



May 18, 2000

VIA EXPRESS MAIL

Dr. Charles Auer
Director
Chemical Control Division
Office Of Pollution Prevention And Toxics
United States Environmental Protection Agency
401 M Street, Southwest
Room 403 East Tower (Mail Code 7405)
Washington, D. C. 20460

Re: **Information On Perfluorooctane
Sulfonates And Related Compounds**

Dear Charlie:

Pursuant to our recent communications, 3M is enclosing additional information on perfluorooctane sulfonates and related compounds. The enclosed information supplements information submitted to you previously under cover of our April 21, 2000 and May 4, 2000 letters. Again, we are providing this information on a voluntary basis as part of our continuing discussions with EPA regarding fluorochemistry. Please note that some of this information qualifies as confidential business information (CBI); we also have enclosed a sanitized version of CBI documents.

The enclosed information covers perfluorooctane sulfonates and certain related compounds listed in Table 1 of the document entitled: "Sulfonated Perfluorochemicals In The Environment: Sources, Dispersion, Fate And Effects", at 12 (March 1, 2000). Specifically, the information covers the following chemicals:

- ⇒ Perfluorooctane sulfonates, including CAS numbers 1763-23-1 (acid); 29081-56-9 (ammonium salt); 70225-14-8 (DEA salt); 2795-39-3 (potassium-salt); 29457-72-5 (lithium salt).
- ⇒ Perfluorooctanesulfonyl fluoride

005983

- ⇒ Perfluorooctanesulfonamide
- ⇒ Perfluorooctane sulfonylamido (ethyl) acetate
- ⇒ Perfluorodecanesulfonate
- ⇒ Perfluorohexane sulfonate
- ⇒ N-ethyl perfluorooctanesulfonamide
- ⇒ N-methyl perfluorooctanesulfonamide
- ⇒ N-ethylperfluorooctane sulfonamidoethanol
- ⇒ N-methylperfluorooctane sulfonamidoethanol
- ⇒ N-ethylperfluorooctanesulfonamidoethyl acrylate
- ⇒ N-ethylperfluorooctanesulfonamidoethyl acrylate
- ⇒ N-ethylperfluorooctanesulfonamidoethyl methacrylate
- ⇒ N-methyl perfluorooctanesulfonamidoethyl acrylate

3M has provided you with information on perfluorooctane sulfonates previously under cover of our April 21, 2000 and May 4, 2000 letters. We are enclosing some additional information on perfluorooctane sulfonates located as part of our continuing file search. For each of the foregoing related compounds, the enclosed information includes the following:

- ⇒ Copies of post-1976 studies and certain other information relating to the following environmental science areas: (i) physical and chemical properties; (ii) environmental fate and transport; (iii) environmental monitoring; and (iv) ecotoxicity. For each study, 3M has prepared a summary in the HPV "robust summary" format. 3M already has provided you with a general executive summary addressing each of these areas under cover of our May 4, 2000 letter.
- ⇒ Copies of post-1976 studies and certain other information relating to the following health effects areas: (i) acute toxicity; (ii) genotoxicity; (iii) repeated-dose toxicity; (iv) pharmacokinetics; (v) teratology; and (vi) medical surveillance and epidemiology. 3M has included a detailed index of this information subdivided by each compound.

005984

- ⇒ Lists of all studies in progress and planned studies, along with study protocols or study plans, where available.
- ⇒ A bibliography of pre-1976 studies subdivided by each compound.
- ⇒ A bibliography of acute toxicity studies subdivided by each compound, except that we are providing copies of key acute studies (with reference to the HPV guidance).
- ⇒ A bibliography of published studies in 3M's possession.
- ⇒ An index of studies in 3M's possession believed to be in the FIFRA docket. Please note that this index has been submitted as CBI. 3M already has provided the Agency with a list of all fluorochemical-related submissions made by 3M to the TSCA Section 8(e) docket.

3M is continuing its file review and will supplement the enclosed information as appropriate. As you review this information, we ask that you bear several points in mind:

- ⇒ The enclosed information spans several boxes. We have organized the information in each box with labeled file folders and indices to aid EPA's review. To ensure that you and your staff are able to access the most pertinent information, we also are attaching to this letter the indices covering studies and other information.
- ⇒ Many of the studies refer to the test substance only by a 3M product identification number with a "T", "L" or "FC" prefix. Although analysis of the test substance has been included, where available, it is often not possible to determine from the study report itself the identity of the test substance. Thus, we have used the index to provide this information based on 3M's historical records keyed to the 3M product number to determine the composition of the test substance and have provided specific information on the index, such as percent composition, solvent context, salt form and purity grade. Please note that the term on the index "wide range" refers to a lower purity grade of the compound, and "narrow range" refers to a higher purity grade. Finally, it should be recognized that product formulations have evolved over the years, and thus, some of the test substances do not constitute current products.
- ⇒ We have included some additional studies on perfluorooctane sulfonates located as part of our continuing file review. As we have discussed, we plan to provide you with information on mixtures containing perfluorooctane sulfonates in the near future. Please be advised, however, that we already have provided you with studies and other information on aqueous and/or solvent solutions of

005985

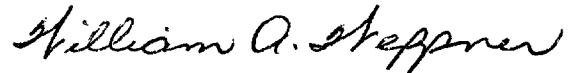
perfluorooctane sulfonates. As to the foregoing related compounds, the enclosed information likewise includes studies and certain other documents on both the compounds as well as on aqueous and/or solvent solutions of these compounds. We are not providing to you today, however, information on other types of mixtures containing these compounds and would like to discuss such information with you.

- ⇒ Consistent with the information previously provided on perfluorooctane sulfonates, 3M has not provided you with all analytical chemistry reports on these related compounds. Rather, we have enclosed certain analytical chemistry reports which may prove useful to EPA in interpreting certain studies; understanding the details of analytical chemistry methods; or verifying human and biomonitoring data.
- ⇒ We provided previously under cover of our April 28, 2000 letter to Oscar Hernandez a "Use And Exposure Information Profile" or "UEIP" for perfluorooctane sulfonates. Our present intention is to provide you with completed UEIP forms for these related compounds early next week. 3M needs additional time to clarify industrial hygiene and other release information to ensure that the data is accurate and placed in appropriate context.
- ⇒ The information on perfluorooctane sulfonates sent under cover of our May 4, 2000 letter included documents relating to ongoing mechanistic research by Dr. Ken Wallace of the University of Minnesota. Please note that this research also encompasses these related compounds. In addition, Dr. Marion Anders of the University of Rochester Medical Center is performing comparative metabolism research relating to perfluorooctane sulfonates and these related chemicals; there are not documents yet available relating to this research.

Charles Auer
May 18, 2000
Page 5

3M looks forward to discussing the enclosed information with you and other EPA staff. In the meantime, please do not hesitate to contact me with any questions.

Very truly yours



William A. Weppner, Ph.D
Director of Environmental, Health, Safety
And Regulatory Affairs
Specialty Materials Markets
3M
Bldg 236-1B-10
3M Center
St. Paul, MN 55144
(651) 733-6374 (phone)
(651) 733-1958 (fax)
E-mail: waweppner@mmm.com

Enclosures

005987

Perfluorooctane sulfonylamido(ethyl)acetate = PFOSAA

Synonyms: FC-109, FC-109-X, FC-128, FC-129, E2113, E2566-2, R1904

Physical/Chemical Properties

Title	Laboratory or Author	Date Completed	Type
-------	----------------------	----------------	------

Environmental Fate and Transport

Title	Laboratory or Author	Date Completed	Type
Tech. Report - Fate of Fluorochemicals in the Environmental (sic) (Warburg respirometer method for biodegradation of FC-128)	3M Env. Lab	8/12/76	Robust summary, technical report
Ready Biodegradability of FC-128 - BOD/COD	3M Env. Lab	7/8/77	Robust summary, copies of data sheets
Tech report - Analysis for Fluorochemicals in Bluegill Fish	3M Env. Lab	5/1/79	Robust summary, technical report
Ready biodegradability of FC-127 - BOD/COD	3M Env. Lab	8/19/81	Robust summary, copies of data sheets
Ready biodegradability of FC-109-X - BOD/COD	Pace Laboratories, Minneapolis, MN	12/31/87	Robust summary, copy of computer results from archives

Summary Reports

Title	Laboratory or Author	Date Completed	Type
-------	----------------------	----------------	------

Ecotoxicity Elements

Title	Laboratory or Author	Completion Date	Type
Acute toxicity of FC-128 to fathead minnow	3M Env. Lab	5/18/74	Robust summary, copies of data sheets
Acute toxicity of FC-128 to fathead minnow	3M Env. Lab	6/29/74	Robust summary, copies of data sheets
Acute toxicity of FC-128 to fathead minnow	3M Env. Lab	8/26/77	Robust summary, copies of data sheets
Acute toxicity of FC-127 to fathead minnow	3M Env. Lab	7/24/81	Robust summary, copies of data sheets
Toxicity of FC-127 to activated sludge respiration	3M Env. Lab	8/14/81	Robust summary, copies of data sheets

005988

Ready Biodegradability: "Modified OECD Screening Test" for Fluorad FC-129	RCC, Itingen, Switzerland	9/19/84	Robust summary, memo about study reliability, final report
Microbics Microtox Toxicity Test - FC-109-X	3M Env. Lab	10/15/87	Robust summary, copies of data sheets
Activated Sludge Respiration Inhibition - FC-109-X	3M Env. Lab	10/30/87	Robust summary, copies of data sheets
Acute Toxicity of E2566-2 to <i>Daphnia magna</i>	ABC Laboratory, Columbia, MO	1/9/88	Robust summary, final report
Acute Toxicity of E2566-2 to Fathead Minnow (<i>Pimephales promelas</i>)	ABC Laboratory, Columbia, MO	1/12/88	Robust summary, final report
Biodegradation (methylene blue active substance)	Pace Laboratories, Inc., Minneapolis, MN	2/15/89	Robust summary, computer report, copies of data sheets
Acute Toxicity of R1904 to <i>Daphnia magna</i>	ASCI Corporation, Duluth, MN	6/17/97	Robust summary, final report
Growth Inhibition of R1904 for Green Alga (<i>Selenastrum capricornutum</i>)	ASCI Corporation, Duluth, MN	6/18/97	Robust summary, final report
Acute Toxicity of R1904 to Fathead Minnow (<i>Pimephales promelas</i>)	ASCI Corporation, Duluth, MN	6/27/97	Robust summary, final report
Microbics Microtox Toxicity Test - FC-129	ASCI Corporation, Duluth, MN	7/9/97	Robust summary, copies of data sheets
Inhibition of R1904 for Activated Sludge Respiration	ASCI Corporation, Duluth, MN	7/10/97	Robust summary, final report
R1904 BOD Report for 3M Company	ASCI Corporation, Duluth, MN	Jul-97	Robust summary, final report

005989

N-MeFOSE Alcohol

Synonyms: FM 3925, L4528, L-4309, PPA-791, PPA-790 (Me & Et FOSE mix) cc 796-10, FM 3974, cc 796-3

Physical/Chemical Properties

Title	Laboratory or Author	Date Completed	Type
Tech Report - Solubility of FM 3925	3M Env. Lab	1/8/79, 1/17/79	Robust summary, tech report, excerpt from Tech report - Analytical Methodology and Support, 1/17/79

Environmental Fate and Transport

Title	Laboratory or Author	Completion Date	Type
Tech Report - Biodegradation Studies on FM 3925, Tech Report - Chemical Oxygen Demand of FM 3925	3M Env Lab	1/8/79, 1/8/79	Robust summary, 2 technical reports
Tech Report - Distribution coefficient of FM 3925 in n-Octanol/Water	3M Env. Lab	1/10/79	Robust summary, technical report
Tech Report - Adsorption of FM-3925 on Soil	3M Env. Lab	3/22/79, 5/19/93	Robust summary, critique from S. Boyd (MSU), technical report
Tech Report - Bioaccumulation of Fluorochemicals in Tenn. River Fish, Tech. Report - Fluorochemicals in Tennessee River Fish, Ar No. 7238 - Determination of Fluorinated Alcohols in Fish Extracts	3M Env. Lab	5/22/79, 12/28/79, 10/23/79	Robust summary, critique from J.W. Gillett (Cornell), 3 technical reports

Summary Reports

Title	Laboratory or Author	Completion Date	Type
None			

Ecotoxicity Elements

Title	Laboratory or Author	Completion Date	Type
Tech Report - Aquatic Toxicity Studies: FM 3925	3M Env. Lab	1/8/79	Robust summaries for fish and daphnia, copies of data sheets, technical report

005990

POSF

Synonyms: FX-8

Physical/Chemical Properties

Title	Laboratory or Author	Date Completed	Type
Water solubility estimate (screen)	3M Env. Lab	5/11/84, 3/1/93	Robust summary, critique by E. Tucker, lab worksheets

Environmental Fate and Transport

Title	Laboratory or Author	Completion Date	Type
Environmental Aspects of POSF	3M Env. Lab	9/1/83	Technical report
Reappraisal of POSF Environmental Fate	3M Env. Lab	12/15/83	Technical report

Summary Reports

Title	Laboratory or Author	Completion Date	Type
None			

Ecotoxicity Elements

Title	Laboratory or Author	Completion Date	Type
96-hour Toxicity to Fathead Minnow	3M Env. Lab	4/6/84	Robust summary, data sheets
7-Minute Exposure Activated Sludge Toxicity Test	3M Env. Lab	5/10/84	Robust summary, data sheets

005991

Methyl FOSEA

Physical/Chemical Properties

Title	Laboratory or Author	Date Completed	Type
Study of Stability of MeFOSEA in Aqueous Buffers Using Gas Chromatography with Atomic Emission Detection	3M Env. Lab	6/14/99	Robust Summary and Technical Report

Environmental Fate and Transport

Title	Laboratory or Author	Date Completed	Type
Determination of the Partition Coefficient (N-Octanol/Water) of T-5969.4	3M Env. Lab	11/9/94	Robust Summary and Technical Report

005992

Ethyl FOSEA

Synonyms: FX-13, B1228, D-1

Physical/Chemical Properties

Title	Laboratory or Author	Date Completed	Type
Determination of Physico-chemical Properties of Sample D-1	Mitsubishi Chemical Safety Institute Ltd., Yokohama, Japan	2/14/96	Robust summary, final report

Environmental Fate and Transport

Title	Laboratory or Author	Completion Date	Type
Ready biodegradability of FX-13 (BOD/COD)	3M Env. Lab	4/26/84	Robust summary, copies of data sheets
Ready Biodegradability Test of D-1	Mitsubishi Chemical Safety Institute Ltd., Yokohama, Japan	10/31/95	Robust summary, final report
Bioaccumulation Study of Sample D-1 with Carp (<i>Cyprinus carpio</i>)	Mitsubishi Chemical Safety Institute Ltd., Yokohama, Japan	11/30/95	Robust summary, final report

Ecotoxicity Elements

Title	Laboratory or Author	Completion Date	Type
Acute toxicity of FX-13 to fathead minnow	3M Env. Lab	4/1/84	Robust summary, copies of data sheets.

005993

Perfluorodecanesulfonate, Ammonium Salt (PFDS)

Synonyms: FC-120, FC-121, LR J2904

Physical/Chemical Properties

Title	Laboratory or Author	Date Completed	Type
None Available			

Environmental Fate and Transport

Title	Laboratory or Author	Date Completed	Type
BOD/COD Testing Results FC-120	Pace Incorporated, Minneapolis, MN	12/4/91	Robust summary, lab report
BOD/COD Testing Results FC-121-X	Pace Laboratories, Inc, Minneapolis, MN	11/3/87	Robust summary, lab report

Summary Reports

Title	Laboratory or Author	Date Completed	Type
None available			

Ecotoxicity Elements

Title	Laboratory or Author	Completion Date	Type
Toxicity of FC-121-X to Microtox	3M Env. Lab	1987	Robust summary, test summary sheet
Toxicity of FC-121-X to activated sludge	3M Env. Lab	10/30/87	Robust summary, test summary sheet
Acute Toxicity of E2566-1 to <u>Daphnia magna</u> (FC-121-X)	ABC Laboratories, Columbia, MO	1/9/88	Robust summary, final report
Acute Toxicity of E2566-1 to Fathead Minnow (<u>Pimephales promelas</u>)	ABC Laboratories, Columbia, MO	1/15/88	Robust summary, excerpts from final report
Static Acute Toxicity of FC-120 to the Fathead Minnow, <u>Pimephales promelas</u>	EnviroSystems Division, Resource Analysts, Inc. Hampton, NH	March, 1992	Robust summary, final report

005994

Static Acute Toxicity of FC-120 to the Daphnid, <i>Daphnia magna</i>	EnviroSystems Division, Resource Analysts, Inc. Hampton, NH	Feb., 1992	Robust summary, final report
OECD Activated Sludge Respiration Inhibition Test #209 - Toxicity of FC-120	3M Env. Lab	3/9/92	Robust summary, data sheets
Microbics' Microtox Test - FC-120	3M Env. Lab	4/20/92	Robust summary, data sheets

005995

**Attachments to Letter to C. Auer dated May 18, 2000
Bibliography of Published Literature in 3M's Possession**

1. POSF – Perfluorooctanesulfonyl fluoride

No literature located.

2. FOSA - Perfluorooctanesulfonamide

Arrendale, R.F., J.T. Stewart, R. Manning, and B. Vitayavirasuk. Determination of GX-071 and its major metabolite in rat blood by cold on-column injection capillary GC-ECD. *Journal of Agricultural and Food Chemistry* **37** (1989) 1130-1135.

Cross, T.J., and R-G. Schnellmann. Mechanism of toxicity of a unique pesticide N-ethylperfluorooctane sulfonamide (NEPFOS), and its metabolite perfluorooctane sulfonamide (PFOS) to isolated rabbit renal cortical mitochondria (RCM). *Toxicologist* **9** (1989) 224.

Grossman, M.R. *Tissue analysis of a fluorinated sulfonamide pesticide: An evaluation of distribution, elimination, and potential for bioaccumulation in orally exposed rats*. MS Thesis, University of Georgia, Athens, 1990.

Lofgren, C.S., W.A. Banks, R.K. Vander Meer, and D.F. Williams. Residual toxicity of some fluoroaliphatic sulfones to the red imported fire ant, *Solenopsis invicra* (Hymenoptera, Formicidae). *Florida Entomologist* **72** (1989) 140-146.

Manning, R.O., J.V. Bruckner, M.E. Mispagel, and J.M. Bowen. Metabolism and disposition of Sulfluramid, a unique polyfluorinated insecticide, in the rat. *Drug Metabolism and Disposition* **19** (1990) 205-211.

Schnellmann, R.G., and R.O. Manning. Perfluorooctane sulfonamide: a structurally novel uncoupler of oxidative phosphorylation. *Biochimica et Biophysica Acta* **1016** (1990) 344-348

Vander Meer, R-K., C.S. Lofgren, and D.F. Williams. Fluoroaliphatic sulfones: A new class of delayed-action insecticides for control of *Solenopsis iniicta* (Hymenoptera: Formicidae). *Journal of Economic Entomology* **78** (1985) 1190-1197.

Williams, D.F., C.S. Lofgren, and R-K. Vander Meer. The red imported fire ant, *Solenopsis invicta*: control with fluoroaliphatic sulfone bait toxicants. *Journal of Agricultural Entomology* **4** (1987) 41-47.

3. PFOSAA – Perfluorooctane sulfonylamido (ethyl) acetate

No literature located.

4. PFDS - Perfluorodecanesulfonate

No literature located.

5. PFHS - Perfluorohexanesulfonate

No literature located.

Attachments to Letter to C. Auer dated May 18, 2000
Bibliography of Published Literature in 3M's Possession

6. N-EtFOSA – N-ethyl perfluorooctanesulfonamide

- Appel, A.G., and S.F. Abd-Elghafar. Toxicity, sublethal effects, and performance of Sulfluramid against the German cockroach (Dictyoptera: Blattellidae). *Journal of Economic Entomology* **83** (1990) 1409-1414.
- Appel, A.G. Laboratory and field performance of consumer bait products for German cockroach (Dictyoptera: Blattellidae) control. *Journal of Economic Entomology* **83** (1990) 153-159.
- Arrendale, R.F., J.T. Stewart, R. Manning, and B. Vitayavirasuk. Determination of GX-071 and its major metabolite in rat blood by cold on-column injection capillary GC-ECD. *Journal of Agricultural and Food Chemistry* **37** (1989) 1130-1135.
- Cross, T.J., and R-G. Schnellmann. Mechanism of toxicity of a unique pesticide N-ethylperfluorooctane sulfonamide (NEPFOS), and its metabolite perfluorooctane sulfonamide (PFOS) to isolated rabbit renal cortical mitochondria (RCM). *Toxicologist* **9** (1989) 224.
- Forschler, B.T., and Evans, G.M. Perimeter treatment strategy using containerized to manage Argentine ants, *Linepithema humile* (Mayr) (Hymenoptera: Formicidae) (abstract). *J. Entomol. Sci.* **29** (1994) 264-267.
- Grossman, M.R., Mispagel, M.E., and Bowen, J.M. Distribution and tissue elimination in rats during and after prolonged dietary exposure to a highly fluorinated sulfonamide pesticide. *Journal of Agric. Food Chem.* **40** (1992) 2505-2509.
- Grossman, M.R. *Tissue analysis of a fluorinated sulfonamide pesticide: An evaluation of distribution, elimination, and potential for bioaccumulation in orally exposed rats*. MS Thesis, University of Georgia, Athens, 1990.
- Lofgren, C.S., W.A. Banks, R.K. Vander Meer, and D.F. Williams. Residual toxicity of some fluoroaliphatic sulfones to the red imported fire ant, *Solenopsis invicta* (Hymenoptera, Formicidae). *Florida Entomologist* **72** (1989) 140-146.
- Manning, R.O., J.V. Bruckner, M.E. Mispagel, and J.M. Bowen. Metabolism and disposition of Sulfluramid, a unique polyfluorinated insecticide, in the rat. *Drug Metabolism and Disposition* **19** (1990) 205-211.
- Nabbefeld, D.J. An Investigation of the Effects of Fluorochemicals on Liver Fatty Acid-Binding Protein. A thesis submitted to the Graduate School of the University of Minnesota, April 1998.
- Reid, B.L., G.W. Bennett, and S.J. Barcay. Topical and oral toxicity of Sulfluramid, a delayed-action insecticide, against the German cockroach (Dictyoptera: Blattellidae). *Journal of Economic Entomology* **83** (1990) 148-152.
- Schal, C. Sulfluramid resistance and vapor toxicity in field-collected German cockroaches (Dictyoptera: Blattellidae) (abstract). *J. Medical Entomology* **29**(2) (1992) 207-215.
- Schnellmann, R.G., and R.O. Manning. Perfluorooctane sulfonamide: a structurally novel uncoupler of oxidative phosphorylation. *Biochimica et Biophysica Acta* **1016** (1990) 344-348.
- Schnellmann, R-G. The cellular effects of a unique pesticide Sulfluramid (N-ethylperfluorooctane sulfonamide) on rabbit renal proximal tubules. *Toxicology in Vitro* **4** (1990) 71-74.

Attachments to Letter to C. Auer dated May 18, 2000
Bibliography of Published Literature in 3M's Possession

- Smith, L.M., Appel, A.G. Toxicity, repellence, and effects of starvation compared among brown cockroaches (Dictyoptera: Blattidae) (abstract). *J. Econ. Entomol.* **89**(2) (1996) 402-410.
- Stump, DG; Nemec, MD; Holson, JF; Piccarillo, VJ; Mares, JT. Study of the Effects of Sulfuramid on Pre- and Post natal Development, Maturation and Fertility in the Rabbit. *Toxicology* (1997) 357.
- Su, N.-Y., and R.H. Scheffrahn. Laboratory evaluation of two slow-acting toxicants against Formosan and eastern subterranean termites. *Journal of Economic Entomology* **84** (1991) 170-175.
- Su, N.-Y., and R.H. Scheffrahn. Toxicity and lethal time of N-ethylperfluorooctanesulfonamide against two subterranean termite species Isoptera Rhinotermitidae. *Florida Entomologist* **71** (1988) 73-78.
- Su, N.-Y., Tokoro, M., and R.H. Scheffrahn. Estimating oral toxicity of slow-acting toxicants against subterranean termites (Isoptera Rhinotermitidae) (abstract). *J. Economic Entomology* **87** (1994) 398-401.
- U.S. EPA Office of Pesticides and Toxic Substances. Pesticide fact sheet number 205: Sulfluramid. Washington, DC 1989.
- United States Air Force, Tyndal AFB, Florida. Environmentally Acceptable Live Fire Training Facility. 5 pages.
- Vander Meer, R-K., C.S. Lofgren, and D.F. Williams. Control of *Solenopsis invicta* with delayed-action fluorinated toxicants. *Pesticide Science* **17** (1986) 449-455.
- Vander Meer, R-K., C.S. Lofgren, and D.F. Williams. Fluoroaliphatic sulfones: A new class of delayed-action insecticides for control of *Solenopsis invicta* (Hymenoptera: Formicidae). *Journal of Economic Entomology* **78** (1985) 1190-1197.
- Williams, D.F., C.S. Lofgren, and R-K. Vander Meer. The red imported fire ant, *Solenopsis invicta*: control with fluoroaliphatic sulfone bait toxicants. *Journal of Agricultural Entomology* **4** (1987) 41-47.

7. N-MeFOSA – N-methyl perfluorooctanesulfonamide

No literature located.

8. N-EtFOSE alcohol – N-ethyl perfluorooctane sulfonamidoethanol

Nabbefeld, DJ. An Investigation of the Effects of Fluorochemicals on Liver Fatty Acid-Binding Protein. A thesis submitted to the Graduate School of the University of Minnesota, April 1998.

9. N-MeFOSE alcohol – N-methyl perfluorooctane sulfonamidoethanol

No literature located.

005998

**Attachments to Letter to C. Auer dated May 18, 2000
Bibliography of Published Literature in 3M's Possession**

10. N-EtFOSEA – N-ethyl perfluorooctane sulfonamidoethyl acrylate

No literature located.

11. N-EtFOSEMA – N-ethylperfluorooctane sulfonamidoethyl methacrylate

No literature located.

12. N-MeFOSEA – N-methylperfluorooctane sulfonamidoethyl acrylate

Lawson, R.G., Jurs, P.C. Cluster analysis of acrylates to guide sampling for toxicity testing (abstract). *J. Chem. Inf. Comput. Sci.* **30** (1990) 137-144.

Lawson, R.G., Jurs, P.C. Cluster analysis of acrylates to guide sampling for toxicity testing (erratum). *J. Chem. Inf. Comput. Sci.* **31** (1991) 361.

13. PFOS – Additional references on Perfluorooctane sulfonate

PFOS

Schnellmann, R-G. The cellular effects of a unique pesticide Sulfluramid (N-ethylperfluorooctane sulfonamide) on rabbit renal proximal tubules. *Toxicology in Vitro* **4** (1990) 71-74.

PFOSH

Derbel, M., Hosokawa, M., Satoh, T. Differences in the induction of carboxylesterase RL4 in rat liver microsomes by various perfluorinated fatty acids, metabolically inert derivatives of fatty acids (abstract). *Biological & Pharmaceutical Bulletin* **19(5)** (1996) 765-767.

Haughom, B., and O. Spydevold. The Mechanism Underlying the Hypolipemic Effect of Perfluorooctanoic Acid (PFOA), Perfluorooctane Sulphonic Acid (PFOSA) and Clofibrilic Acid. *Biochim. Biophys. Acta.* **1128[1]** (1992) 65-72.

Henwood, S.M., McKee-Pesik, P., Costello, A.C., Osimitz, T.G. Developmental toxicity study with lithium perfluorooctane sulfonate in rabbits (abstract). *Teratology* **49(5)** (1994) 398.

Costello, A.C., Henwood, S.M., Osimitz, T.G. Developmental toxicity study with lithium perfluorooctane sulfonate in rabbits (abstract). *Toxicologist* **14(1)** (1994) 161.

Hato, M., and Shinoda, K. Solubility and critical micelle concentrations of fluorinated surfactants in water (abstract). *Nippon Kagaku Zasshi* **91(1)** (1970) 27-31.

He, M., and Fu, X. Kinetics and linear free energy relationship of superacid POSA (perfluorooctane sulfonic acid) catalyzed esterification (abstract). *Wuli Huaxue Xuebao* **6(6)** (1990) 739-742.

Hosokawa, M., and T. Satoh. Differences in the induction of carboxylesterase isozymes in rat liver microsomes by perfluorinated fatty acids. *Xenobiorica* **23** (1993) 1125-1133.

Ikeda, T., K. Fukuda, I. Mori, M. Enomoto, T. Komai, and T. Suga. Induction of cytochrome P-450 and peroxisome proliferation in rat liver by perfluorinated octane sulphonate acid (PFOS).

Attachments to Letter to C. Auer dated May 18, 2000
Bibliography of Published Literature in 3M's Possession

Peroxisomes in Biology and Medicine. H.D. Fahimi and H. Sies, Eds., Berlin: Springer-Verlag, 1987, 304-308.

Kozuka, H., Yamada, J., Horie, S., Watanabe, T., Suga, T., Ikeda, T. Characteristics of induction of peroxisomal fatty acid oxidation-related enzymes in rat liver by drugs: relationships between structure and inducing activity (abstract). *Biochem. Pharmacol.* **41(4)** (1991) 617-623.

Lyon, P.A., Tomer, K.B., Gross, M.L. Fast atom bombardment and tandem mass spectrometry for characterizing fluoroalkanesulfonates. *Anal. Chem.* **57(14)** (1985) 2984-2989.

Remde, A., and Debus, R. Biodegradability of fluorinated surfactants under aerobic and anaerobic conditions (abstract). *Chemosphere* **32(8)** (1996) 1563-1574.

Sohlenius-, A.K., A.M. Eriksson, C. Hogstrom, M. Kimland, J.W. Depierre. Perfluorooctane sulfonic acid is a potent inducer of peroxisomal fatty acid B-oxidation and other activities known to be affected by peroxisome proliferators in mouse liver. *Pharmacology and Toxicology* **72** (1993) 90.

PFOS.K salt

Brown, R.B. The Treatment and Disposal of Aqueous Film Forming Foam. Masters Thesis in Public Health Engineering, University of New South Wales, Australia, 1986.

Cavalli, L., A. Gellera, and A. Landone. Las removal and biodegradation in a wastewater treatment plant. *Environmental Toxicology and Chemistry* **12** (1993) 1777-1788.

Chan, D.B., and E.S.K. Chian. Economics of membrane treatment of wastewaters containing firefighting foam. *Environmental Progress* **5** No. 2, May 1986, 104-109.

Chan, D.B. Disposal of wastewater containing aqueous film forming foam (AFFF). TM No. M-54-78-06, Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, Calif. 93043, April 1978, 19 pgs.

Chan, D.B. Disposal of wastewater containing aqueous film forming foam (AFFF) - by physico-chemical processes. TM No. M-54-79-19, Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, Calif. 93043, Sept. 1979, 21 pgs.

Chan, D.B. Toxic substance: Disposal of wastewater containing aqueous film forming foam (AFFF) - A summary of progress to date on development of all AFFF treatment processes. TM No. M-54-80-10, Civil Engineering Laboratory, Naval Construction Battalion Center, Port Hueneme, Calif. 93043, August, 1980, 6 pgs.

Chian, E.S.K., T.-P. Wu, and R.W. Rowland. Membrane treatment of aqueous film forming foam (AFFF) wastes for recovery of its active ingredients. Georgia Institute of Technology for U.S. Navy Civil Engineering Laboratory, Port Hueneme, CA 93043, Oct. 1980, 10 pgs.

Darwin, R. L., R. E. Ottman, E. C. Norman, J. E. Gott, and C.P. Hanauska. Foam and the Environment: A Delicate Balance. *National Fire Protection Association Journal*, May/ June 1995, 67-73.

DiMaio, L. R., and R. F. Lange. Effect of Water Quality on Fire Fighting Foams. *Plant.10perations Progress* **3** (1984) 42-46.

006000

**Attachments to Letter to C. Auer dated May 18, 2000
Bibliography of Published Literature in 3M's Possession**

- Hylton, T.D., and J.F. Walker. Environmental studies in support of the live fire training facilities project. Prepared for the US Air Force under Interagency Agreement DOE 1489-1489-A1 by Oak Ridge National Laboratory, Aug. 1989, 55 pgs.
- Johnson, J.D., S.J. Gibson, and R.E. Ober. Cholestyramine-enhanced fecal elimination of Carbon-14 in rats after administration of ammonium perfluorooctanoate or potassium perfluorooctanesulfonate. *Fundamental and Applied Toxicology* 4 (1984) 972-976.
- Kroop, R.H., and J.E. Martin. Treatability of aqueous film-forming foams used for fire fighting. Technical Report No. AFWL-TR-73-279, Air Force Weapons Laboratory (DEE), Kirtland AFB, New Mexico, 87117, Feb. 1974, 94 pgs. Available from NTIS, order no. AD-755 336.
- Landon-Arnold, S., and D.B. Chan. Application of rotating biological contactor (RBC) process for treatment of wastewater containing a firefighting agent (AFFF), undated report, 17 pgs.
- Landon-Arnold, S.E. Microbial treatability of aqueous film forming foam (AFFF) with a chemostat and a rotating biological contactor. Ph.D. Dissertation, University of Oklahoma, Norman, Okla. 1982. (University Microfilms International, 300 N. Zeeb Road, Ann Arbor, Mich. 48106, 800-521-0600, Order No. 8302452).
- McKay, J.C., and B. Mason. Improved fire training facility plan. *The Military Engineer* 523 August 1988, 457-8.
- Mueller, J.A., E.W. Poth, and W.W. Melvin. REHL(K) 67-14 Biological treatment of fire fighting foam waste. Regional Environmental Health Laboratory (AFLC), USAF, Kelly AFB, TX, 78241, Sept. 1967, 38 pgs.
- O'Brien, A. F. Treatment of Aqueous Film Forming Foam (AFFF) Wastewater at Andrews Air Force Base, Maryland. Masters Thesis, University of Maryland, College Park, Maryland, December 1, 1994.
- Saam, R-D., P.A. Rakowski, and G.M. Aydlett. Treatability of firefighting school wastewaters: U.S. Navy Compliance with POTW pretreatment requirements. Presented at the 34th Annual Purdue Industrial Waste Conference, undated, 40 pgs.
- Salazar, S. M. Toxicity of Aqueous Film Forming Foams to Marine Organisms: Literature Review and Biological Assessment. Naval Ocean Systems Center, San Diego, California, Technical Document 825, July 1985.
- Shinoda, K., and T. Nomura. Miscibility of fluorocarbon and hydrocarbon surfactants in micelles and liquid mixtures. Basic studies of oil repellent and fire extinguishing agents. *Journal of Physical Chemistry* 84 (1980) 365-369.
- Ventullo, R. M. Biodegradation of Aqueous Film Forming Foam Component in Laboratory Scale Microcosms. Department of Biology, University of Dayton, Dayton, OH. November 30, 1986 - November 30, 1987, 34 pages.

PFOS.Li salt

Costello, Henwood, and Osimitz, "Developmental Toxicity Study with Lithium Perfluorooctane Sulfonate in Rabbits" (abstract)

006001

Attachments to Letter to C. Auer dated May 18, 2000
Bibliography of Published Literature in 3M's Possession

EPA, "New Pesticide Fact Sheet: Lithium Perfluorooctane Sulfonate (LPOS)" (abstract)

Henwood, Costello and Osimitz, "Developmental Toxicity Study with Lithium Perfluorooctane Sulfonate in Rats" (abstract)

Matsuki, H., N. Ikeda, M. Aratono, S. Kaneshina, and K. Motomura. Study on the miscibility of lithium tetradecyl sulfate and lithium perfluorooctane sulfonate in the adsorbed film micelle. *Journal of Colloid and Interface Science* **154** (1992) 454-460.

Shinoda, K., M. Kobayashi, and N. Yamaguchi. Effect of "iceberg" formation of water on the enthalpy and entropy of solution of paraffin chain compounds: The effect of temperature on the critical micelle concentration of lithium perfluorooctanesulfonate. *Journal Of Physical Chemistry* **91** (1987) 5292-5294.

Tamori., K.,- K. Kihara, H. Sanda, K. Esumi, K. Meguro, C. Thunig, and H. Hoffmann. Phase behavior and dynamic properties in mixed systems of anionic and cationic surfactants: lithium perfluorooctanesulfonate/diethanolheptadecafluoro-2-undecanolmethylarnmonium chloride (DEFUMAQ and lithium dodecyl sulfate/DEFUMAC aqueous mixtures. *Colloid and Polymer Science* **270** (1992) 883-893.

006002