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RICHMOND, VIRGINIA
FIBERS DEPARTMENT
SPRUANCE "TEFLON" TECHNICAL
E. I. DU PONT DE NEMOURS & CO., INC.
COMPANY CONFIDENTIAL

TECHNICAL REPORT

PERFLUORO OCTANOIC ACID CONCENTRATION (C8) IN WASTE WATER

J. C. Moore

REPORT WRITTEN BY: J. C. Moore

WORK SUPERVISED BY: JAMES L. SIBLEY

PREVIOUS RELATED REPORTS: SPAR 79-3, SPAR 82-1, TR 82-1

PROJECT CODE: N/A

PERIOD COVERED: 9/91 - 12/91

NOTEBOOKS COVERED: N/A

ABSTRACT

The company has set a CEG (Community Exposure Guideline) of 1 ppb in water for ammonium pefluoro octanoate (C8), a surfactant in the Teflon* dispersion used to produce Teflon* Fiber. A conservative position of assuming all C8 ends up in the James River would produce an average concentration of 0.1 ppb. The only time the CEG could be exceeded would be during periods of extreme low flows in the river.

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1. INTRODUCTION

Teflon* colloidal dispersion is mixed with viscose in the manufacture of Teflon* fiber. The cellulose contained in the viscose is regenerated in the coagulation/acid bath in spinning. The regenerated cellulose acts as a matrix to bind Teflon* particles prior to sintering. Surfactants are used in the manufacture of colloidal Teflon* dispersions to prevent conglomeration of particles. One of the surfactants used is F-143, ammonium perfluoro octanoate (commonly referred to as C8).

2. DISCUSSION

A. EARLIER ISSUES

In 1978, the 3M Company notified DuPont that C8 used in Teflon* polymerization may be teratogenic. Airborne dust or vapors were felt to be the source of the exposure. Several technical projects(Reports SpAR 79-3, SpAR 82-1 & TR 82-1) were initiated to study the potential exposure to C8 by DuPont employees. C8 was not detected in the work place air environment. The handling of coated packing yarns or direct contact with Teflon* dispersion were the only potential areas that personnel can be exposed to significant levels of C8 (Ref. 4). Tests at Haskell Lab showed no transfer of C8 from yarns to rabbit skin and suggested C8 exposure of persons handling dry yarn is minimal (Ref. 5). C8 was later determined not to be teratogenic by 3M and DuPont's Haskell Labs.

B. TEFLON* DISPERSION

Teflon* dispersion is produced in a batch operation at Washington Works. C8 which is the ammonium salt of perfluoro octanoic acid is used as a wetting agent to prevent conglomeration of the Teflon* particles. A batch of dispersion is initially about 7000 lbs which contains 3000 lbs of Teflon* monomer. A total of 4060 grams of C8 is added to the batch in the precharge and injection steps. After polymerization is completed, the dispersion is decanted to obtain 60% solids. Washington Works estimates that 50% of the C8 is removed with the decanted superannuate and the other 50% goes with the concentrated dispersion. On a Teflon* solids basis, the C8 concentration would be 1490 ppm, and 900 ppm on a dispersion basis.

The Teflon* dispersion (T 3311) used for fiber production is pH adjusted with sodium hydroxide which changes the C8 from an ammonium salt to a sodium salt. In the coagulating/acid bath used in Teflon* fiber spinning, the C8 will convert to the acid form, perfluoro octanoic acid.

2. DISCUSSION CONT'D

C. PREVIOUS CONCERNS

Previous research examined employee potential exposure to C8 through handling of yarn. Sintered Teflon* yarn had non-detectable levels of C8 (Ref. 4). The Teflon* fiber sintering temperature is 325 C.

The boiling point of perfluoro octanoic acid is 188 C. Yarns with a Teflon* coating, which are not exposed to high temperatures did contain detectable levels of C8. Thermal treatment of these yarns was effective in removing the C8. The research showed that the C8 removal was a function of time and temperature (Table 1),(Ref. 2). IR scans of off gas from the heated yarn samples provided the basis for the conclusion that the C8 decarboxylates into CO2 and perfluoro monohydride and does not evaporate as it is heated up to 200 C (Ref. 4).

The data follows the kinetic "rule of thumb" that increasing the temperature 10 C produces a doubling of the rate. Extrapolating this relationship up to the sintering temperature of Teflon* predicts that all the C8 is removed from the fiber.

D. PRESENT ENVIRONMENTAL CONCERNS

The present environmental concerns with C8 are with ground water contamination. A CEG(Community Exposure Guidelines) of 1 ppb in water has been established by Haskell Labs.

Samples of effluent from different spots in the Teflon* spinning process were taken to estimate the concentration of C8 in the site's waste streams. Sample locations are listed in Appendix I. CH2M Hill was contracted to analyze the samples. A summary of their results are in Appendix I. A complete report from CH2M Hill is contained in Appendix II. The sample results do not allow for a complete mass balance. The measured concentrations in the effluent streams only accounts for about 50% of the C8,(Fig. 1 & 2). There are several possible explanations, the initial C8 concentration is 750 ppm on a dry Teflon* basis, the C8 chemically reacts, it is encased in the yarn, it decomposes, evaporates or the reported levels are in error low. The lower initial C8 concentration is not likely because of independent analysis done by Washington Work and Spruance have measured the concentration at about 1000 ppm on a dispersion basis. The C8 will change to perfluoro octanoic acid in the bath which should not react with the normal contents of the Teflon* spinning acid bath. There is no reasonable way to prove the idea of C8 being encased in the yarn.

2. DISCUSSION CONT'D

D. PRESENT ENVIRONMENTAL CONCERNS CONT'D

Previous work measured C8 on unsinterred Teflon* yarn at 60 ppm (Ref. 4). The concentration would need to be 700 ppm to account for the missing C8. The previous work concluded that the C8 carried with the unsinterred Teflon* yarn would decompose during the sinterring process. This is in contradiction to Washington Works process of recovering C8 from their "fine powder" exhaust stream.

"Fine powder" Teflon* has been tested and found to contain little or no C8. The "fine powders" are dried at 190 C. Washington Works recovery of C8 from the "fine powders" exhaust contradicts the previous conclusion about decarboxylation versus evaporation. If C8 evaporates off the yarn in the fiber spinning process, it should condensed in the spinning exhaust system. To reduce the potential for a duct fire, water is sprayed in the exhaust hood to reduce the temperature down below 65 C. The exhaust gas then passes through a wet scrubber and the final gas temperature is basically reduced to ambient conditions. The water drained from the exhaust hood and the scrubber go into the Teflon* basement east floor trench. If all of the C8 eventually ends up in the sewer, this would lead to the conclusion that the analysis from CH2M Hill are low.

CH2M Hill ran surrogates on three samples. Surrogate recoveries were not determined on the high concentrated samples due to the large dilution required for analysis. Surrogates were run on the discharge from the exhaust scrubber and two distilled water samples, one sent by Spruance and one from CH2M Hill's lab. The exhaust scrubber effluent was analyzed to have 1.8 ppb of C8, and the detection of known amounts of surrogate material added was less than 50%. The explanation for the low surrogate recovery was due to the noise created by a large non-target chromatographic peak coupled with a large dilution factor. Decomposition products of cellulose that are scrubbed out of the exhaust gas are the mostly likely cause of the non-target chromatographic peak. The surrogate recoveries on the distilled water samples ran from 52% to 86%. The possibility of the analysis being low is real.

There is alot of contradicting material on the fate of C8 in the Teflon* spinning process. The belief that CH2M Hill's results are low by a factor of ~2X would tie together the majority of the material. The 60 ppm measured concentration of C8 on the yarn only accounts for ~5% of the total material. The other 95% exits the process in the wet portion of the spinning process, the washing step since the acid bath is 100% recycled. The 5% on the yarn evaporates and then condenses in the exhaust hood similar to Washington Works recovery process. Only trace amounts of C8 should reach the scrubber. The amount found in the exhaust scrubber was less than 0.02% of the total amount.

2. DISCUSSION CONT'D

D. PRESENT ENVIRONMENTAL CONCERNS CONT'D

If 95% of the C8 exits the process with the wash water, the concentration of SM #2 sample should have been 4600 ppb. CH2M Hill's measured amount of 2400 ppb is 52% of that level. This percentage is in the range of report surrogate recoveries on distilled water.

The most conservative position in estimating the potential environmental impact is to assume that all of the C8 ends up in the plant's waste effluent. This would about double all of CH2M Hill's measured concentrations (Fig 3 & 4).

During the sampling period 11/13 & 11/14/91 and estimated 1194 grams/day of C8 were discharge to the James River. The long term average(1937 to 1987) flow for the James River is 5104 MMgpd. This would make the C8 concentration in the James River an estimated 0.06 ppb.

The average annual production rate for Teflon* fibers is 1 MM lb. This would discharge 1490 lb. of C8 to the James River annually. The estimated C8 concentration in the river would be 0.10 ppb. The maximum production rate for Teflon* fibers is 4200 lb./day. This could add 6.3 lbs C8/day to the James River and produce an estimated C8 concentration of 0.15 ppb in the river.

The low flow in a 10 year repeating cycle (as defined by 7Q10) for the James River is 408 MMgpd. An average production rate during this period would produce an estimated C8 concentration in the James River of 1.20 ppb and maximum production rates would increase the concentration to 1.84 ppb. During the low flow periods, which should happen once every 10 years, production may need to be curtailed to 2300 lb./day of Teflon* fiber to stay below the CEG of 1 ppb.

REFERENCES

1. Forte, M.A. - SpAR 79-3

2. Forte, M.A., Mokhtar, A.M. - PCD Monthly, June, 1981

3. Shelburne, S.S. - PCD Monthly, December, 1981

4. Shelburne, S.S., Forte, M.A., Mokhtar, A.M. - SpAR 82-1

5. Burks, P.P., - TR 82-1

TABLE 1

THE EFFECT OF HEAT

ON EXTRACTABILITY OF

C8 FROM YARN (Ref. 2)

Initial C8 concentration on 9450 I & T yarn ~ 600 ppm

	% C8 Remaining on Yarn		
Time of Heat(minutes)	150 C	175 C	200 C
10	75	41	N/D
20	72	12	N/D
30	72	N/D	N/D
40	47	N/D	N/D

N/D Not detectable, < 5 ppm

Least Square Fit for proposed 1st Order Decarboxylation

150°C $A = A_o * e^{-0.0155t}$ (t=minutes)

175°C $A = A_o * e^{-0.106t}$ +10°C => $(0.106/0.0155)^{0.4} = 2.16$
(close to "rule of thumb" for temperature dependency of kinetic reactions, +10°C roughly doubles reaction rate)

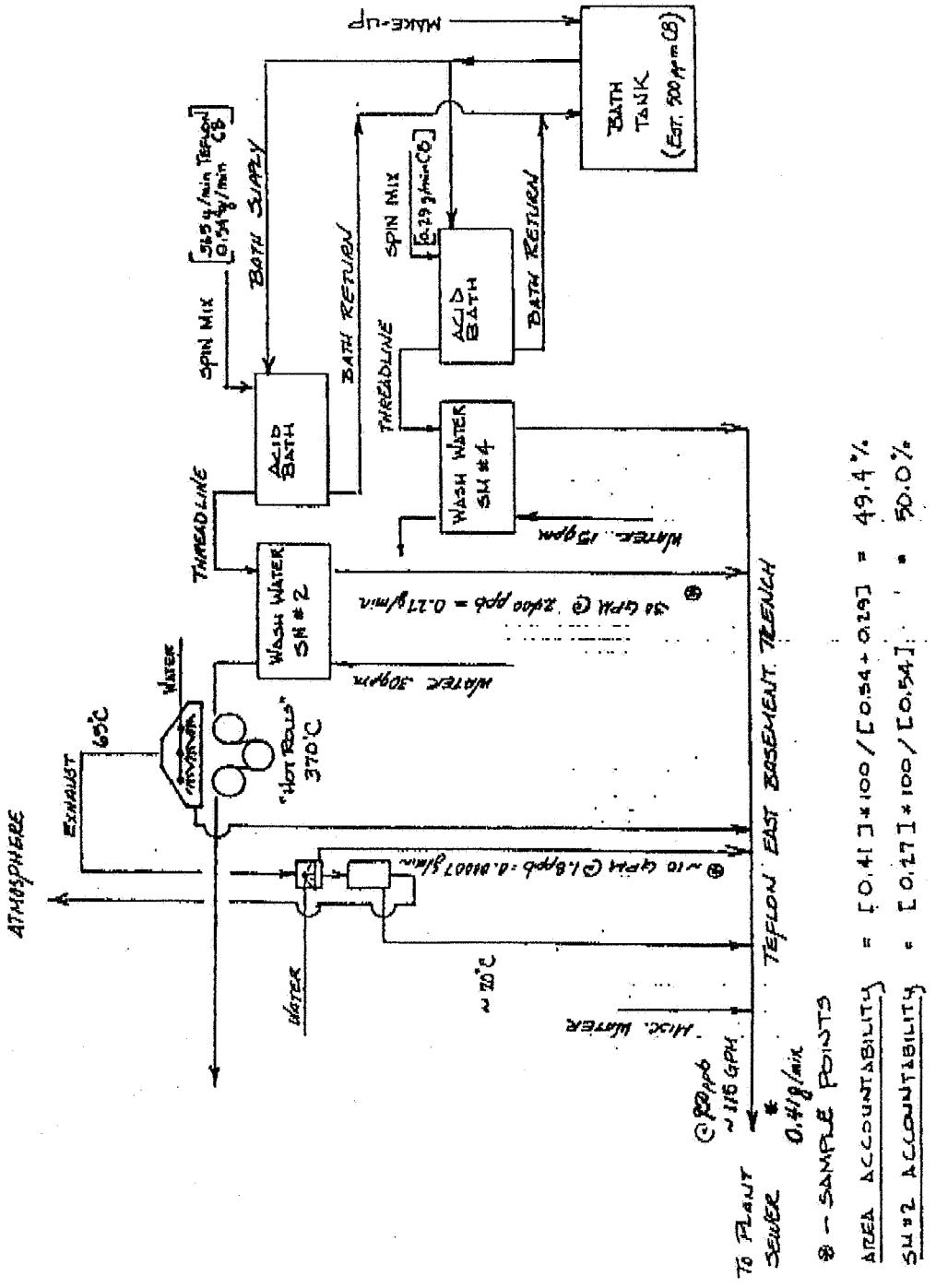
Extrapolation to 200°C using a power of 2.16 per 10°C

@200°C $A = A_o * e^{-0.725t}$
$t = 10$ min, $A_o = 600$ ppm
$A = 0.4$ ppm which is <5 ppm minimum detectable limit

FIGURE 1

MASS BALANCE OF C8 USING CH_2M HILL TEST RESULTS

TEFLON* SPINNING
NOVEMBER 13, 1991



STT-91-1 FIGURE 2 8.

MASS BALANCE OF C8 USING CH_2M HILL TEST RESULTS

SPRUANCE WASTE WATER TREATMENT SYSTEM
NOVEMBER 13, 1991

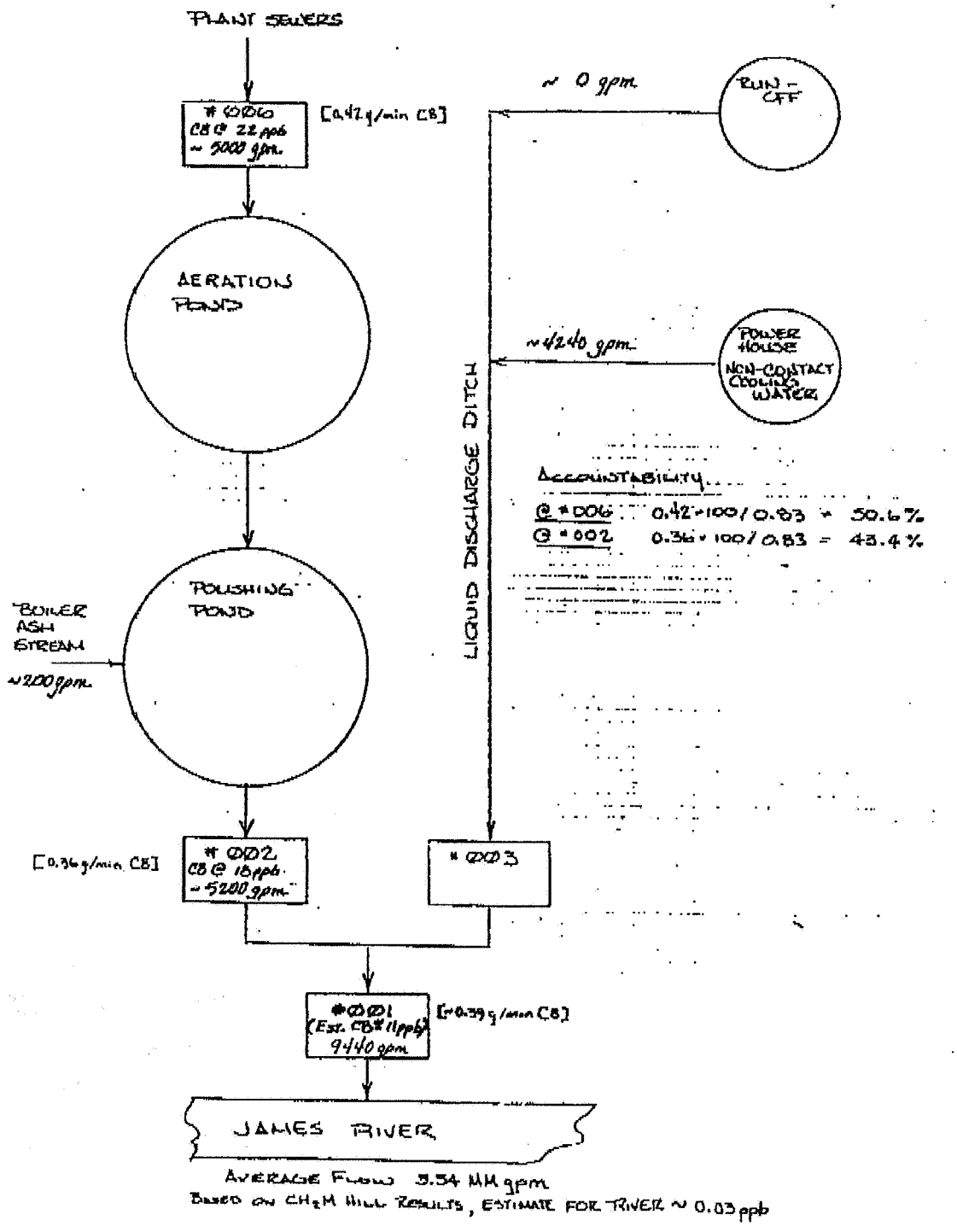


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FIGURE 3

PROPOSED MASS BALANCE OF C8 IN TEFLON* SPINNING

NOVEMBER 13, 1991

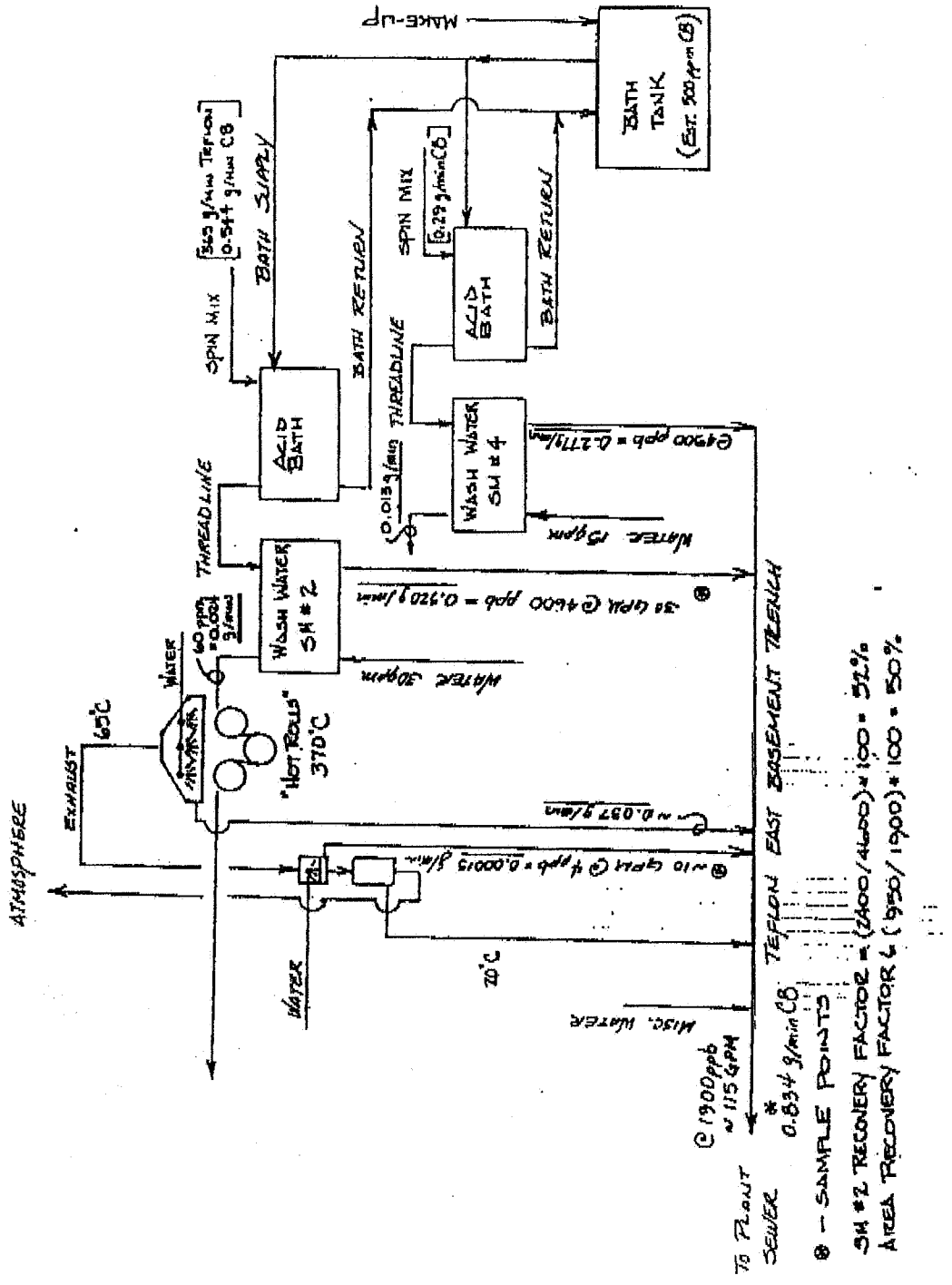
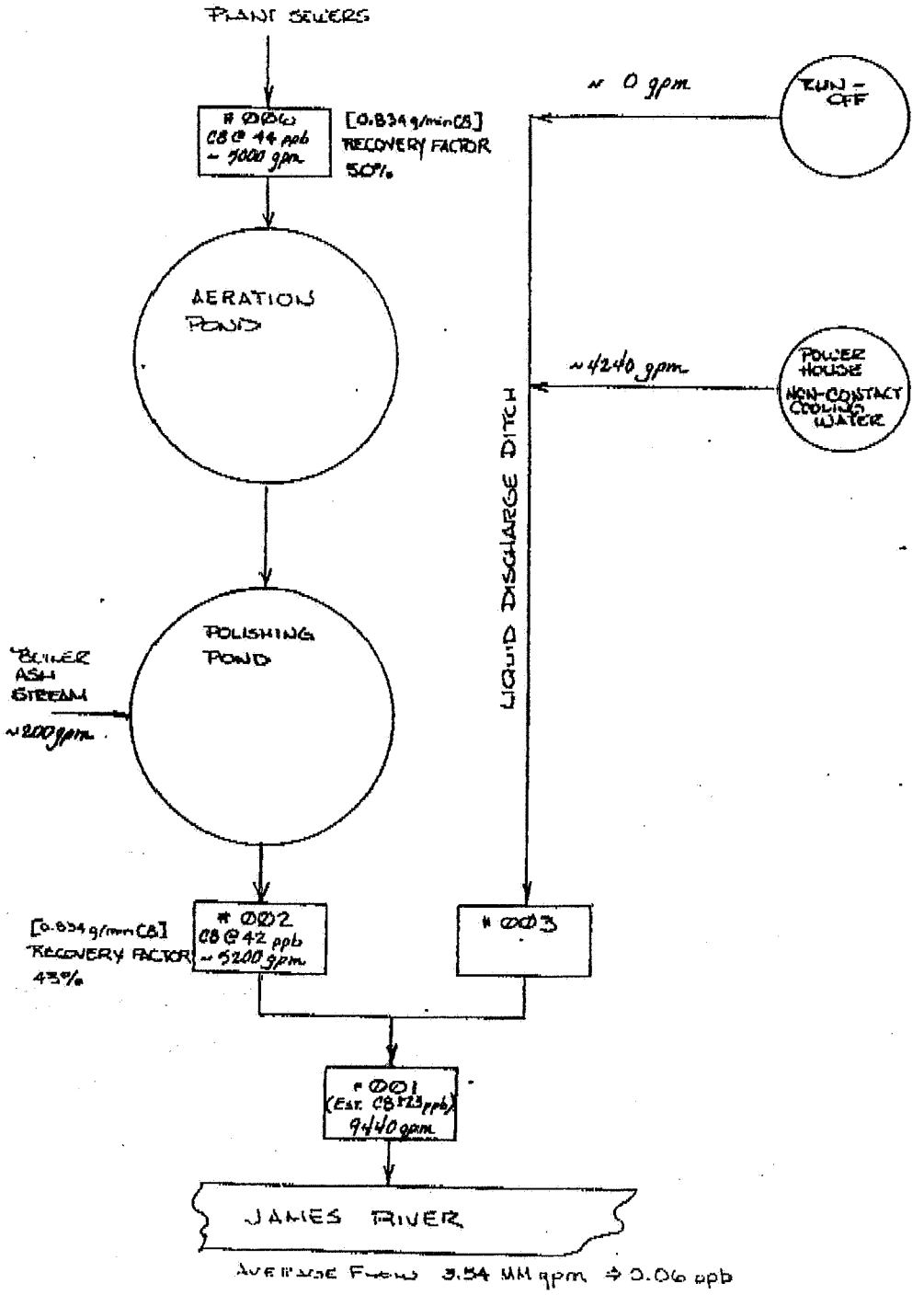


FIGURE 4

PROPOSED MASS BALANCE AROUND WASTE WATER SYSTEM

NOVEMBER 13, 1991



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11.

APPENDIX I

SPRUANCE C8 ASSESSMENT

E. I. DU PONT DE NEMOURS & CO., INC.

Fibers Business

cc: G. L. Kennedy - Haskell
G. A. Hapka - Legal
R. A. Reich- Engr. - Louviers
J. D. Chidley
R. L. Dunn
C. P. Mihal
R. C. Yeatts
D. M. Schwartz
G. R. Sisson
J. S. Tschritter

SPRUANCE FIBERS PLANT
Richmond, Virginia
December 4, 1991

TO: J. C. MOORE - TEFLON® TECHNICAL

FROM: T. V. ROBERTSON - ENVIRONMENTAL AFFAIRS

SPRUANCE C8 ASSESSMENT

As a result of our discussions of 11/1/91, Environmental Affairs has sampled various points in the Spruance Teflon® process as well as the site wastewater treatment system for ammonium perfluorooctanate (C8). The results are contained in the attached table. C8 is used as a dispersant to make PTFE at Parkersburg. PTFE is used at Spruance to make Teflon® fiber. C8 is an impurity in PTFE and, thus, is introduced into the process at Spruance. The sampling scheme employed evaluated the C8 content at the wash water discharge in the spinning operation, in the air emissions control scrubber effluent, in the area process sewer, in the site composite process sewer (inlet to wastewater treatment system), and at the discharge of the WWTS which combines with the non-contact streams discharging to the James River.

C8 content in these samples appear in line with your earlier estimates. Assuming Outfall 002 flow of 10 MMGD, a total site effluent of 14.4 MMGD (winter time), and a James River low flow 7Q10 of 408 MMGD, a river concentration of 0.4 ppb is calculated as a worst case.

I would appreciate your comments on these sample results.

TVR:mcp
29:1.30

APPENDIX II

SPRUANCE C8 ASSESSMENT

SPRUANCE C8 ANALYSIS

SAMPLE NO.	SAMPLE TYPE	LOCATION	C8 CONC. (μg/L)
1	Composite*	SM#2 Wash Water Discharge	2400
2	Composite*	Scrubber Effluent Discharge	1.8
3	24 Hour Composite	East Trench (Process Sewer)	950
4	24 Hour Composite	Influent to WWTS (Outfall 006)	22
5	24 Hour Composite	Effluent from WWTS (Outfall 002)	18
6	Blank-DI Water	–	<MDL

* 4 grabs collected over 8 hours and combined as one sample.

MDL - detection limit 0.1 μg/L

29:1.30

APPENDIX III

ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

November 27, 1991

LMG27317.XY

Mr. Tom Robertson
EI DuPont de Nemours & Co., Inc.
Spruance Plant - East Office Bldg.
P.O. Box 27001, Jefferson Davis Hwy.
Richmond, Virginia 23261

RE: Analytical Data for LMG Laboratory No. 20152

Dear Mr. Robertson:

On November 15, 1991, the CH2M HILL Montgomery Laboratory received six samples with a request for analysis of selected organic parameters.

The analytical results and associated quality control data are enclosed. Any unusual difficulties encountered during the analysis of these samples are discussed in the case narrative.

If you should have any questions concerning the data, please inquire.

The CH2M HILL policy is to store samples for up to 30 days after reporting. If you desire, our laboratory will maintain your samples for a longer period at a cost of $5.00 per sample per month. Samples determined to be hazardous can either be returned to you or disposed of at a cost of $25.00 per sample.

Sincerely,

Wanda L. Hall

Wanda L. Hall
Data Package Supervisor

Enclosures

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ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

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CH2M HILL Laboratory No. 20152

C8 (mg
2460
1.8
950
22
18
4

APPENDIX III

ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

ANALYTICAL METHODS

Organic Analysis

Priority Pollutants: Water, soil and waste sample are analyzed in accordance with procedures described in Methods 608, 624, and 625, EPA-600/4-82-057 (1982); Methods 8080, 8240, and 8270, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition; and methods outlined in the USEPA Contract Laboratory Program Statement of Work for Organics Analysis, February, 1988.

Volatile Analysis (Safe Drinking Water Act): Water samples are analyzed in accordance with procedures described in Method 524.2, Federal Register (50 FR 46902), November 13, 1985.

Chlorinated Phenoxyacid Herbicides: Samples are analyzed in accordance with procedures described in Method 8150, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition.

Organophosphorous Pesticides: Samples are analyzed in accordance with procedures described in Methods 614 and 622, EPA-600/4-79-019 (1979) and in Method 8140, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition.

Phenolic Acid Analysis by GC: Samples are analyzed in accordance with procedures described in Method 604, Federal Register, 40 CFR, Part 136 (July 1, 1987) and in Method 8040, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition.

Polynuclear Aromatic Hydrocarbons (GC analysis): Samples are analyzed in accordance with procedures described in Method 610, Federal Register, 40 CFR, Part 136 (July 1, 1987) and in Method 8100, Test Methods for Evaluating Solid Waste, 1986, SW-846, Third Edition.

Ethylene Dibromide: Water samples are analyzed in accordance with procedures described in Method 504, Federal Register, (50 FR 46902), November 13, 1985.

Trihalomethanes: Water samples are analyzed in accordance with procedures described in Method 501.2, Federal Register, Vol. 44, No. 231, Part II, November 29, 1979.

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ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

EPA - DEFINED QUALIFIERS

ORGANICS

Definitions for the EPA-defined qualifiers:

U -- Indicates the compound was analyzed for but not detected. The number adjacent to the "U" qualifier indicates the quantitation limit for that compound. The detection limit can vary from sample to sample depending on dilution factors or percent moisture adjustment when indicated.

J -- Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound below the stated quantitation limit. The "J" qualifier is not used with pesticide results.

C -- This flag applies to pesticide results only. The "C" flag indicates the presence of this compound has been confirmed by GC/MS analysis.

B -- This flag is used when the analyte is found in the associated blank as well as the sample. This notation indicates possible blank contamination and suggests the data user evaluate these compounds and their amounts carefully.

E -- This flag applies to GC/MS only. The "E" qualifier indicates a compound may be above or below the linear range of the instrument. If the particular compound level is deemed above the linear calibration range, then the sample should be reanalyzed at an appropriate dilution. Therefore, the "E" qualified amount is an estimated concentration. The results for the dilution will be reported on a separate Form I and will be flagged with a "D" if the dilution brings the concentration within proper calibration.

D -- This flag identifies compounds which have been run at a dilution to bring the concentration of that compound within the linear range of the instrument. "D" qualifiers are only used for samples that have been run initially with results above acceptable ranges. For secondary dilutions the "DL" suffix is appended to the sample number on the Form I.

A -- Indicates the Tentatively Identified Compound (TIC) is a suspected aldol-condensation product.

X -- Indicates the compound concentration has been manually modified or the EPA qualifier has been manually modified or added.

JX -- The compound was detected and quantitated below the Contract Required Quantitation Limit.

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ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

CLIENT SAMPLE ID QUALIFIERS

LEVEL 1

The qualifiers that GC/MS and GC use with the client sample ID are defined below:

DL	--	Dilution Run
R	--	Rerun (may be followed by a digit to indicate multiple reruns)
RD	--	Diluted Rerun
RX	--	Re-extraction Analysis
MS	--	Matrix Spike (may be followed by a digit to indicate multiple matrix spikes within a sample set)
MSD	--	Matrix Spike Duplicate (may be followed by a digit to indicate multiple matrix spike duplicates within a sample set)
QC_BLANK	--	Method Blank (may be followed by a "W" for waters, "S" for soils run at a low level, or "SM" for soils run at a medium level -- these letters may be followed by a digit to indicate multiple blanks of that type; if there are no letters, the digit indicates multiple blanks).

These qualifiers allow GC/MS and GC to have unique client sample ID's so that the client can get more accurate information from the data reported.

APPENDIX III

ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

TABLE 1

SAMPLE CROSS-REFERENCE SUMMARY

CH2M HILL Laboratory No. 20152

CH2M HILL Sample No.	Sample Description			
20152001	NUMBER 1	11/14/91	0830	COMP
20152002	NUMBER 2	11/14/91	0830	COMP
20152003	NUMBER 3	11/14/91	0830	COMP
20152004	NUMBER 4	11/14/91	0830	COMP
20152005	NUMBER 5	11/14/91	0830	COMP
20152006	NUMBER 6	11/14/91	0830	GRAB

APPENDIX III

ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

CASE NARRATIVE FOR FC-143
GAS CHROMATOGRAPHY SAMPLES

LABORATORY: CH2M HILL LABORATORIES CLIENT: E. I. DUPONT

CASE NO. : N/A CONTRACT NO.: N/A

LAB NO. : 20152 SDG NO.: N/A

I. RECEIPT

A. DATE: November 15, 1991

B. SAMPLE INFORMATION

LAB ID	CLIENT ID	SAMPLE MATRIX	DATE SAMPLED	EXTRACTION DATE	ANALYSIS DATE
20152001	NUMBER 1	WATER	11/14/91	11/21/91	11/22/91
20152002	NUMBER 2	WATER	11/14/91	11/21/91	11/22/91
20152003	NUMBER 3	WATER	11/14/91	11/21/91	11/22/91
20152004	NUMBER 4	WATER	11/14/91	11/21/91	11/22/91
20152005	NUMBER 5	WATER	11/14/91	11/21/91	11/22/91
20152006	NUMBER 6	WATER	11/14/91	11/21/91	11/22/91
W11211B1	QC BLANK	WATER	NA	11/21/91	11/22/91

C. Documentation
Exceptions : No exceptions were encountered.

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ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

II. EXTRACTION

A. Holding times: All holding times were met.

B. Extraction Exceptions : The native pH of two samples were unusually extreme for environmental samples. The native pH of 20152001 (NUMBER 1) was 3 and the native pH of 20152003 (NUMBER 3) was 12. No other exceptions were encountered.

III. ANALYSIS

A. Holding times: All holding times were met.

B. Analytical Exceptions : Sample 20152002 (NUMBER 2) was diluted by a large factor due to interferences not removed by our cleanup procedures. No other exceptions were encountered.

IV. QUALITY CONTROL

A. Method Blank : All associated method blanks met acceptable QC criteria.

B. Surrogate Recoveries : Surrogate recoveries were not determined for four field samples due to large dilutions required for analysis. Surrogate recoveries were below 50% for sample 20152002 (NUMBER 2). All other samples met acceptable QC limits.

C. Matrix Spike Results : Matrix spike results have not been reported with this contract.

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his designee, as verified by the following signature.

_____ 11/27/91

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ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	CH2M HILL/MGM	Concentration:	LOW	Date Extracted:	11/21/91
Lab Sample ID:	20152001	Sample Matrix:	WATER	Date Analyzed:	11/22/91
Client Sample ID:	NUMBER 1	Percent Moisture:		Dilution Factor:	2500

FC-143

CAS Number		ug/L	CAS Number		ug/L
3825-26-1	FC-143	2400			
	Perfluorononanoic acid - SS	ND			
	Perfluorodecanoic acid - SS	ND			
	11H-Eicosafluoroundecanoic acid - SS	ND			

U - Analyzed for but not detected.
JX - Present, concentration estimated.
B - Detected in QC blank.
SS - Surrogate Standard reported as percent recovery.
ND - Not determined.

Comments: Surrogate recoveries were not determined due to the large dilution required for analysis.

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ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	CH2M HILL/MGM	Concentration:	LOW	Date Extracted:	11/21/91
Lab Sample ID:	20152002	Sample Matrix:	WATER	Date Analyzed:	11/22/91
Client Sample ID:	NUMBER 2	Percent Moisture:		Dilution Factor:	10

FC-143

CAS Number		ug/L	CAS Number		ug/L
3825-26-1	FC-143	1.8			

Perfluorononanoic acid - SS	<50 %
Perfluorodecanoic acid - SS	<50 %
11H-Eicosafluoroundecanoic acid - SS	<50 %

U - Analyzed for but not detected.
JX - Present, concentration estimated.
B - Detected in QC blank.
SS - Surrogate Standard reported as percent recovery.

Comments: This sample was diluted for analysis because of large non-target chromatographic peaks discovered when the sample was screened. Surrogate recoveries could not be determined accurately because of chromatographic noise coupled with a large dilution factor.

Form I

OWS

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ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	CH2M HILL/MGM	Concentration:	LOW	Date Extracted:	11/21/91
Lab Sample ID:	20152004	Sample Matrix:	WATER	Date Analyzed:	11/22/91
Client Sample ID:	NUMBER 4	Percent Moisture:		Dilution Factor:	20

FC-143

CAS Number		ug/L	CAS Number		ug/L
3825-26-1	FC-143	22			
	Perfluorononanoic acid - SS	ND			
	Perfluorodecanoic acid - SS	ND			
	11H-Eicosafluoroundecanoic acid - SS	ND			

U - Analyzed for but not detected.
JX - Present, concentration estimated.
B - Detected in QC blank.
SS - Surrogate Standard reported as percent recovery.
ND - Not determined.

Comments: Surrogate recoveries were not determined due to the large dilution required for analysis.

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APPENDIX III

ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	CH2M HILL/MGM	Concentration:	LOW	Date Extracted:	11/21/91
Lab Sample ID:	20152005	Sample Matrix:	WATER	Date Analyzed:	11/22/91
Client Sample ID:	NUMBER 5	Percent Moisture:		Dilution Factor:	20

FC-143

CAS Number		ug/L	CAS Number		ug/L
3825-26-1	FC-143	18			
Perfluorononanoic acid - SS		ND			
Perfluorodecanoic acid - SS		ND			
11H-Eicosafluoroundecanoic acid - SS		ND			

U - Analyzed for but not detected.
JX - Present, concentration estimated.
B - Detected in QC blank.
SS - Surrogate Standard reported as percent recovery.
ND - Not determined.

Comments: Surrogate recoveries were not determined due to the large dilution required for analysis.

APPENDIX III

ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	CH2M HILL/MGM	Concentration:	LOW	Date Extracted:	11/21/91
Lab Sample ID:	20152006	Sample Matrix:	WATER	Date Analyzed:	11/22/91
Client Sample ID:	NUMBER 6	Percent Moisture:		Dilution Factor:	1.0

FC-143

CAS Number		ug/L	CAS Number		ug/L
3825-26-1	FC-143	0.1 U			

Perfluorononanoic acid - SS	86 %
Perfluorodecanoic acid - SS	75 %
11H-Eicosafluoroundecanoic acid - SS	83 %

U - Analyzed for but not detected.
JX - Present, concentration estimated.
B - Detected in QC blank.
SS - Surrogate Standard reported as percent recovery.

Comments:

Form I

APPENDIX III

ANALYTICAL DATA FOR LMG LABORATORY NO. 20152

ORGANICS ANALYSIS DATA SHEET

Laboratory Name:	CH2M HILL/MGM	Concentration:	LOW	Date Extracted:	11/21/91
Lab Sample ID:	W11211B1	Sample Matrix:	WATER	Date Analyzed:	11/22/91
Client Sample ID:	QC BLANK	Percent Moisture:		Dilution Factor:	1.0

FC-143

CAS Number		ug/L	CAS Number		ug/L
3825-26-1	FC-143	0.1 U			

Perfluorononanoic acid - SS	81 %
Perfluorodecanoic acid - SS	52 %
11H-Eicosafluoroundecanoic acid - SS	53 %

U - Analyzed for but not detected.
JX - Present, concentration estimated.
B - Detected in QC blank.
SS - Surrogate Standard reported as percent recovery.

Comments:

Form I