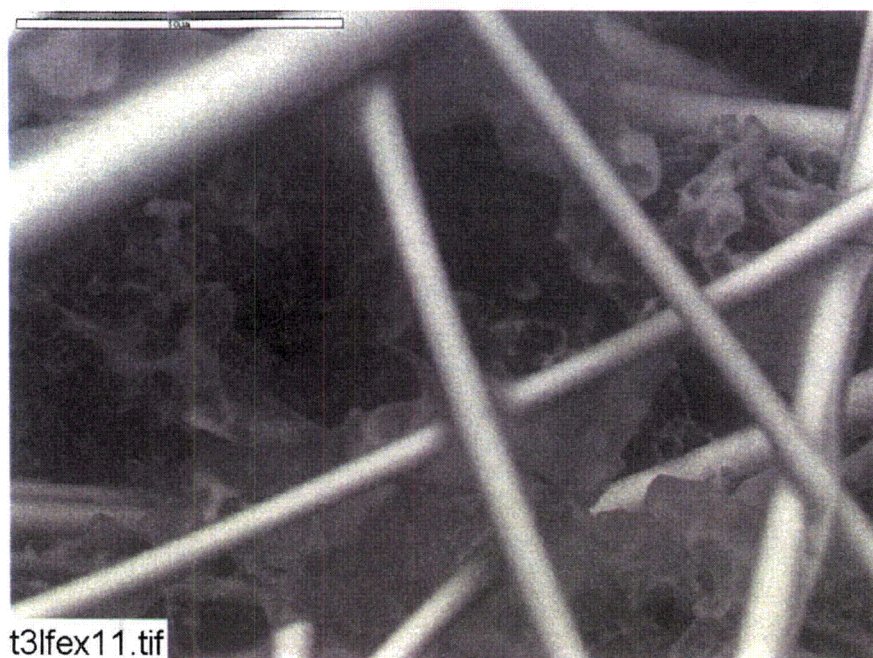


**Figure C2-1.** ESEM image magnified 70 times for a Test #3, Day-30 exterior low-flow fiberglass sample. (t3lfex09)

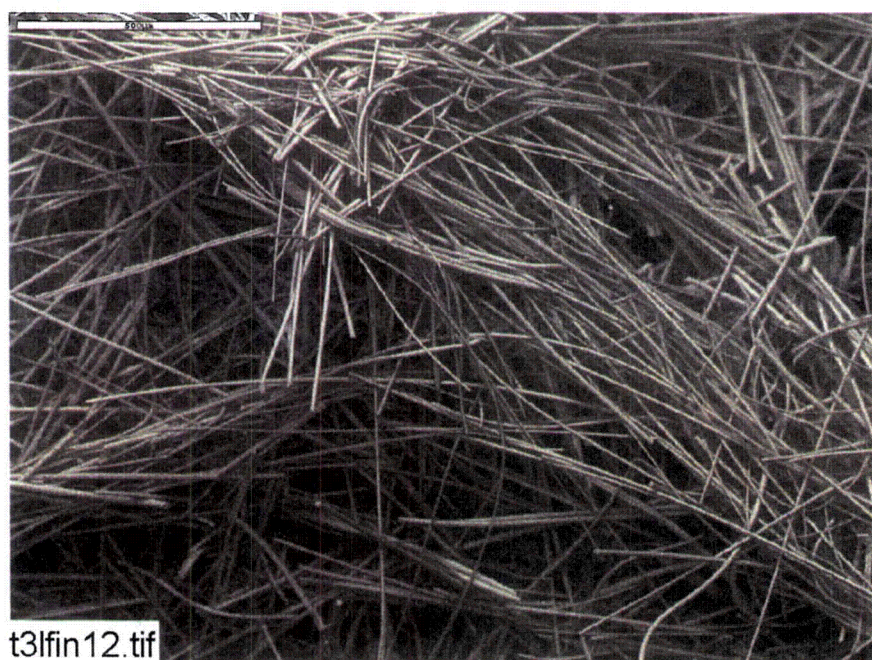


**Figure C2-2.** ESEM image magnified 1000 times for a Test #3, Day-30 exterior low-flow fiberglass sample. (t3lfex10)



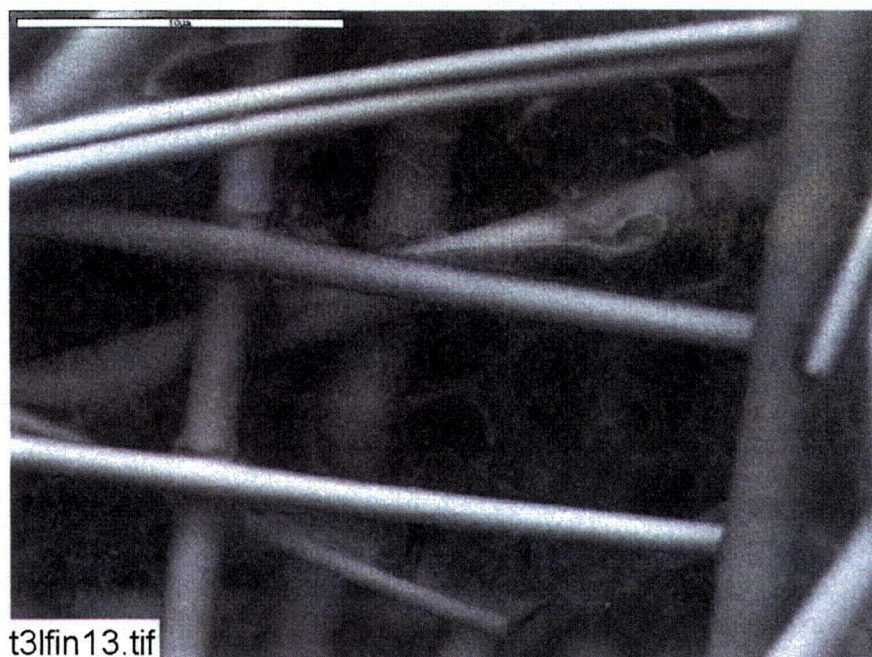


**Figure C2-3.** ESEM image magnified 1000 times for a Test #3, Day-30 exterior low-flow fiberglass sample. (t3lfex11)

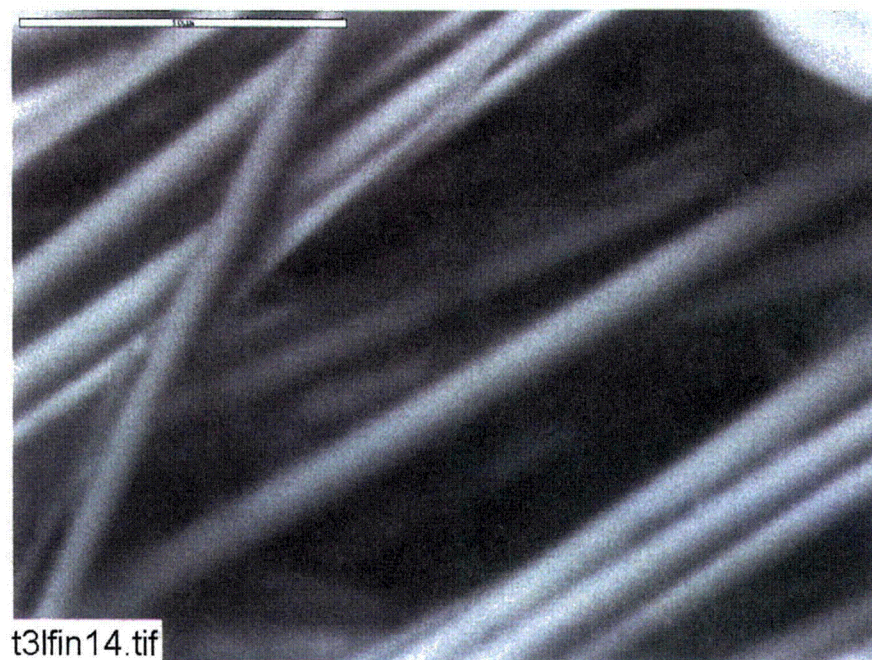


**Figure C2-4.** ESEM image magnified 70 times for a Test #3, Day-30 interior low-flow fiberglass sample. (t3lfin12)

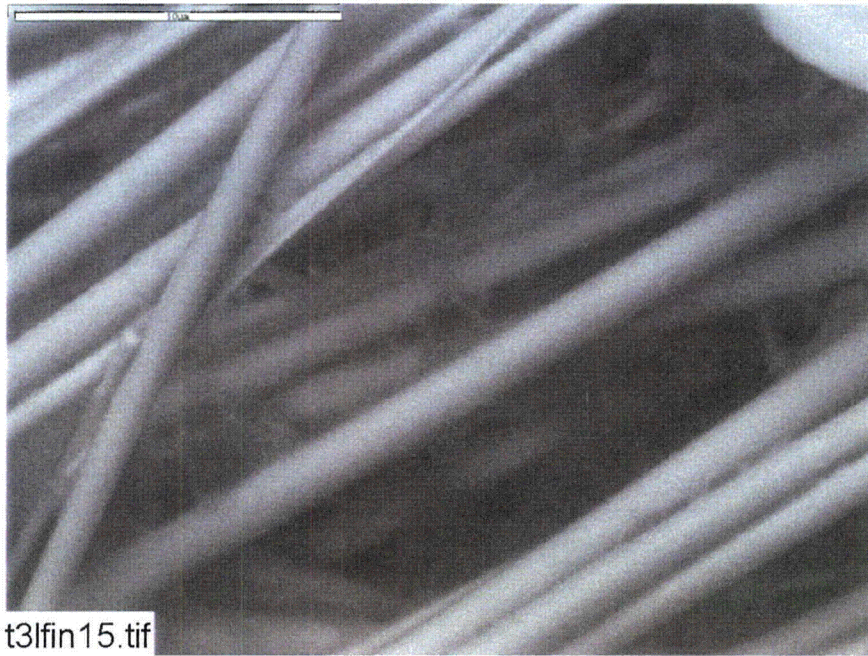




**Figure C2-5.** ESEM image magnified 1000 times for a Test #3, Day-30 interior low-flow fiberglass sample. (t3lfin13)



**Figure C2-6.** ESEM image magnified 1000 times for a Test #3, Day-30 interior low-flow fiberglass sample. (t3lfin14)



**Figure C2-7.** ESEM image magnified 1000 times for a Test #3, Day-30 interior low-flow fiberglass sample. (t3lfin15)





## Appendix C3

### ESEM/EDS Data for Test #3, Day-30 Drain Collar Fiberglass

#### Figures

Figure C3-1. ESEM image magnified 100 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (adjacent to the drain screen). (t3DCSC16).....	C3-4
Figure C3-2. ESEM image magnified 1000 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (adjacent to the drain screen). (t3dcsc17).....	C3-4
Figure C3-3. EDS counting spectrum for the particulate deposits shown in Figure C3-2. (t3dcsc18).....	C3-5
Figure C3-4. ESEM image magnified 70 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (adjacent to the drain screen). (t3dcsc19).....	C3-5
Figure C3-5. ESEM image magnified 70 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (away from the drain screen). (t3dcEx20).....	C3-6
Figure C3-6. ESEM image magnified 1000 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (away from the drain screen). (t3dcex21) .....	C3-6
Figure C3-7. EDS counting spectrum for the light particulate deposits (EDS1) shown in Figure C3-6. (t3dcex22) .....	C3-7
Figure C3-8. EDS counting spectrum for the dark deposits (EDS2) shown in Figure C3-6. (t3dcex23) .....	C3-7
Figure C3-9. Comparison of EDS counting spectra between Figure C3-7 (yellow) and Figure C3-8 (red). (t3dcex24) .....	C3-8

Figure C3-10. ESEM image magnified 100 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (away from the drain screen). (t3dcex25) .....	C3-8
Figure C3-11. ESEM image magnified 80 times for a Test #3, Day-30 interior fiberglass sample on the drain collar. (t3dcin26) .....	C3-9
Figure C3-12. ESEM image magnified 1000 times for a Test #3, Day-30 interior fiberglass sample on the drain collar. (t3dcin27) .....	C3-9
Figure C3-13. ESEM image magnified 100 times for a Test #3, Day-30 interior fiberglass sample on the drain collar. (t3dcin28) .....	C3-10



As mentioned before, the debris accumulated on fiberglass during ICET tests is of great concern because such debris may cause significant head loss for the recirculation of coolant during a LOCA. The ICET tank drain collar was used to simulate the sump screen used in nuclear reactor containment systems. Therefore, it is very important to perform SEM/EDS examinations of the fiberglass samples within the drain collar submerged in the tank.

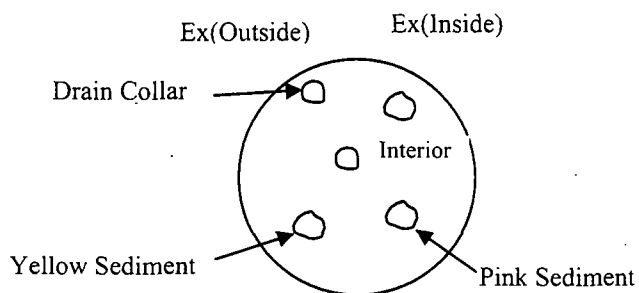
In this appendix, the fiberglass samples within the drain collar were extracted on the date that Test #3 was shut down (May 5, 2005). The fiberglass samples located at the outside exterior (away from the drain screen), the inside exterior (next to the drain screen), and the interior were examined. ESEM was employed to analyze the wet fiberglass samples; it was performed without any coating on the samples and under low-vacuum conditions (i.e., 80 Pa). This evaluation technique minimizes the modification of the fiberglass that could occur through a drying process. EDS results provide an elemental composition analysis of the debris attached on the fiberglass. Available logbook entries for this laboratory session are included in this appendix as transcribed notes.



## Transcribed Laboratory Log

Laboratory session from May 6, 2005.

Test #3, Day-30 Drain Collar Fiberglass.



### Drain Collar Inside

Image:	t3DCSC16	100 ×		Figure C3-1
	t3dcsc17	1000 ×	Particles	Figure C3-2
EDS:	t3dcsc18		EDS on particles	Figure C3-3
Image:	t3dcsc19	70 ×		Figure C3-4

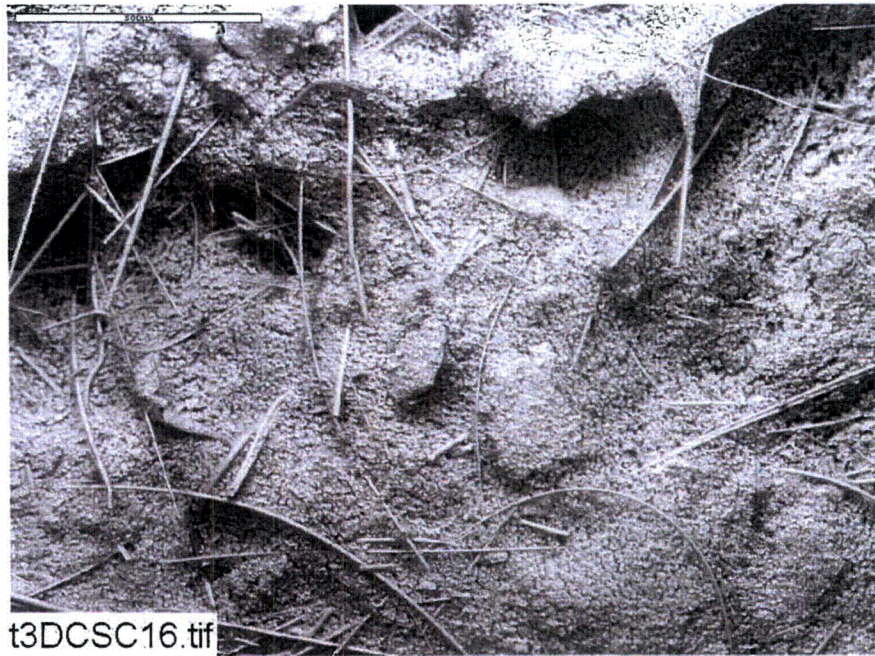
### Drain Collar Outside

Image:	t3dcEx20	70 ×		Figure C3-5
	t3dcex21	1000 ×		Figure C3-6
EDS:	t3dcex22		EDS on white bright particles shown in 21	Figure C3-7
	t3dcex23		EDS on dark particles shown in 21	Figure C3-8
	t3dcex24		Comparing t3dcex22 & t3dcex23	Figure C3-9
Image:	t3ccex25	100 ×		Figure C3-10

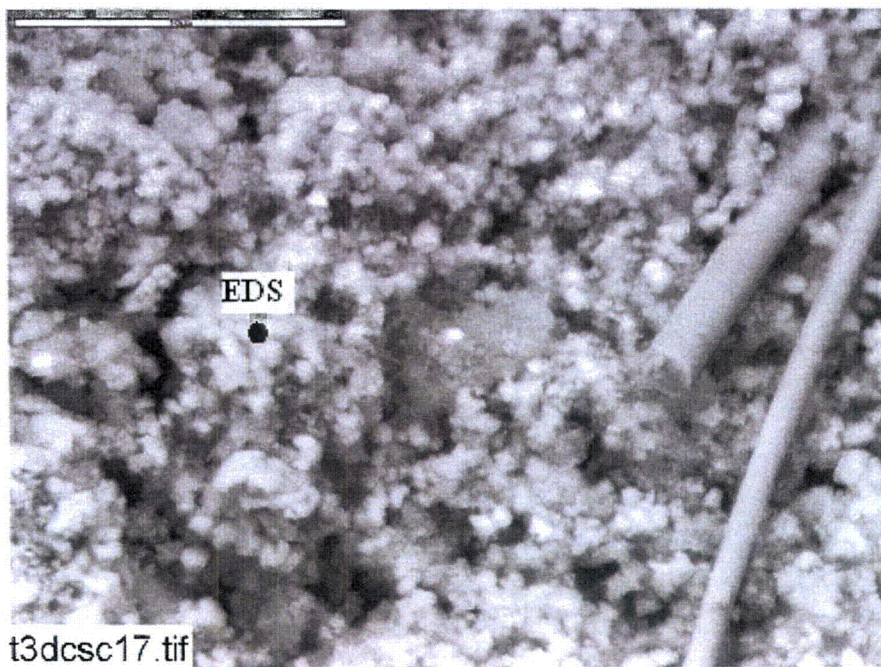
### Drain Collar Interior

Image:	t3dcin26	80 ×		Figure C3-11
	t3dcin27	1000 ×		Figure C3-12
	t3dcin28	100 ×		Figure C3-13





**Figure C3-1.** ESEM image magnified 100 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (adjacent to the drain screen). (t3DCSC16)



**Figure C3-2.** ESEM image magnified 1000 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (adjacent to the drain screen). (t3dcsc17)



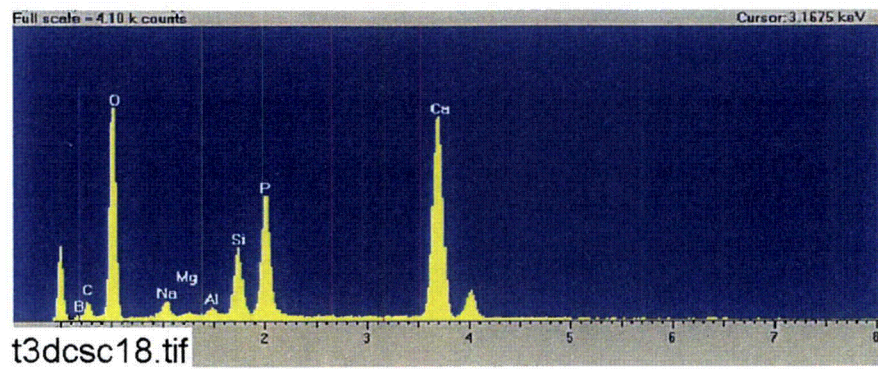


Figure C3-3. EDS counting spectrum for the particulate deposits shown in Figure C3-2. (t3dcsc18)

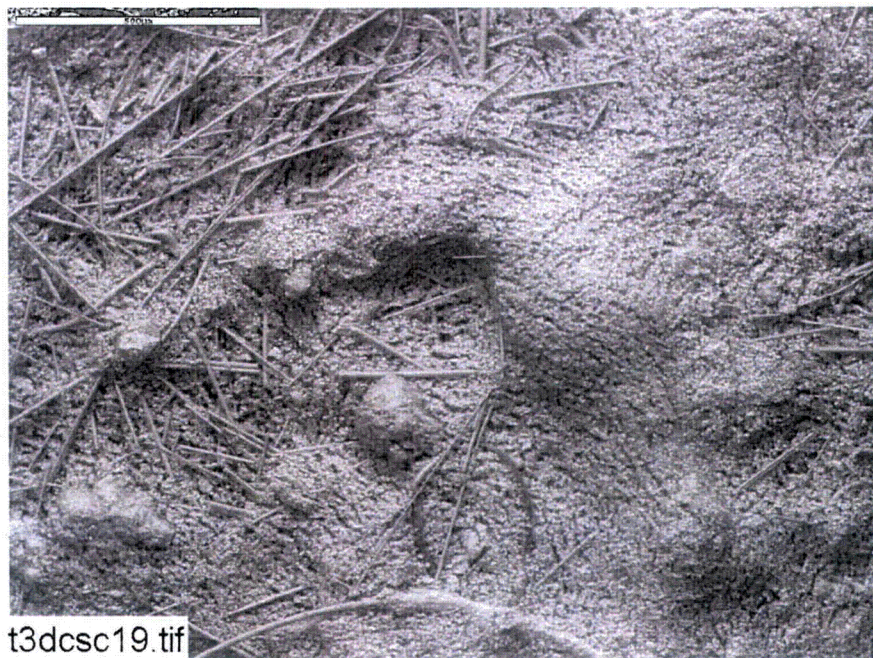


Figure C3-4. ESEM image magnified 70 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (adjacent to the drain screen). (t3dcsc19)



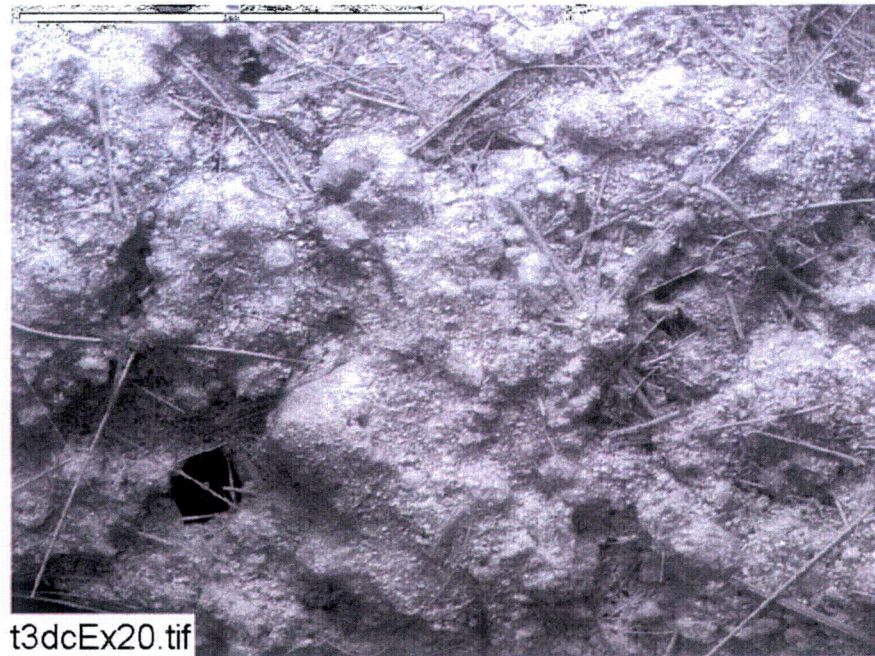


Figure C3-5. ESEM image magnified 70 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (away from the drain screen). (t3dcEx20)

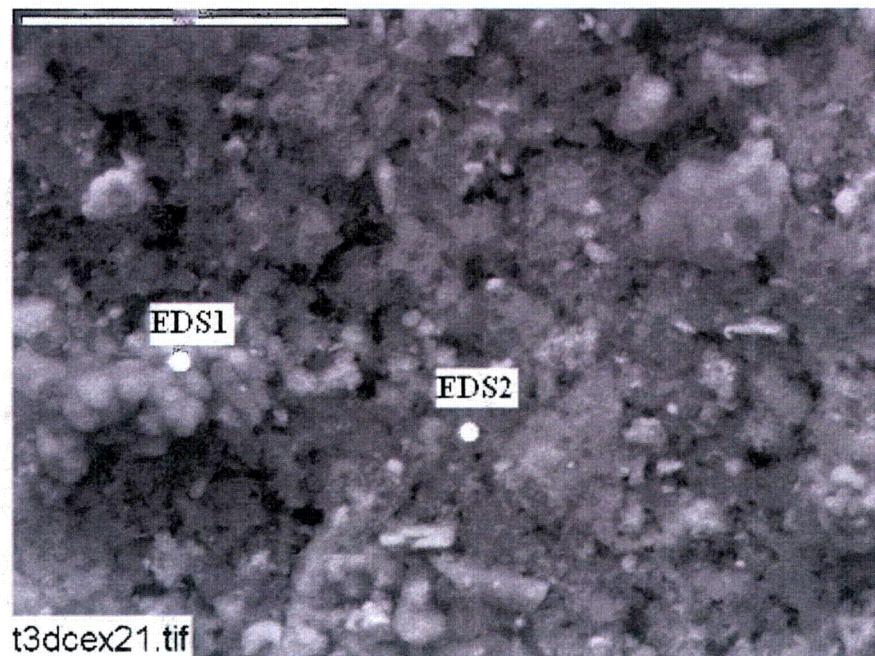


Figure C3-6. ESEM image magnified 1000 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (away from the drain screen). (t3dcex21)



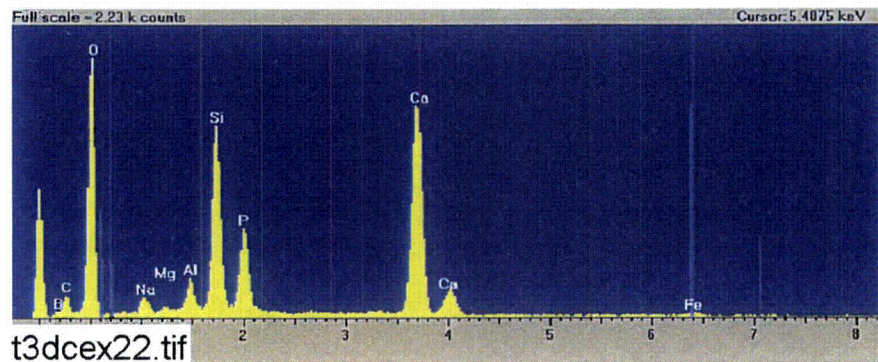


Figure C3-7. EDS counting spectrum for the light particulate deposits (EDS1) shown in Figure C3-6. (t3dcex22)

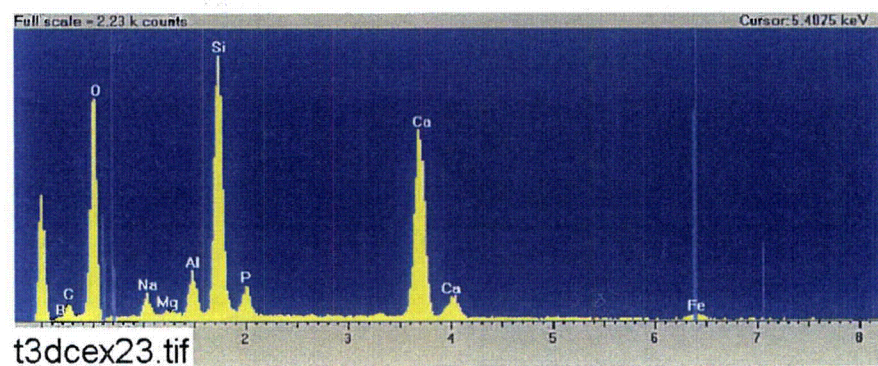


Figure C3-8. EDS counting spectrum for the dark deposits (EDS2) shown in Figure C3-6. (t3dcex23)

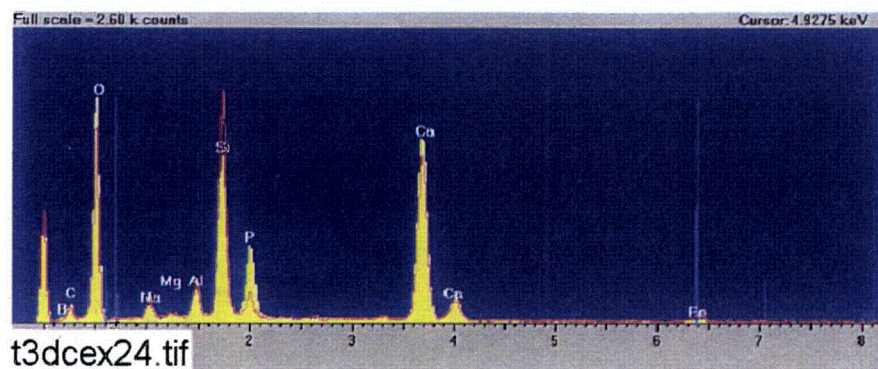


Figure C3-9. Comparison of EDS counting spectra between Figure C3-7 (yellow) and Figure C3-8 (red). (t3dcex24)

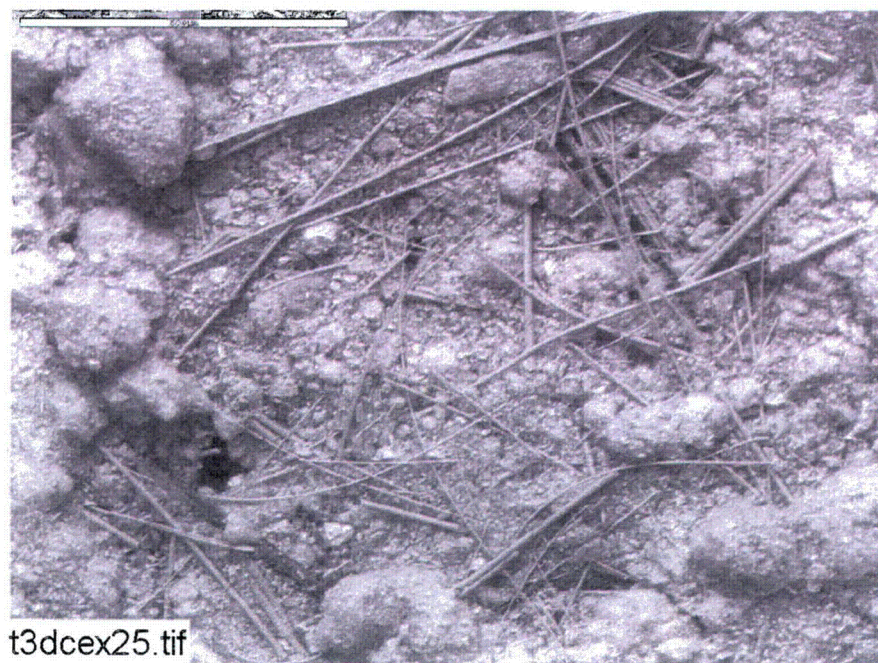
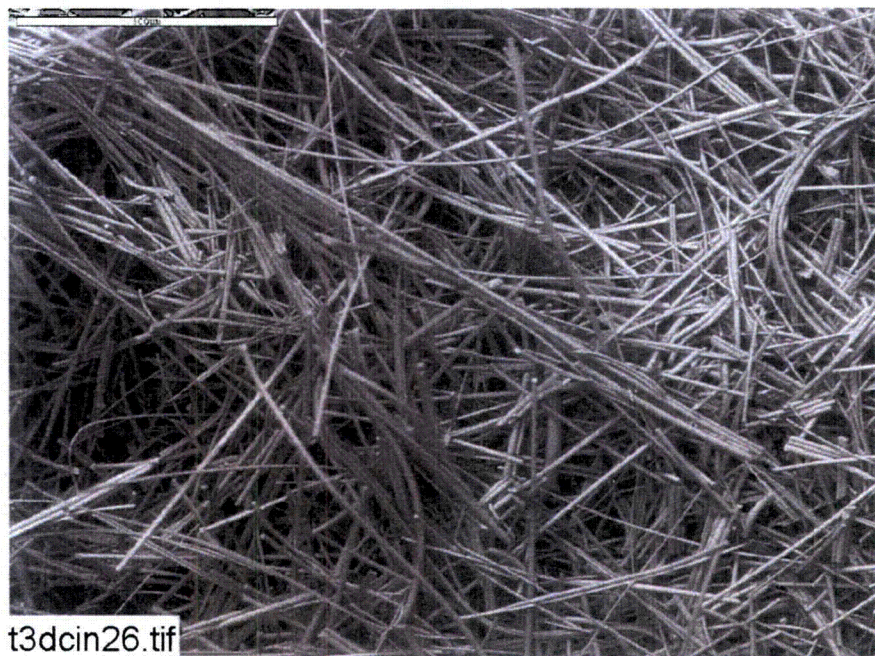
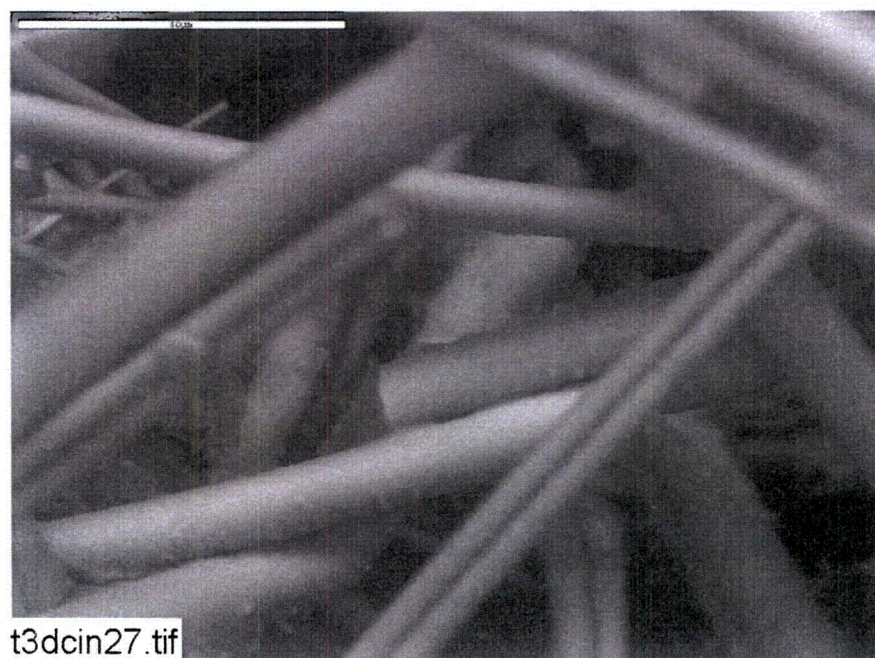


Figure C3-10. ESEM image magnified 100 times for a Test #3, Day-30 exterior fiberglass sample on the drain collar (away from the drain screen). (t3dcex25)



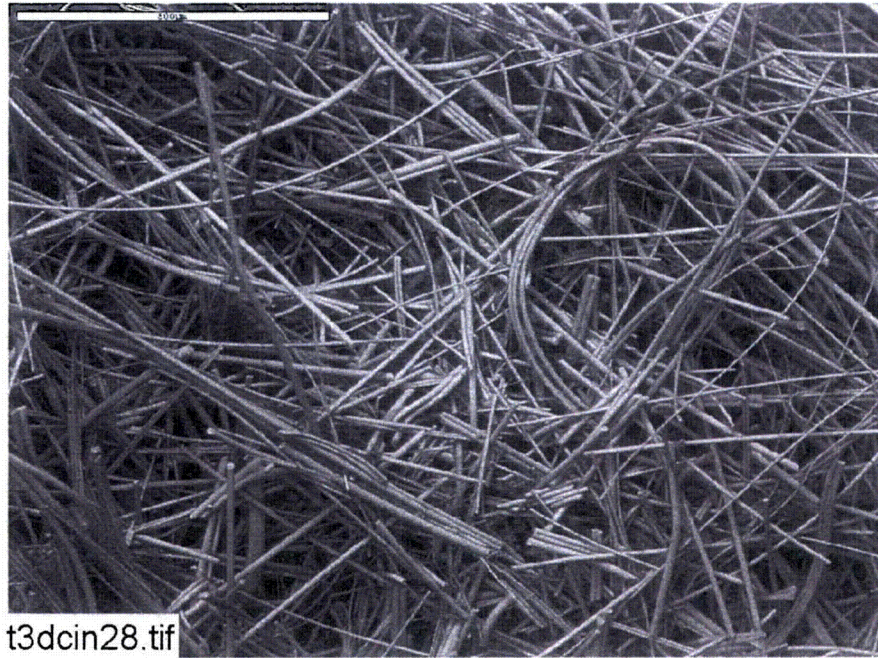


**Figure C3-11.** ESEM image magnified 80 times for a Test #3, Day-30 interior fiberglass sample on the drain collar. (t3dcin26)



**Figure C3-12.** ESEM image magnified 1000 times for a Test #3, Day-30 interior fiberglass sample on the drain collar. (t3dcin27)





**Figure C3-13. ESEM image magnified 100 times for a Test #3, Day-30 interior fiberglass sample on the drain collar. (t3dcin28)**

## Appendix C4

### SEM/EDS and ESEM/EDS Data for Test #3, Day-30 Birdcage Fiberglass

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fiberglass sample within a birdcage. (t3bcin07) ..... C4-12



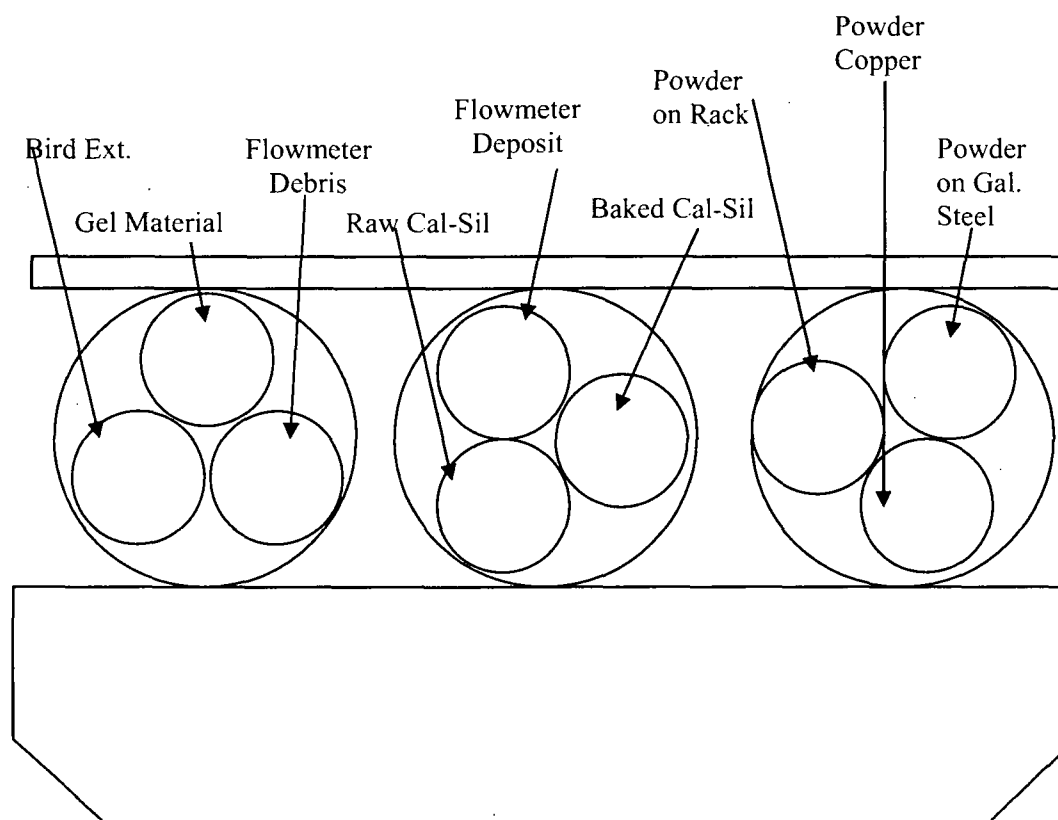
This appendix lists the ESEM/SEM/EDS results for the fiberglass samples within a birdcage submerged in the testing solution. The purpose of this analysis was to determine the degree and the extent of particulate debris that migrated and attached on fiberglass. In this appendix, the fiberglass samples within the birdcage were extracted on the shutdown date of Test #3 (May 5, 2005). Both exterior and interior fiberglass samples were examined. Probe SEM was used to examine the fiberglass samples after drying at room temperature followed by being coated with Au/Pd. In addition to probe SEM, ESEM was employed to analyze the uncoated, wet fiberglass samples under a low-vacuum condition (i.e., 80 Pa) to minimize the potential for modification of the fiberglass samples that might occur through the drying process. Available logbook entries for this laboratory session are included in this appendix as transcribed notes.



## Transcribed Laboratory Log

Laboratory session from May 9, 2005.

Test #3, Day-30 Birdcage



### Birdcage Exterior

Image: T3D30BirdExt001 100 ×

Figure C4-1

T3D30BirdExt002 550 ×

Figure C4-2

EDS: T3D30BirdExtPt01

Particles on fiberglass, image 002 Figure C4-3

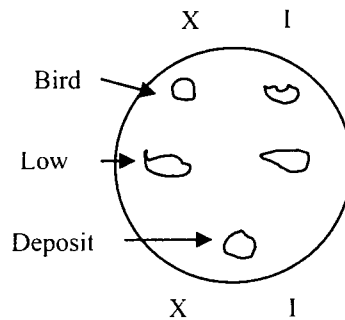


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## Transcribed Laboratory Log

Laboratory session from May 6, 2005.

Test #3, Day-30 Birdcage Fiberglass.



### Birdcage Exterior

Image:	T3BCEx01	80 ×		Figure C4-4
EDS:	t3bcexe2		EDS on particles-T3BCEXE2	Figure C4-5
Image:	t3bcex02	80 ×		Figure C4-6
	t3bcex03	500 ×		Figure C4-7
EDS:	T3BCExE1		EDS on particles in t3bcex03	Figure C4-8
	t3bcexe3		Comparing t3bcexe2 & T3BCExE1	Figure C4-9
Image:	t3bcex04	1000 ×		Figure C4-10

### Birdcage Interior

Image:	t3bcin05	80 ×		Figure C4-11
	t3bcin06	950 ×		Figure C4-12
	t3bcin07	1000 ×		Figure C4-13

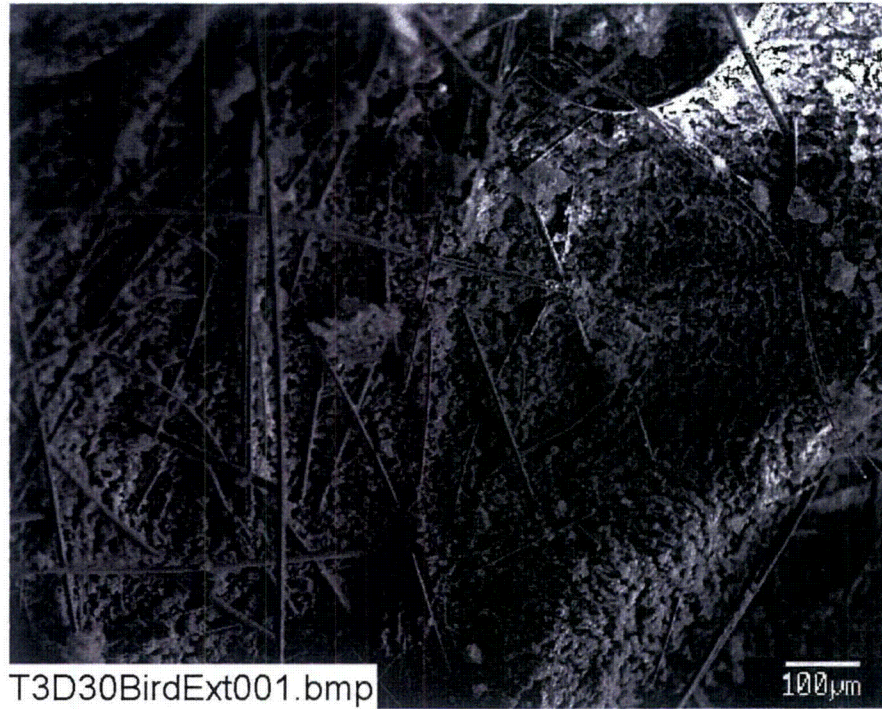


Figure C4-1. SEM image magnified 100 times for a Test #3, Day-30 exterior fiberglass sample within a birdcage. (T3D30BirdExt001)



Figure C4-2. SEM image magnified 550 times for a Test #3, Day-30 exterior fiberglass sample within a birdcage. (T3D30BirdExt002)



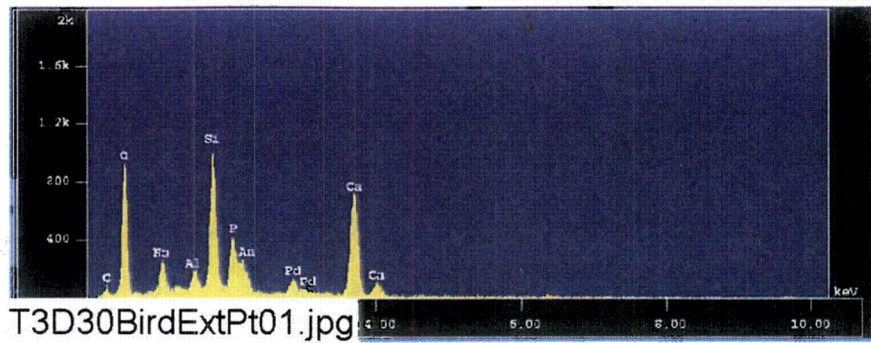


Figure C4-3. EDS counting spectrum for the large masses of particulate deposits shown in Figure C4-2. (T3D30BirdExtPt01)

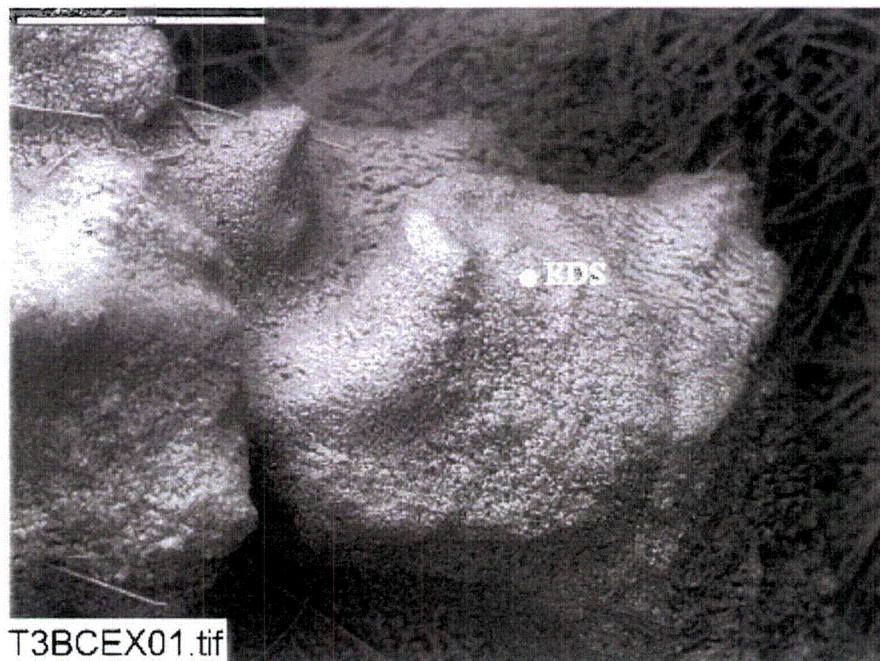


Figure C4-4. ESEM image magnified 80 times for a Test #3, Day-30 exterior fiberglass sample within a birdcage. (T3BCEX01)

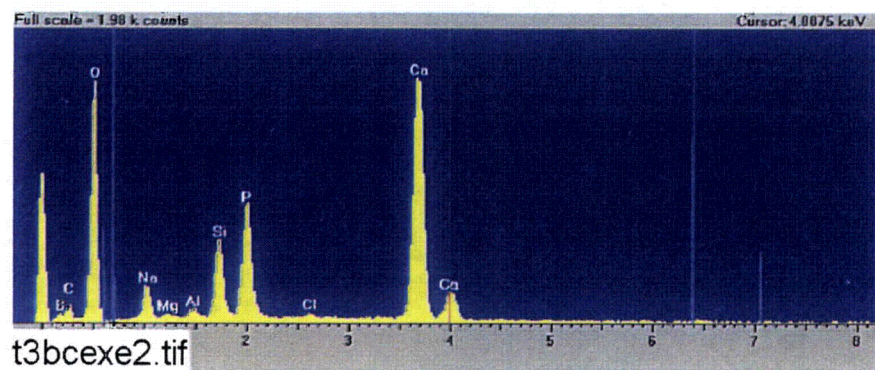


Figure C4-5. EDS counting spectrum for the the large deposits shown in Figure C4-4. (t3bcexe2)



Figure C4-6. ESEM image magnified 80 times for a Test #3, Day-30 exterior fiberglass sample within a birdcage. (t3bcex02)



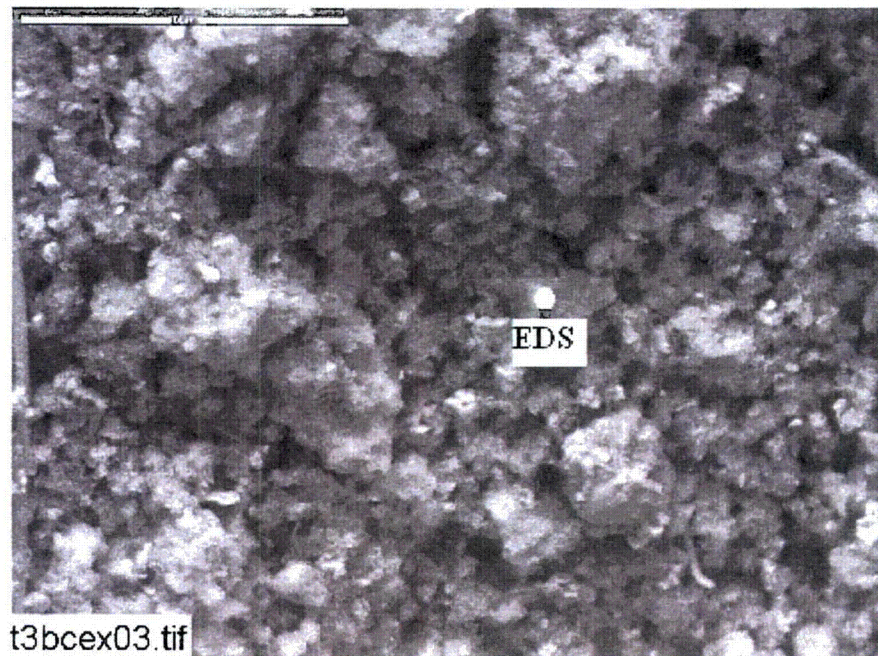


Figure C4-7. ESEM image magnified 500 times for a Test #3, Day-30 exterior fiberglass sample within a birdcage. (t3bcex03)

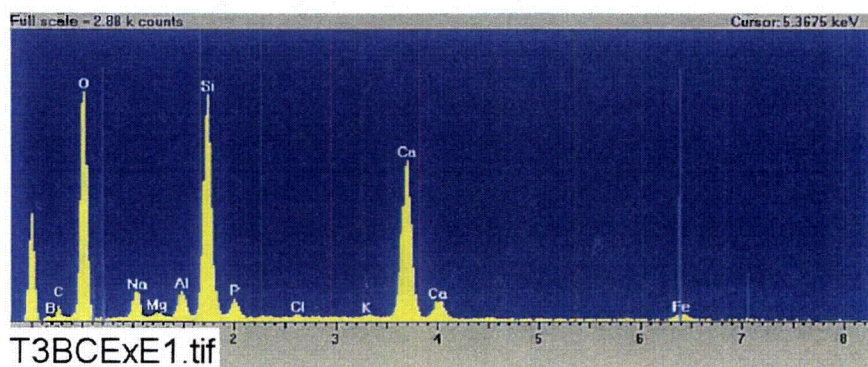


Figure C4-8. EDS counting spectrum for the deposits shown in Figure C4-7. (T3BCExE1)



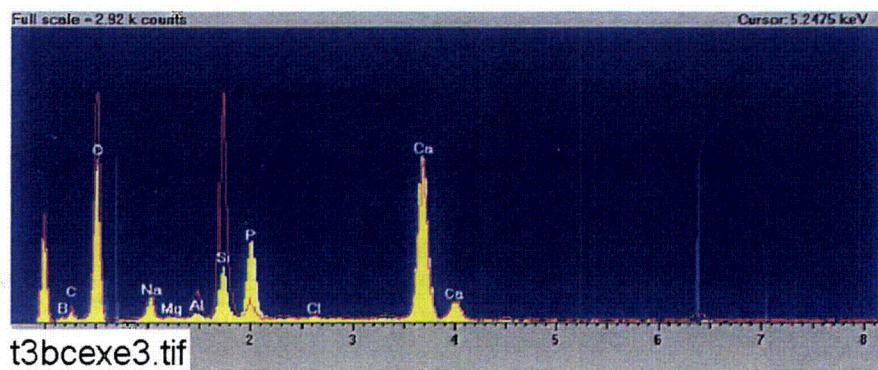


Figure C4-9. Comparison of EDS counting spectra of Figure C4-5 (yellow) and Figure C4-8 (red). (t3bcexe3)

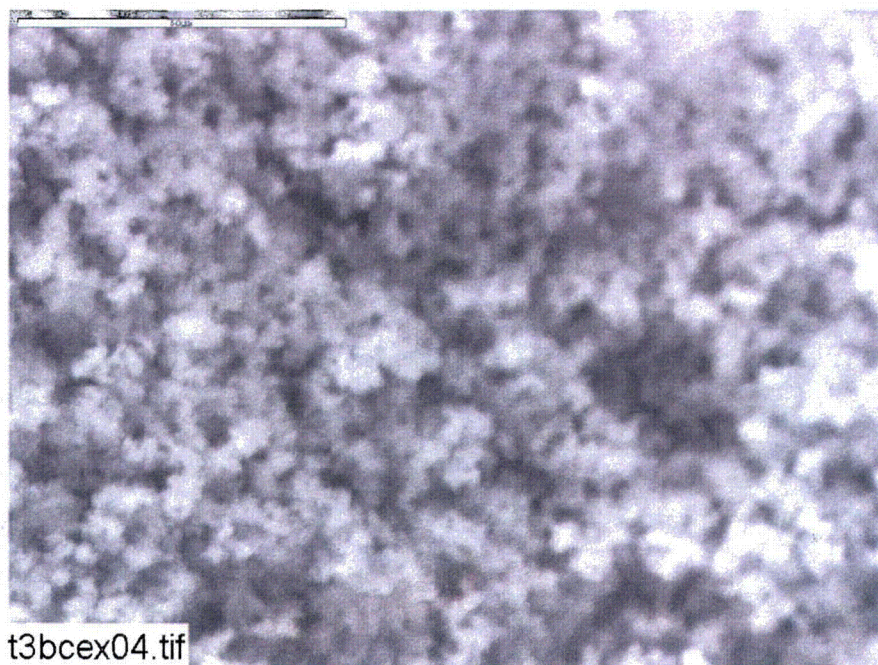
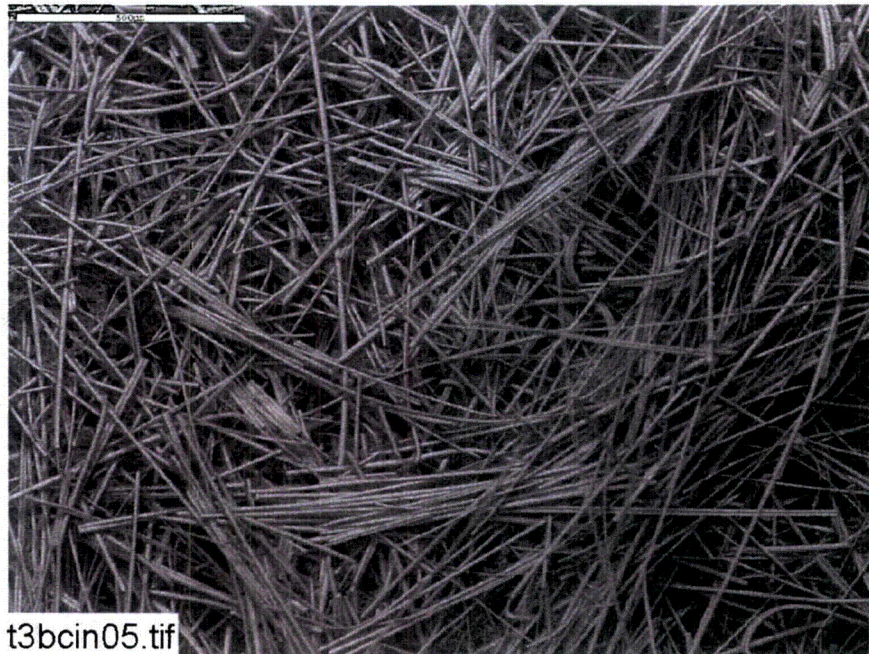
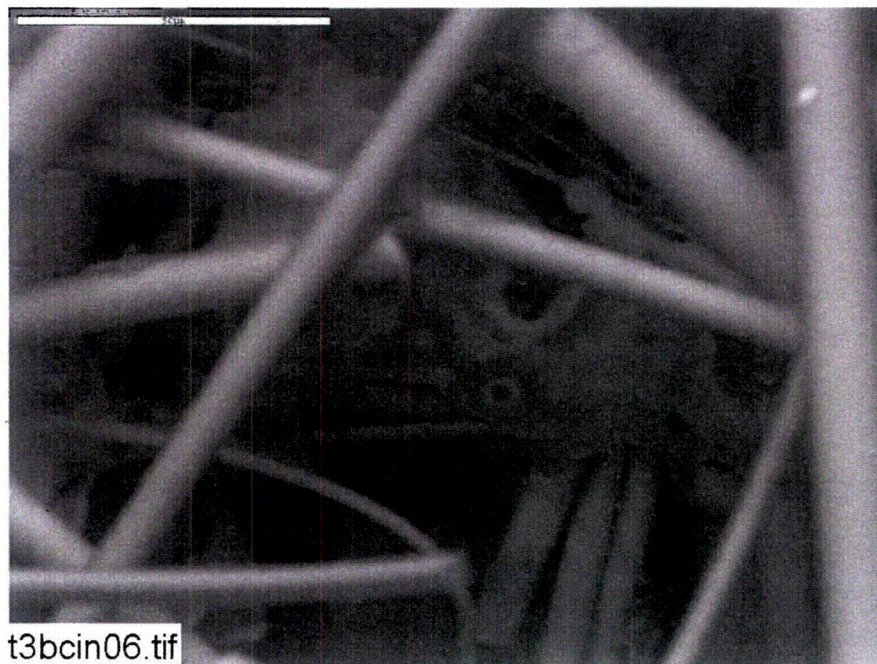


Figure C4-10. ESEM image magnified 1000 times for a Test #3, Day-30 exterior fiberglass sample within a birdcage. (t3bcex04)

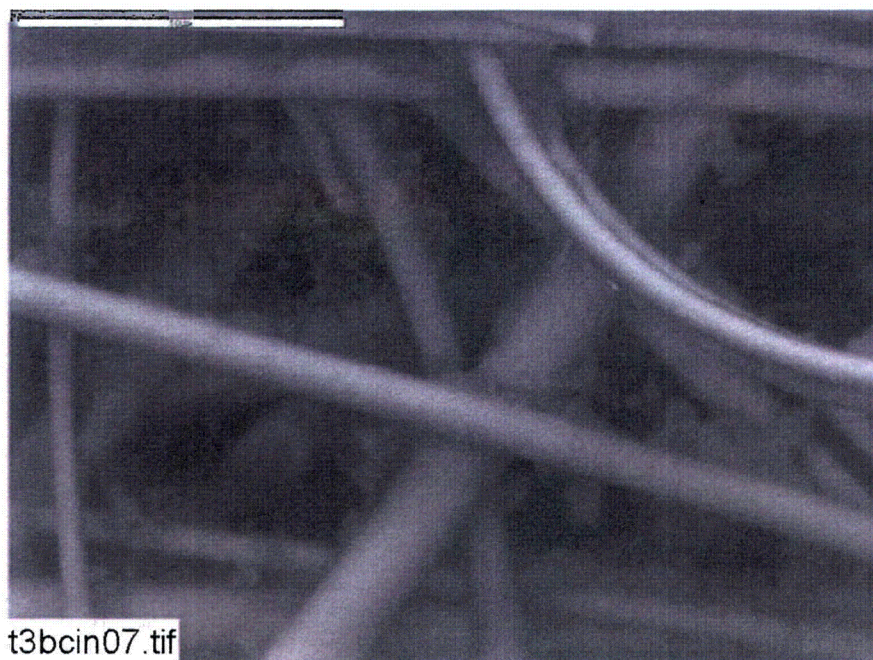




**Figure C4-11.** ESEM image magnified 80 times for a Test #3, Day-30 interior fiberglass sample within a birdcage. (t3bcin05)



**Figure C4-12.** ESEM image magnified 950 times for a Test #3, Day-30 interior fiberglass sample within a birdcage. (t3bcin06)



**Figure C4-13. ESEM image magnified 1000 times for a Test #3, Day-30 interior fiberglass sample within a birdcage. (t3bcin07)**



## Appendix D

### ESEM and SEM/EDS Data for Test #3, Day-30 Corrosion Products

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For ICET tests, one process of interest is the corrosion effect of metal and concrete coupons. One means of understanding the corrosion process is through direct examination of the corrosion products after the test is completed. For this purpose, corrosion products were collected when Test #3 was shut down (May 5, 2005). These corrosion products included (1) fine powders on a vertical piece of the submerged CPVC rack, (2) corrosion products on a submerged galvanized steel coupon, (3) corrosion products on a submerged copper coupon, (4) corrosion products on a submerged aluminum coupon, and (5) corrosion products on a submerged concrete coupon.

Corrosion products were collected by directly adhering the sample onto double-sided carbon tape suitable for SEM/EDS examination. After the samples were dried in air, an Au/Pd coating was applied to enhance the surface conductivity of the samples and to prevent possible charging problems during the SEM examination process. Based on EDS results, a semi-quantitative elemental analysis was performed after calibration of the x-ray signal using an internal standard of the microscopy. This appendix presents the SEM/EDS data that were generated on May 17, 2005. Available logbook entries for this laboratory session are included in this appendix as transcribed notes.

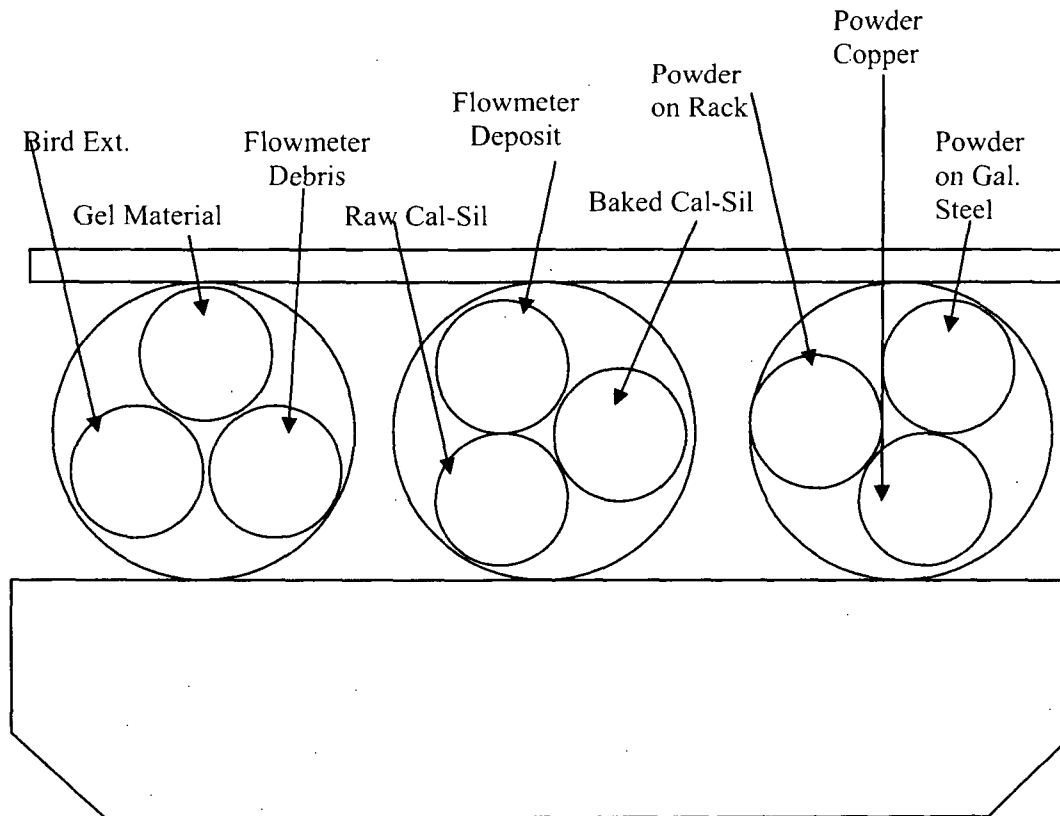




## Transcribed Laboratory Log

Laboratory session from May 9, 2005.

Test #3, Day-30 Powder Deposits



### Powder on Rack

Image: T3~RackPowder013 200 ×

Figure D-1

EDS: T3RackPowder09

Powder on image 013

Figure D-2

## Powder on Galvanized Steel

Image: T3~Gal~Steel~Powder014 500 ×

Figure D-3

EDS: CorPdct~GalStel10

White powder on image 014

Figure D-4

CorPrdct~GalSteel11

Dark powder on image 014 Figure D-5

## Powder on Copper

Image: T3~Copper~Powder015 500 ×

Figure D-6

EDS: CorPrdct\_cul2

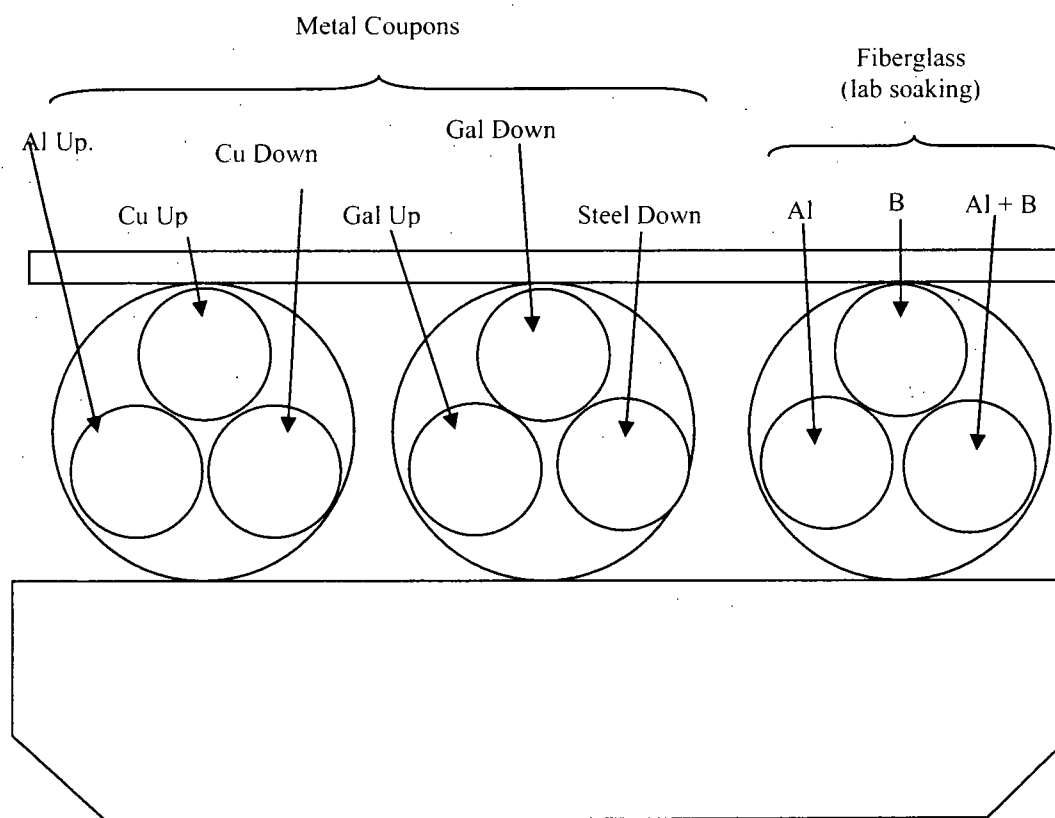
Powder on image 015

Figure D-7

## Transcribed Laboratory Log

Laboratory session from May 17, 2005.

Test #3, Day-30 Metal Coupons



\*\*Coat with Gold

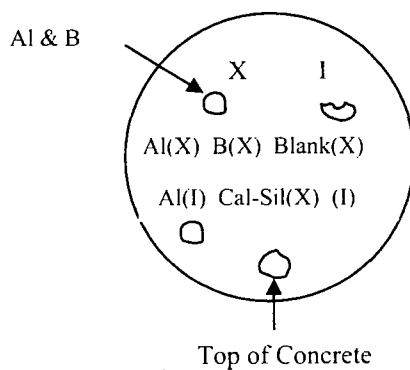


## Corrosion Product on Submerged Aluminum

Image:	T3D30CorrPrdctSubmAl039	100 ×		Figure D-8
	T3D30CorrPrdctSubmAl040	100 ×	Backscattering	Figure D-9
EDS:	T3D30CorrPrdtAl22		Particles on image 040	Figure D-10
Image:	T3D30CorrPrdctSubmAl041	1000 ×		Figure D-11

## Transcribed Laboratory Log

Laboratory session from May 10, 2005.  
 Test #3, Day-30 ESEM.



## Deposits on the Top of Concrete

Image:	T3Cont28	1000 ×		Figure D-12
	t3cont29	100 ×		Figure D-13
EDS:	t3cont30		Particles on image 29	Figure D-14

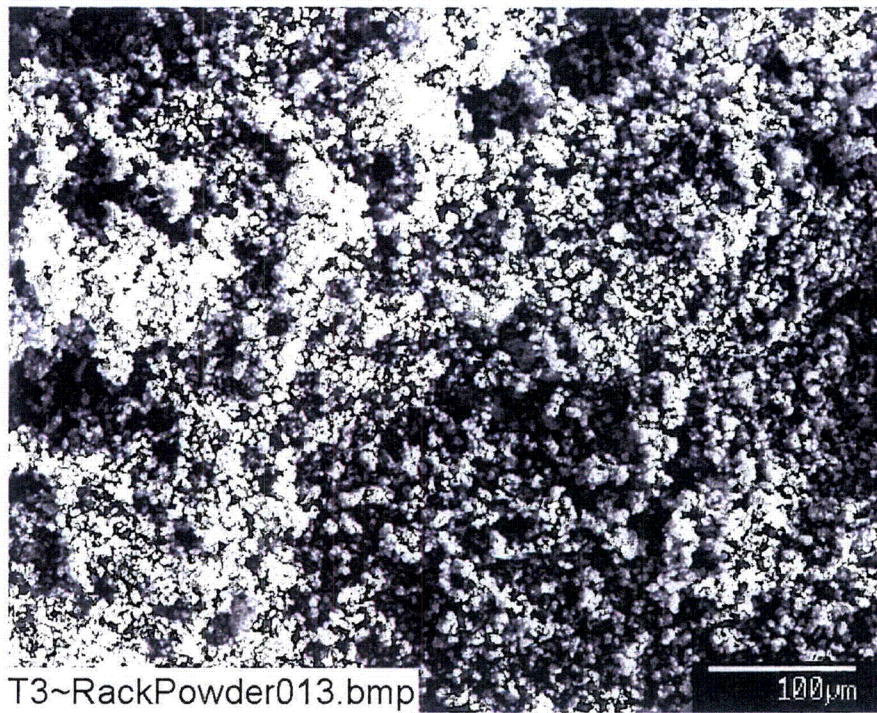


Figure D-1. SEM image magnified 200 times for a Test #3, Day-30 powder on the submerged rack. (T3~RackPowder013)

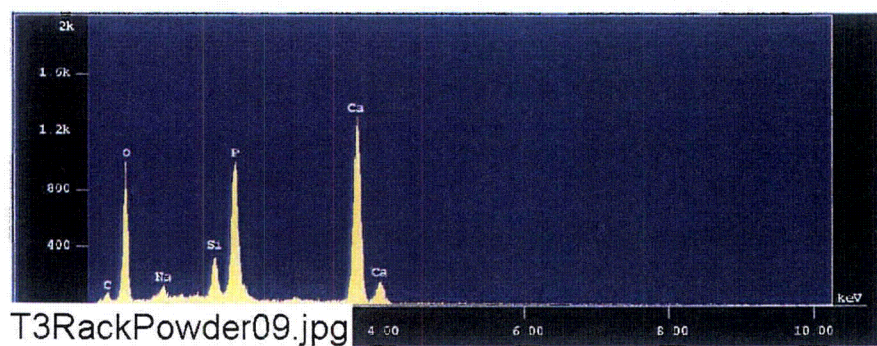


Figure D-2. EDS counting spectrum for the powder on the submerged rack shown in Figure D-1. (T3RackPowder09)

The results from the chemical composition analysis for T3RackPowder09 are given in Table D-1.

**Table D-1. Chemical Compositions for T3RackPowder09, Figure D-2**

May 9 2005

Group : NRC  
Sample : T3D30 ID# : 9  
Comment : Powder on submerged Rack  
Condition : Full Scale : 20KeV(10eV/ch,2Kch)  
Live Time : 60.000 sec Aperture # : 1  
Acc. Volt : 15.0 KV Probe Current : 1.608E-09 A  
Stage Point : X=23.811 Y=58.398 Z= 9.938  
Acq. Date : Mon May 9 15:02:46 2005

Element	Mode	ROI(KeV)	K-ratio(%)	+/-	Net/Background
O K	Normal	0.25- 0.77	16.4417	0.0037	6188 / 66
Na K	Normal	0.81- 1.27	0.4147	0.0011	448 / 64
Si K	Normal	1.50- 2.05	1.8593	0.0006	2708 / 288
P K	Normal	1.75- 2.38	10.0274	0.0058	9012 / 160
Ca K	Normal	3.39- 4.30	22.3191	0.0043	15798 / 22
C K	Normal	0.09- 0.46	0.0345	0.0005	19 / 166

-----  
Chi\_square = 55.4587

Element	Mass%	Atomic%	ZAF	Z	A	F
O	48.147	67.3988	1.8951	0.9734	1.9469	1.0000
Na	0.977	0.9516	1.5243	1.0269	1.4843	1.0000
Si	3.302	2.6332	1.1493	0.9767	1.1837	0.9941
P	13.197	9.5423	0.8517	1.1722	0.7283	0.9977
Ca	34.174	19.0962	0.9909	0.9956	0.9953	1.0000
C	0.203	0.3778	3.7963	1.0208	3.7192	0.9999

-----  
Total 100.000 100.0000  
Normalization factor = 1.5452  
Total 100.000 100.0000  
Normalization factor = 2.1120



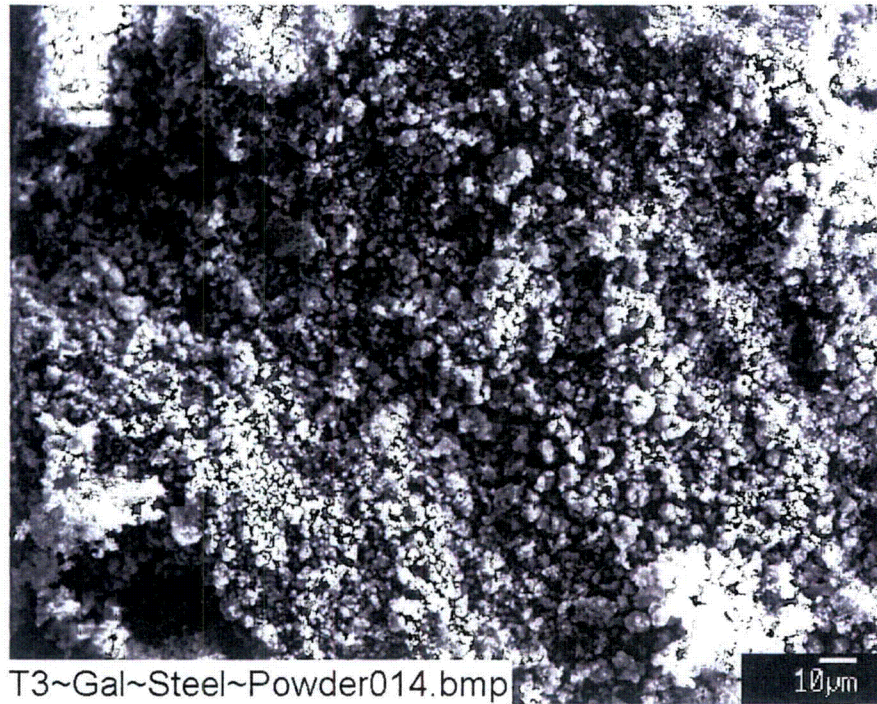


Figure D-3. SEM image magnified 500 times for a Test #3, Day-30 powder on a submerged galvanized steel coupon. (T3~Gal~Steel~Powder014)

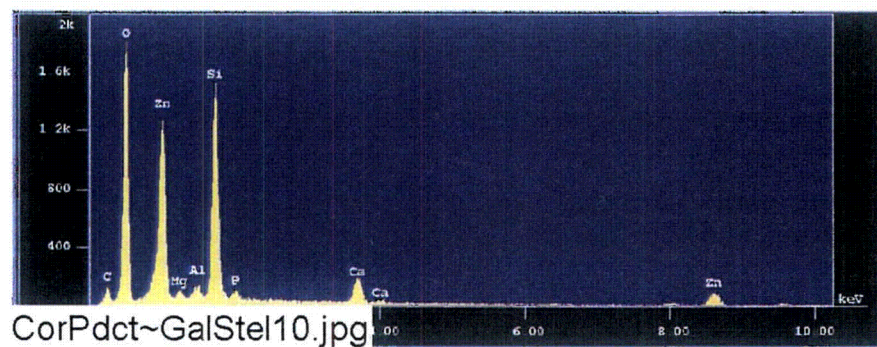


Figure D-4. EDS counting spectrum for the white powder on galvanized steel shown in Figure D-3. (CorPdct~GalStel10)

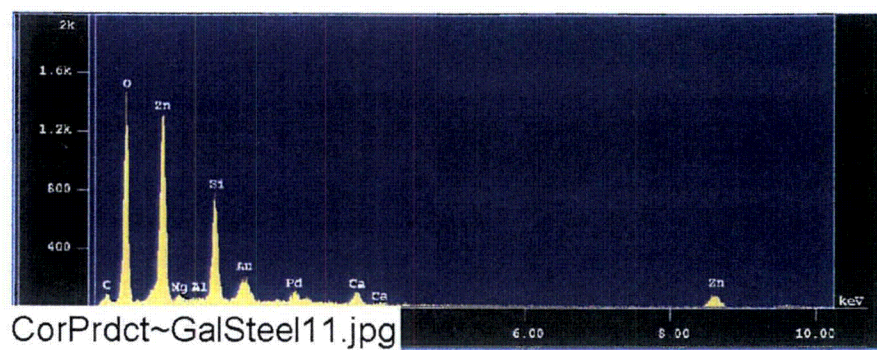


Figure D-5. EDS counting spectrum for the dark powder on galvanized steel shown in Figure D-3. (CorPrdct~GalSteel11)

The results from the chemical composition analysis for CorPrdct~GalSteel11 are given in Table D-2.

**Table D-2. Chemical Compositions for CorPrdct~GalSteel11, Figure D-5**

May 9 2005

Group : NRC  
Sample : T3D30 ID# : 11  
Comment : Corrosion product of Gal-Steel  
Condition : Full Scale : 20KeV(10eV/ch,2Kch)  
Live Time : 60.000 sec Aperture # : 1  
Acc. Volt : 15.0 KV Probe Current : 1.608E-09 A  
Stage Point : X=12.508 Y=58.337 Z= 9.938  
Acq. Date : Mon May 9 15:23:47 2005

Element	Mode	ROI(KeV)	K-ratio(%)	+/-	Net/Background
O K	Normal	0.25- 0.77	24.6017	0.0044	9259 / 71
Mg K	Normal	0.97- 1.57	0.1342	0.0003	211 / 424
Si K	Normal	1.50- 2.05	4.3383	0.0008	6318 / 94
Ca K	Normal	3.39- 4.30	1.4823	0.0016	1049 / 28
Zn K	Normal	8.22-10.03	13.8053	0.0096	1501 / 6
Al K	Normal	1.19- 1.83	0.1257	0.0003	196 / 77
C K	Normal	0.09- 0.46	0.0000	0.0000	0 / 254

Chi\_square = 39.1864

Element	Mass%	Atomic%	ZAF	Z	A	F
O	47.383	72.4077	0.9119	0.9354	0.9750	1.0000
Mg	0.655	0.6591	2.3126	0.9284	2.4928	0.9993
Si	13.143	11.4404	1.4344	0.9377	1.5298	0.9999
Ca	3.059	1.8657	0.9770	0.9542	1.0247	0.9991
Zn	35.285	13.1966	1.2102	1.2129	0.9978	1.0000
Al	0.475	0.4304	1.7897	0.9594	1.8692	0.9979
C	0.000	0.0000	5.2279	0.9811	5.3287	1.0000

Total 100.000 100.0000  
Normalization factor = 2.1120



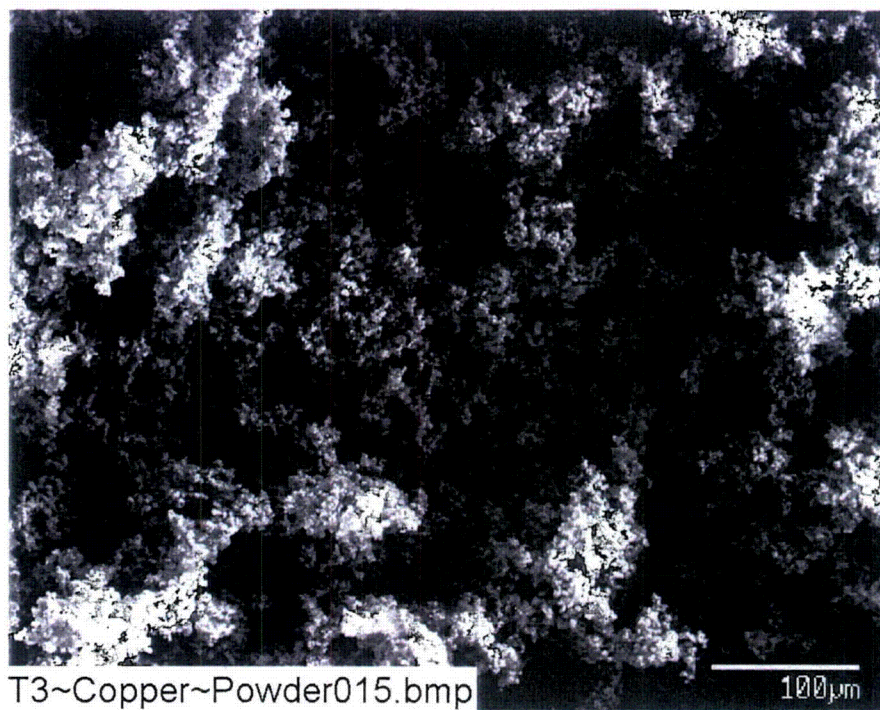


Figure D-6. SEM image magnified 500 times for a Test #3, Day-30 powder on a submerged copper coupon. (T3~Copper~Powder015)

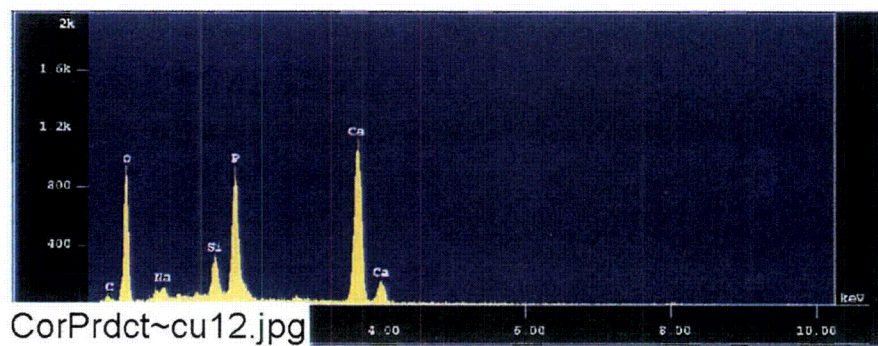


Figure D-7. EDS counting spectrum for the powder on copper shown in Figure D-6. (CorPrdct~cu12)

The results from the chemical composition analysis for CorPrdct~cu12 are given in Table D-3.

Table D-3. Chemical Compositions for CorPrdct~cu12, Figure D-7

May 9 2005

Group : NRC  
Sample : T3D30 ID# : 112  
Comment : Corrosion product of Copper  
Condition : Full Scale : 20KeV(10eV/ch,2Kch)  
Live Time : 60.000 sec Aperture # : 1  
Acc. Volt : 15.0 KV Probe Current : 1.609E-09 A  
Stage Point : X=17.909 Y=70.722 Z= 9.938  
Acq. Date : Mon May 9 15:34:51 2005

Element	Mode	ROI (KeV)	K-ratio(%)	+/-	Net/Background
O K	Normal	0.25- 0.77	16.9583	0.0036	6386 / 54
Na K	Normal	0.81- 1.27	0.3712	0.0011	402 / 46
Si K	Normal	1.50- 2.05	1.7009	0.0006	2479 / 254
P K	Normal	1.75- 2.38	8.6109	0.0054	7744 / 164
Ca K	Normal	3.39- 4.30	19.7450	0.0040	13984 / 28
C K	Normal	0.09- 0.46	0.0000	0.0000	0 / 156

Chi\_square = 59.8005

Element	Mass%	Atomic%	ZAF	Z	A	F
O	51.054	70.0693	1.8119	0.9751	1.8582	1.0000
Na	0.947	0.9045	1.5353	1.0287	1.4923	1.0000
Si	3.260	2.5484	1.1533	0.9785	1.1852	0.9945
P	12.216	8.6603	0.8538	1.1744	0.7286	0.9978
Ca	32.523	17.8176	0.9913	0.9976	0.9936	1.0000
C	0.000	0.0000	3.6900	1.0225	3.6090	0.9999

Total 100.000 100.0000

Normalization factor = 1.6616

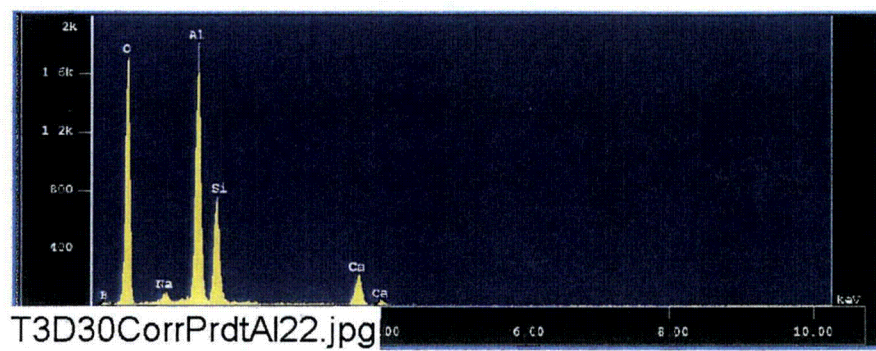


**Figure D-8.** SEM image magnified 100 times for Test #3, Day-30 corrosion products on a submerged aluminum coupon. (T3D30CorrPrdctSubmAl039)



**Figure D-9.** Backscattered SEM image magnified 100 times for Test #3, Day-30 corrosion products on a submerged aluminum coupon. (T3D30CorrPrdct SubmAl040)





**Figure D-10.** EDS counting spectrum for the corrosion products (particles) shown in Figure D-9. (T3D30CorrPrdtAl22)

The results from the chemical composition analysis for T3D30CorrPrdtAl22 are given in Table D-4.

**Table D-4. Chemical Compositions for T3D30CorrPrdtAl22, Figure D-10**

May 17 2005

Group : NRC  
Sample : T3D30 ID# : 25  
Comment : Corr Prodct on Submerged Al  
Condition : Full Scale : 20KeV(10eV/ch,2Kch)  
Live Time : 60.000 sec Aperture # : 2  
Acc. Volt : 15.0 KV Probe Current : 7.686E-09 A  
Stage Point : X=17.100 Y=58.819 Z=11.000  
Acq. Date : Tue May 17 16:07:30 2005

Element	Mode	ROI(KeV)	K-ratio(%)	+/-	Net/Background
O K	Normal	0.25- 0.77	43.5604	0.0044	10399 / 29
Na K	Normal	0.81- 1.27	0.7246	0.0010	497 / 45
Al K	Normal	1.26- 1.78	15.1592	0.0021	15016 / 184
Si K	Normal	1.50- 2.05	6.6963	0.0008	6185 / 674
Ca K	Normal	3.40- 4.30	4.2145	0.0082	1892 / 14
B K	Normal	0.00- 0.36	0.6943	0.0002	69 / 10

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Chi\_square = 107.5732

Element	Mass%	Atomic%	ZAF	Z	A	F
O	52.728	58.8383	1.0170	0.9767	1.0413	1.0000
Na	1.120	0.8699	1.2989	1.0311	1.2612	0.9988
Al	19.542	12.9304	1.0831	0.9932	1.0934	0.9974
Si	10.480	6.6618	1.3149	0.9816	1.3397	0.9999
Ca	4.923	2.1928	0.9814	0.9916	0.9896	1.0001
B	11.207	18.5068	13.5610	1.1342	11.9568	1.0000

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Total 100.000 100.0000

Normalization factor = 1.1902

re	2.399	1.5375	0.9896	1.0503	1.0060	0.9366
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Total 100.000 100.0000

Normalization factor = 3.2486



Figure D-11. SEM image magnified 1000 times for Test #3, Day-30 corrosion products on a submerged aluminum coupon. (T3D30CorrPrdctSubmAl041)

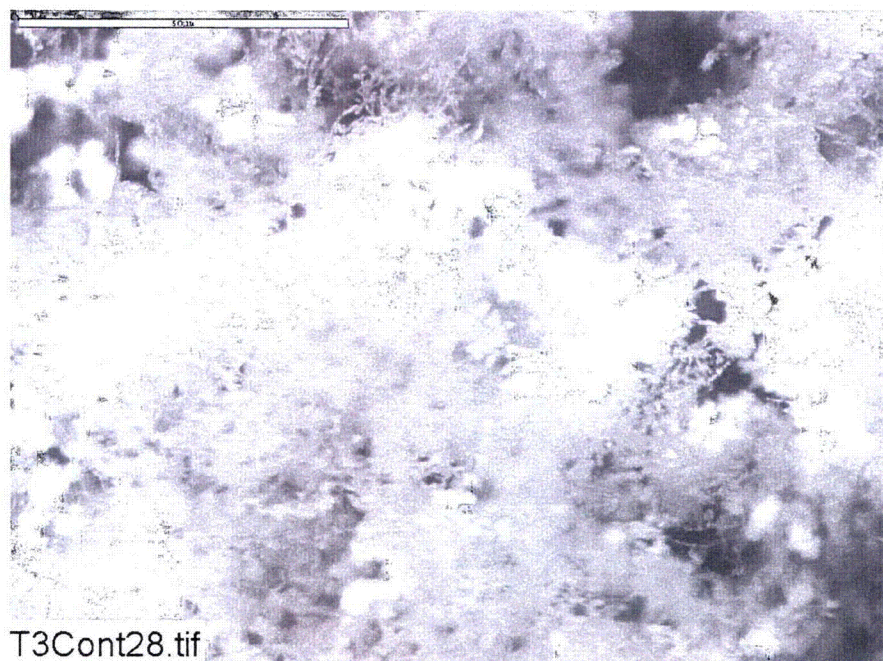


Figure D-12. ESEM image magnified 1000 times for Test #3, Day-30 corrosion products on a submerged concrete coupon. (T3cont28)



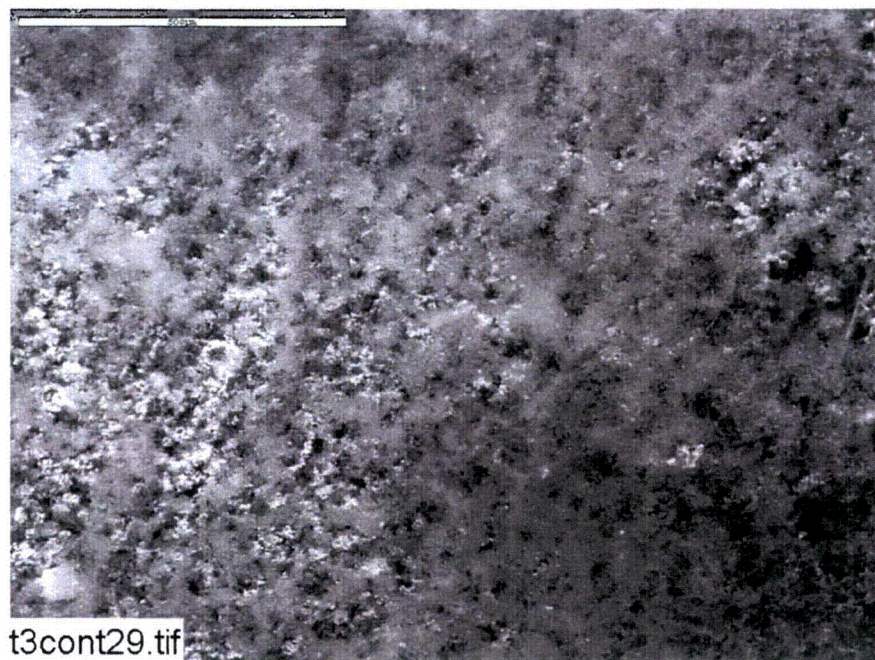


Figure D-13. ESEM image magnified 100 times for Test #3, Day-30 corrosion products on a submerged concrete coupon. (t3cont29)

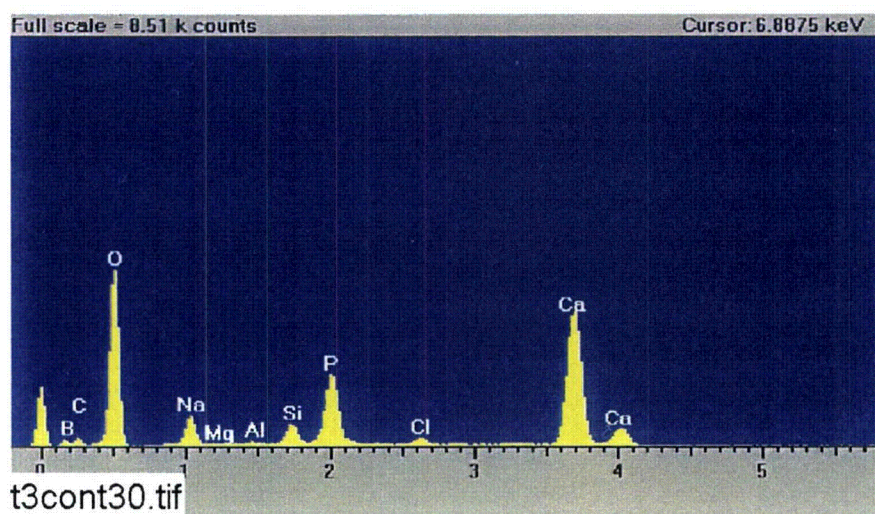


Figure D-14. EDS counting spectrum for the corrosion products (particles) shown in Figure D-13. (t3cont30)

