Voluntary Use and Exposure Information Profile
Perfluorooctane sulfonamide

I. CHEMICAL IDENTIFICATION

Chemical Name: Perfluorooctane sulfonamide
CAS Number: 754-91-6

II. COMPANY IDENTIFICATION

Company Name: 3M

Site Location: 10746 Innovation Road
Cottage Grove, MN 55016

1400 State Docks Road
Decatur, AL 35601

Technical Contact: W.A. Weppner
Phone: 651/733-6374
Address: 3M Center, Building 236-1B-10
St. Paul, MN 55144

III. ON-SITE ACTIVITIES

CAS #	Mfg. (1997)	Imported
754-91-6	0 No Commercial Activity	0

Estimate the amount of subject chemical distributed off-site:

% of manufacture/import

If you have already provided the above information to EPA and it is still representative please reference that submission here:

Narrative Description and Process Flow Schematic:

3M Company utilizes a process known as Simons Electro-Chemical Fluorination (ECF) to synthesize organofluorine molecules. In this process, organic feedstocks are dispersed in liquid, anhydrous hydrogen fluoride, and an electric current is passed through the solution, causing the hydrogen atoms on the molecule to be replaced with fluorine. The predominant components of the products created by this process have the same carbon skeletal arrangement as the feedstock used, but with all of the hydrogen atoms replaced by fluorine. However, fragmentation and rearrangement of the carbon skeleton can also occur and significant amounts of cleaved, branched and cyclic structures may be formed. The degree of fluorination of the organic feedstock is also dependent upon the specific carbon chain length of the feedstock and parameters of the ECF process such as electrical current and the length of time the process is run. It is possible to synthesize fully fluorinated or perfluoroorganic molecules where all of the hydrogen atoms of the hydrocarbon feedstock have been replaced by fluorine atoms. Using these perfluoroorganic molecules as basic building blocks, unique chemistries can be created by further reactions with functionalized hydrocarbon molecules.

3M has produced sulfonyl based fluorochemicals commercially for over 40 years using the ECF process. A basic building block of such products and the highest production volume fluorochemical 3M manufactures is perfluorooctanesulfonyl fluoride (POSF). The starting feedstock for this reaction is 1-octanesulfonyl fluoride.
(Reaction 1)

Reaction 1

$$C_8H_{17}S0_2F + 17\ HF \xrightarrow[\text{ECF}]{\text{Energy}} C_8F_{17}S0_2F + 17\ H_2$$

1-Octanesulfonyl fluoride Perfluorooctanesulfonyl fluoride

The electrochemical fluorination process yields about 35%-40% straight chain (normal) POSF, and a mixture of biproducts and waste of unknown and variable composition comprised of the following:

1) higher and lower straight-chain homologs, i.e., n-$CnF_2n_{+1}SO_2F$, e.g., $C_6F_{13}SO_2F$, $C_7F_{15}SO_2F$, $C_9F_{19}SO_2F$ which comprise about 7% of the process output

2) branched-chain, perfluoroalkylsulfonyl fluorides with various chain lengths, about 18-20% of the output

3) straight-chain, branched, and cyclic (non-functional) perfluoroalkanes and ethers, which comprise about 20-25% of the output

4) "tars" (high molecular weight fluorochemical byproducts) and other byproducts, including molecular hydrogen, which comprise about 10-15% of the output.

Because of slight differences in process conditions, raw materials, and equipment, the mixture produced by the electrochemical fluorination process varies somewhat from lot-to-lot and from plant-to-plant. The product that results from electrochemical fluorination is thus not a pure chemical but rather a mix of isomers and homologues. The commercialized POSF derived products are a mixture of approximately 70% linear POSF derivatives and 30% branched POSF derived impurities.

During production, byproducts and waste products are formed. The volatile waste products, such as perfluoromethane, have been vented to the atmosphere in the past, but plans are being implemented to capture and destroy these releases by thermal oxidation over the next few years. The tars have been landfilled in a hazardous waste landfill in the past, but are all currently being incinerated at an in-house or external hazardous waste incinerator. The byproducts, many of which are incompletely fluorinated with hydrogen atoms still present, can be recycled back into the ECF process or are partially degraded in stabilization processes and discharged to controlled, in-house, wastewater treatment systems. The treatment sludge associated with the ECF process has been either landfilled or land-incorporated in the past, but all of this treatment sludge is being landfilled off-site since early 1998.

POSF is itself a commercially viable product, but is primarily an important intermediate in the synthesis of substances used in many other 3M fluorochemical products. The majority is used to produce functionally derivatized fluorochemicals and high molecular weight polymeric products.

Unique chemistries can be created by derivatizing POSF through the sulfonyl fluoride moiety of the molecule using conventional hydrocarbon reactions. POSF is reacted with methyl or ethyl amine to produce either N-methyl or N-ethylperfluorooctanesulfonamide (MeFOSA or EtFOSA). Some of the MeFOSA and EtFOSA is isolated to be used as intermediates to be reacted to form other materials. The majority of the MeFOSA and EtFOSA is not isolated and subsequently reacted with ethylene carbonate to form either N-methyl or N-ethylperfluorooctane sulfonamido ethanol. These are the principal building blocks of the 3M product lines.

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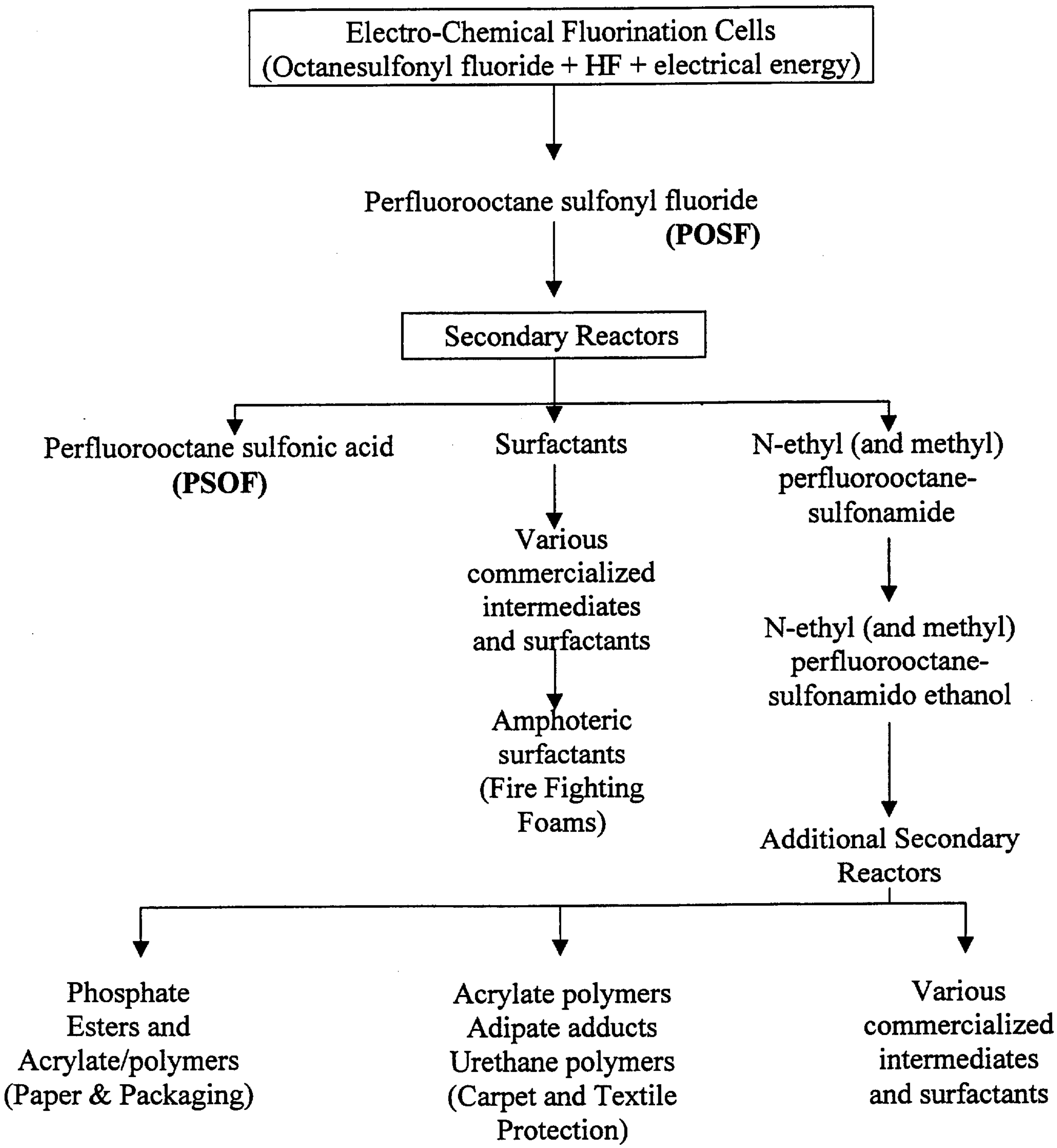
CAS number 754-91-6, perfluorooctanesulfonamide (R-SO_2NH_2), is a small undesired byproduct of the reaction of POSF with methyl or ethylamine because of the presence of a small amount of ammonia (NH_3) in the methyl or ethylamine raw material. Perfluorooctane sulfonamide is not produced for a commercial purpose. This chemical is present in very small amounts (0.1% or less) in the various POSF based intermediates produced by 3M. It can theoretically be present in final 3M products but is currently monitored only in 3M FDA regulated indirect food additive products. It is present at approximately 0.01% in the latter products.

The following block flow diagram describes the process discussed above.

BLOCK FLOW DIAGRAM



IV. SITE RELEASE AND TRANSFER INFORMATION FOR TRI CHEMICALS

Not applicable.

V. SITE RELEASE AND TRANSFER INFORMATION FOR NON-TRI CHEMICALS

While analytical methods have improved over time, large variability still exists for certain matrices and compounds, so data available for this report is mostly of a qualitative nature. Although limited monitoring data exists, most emission and waste estimates are based upon process models and engineering calculations. Engineering calculations, however, have limitations with respect to fluorochemicals because fluorochemical losses were not always included in the analysis of each intermediate step.

The accuracy of the emissions data submitted varies due to several factors. Batch process systems are difficult to measure due to quickly changing process conditions, venting pressures and difficulty in isolating processes to take measurements. Additionally, the unique characteristics of these compounds cause them to behave differently from conventional compounds, and physical chemical data properties are not available for all intermediate reaction steps in the past.

A. ON-SITE AIR RELEASES

ALL PLANTS - Fugitive emissions may occur from vacuum charging from drums, sampling from reactors, drumming of product/intermediate, flaking monomer, drying operations. Materials may be handled in a molten or solid state; vapors are produced from molten material. Industrial hygiene monitoring has been conducted for some compounds. Some minor amounts of these compounds have been detected as fugitive emissions during industrial hygiene exposure testing.

Emission estimates are based upon existing process models and engineering calculations from the facility. Fugitive emissions may have occurred during some handling steps but have not been quantified.

	Estimated Total Annual Releases (lbs.)	Estimated % Accuracy of Estimate (optional)	#days/years release occurs
Fugitive (non-point)	No data available.		
Stack (point)	No data available.		

Comments:

B. WATER RELEASES FROM SITE

Decatur, AL

The data presented is part of wastewater testing conducted in 1998, since the individual compounds of interest were not analyzed in the 1997 wastewater material balance due to method availability and initial program focus. The 1998 data has not been adjusted for production levels in 1997, since most production remained at similar levels.

Materials in the sludge and wastewater may result from production losses in the manufacturing of these compounds or from the hydrolysis of more complex molecules.

	Estimated Total Annual Releases (lbs.)	Estimated % Accuracy of Estimate (optional)
Water releases:	370	

Number of days/year release occurs: 250 days/year

Receiving Water Name: Baker's Creek at Junction with Tennessee River

NPDES Number: ADL004023164

Comments:

Cottage Grove, MN

	Estimated Total Annual Releases (lbs.)	Estimated % Accuracy of Estimate (optional)
Water releases:	No data available.	

Number of days/year release occurs:

Receiving Water Name:

NPDES Number:

Comments:

Cordova, IL

	Estimated Total Annual Releases (lbs.)	Estimated % Accuracy of Estimate (optional)
Water releases:	No data available.	

Number of days/year release occurs:

Receiving Water Name:

NPDES Number:

Comments:

C. ON-SITE LAND RELEASES

Decatur, AL

The land treatment of Decatur sludge was discontinued in early 1998. Sludge is now transported to an offsite landfill, after passing through a thickener and a sludge press. An impoundment was used in 1997 as part of the wastewater treatment operation but is now only used for back-up operation. Levels of the compound in the sludge were determined from wastewater data.

	Estimated Total Annual Releases (lbs.) (1997)	Estimated % Accuracy of Estimate (optional)
Landfill	No data available.	
Land Treatment/Land Amendment	30	
Surface Impoundments	0	
Underground Injection	0	
Other (specify):		

Comments:

Cordova, IL

The manufacture of these compounds has been discontinued so these releases have also been discontinued.

Engineering calculations were used to estimate the amount of material discharged to wastewater. The amount of material discharged to the sludge was determined through use of existing removal efficiency testing results from another facility.

	Estimated Total Annual Releases (lbs.) (1997)	Estimated % Accuracy of Estimate (optional)
Landfill	0	
Land Treatment/Land Amendment	< 9	
Surface Impoundments	0	
Underground Injection	0	
Other (specify):		

Comments:

Cottage Grove, MN

Sludge from the Cottage Grove facility is sent to an off-site industrial landfill

	Estimated Total Annual Releases (lbs.) (1997)	Estimated % Accuracy of Estimate (optional)
Landfill	0	
Land Treatment/Land Amendment	0	
Surface Impoundments	0	
Underground Injection	0	
Other (specify):		

Comments:

C. OFF-SITE TRANSFERS

D1. Transfer to Publicly Owned Treatment Works (POTW)

Process wastewaters are managed in an on-site wastewater treatment facility and are not sent to the POTW.

Number of days/year the release occurs:

Annual Transfer (lb):

Estimated % Accuracy of Transfer Estimate (optional) (%):

POTW Name:
Street Address:
City: **Country:**
State: **Zip Code:**
NPDES Number:

Comments:

D2. TRANSFERS TO OTHER OFF-SITE LOCATIONS

General Waste Information: There is limited information by CAS number for compound specific reporting and off-site transfers cannot be readily verified. Rather, wastes are classified by halogen content, regulatory waste codes, physical properties and non-specific fluorochemical categories. Where wastes are tracked by CAS number, the amounts have been included.

	Estimated Total Annual Releases (lbs.)	Estimated % Accuracy of Estimate (optional)
Incineration:	No specific CAS number data available.	
Wastewater Treatment (Excluding POTW)	0	
Underground Injection	0	
Hazardous Waste (RCRA Subtitle C) landfill	No specific CAS number data available.	
Other Landfill	No specific CAS number data available.	
Recycle or Recovery	No specific CAS number data available.	
Unknown or Other		

Comments:

VI. ON-SITE WORKPLACE EXPOSURE

This information will assist EPA in characterizing the number of workers potentially exposed and the magnitude, frequency, and duration of potential exposure. When providing monitoring data, ensure that data is linked with worker activities described in question 2.

1. **Estimate the number of workers potentially exposed routinely to the subject chemical for each of the exposure duration times. If a worker is involved in more than one activity, enter only his/her most typical activity in the table. Don't count a worker more activity, enter only his/her most typical activity in the table. Don't count a worker more than once. The total number in the table should equal the total number of workers potentially exposed.**

Hrs/day	Days/yr.			
	< 10	10-100	100-250	>250
<2.5				
25-1				
1-8				
>8				

2. **Describe the routine worker activities to which the workers in question 1 are exposed: sampling, removal of filter cake, and drumming of liquids, manufacture an article, etc. For these activities, describe the physical state of the subject chemical (liquid, gas, particulate, or aerosol, etc.) and, if in a mixture, the chemical's concentration:**

   This material is not handled at any of the facilities.

3. **Provide industrial hygiene monitoring data, if available, with a brief description of the sampling method and exposure scenario monitored, e.g., describe the specific worker activities performed by the individuals monitored. For privacy considerations, please do not include any personal identifiers such as a worker's name or social security number with any data submitted to EPA.**

4. **Briefly describe the engineering controls used to minimize exposure to this chemical:**

5. **Briefly list the personal protective equipment your workers regularly wear to prevent exposure of this chemical:**

COMMENTS:

VII. CHEMICAL END USES

A. END USE AS AN INTERMEDIATE CONSUMED TO MAKE OTHER CHEMICALS

A1. On-Site Use as a Intermediate:

Product chemical class or product chemical (Include CAS number if appropriate)	% of total volume of subject chemical manufactured or imported
1.	As reported in Part III, p.2

A2. Off-Site Use as an Intermediate

Product chemical class or product chemical (Include CAS number if appropriate)	% of total volume of subject chemical manufactured or imported
1.	As reported in Part III, p.2

Use Number 1 of 1

Description of Chemical End Use:

Percent of total manufactured or imported volume going to this use: ±

If used in a mixture check appropriate box to indicate weight fraction. Average values are acceptable:

___ <1
___ 1-30%
___ 30-60%
___ 60-90%
___ >90%

Check all physical forms of the chemical during this use:

___ Aerosol
___ Dry Powder
___ Pellets or large crystals
___ Water or solvent – wet solid
___ Gas or vapor
___ Liquid solution
___ Other (Explain)