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Mr. Charles M. Auer
Director, Chemicals Control Division
Office of Pollution Prevention and Toxics
Environmental Protection Agency
Ariel Rios Building (Mail code: 7405)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Dear Mr. Auer:

Subject: Comments on the Proposed Significant New Use Rule (SNUR) for Perfluoroalkyl Sulfonates (PFAS) published March 11, 2002 (67 FR 11014);
Docket Control Number OPPTS -50639C

Member companies (Agfa, Eastman Kodak Company, Fuji Photo Film, Konica, and Kodak Polychrome Graphics) of the International Imaging Industry Association or I3A (formerly the Photographic & Imaging Manufacturers Association) appreciate the opportunity to provide comments on the Proposed Significant New Use Rule (SNUR) for Perfluoroalkyl Sulfonates (PFAS) published March 11, 2002 (67 FR 11014).

These comments are intended to update the Agency on progress made by company efforts to reduce or eliminate uses of the PFAS substances that are the subject of the proposed SNUR.

The comments will respond to a range of questions raised by the Agency concerning anticipated exposures and releases that may result from imaging uses of PFAS materials, provide information on handling and disposal controls that would manage, reduce, or eliminate exposures and release, and address issues raised by publication of the proposed SNUR.

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Health and Environment Laboratories
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These comments will also address additional specific issues that the Agency raised with regard to:

- Volumes of PFAS materials associated solely with operations in the United States.
- Specific descriptions of the various operations in which PFAS chemicals are used, with particular attention to any exposure and release controls that would apply, including the use of personal protective equipment or closed system automation.
- Information providing an understanding about how PFAS exposure numbers were derived and what data produced them.
- Information about how industry has changed products and processes to achieve PFAS reductions.
- Information about alternative fluorinated chemistries that have been used as replacements particularly with regard to the extent to which PFAS reductions rely on some of the other chemicals currently under investigation by the Agency.
- Information about how and why the remaining PFAS chemicals are used to help distinguish functions in which these chemicals can be replaced by others versus uses in which PFAS chemicals may provide functionality or product efficacy not available from other chemical alternatives or process changes.
- Information on the number of manufacturing facilities involved in use of PFAS materials worldwide and within the USA.
- Information on the downstream exposures and releases of PFAS materials, including how much of the PFAS chemicals remain with the film, paper, or plates; what form those chemicals are in; and whether users could come into physical contact with them.
- Information on the distribution of waste to different environmental compartments, including wastewater, landfill, and various types of incinerators.
- Information about possible exposures to workers during silver reclamation facilities as well as during aluminum recycling.

We will also provide our recommendation for a regulatory exemption for the use of PFAS materials for imaging uses.

1.0 Background Information on the Use of PFAS in Imaging Materials

The companies making this request have actively participated in the process that resulted in the publication of the proposed SNUR. In December of 2000, the companies submitted comments on the original proposed rule for perfluorooctyl sulfonates (PFOS) and made a public presentation in April 2001 requesting an exemption for use of PFAS chemicals covered by the proposed SNUR in the areas of digital or semiconductor-based and analog-based imaging and outlining company commitments to developing a voluntary phase-out of PFAS chemicals where feasible[1, 2]. Subsequent to the public meeting, the companies provided the Agency with the additional information requested at the public meeting by the Agency[3]. Company representatives made themselves available to the Agency to provide additional information that might be needed to make a decision on this important issue[4]. In the absence of a final rule for PFAS chemicals, the companies have spent significant amounts of time and resources in developing alternatives to the PFAS chemicals.

As indicated in our prior communications with the Agency, small amounts of PFAS-related materials have critical uses in several different types of products and throughout the chain of activities involved in manufacturing and using imaging products. The PFAS materials not only provide performance features necessary for the manufacture and use of imaging products, they also provide important safety features by controlling the build-up and discharge of static electricity. The antistatic properties of these materials are important for preventing employee injury, operating equipment and product damage, and fire and explosion hazards.

2.0 Volumes and Uses of PFAS for Imaging Purposes as Identified to the Agency in Prior Comments

Precise historical information about the use of PFAS materials for imaging purposes is difficult to develop; however, trends can be described. Prior to 3M's development of this class of chemicals, PFAS chemicals were not used for imaging purposes. However, with the development of materials that were more sensitive to light (i.e., faster film speeds, more sensitive diagnostic X-ray products), the control of static became more difficult and required the use of perfluorinated coating aids. The current trend in imaging uses has been toward the development of digital products that are processed dry. The trend toward dry processing has increased demands for static control and tended to increase the use of PFAS materials. Thus until the mid-1990's, historic use of PFAS materials was one-half to one-third of the level used in 2000 when 3M announced its voluntary PFAS phase-out.

In previous submissions to the Agency[1, 2], we provided estimates of year 2000 use levels (i.e., prior to the phase-out announced by 3M). These estimates were developed based on purchase and market share information for major US-based operations. In calculating the estimates, an assumption was made that all manufacturers, even those not members of I3A, were using PFAS materials supplied by 3M. Thus, the estimated worldwide use of the PFAS-related chemicals listed in the proposed SNUR for imaging purposes (36,000 kg/yr) is expected to be a high estimate of the actual use level. Of this amount 30,600 kg/yr is estimated to be used in medical applications for disease diagnosis and 5,400 kg/yr is estimated to be used in consumer and industrial applications. The use of these materials in the USA at this same time point was approximately one-half of the total worldwide use or 18,000 kg/yr. We are concerned that the wording in the proposed SNUR used to describe these volumes is ambiguous and suggests that the volume of material used in the USA and subject to the proposed SNUR is 36,000 kg/yr rather than the actual volume of 18,000 kg/yr. **We request that the Agency either cite only the volume subject to use in the USA or provide wording that makes a distinction between worldwide and USA-only use in the final SNUR.**

In previous comments provided to the Agency[1, 2], the uses of the PFAS chemicals that were identified by imaging companies included:

1) Surfactants for mixtures used in coatings applied to films, papers, and printing plates,

2) Electrostatic charge control agents for mixtures used in coatings applied to films, papers, and printing plates,

3) Friction control agents for mixtures used in coatings applied to films, papers, and printing plates,

4) Dirt repellant agents for mixtures used in coatings applied to films, papers, and printing plates,

5) Adhesion control agents for mixtures used in coatings applied to films, papers, and printing plates,

6) Surfactants in photographic processing solutions used in the processing of films and papers,

7) Defoamer used in the production of processing chemicals for films, papers, and printing plates,

8) Photoacid generators in photolithographic processing solutions used in the manufacture of integrated circuits and printing plates,

9) Surfactants in photolithographic processing solutions used in the manufacture of integrated circuits and printing plates, and

10) Surfactants in top and bottom antireflective coatings used in the manufacture of integrated circuits.

These comments are not intended to address Uses 8, 9, and 10 above for manufacture of integrated circuits; as these uses have already been addressed by comments prepared by the Semiconductor Industry Association (SIA) and Semiconductor Equipment and Materials International (SEMI)[5]. The I3A member companies support the comments provided by SIA and SEMI.

3.0 PFAS Chemicals Included in the Proposed SNUR with Imaging Uses and PFOS Equivalence

At the public hearing on the proposed SNUR, the Agency requested identification of PFAS chemicals potentially subject to the SNUR that were used (Uses 1-6 above) by the imaging industry. In response to this request, the information in Table 1 below, along with Confidential Business Information submitted by individual companies, was provided to the Agency[3]. Since these submissions, the use of the material listed on Table 1 as CAS 2991-51-7 or FC-125 has been discontinued for imaging materials. Previously, the industry reported the total number of PFAS materials used for imaging purposes as ten (the 5 cited on Table 1 and 5 reported as CBI submissions) as identified by CAS or PMN numbers.

Table 1

CAS No./PMN	Chemical name or identifier
1652-63-7	1-Propanaminium,3-[[(heptadecafluorooctyl)sulfonyl]amino]-N,N,N-trimethyl-, iodide. This chemical is provided in a mixture with other fluorochemicals (C4-C7) (CAS No. 68957-58-4, 67584-58-1, 67939-95-1, and 68957-57-3) and residual organic fluorochemicals in a product with the trade name Fluorad FC-135. All of the chemicals in the mixture would require an extension from the requirements of the SNUR.
P-96-1262	Sulfonic acids, C6-8-alkane, perfluoro, compounds with polyethylene -polypropylene glycol bis(2-aminopropyl)ether.
11114-17-3	Fluoroaliphatic polymeric esters + (5049P). This material is provided in a mixture with residual organic fluorochemicals, and a fluorochemical monomer in a product with the trade name Fluorad FC-430. All of the chemicals in the mixture would require an extension from the requirements of the SNUR.

12707-52-7	Fluoroaliphatic polymeric esters + (5050P). This material is provided in a mixture with residual organic fluorochemicals in a product with the trade name Fluorad FC-431. All of the chemicals in the mixture would require an extension from the requirements of the SNUR.
2991-51-7	Glycine, N-ethyl-N-[(heptadecafluorooctyl)sulfonyl], Potassium salt. This chemical is provided in a mixture with residual fluorochemicals (C4-C7) CAS No. 67584-53-6, 67584-51-4, 67584-62-7, 67584-52-5) in aqueous solution in a product with the trade name Fluorad FC-125. All of the chemicals in the mixture would require an extension from the requirements of the SNUR.

The 3M material safety data sheets (MSDS) for the Table 1 PFAS products are attached (Attachments 1-5) to these comments for your review. The MSDS are for the product as delivered to the customer and not for the fluorochemical solids in the product. All of the Table 1 products except for FC-430 are significant dilutions of the fluorochemical solids with organic solvents or water.

Seven of the ten fluorochemicals identified on Table 1 or in CBI submissions are polymeric (3 on Table 1 and 4 CBI). Use of one of the non-polymeric materials (FC-125; CAS 2991-51-7) has been discontinued by the industry.

On an equivalence basis, the PFOS content of the polymers is low. For example for FC-430 (CAS 11114-17-3), the molecular weight of the polymer is approximately 14,200 while the molecular weight of the PFOS moieties is approximately 966 or about 7% of the total weight of the molecule. For FC-431 (CAS 12707-52-7), the molecular weight of the polymer is approximately 9,930 while the molecular weight of the PFOS moiety is 483 or about 5% of the weight of the molecule. For P-96-1262, the molecular weight of the polymer is on average 1550 while that of the PFOS moieties is 966 or 62% of the weight of the molecule.

For FC-135 (CAS 1652-63-7), a non-polymeric material, the molecular weight is 726 while the weight of the PFOS moiety is 483 or 67% of the total weight of the molecule.

The PFOS equivalents in the 3M products are actually less than the amounts listed above because there are shorter chain perfluorochemicals in each of the products that are not accounted for in the calculations.

4.0 Results of Voluntary Withdrawal Activities and Continuing Uses of PFAS Chemicals

In prior communications[1, 2, 3], the imaging companies identified to the Agency their commitment to voluntarily withdraw from the use of

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perfluorooctylsulfonate-related chemicals including, but not limited to, those subject to the proposed SNUR. The withdrawal process began in the summer of 2000, some months before the publication of the original proposed SNUR for PFAS chemicals. As previously indicated last year[1], this process could take 5-7 years to complete because inventions may be required to find adequate replacement materials for some product applications. The withdrawal effort is a worldwide effort not limited to activities subject to the Toxic Substances Control Act (TSCA).

In the year since the public meeting called to address the proposed SNUR, the companies have aggressively pursued alternatives and made significant progress in identifying and implementing changes that reduce the amount of the Table 2 (See 67 FR 11014 for chemical list) PFAS chemicals. This progress has come about by the imaginative research efforts of scientists and engineers from the imaging companies and their suppliers who worked together to identify replacement materials, used the EPA's Pollution Prevention Framework to identify promising greener materials, and developed re-formulations that eliminated the need for PFAS replacements.

As a consequence of the progress made to date, the following uses can be eliminated from the imaging industry's request for exemption:

> 7) Defoamer used in the production of processing chemicals for films, papers, and printing plates,
>
> 8) Photoacid generators in photolithographic processing solutions used in the manufacture of printing plates, and
>
> 9) Surfactants in photolithographic processing solutions used in the manufacture of printing plates.

In addition, Use 6 (Surfactants in photographic processing solutions used in the processing of films and papers) can be modified to eliminate the use for a surfactant in processing solutions for papers.

The remaining uses (Uses 1-5 and 6 with modification) remain critical applications for PFAS coating aids used to manufacture film, paper, and printing plates. While these uses may be considered two uses (i.e., coating aid and surfactant), the effects they are intended to impart to a product could be one or all of the properties described in Uses 1-6. While an exemption is being requested for Uses 1-6, the imaging industry's voluntary withdrawal efforts have made significant reductions in these uses as well.

As a result of these voluntary efforts, the demand for PFAS chemicals included in the proposed SNUR for imaging uses is expected to be 3,000 kg/yr in the USA by

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yearend 2002. Of this amount less than 50 kg/yr are used for paper products and less than 300 kg/yr are used for printing plates with the remainder being used for various film products in the USA. Of the remaining 2650 kg/yr that is used for film, 30 kg/yr is used as a surfactant in processing solutions and 2620 kg/yr is used in film coatings.

When the use volumes are viewed in terms of PFOS equivalents, as discussed above, actual PFOS use is significantly lower (5-67% of the stated use level depending on which PFAS chemical is used for a particular imaging product type (i.e., film, paper, printing plate)). In terms of PFOS equivalents, the total amount of PFAS used for imaging products is at least one-third less or 2000 kg/yr based on the highest PFOS-containing chemical listed on Table 1.

While the imaging companies expect that sales of imaging products will grow in the range of 5-15% depending on the product line, PFAS use is not expected to grow as replacement activities are expected to offset any demand created by imaging product sales growth.

5.0 Information on Global vs. Domestic Use of PFAS Materials, Domestic Sourcing vs. Import of PFAS, Import and Export of PFAS-containing Products, and the Polymeric Nature of PFAS Materials by Product Type

The USA use cited above (3000 kg/yr) includes both use by the customer and use in the manufacture of imaging materials. The USA use is estimated to be about half of the global use of PFAS materials in imaging products.

Of the 2620 kg/yr used in the USA for film coatings, approximately half of the PFAS volume is sourced in the USA and half is imported. Approximately 15% of the imported PFAS materials are imported as finished articles. Approximately, 25% of the material used in manufacture in the USA is exported or re-exported (export of imported PFAS incorporated into finished articles). The majority of the exported/re-exported PFAS is PFAS that is sourced in the USA and is polymeric.

Of the 300 kg/yr used for printing plates, approximately 30% of the PFAS is sourced in the USA and 70% is imported (65% as raw material and 5% incorporated into printing plates). Approximately 20% of the material used in manufacturing printing plates in the USA is exported or re-exported. The PFAS materials used in this application are polymeric.

Of the 50 kg/yr used for paper, the PFAS is imported as a finished article; although sourcing can change based on customer demand. The materials used in this application are non-polymeric.

Of the 30 kg/yr used for film processing, the PFAS is imported in a finished product and used by customers in the USA. None of this material is re-exported and none is polymeric.

Table 2

GLOBAL/DOMESTIC SOURCING AND USE OF PFAS MATERIALS

PFAS Use	**PFAS Volume (kg/yr)**	**PFAS Sourced in USA (% of volume)**	**Imported PFAS (% of volume)**	**Exported and Re-exported PFAS (% of volume))**	**Polymeric or Non-polymeric**
Film Coating Aid	2620	50%--raw material	35%--raw material 15%--finished article	25%	Majority is polymeric; some non-polymeric
Printing Plate Coating Aid	300	30%--raw material	65%--raw material 5%--finished article	20%	Polymeric
Paper Coating Aid	50	0	100%--finished article	- 0 -	Non-Polymeric
Film Processing Surfactant	30	0	100%--finished product	- 0 -	Non-Polymeric

6.0 Information About How Industry Has Changed Products and Processes to Achieve PFAS Reductions

While imaging products may perform in a similar manner and the manufacturing processes are very similar across the industry, the formulae for imaging coatings differ company-to-company and product-to-product. Thus, each manufacturer and each product development team must assess replacements for PFAS in reference to its own formulations. The imaging companies have met with their suppliers and received information about possible replacement materials. The suppliers include companies providing both perfluorinated and non-fluorinated chemicals. In evaluating alternatives, imaging companies have been reviewing alternatives both from a performance perspective and a health, safety, and environment perspective. Although suppliers can provide suggestions for replacements based on physical property similarities to the PFAS chemicals, suppliers are not in a position to make definitive recommendations for replacements as each product formulation may have unique performance properties.

Three basic processes are being followed for replacement 1) find alternatives to PFAS that are compatible with existing formulations, 2) reformulate products to make them more compatible with existing alternatives, and 3) redesign products to replace or eliminate PFAS use.

These alternatives involve laboratory scale evaluations of many different candidate replacements (alternative chemicals or alternative formulations), small volume formulation evaluations on a research and development scale, chemical interaction studies to define chemical and imaging interferences, film coating experiments to gain an understanding of how an altered coating will behave while being coated by machine, high-speed film transport studies to understand how coatings will behave when moving through manufacturing and processing machinery, full-scale internal trials using processes and equipment that will actually be used to make and process a product, and trade trial evaluations to learn how a product will behave during customer use.

Each formulation change takes many months of effort by skilled research and development teams.

Successful alternatives to PFAS materials have included non-perfluorinated chemicals, chemicals with short (C3-C4) perfluorinated chains that have been reviewed by the Agency under TSCA Section 5 procedures, telomers, and in a few cases reformulations that are inherently less sensitive to static build-up. Experience has shown that no one alternative fits all product applications for any of the PFAS materials.

7.0 Information About Alternative Fluorinated Chemistries that have been Used as Replacements Particularly with Regard to the Extent to which PFAS Reductions Rely on Some of the Other Chemicals Currently Under Investigation

As stated at the April 2001 public meeting on the proposed SNUR, the imaging companies have made a voluntary commitment to withdraw from use of the PFAS materials; therefore, it would be inconsistent for the companies to substitute the materials that are being withdrawn by 3M with the same or similar materials provided by other vendors. Specifically, C6-C8 PFAS materials that are not the subject of the proposed SNUR have not been used to accomplish withdrawal goals.

PFOA, chemicals related to PFOA, or chemical mixtures containing PFOA have not been used as replacements.

Telomers are under review as replacements. The materials that are being considered have predominantly ≤C6 or ≥C10 perfluoroalkyl chains (90-99%). In a limited number of small volume applications, water insoluble, high molecular weight polymers with primarily C8 perfluoroalkyl chains are being considered.

8.0 Continuing Uses and Recommended Wording of Exemption for PFAS Materials in Coatings

Voluntary efforts to remove PFAS materials from use in imaging products have resulted in the discontinuance of several applications (Uses 7-9 above plus Use 6 as it applies to paper). With these changes, the primary uses (Uses 1-5) are in coatings. A significant reduction in the amount of PFAS materials used for specific coating applications has also been achieved. However, no universal coating aid replacements have been found for PFAS materials. Products where reformulation has not been successful continue to require PFAS-related materials for their successful manufacture and use.

As a result of the voluntary efforts, the following remaining imaging uses are requested for the final SNUR. All of these requests, except Use 6, are for use of PFAS as coatings aids that produce certain desired effects during the manufacture and use of imaging materials. These uses include:

1) Surfactants for mixtures used in coatings applied to films, papers, and printing plates,

2) Electrostatic charge control agents for mixtures used in coatings applied to films, papers, and printing plates,

3) Friction control agents for mixtures used in coatings applied to films, papers, and printing plates,

4) Dirt repellant agents for mixtures used in coatings applied to films, papers, and printing plates,

5) Adhesion control agents for mixtures used in coatings applied to films, papers, and printing plates, and

6) Surfactants in photographic processing solutions used in the processing of films.

PFAS coating aids have a combination of surface-active properties that are unique and not found with any other type of coating aid. Only small quantities of PFAS materials are required to function as coating aids in imaging media; this property is important because the required addition of non-photoactive materials to coatings in significant quantities diminishes the ability of the imaging material to form the sharpest images. That is to say, thinner coatings make clearer, sharper images.

The ability to control surface tension in imaging materials (films, papers, and printing plates) is a critical aspect of the use of PFAS materials as coating aids. In order to function, imaging materials must be coated with multiple thin (up to 18) layers of light sensitive materials at high speed to prevent drying of materials as they are laid down. The overall thickness of an imaging film with 18 imaging layers on a 3 mil film base is on the order of 0.11 mm. PFAS materials play a key role in minimizing manufacturing waste by contributing to the technology for creating coatings of high complexity in a highly consistent manner. The coating aid must allow the rapid uniform spreading of the layers so that irregularities in the coatings are avoided. Any irregularity in coating thickness makes imaging materials useless and increases manufacturing waste significantly. Coating aids must also not be photoactive, otherwise, unacceptable fogging or speed effects may occur in the coatings.

PFAS coating aids also have unique properties at low concentrations for controlling static charge during the manufacture and use of imaging materials. This is particularly important for imaging materials that have a high sensitivity to light (i.e., high speed), as these products are unusually sensitive to light produced by static discharge during transport of imaging materials. While friction control during transport of imaging materials through manufacturing equipment and other devices and dirt repellency are properties that are likely to be related to control of static charge; they have been called-out here to emphasize the important effects resulting from the use of PFAS materials in coatings. Excessive friction during the transport of imaging materials and contamination of imaging materials by dirt or clogging of magnetic strip readers with debris can lead to significant waste of imaging materials during manufacturing and use.

Adhesion control is a property imparted to film coatings as a result of the use of PFAS materials as coating aids. Control of adhesion of various tapes to imaging materials is important because tape is the primary way in which imaging materials are attached to spools and to each other during processing. The strength of the bond between the tape and the imaging materials must be controlled so that imaging devices (e.g., cameras, photoprocessors) and imaging materials are not damaged during transport (i.e., the adhesive bond between the tape and the imaging material must be broken by a force that will not damage devices or materials being transported).

For Use 6, the PFAS material functions as a surfactant in a limited number of solutions used in the processing of films. This use involves incorporation of a PFAS material into a mixture that is used as a photoprocessing solution where its surfactant properties function to prevent discoloration of films while the films are being processed through the solution. Without the PFAS surfactant, waste from damaged film is significant. Alternatives to PFAS have not yet been identified for this use.

With regard to the uses identified in the proposed SNUR, an issue that warrants clarification is the wording of the exemption as stated in Units II.A.iv and III. 2.iv that refer to: "***iv. Use in surface tension and static discharge control coating on films, papers, and printing plates, or as a surfactant defoamer in solutions used to process films and papers, in traditional and laser medical imaging and in industrial and consumer film products***."

In order to more explicitly demonstrate that the proposed wording covers the requested exemption and to take into account the recommended deletions identified above, the following wording is proposed:

" **iv.** ***Use in coatings for surface tension, static discharge, and adhesion control for analog and digital imaging films, papers, and printing plates or as a surfactant in mixtures used to process imaging films.***"

The intent of the proposed wording is to define an exemption that:

- Encompasses only specific, critical, existing uses of PFAS materials in use in imaging products.
- Excludes discontinued and new uses of PFAS materials,
- Clearly defines the PFAS uses in terms of their function as coating aids and a surfactant,
- Limits the purpose for which PFAS materials are used in coating aids and as a surfactant, and
- Clearly defines imaging uses as including both analog and digital products.

Note: The terms analog and digital are preferred descriptors rather than use of the term photographic because these terms are commonly used in the industry to describe product types and because they more precisely describe the imaging products that contain PFAS. A primary distinguishing characteristic of analog processes is that they record data in continuously variable physical quantities, while digital processes record data in discrete or binary units (the

> digits 1 and 0). Imaging products can record data using either process and some products use both processes, typically for different types of data (for example, an imaging film may store data for a "picture" using an analog process such as silver halide deposition and information about the picture (time taken, lighting conditions, etc) using a digital process). In addition, all of the data stored in imaging products is not photographic, for example, movie film records both photographic and audio data. What distinguishes imaging products from other types of products is that they are primarily intended to record an image and/or information about an image (i.e., data, sound, heat, density, ionizing radiation, etc.).

We believe that this approach to defining the exemption will address the Agency's intent to allow restricted use of PFAS in an environmentally responsible manner and the manufacturing need for access to materials that have unique properties.

9.0 Recommendation for Inclusion for Use of PFAS Chemicals as Intermediates for the Production of Chemical Substances Solely for Approved Uses

The imaging companies are recommending that exemption ***III.2.iii. Use as an intermediate only to produce other chemical substances to be used solely for the uses listed in Unit III.2.i or ii*** be expanded to include imaging uses identified in the proposed rule as ***III.2.iv.***

10.0 Information About How and Why the Remaining PFAS Chemicals are Used to Distinguish Functions in Which These Chemicals Can be Replaced by Others Versus Uses in Which PFAS Chemicals may Provide Functionality or Product Efficacy Not Available from Other Chemical Alternatives or Process Changes.

The Agency has asked for information about the remaining uses of PFAS chemicals. As previously stated, the imaging industry is in the midst of a voluntary replacement for all PFAS chemicals and has indicated that this process could take 5-7 years to complete, and that there may be some uses for which no replacement will be found. The reasons for this uncertainty is that the replacement process is a discovery or research process that requires a significant investment in resources and in some cases may require an invention that is presently not obvious.

Uses 1-6, as defined above, involve formulation of PFAS chemicals as coating aids and surfactants to control dynamic and static surface tension and static charge, to ensure operational and employee safety, eliminate unwanted photographic effects, and enhance transport characteristics. Imaging materials that are more sensitive to light (i.e., high-speed films) have a greater requirement for the properties provided by PFAS materials and are consequently more difficult to reformulate. The remaining PFAS uses are also important because PFAS materials: 1) lack photoactivity and thus do not interfere with the imaging process; 2) promote uniformity of photoprocessing results; 3) control splicing tape adhesion properties; 4) are compatible with photo-retouching materials; 5) improve camera, projector, and printer transport to eliminate unwanted photographic effects; and 6) prevent clogging of magnetic strip readers.

11.0 Response to Questions Raised by the Agency Concerning Anticipated Exposures and Releases

In the proposed SNUR, the Agency requested information concerning anticipated exposures and releases that may result from imaging uses and information on handling and disposal controls that would control, reduce, or eliminate exposures and release, and address issues raised by publication of the proposed SNUR. The response to this request will follow a life cycle approach (LCA) covering the potential for human exposure to PFAS materials and environmental release during manufacture, use, and recycling.

There are several assumptions used in making these estimates that should be recognized. The volume of PFAS material that is estimated to be used in the USA is based on the solids content of the 3M products rather than the volume of product that is purchased; this factor eliminates solvent weight from the estimates. The model assumes that all of the PFAS used for these imaging products is sourced in the USA from 3M whereas approximately half is sourced from other companies outside of the USA. The model also assumes all of the material used in manufacturing processes was coated and finished within the USA; whereas, some of the manufacturing was completed outside of the USA. The model also assumes that all product that was manufactured or imported into the USA was used within the USA; whereas, approximately 25% of the products were exported. The weight of the PFAS is shown as the total solids weight; whereas, the PFOS equivalence of the weight of the polymeric materials is 5-62% and the PFOS equivalence of the non-polymeric material is 67% based on the Table 1 chemicals.

Figures 1 and 2 provide schematics showing the potential distribution of PFAS materials during their life cycle. As requested by the Agency, the information on recycling has been removed from the Figure 1 and expanded upon in the comments below. Process knowledge and engineering principles were used to create scenarios that explain the potential for environmental release of PFAS materials from imaging uses. The process scenarios were reviewed and agreed on by the engineering and scientific staff of the imaging companies. Probabilistic modeling was used to estimate mean release values.

The probabilistic LCAs for PFAS release were conducted using Microsoft Excel 2000 and Crystal Ball 2000 Version 5.0 (Decisioneering, Denver Colorado). Each simulation was performed using the Monte Carlo Sampling Method set for 10,000 trials. All inputs were characterized as triangular distributions with maximum and minimum values, and with the likeliest value set at mid-range in most cases. Simulation outputs were selected to reflect modeled PFAS disposition, e.g., Total PFAS to Incineration (Smelter). Mean values from the Monte Carlo output distribution were then chosen as representative of PFAS disposition.

In addition, information was requested and received from recyclers of film, paper, and printing plates including operations that recover silver, aluminum, and film base materials from these products.

11.1 Manufacturing Operations: Potential for Occupational Exposure and Environmental Release

11.1.1 Information on the Number of Manufacturing Facilities Involved in Use of PFAS Materials Worldwide and Within the USA

The Agency has requested information on the number of manufacturing sites involved in the use of PFAS materials. Caveats that need to be considered when reviewing this information are: 1) the number of manufacturing sites in countries formerly part of the Soviet Union is not available and 2) it has been assumed that all of the sites use PFAS materials that are supplied by 3M; this latter assumption provides a high or over-estimate of the number of sites using the PFAS chemicals named in the proposed SNUR. There is some additional uncertainty in these estimates because some sites that were formerly manufacturing materials may be supplying products produced at other sites; that is, due to consolidation within the industry, some manufacturing sites may have been converted to distribution sites. The estimate of the number of worldwide sites potentially using PFAS materials is 69 (30 film and paper; 39 printing plates) while the number of sites in the USA is 17 (6 film and paper; 11 printing plates).

11.1.2 Information on Incineration Facilities and Practices

The Agency requested information about incineration facilities and practices in the industry. As indicated in data from 1999 held by the Office of Solid Waste and Emergency Response, one industry facility in the USA has on-site incineration capability. However, other industry manufacturing locations in the USA have incineration facilities available through off-site contracts. In addition, some non-USA locations have incineration capability on-site as late as 2001 and all non-USA sites have incineration facilities available through off-site contracts.

11.1.3 Potential for Occupational Exposure During Manufacture of Film and Paper

As indicated in prior comments[1,2] occupational exposure to PFAS chemicals occurs, if at all, at minimal levels.

Three of the five materials listed on Table 1 are polymeric materials of relatively large molecular weight. All but one of the PFAS materials has been provided by 3M in concentrations ranging from 50-90%. Historically, these materials have been controlled in the workplace because of their VOC content, which includes toluene, ethyl acetate, methyl ethyl ketone, and isopropyl alcohol.

Potentially, exposure to 3M materials occurs when coating formulations are made by addition of 3M-supplied (typically in 5 gallon containers) PFAS materials to the coating mixtures. This operation occurs in chemical preparation areas where employees are wearing company-supplied uniforms, eye shields, and gloves. In some operations, respirators are required to be worn while in others, they are available but not required. After mixing, the diluted PFAS-containing mixtures are transferred via automatic piping from the mix preparation area to the production area where they are added to coating machines that handle the actual application of the coating mixtures with only minimal human intervention at the start of the coating process. Because coatings need to be conducted in a clean environment, access to coating machines is very limited. To prevent contamination of the coatings, employees are generally not allowed in the coating rooms during coating and drying operations. One manufacturer indicted that a very limited number of employees could be present in coating rooms during operation, but they would be wearing PPE. For most employees, there is no exposure during coating operations unless a mechanical failure were to occur. To correct mechanical failures, personnel allowed in the coating area, wear company-supplied uniforms and eye shields. The number of employees allowed in the coating operation is limited to prevent product contamination. Exposure to PFAS materials even during mechanical failures is expected to be zero to minimal as the PFAS materials are bound in coating media, some products have surface overcoats that cover PFAS-containing coatings, and contact is at most limited to the hands, if gloves are not worn.

Monitoring for occupational exposure was conducted in four different workplaces where PFAS products as provided by 3M are handled and mixed. The workplaces studied handled these products as supplied by 3M. Four of the five 3M products listed on Table 1 are significant dilutions on the order of 50-90% as received from 3M. These studies were conducted with the cooperation of 3M, which provided a consulting analytical test laboratory with test standards. The analytical laboratory had prior experience analyzing PFAS chemicals. At the workplaces, there was no opportunity for ingestion of or dermal or ocular contact with the 3M products as protective gloves, goggles, and eye shields are routinely in use. The purpose of the monitoring was to quantify airborne concentrations of residual fluorochemicals while dispensing and mixing four different 3M products. Personal and area monitoring were performed in each workplace.

During the sampling process, pumps were fitted with MTO-ORBO tubes and calibrated to 1 L/min. The analysis conducted by Centre Analytical Laboratories followed Standard Operating Procedures CAL-24FHE/1, CAL-24FGM/1, and CAL-24FLM/1. MSA pumps were calibrated before and after use. The sample tubes were separated into three fractions and each section was extracted with 1 ml of acetone and analyzed by liquid chromatography / mass spectrometry (LC/MS).

In all cases (Attachments 6-9), the results show that airborne concentrations in the workplace were below detectable levels (< 0.013 mg/m^3).

During finishing operations, imaging materials are slit to commercial sizes, films are perforated as needed, quality assurance test are performed, and finished product is spooled, wrapped, and boxed. Operators use bulk handling equipment to transfer light sensitive materials to the slitting and perforating machines. These operations are automated to maintain the light sensitive nature of the product and avoid contamination with dust or other debris that can make the product unusable. Contact with product is minimal but may occur during machine set-up, machine failure, and quality control sampling. Some dusts may be present during cutting and perforating operations; dust masks are available for use to reduce exposure.

11.1.4 Potential for Occupational Exposure During Manufacturing Operations for Printing Plates

The process for manufacture of printing plates is similar to that of a clean-room environment in that the coating process is fully automated and carefully controlled to maintain a clean environment. Containers of PFAS materials and other solutions are connected to automatic diluters that pump the solutions to the coating operation where they are mixed and coated without human intervention. Employees in manufacturing operations wear company-supplied uniforms, eye shields, and gloves to prevent contact with the products. Employees are not allowed in the room with the coating machine during operation to prevent product contamination. Products are typically packaged and boxed using automated equipment designed to reduce product contact. Where packaging is done manually, employees wear gloves to prevent product damage. In the event of a mechanical failure, employees wear company-supplied clothing and equipment to avoid product contamination.

11.1.5 Potential for Occupational Exposure During Manufacture of Processing Solutions for Film

The products containing the surfactant are imported into the USA in a finished form; thus, there is no employee exposure in the USA. The employees that manufacture the finished product wear company-supplied uniforms, chemical resistant gloves, safety glasses, and approved disposable respirators under local ventilation when handling the PFAS material.

11.1.6 PFAS Dermal Absorption and Blood Level Data

The Agency has asked for information about dermal absorption studies and blood level data for the PFAS chemicals used for imaging products. As indicated above in Sections 11.1.3 and 11.1.4, we do not believe that there is any opportunity for absorption of PFAS materials during use of PFAS materials in the imaging industry. To address the Agency's request, we took three actions 1) confirmed that the imaging companies do not have studies on dermal absorption or blood levels for PFAS chemicals, 2) searched the TSCA 8(e) docket for relevant information, and 3) contacted 3M Corporation for information that would address the Agency's queries.

A search of the TSCA 8(e) PFOS docket identified one file (AR226-0223; Page 000252-000253) with a reference to a dermal absorption study with FC-135 (CAS 1652-63-7) using rabbits. Additional information on this study was provided by 3M (Attachment 10). In this study, New Zealand rabbits were dosed dermally with 5,000 mg/kg of FC-135. Blood was collected for total serum fluorine analysis on Days 1 and 28. Male rabbits had serum fluorine of 2.3 ppm on Day 1 and 7.6 ppm on Day 28. Female rabbits had serum levels of 6.9 ppm on Day 1 and 20.8 ppm on Day 28. The 3M report considered these data to indicate absorption; however, the endpoint analyzed is not specific to FC-135, no baseline data were reported for the test animals, and no control data were reported for comparative purposes.

Representatives of 3M indicated that 3M had no other skin absorption data (human or animal)) or blood level measurements (human or animal) for the PFAS chemicals used by the imaging industry.

11.1.7 Potential for Environmental Release During Film and Paper Manufacture

In considering the potential for environmental release of PFAS materials, a combined life cycle assessment model (LCA) was considered for film and paper because the manufacturing and use processes are similar for these products. Process knowledge and engineering principles were used to create scenarios that explain the potential for environmental release of PFAS materials from imaging uses. The process scenarios were reviewed and agreed on by the engineering and scientific staff of the imaging companies. As previously described, probabilistic modeling was used to estimate mean release values. The PFAS materials (50 kg/yr) used for paper are non-polymeric materials. The PFAS materials used for film are primarily polymeric.

The manufacturing phase of the model includes two stages: Coating and Finishing. While small amounts of PFAS materials are added to products during the Coating stage of the product life cycle, they have impacts on film and paper (i.e., surface tension, electrostatic discharge, adhesion, dirt repellency) throughout the life of the product, which is generally considered to have a useful life in excess of 100 years. Therefore, the PFAS materials must remain in the product for the product to perform adequately.

The Coating stage involves the laying down of up to 18 layers of emulsions or dispersions on a film or paper base that is several meters wide. The thickness of the resulting film (film base and coatings) is approximately 0.11 mm. The waste involved in this process includes containers that originally held the PFAS product and coating waste. The containers are disposed of through high temperature incineration in a rotary kiln or placement in a secure landfill. Coatings that are excess or not suitable for use are sent for silver recovery where the waste is incinerated at high temperature as described below in Section 11.4. PFAS material that is not used and containers are incinerated as hazardous waste. This waste amounts to 1-3% of the available PFAS material, which is a mean loss of 53 kg/yr. Coatings that cannot be used amount to 5-28.5% of the available PFAS material, which results in a mean loss of 447 kg/yr that is incinerated prior to silver recovery.

The Finishing stage involves slitting and perforating (where necessary) the rolls of film and paper which are several meters wide into product dimensional sizes of sheet or roll film and paper, spooling of rolls of film and paper, and placement of film and paper into light tight cassettes or pouches. The wastes from this process are all solid (e.g., sprocket hole chads) and are either incinerated or washed prior to recovery of silver and PET as described below in Section 11.4. Ultimately, all of the PFAS waste is incinerated. Waste from Finishing operations is in the range of 5-15% of the available PFAS that on average is 217 kg/yr of PFAS materials.

11.1.8 Potential for Environmental Release During Printing Plate Manufacture

The manufacturing phase of the environmental release model for printing plates includes two stages: Coating and Finishing. While small amount of polymeric PFAS materials are only added during the Coating stage of the product life cycle, they have an impact on the printing plates (i.e. surface tension, electrostatic discharge, adhesion) throughout the life of the product. The useful life is generally considered to be 2-4 years. Therefore, PFAS or an appropriate replacement must remain in the product for the product to perform adequately.

The Coating stage involves the laying down of one or two layers each of which is approximately 1-3 μm thick, on an aluminum base that will range from 0.70–1.5 meters wide. The waste involved in this process includes containers that originally held the PFAS product and coating solution waste. These drums are disposed of by incineration. The coating waste is drummed and removed as solvent waste, which is incinerated at high temperature in a rotary kiln. Waste from this operation is in the range of 1-10% of the available PFAS that on average is 14 kg/yr.

Coated printing plates are inspected and finished to final size. The finished printing plates are packaged into corrugated boxes and/or wood crates. The wastes from this process are solid sheets of coated aluminum. The aluminum sheets are sent for incineration and recovery of the aluminum. Waste from this operation is in the range of 10-24 % of the available PFAS that is on average 49 kg/yr of PFAS materials.

11.1.9 Potential for Environmental Release During Manufacture of a Processing Solution for Film

The products containing the surfactant are imported into the USA in a finished form; therefore, there is no environmental release in the USA during manufacture. Use during product manufacture is a simple mixing process. Waste from this process includes residual materials in containers that are either incinerated or placed in a secure landfill.

11.2 Product Use of Film, Paper, and Printing Plates: Potential for Consumer and Professional Exposure and Environmental Release

11.2.1 Potential for Consumer and Professional Exposure During Product Use of Film, Paper, and Printing Plates

A single scenario for consumer and professional products was considered. Film and printing plates were considered to present similar exposure potentials because both are typically negative images used for making positive images and even when films/plates are positive images they must be handled as are negative images in order for image quality (i.e., absence of finger prints, scratches, dirt, and oils) to be preserved. With regard to films and plates, the concentration of PFAS materials in coatings is in the range of 0.1-0.8 $\mu g/cm^2$ on one side of the film or plate; however, all of this material will not be on the surface of the coating as the PFAS material is contained within a coating matrix. Although, actual binding data are not available, cationic PFAS material (i.e., CAS 1652-63-7, Table 1) is expected to bind to gelatin in coating matrices[6], while other PFAS materials are polymeric materials that are mixed into coatings and have limited water solubility (i.e., CAS 1114-17-3, 12707-52-7, P-96-1262, Table 1). Films that are part of the APS product lines are returned to consumers in a sealed cassette that prevents all contact with film surfaces. However, even in the absence of a sealed cassette, most films are not handled at all once printed and those films and plates that might be handled are handled along the edges and by the fingertips to avoid damage to the negative image. Voluntary withdrawal efforts underway have already identified replacements for some of the most common varieties of consumer film. Voluntary withdrawal efforts and substitution of analog imaging technology with digital imaging technology will further reduce any potential exposure to PFAS from films and printing plates.

With regard to potential exposure from paper products, <50 kg of the PFAS materials are used for paper products. The majority of consumer and professional imaging papers do not contain these materials. For papers that do contain PFAS materials, the coatings contain in the range of 0.1-0.8 $\mu g/cm^2$ of the PFAS materials; however, all of this material will not be on the surface of the coating as the PFAS material is contained within a matrix. Although, actual binding data are not available, PFAS chemicals are likely to bind to coating matrices in a manner similar to that discussed for film. While the potential contact area for paper is greater than for film, the likelihood of a significant exposure occurring is regarded as minimal.

With regard to the use of the film processing surfactant, there is no expected exposure because the surfactant is washed off of the film prior to being returned to the customer.

11.2.2 Potential for Environmental Release During Product Use of Film and Paper

For film and paper uses, consumer purchased product that is not used is discarded in municipal waste collection systems, the majority of which is expected to be deposited in landfills as only 8% of municipal waste is incinerated[7]. The amount of the available PFAS material that is estimated to be disposed of through this route is 1-5 % with on average 55 kg/yr going to landfills (92% of total disposed) and 4 kg/yr for incineration (8% of total disposed).

11.2.3 Potential for Environmental Release During Product Use of Printing Plates

For printing plates, 1-5% of purchased product is estimated to be discarded prior to processing due to handling or other forms of product damage; this amount of scrap is included in the Finishing phase shown in Figure 2. Damaged plates are collected and recycled for aluminum as described below.

11.3 Photoprocessing Operations for Film and Paper, and Plate Processing: Potential for Occupational Exposure and Environmental Release

11.3.1 Potential for Occupational Exposure During Photoprocessing of Film and Paper

Photoprocessing involves the development of latent images and fixation, bleaching, and washing of the film prior to printing, scanning, or direct viewing as in the case of medical X-ray film. As discussed in Section 11.2.1, handling of film or paper is expected to provide only negligible contact with PFAS materials. The PFAS materials listed in Table 1 are primarily used in wet processed film as the remaining dry processed demand is expected to be discontinued by year-end 2002. Therefore, this discussion will focus only on wet processed film and paper. In wet processing film, approximately 5-10% of one PFAS material may be released from film into film developer. None of the other PFAS materials used in imaging (see Table1) would be expected to be released into photoprocessing solutions. Although actual binding data are not available, cationic PFAS chemicals (i.e., CAS 1652-63-7, Table 1) are expected to bind to the coating matrices, while other PFAS materials are polymeric materials that are mixed into coatings and have limited water solubility (i.e., CAS 1114-17-3, 12707-52-7, P-96-1262). In most situations, machine operators or technicians place dry film or paper into a processor that mechanically moves the film or paper through the processing baths without operator contact. Processing bath tanks have been sized so that it is difficult for an operator to come into direct contact with developer solution. During processor upsets, it is recommended that operators wear gloves, if they have to handle wet film, to avoid contact with processing solutions and prevent film or paper damage; therefore, contact with PFAS materials is expected to be minimal. The PFAS materials used in films and paper are of low volatility; therefore, inhalation exposure to PFAS is not anticipated.

A PFAS material identified to the Agency under CBI is used in a mixture to make photoprocessing solutions. The photoprocessing solutions are dispensed into the film processing machines without employee contact. The amount used in this application is very small and, when present in photoprocessing solutions, is below the analytical detection limit for PFAS chemicals. The processing tanks that are used in this application do not allow employee contact and waste solutions are stored in tanks in the unit without employee contact.

11.3.2 Potential for Occupational Exposure During Plate Processing

Presensitized plates are offset printing plates used by commercial printers to reproduce photographic or digitally produced original data.

Plates are packaged in 20, 30, or 50 sheet bundles (constrained with tape, and by top and bottom chipboard), and wrapped by foil lined Kraft paper that is then placed in a corrugated shipping container that is shipped to the end user. The box is not opened until it arrives at end users to reveal the usable bundle of plates.

Plates are exposed using visible light or IR laser (depending on the type of plate) to create the desired image area on the plate surface. Due to the high throughput capability of modern platesetters, automation has become a mainstay of operations. To load the plates into an automated platesetter cassette, it is recommended that operators wear cotton gloves to handle the plate bundles with the top and bottom coverings (e.g., chipboard) in place. Once the bundle is secure in the cassette, the operator removes the chipboard and constraining tape and secures the cassette into the platesetter for operation.

The platesetter automatically picks one plate from the bundle and transports that plate onto the imaging drum of the platesetter. When the platesetter is finished exposing the plate on the drum, the automation transports the plate out of the platesetter, and into the processor to develop the plate in aqueous developer. As this cycle is completed, the platesetter automation is transporting the next plate onto the imaging drum.

The aqueous developer in the processor is exchanged with fresh developer at regular intervals. Addition of developer is performed by the platesetter operator; goggles, rubber gloves, and aprons are recommended PPE of the developer exchange operation. The operator does not come in contact with this developing solution since there are valves on the processor that are opened to release the developer directly into the end users wastewater collection and neutralization system. Therefore, exposure to PFAS materials is not expected from use of printing plates.

11.3.3 Potential for Environmental Release During Photoprocessing of Film and Paper

Photoprocessing involves the development of latent images and fixation, bleaching, and washing of the film prior to printing, scanning, or direct viewing as in the case of medical X-ray film. The PFAS materials listed in Table 1 are primarily used in wet processing of film and the need for remaining dry processing use is expected to be discontinued by year-end 2002. Therefore, this discussion will focus only on wet processed film and paper. In wet processing film, approximately 5-10% of one PFAS material may be released from film into film developer. None of the other PFAS materials used in imaging (see Table1) would be expected to be released into photoprocessing solutions. Although actual binding data are not available, some PFAS chemicals (i.e., CAS 1652-63-7, Table 1.) cationic are expected to bind to gelatin in coating matrices[6], while other PFAS materials are polymeric materials that are mixed into solvent-coated materials with limited water solubility (i.e., CAS 1114-17-3, 12707-52-7, P-96-1262). As a worst case, it assumed that all PFAS materials are released from products at 5-10% or on average 142 kg/yr. It is assumed that all of this material is sent to a publicly owned wastewater treatment plant (POTW); although silver recovery systems such as silver precipitating columns that are in common use may trap any PFAS released, in which case the PFAS would be incinerated during silver recovery.

A PFAS material (30 kg/yr) identified to the Agency under CBI is used in a mixture to make photoprocessing solutions. The amount used in this application is very small and, when present in the photoprocessing solution, is below the analytical detection limit for PFAS chemicals. Waste solutions are stored in tanks in the unit without employee contact. All of the PFAS material added to processing chemistry is assumed to be released and be contained in the wastewater effluent from the photoprocessing facility; however, the material discharged is expected to be below analytical detection limits for PFAS chemicals. The wastewater from the photoprocessing facility is disposed according to local, state, and federal regulations. The PFAS materials used in this application are not recycled.

The total potential release to POTWs for this segment of the LCA is 172 kg/yr (142 kg/yr plus 30 kg/yr).

11.3.4 Potential for Environmental Release During Plate Processing

Printing plates are processed using a developing solution. The aqueous developer in the processor is exchanged with fresh developer at regular intervals. It is estimated that 10-26.4% of the available PFAS material (on average 43 kg/yr PFAS) is removed during the developing process and sent to POTWs. Typical processor developer capacity is 7.5 or 12 gallons, depending on processor model. For waste handling, customers work with their local municipality (POTW), using a manufacturer-supplied effluent profile. In addition, 12-34% or on average 55 kg/yr PFAS is incinerated when the printing plates are sent for aluminum recovery.

11.4 Recycling Operations: Potential for Occupational Exposure and Environmental Release

11.4.1 Background Information on Recycling Of Imaging Materials

The imaging industry and its suppliers have a 100 year history of recycling manufacturing waste and recovering and recycling products post-customer use[8]. One manufacturing site alone has reported recycling and reuse of 285 x 10^6 kg of manufacturing and post-customer materials (consumer, professional, and industrial customers) during 2001[8]. This included: solvents (127 x 10^6 kg), polyethylene terephthalate (film base and other materials) (44 x 10^6 kg), and silver (0.5 x10^6 kg). Another company reported recycling 5.8 x 10^6 kg of solvents, 1.8 x 10^5 kg silver, and several other raw materials used for manufacturing imaging materials[9].

11.4.2 Film, Printing Plate, and Paper Recycling in the USA: Number and Size of Operations

The following information was developed through discussions and on-site visits with recycling operations at manufacturing sites and independent recyclers. Seventeen recyclers of scrap film were identified in the USA.

Imaging paper recycling is limited to manufacturing waste and thus is typically associated with manufacturing operations. It is estimated that there are two sites in the USA that process imaging paper for its silver content.

While the imaging companies identified use of only two recyclers for aluminum printing plates; there are at least 22 aluminum recycling plants in the USA[8]. Many of these aluminum-recycling operations are involved in processing beverage containers and other types of scrap; but some of them may also receive printing plates.

The Agency has expressed some concern about "exposure in the myriad of small silver reclamation facilities". While we were able to identify independent film recyclers of varying size (annual volumes of 2-15x10^3 tons of film), we were not able to identify a large number of these operations. There are several reasons why consolidation of recycling operations and the closing of others may have occurred in recent years. First the value of silver has been depressed making small operations unprofitable. Second, consolidation has occurred among imaging customers, particularly among hospitals, thus sources of smaller volumes of film for purchase have become fewer in number. Third, increased requirements for pollution control of small operators are likely to have made small-scale film recycling operations unprofitable.

11.4.3 Recycling of Post Consumer Materials

Recycling of post-consumer waste includes take-back of packaging, film spools, film canisters, film leaders, and single-use cameras. The single-use camera-recycling rate of nearly 75% makes it one of the most recycled products in the world. Recycling options for consumer film and paper (except potentially for small amounts of materials returned by photofinishers) are typically not available. Consumer interviews have found that consumers typically archive film and printed images along with cameras for a lifetime and across generations. Resale markets exist for private photographic holdings when consumers desire to sell materials. Materials that are discarded may be sent for recycling by dealers who purchase private holdings or are disposed in municipal waste systems. Recent estimates of municipal waste handling indicate that about 8% of municipal waste is incinerated and that significant degradation of PFAS materials should occur in combustion units meeting current EPA standards[7].

11.4.4 Paper Recycling: Potential for Occupational Exposure and Environmental Release

Imaging paper recycling is limited to manufacturing waste and is typically associated with manufacturing operations. Recycling of paper involves combustion in a commercial burner operating in excess of 1800° F for recovery of heat and silver (from the resulting ash). As a result of the industry's voluntary efforts to replace PFAS, annual usage for paper is estimated to be 50 kg/yr. None of this material is expected to be released to the environment as a result of recycling operations.

Employee exposure to PFAS materials is expected to be zero to negligible because most papers will contain no PFAS and handling of papers for incineration is a bulk handling operation. No environmental release is expected, as incineration temperatures are hot enough to thermally degrade PFAS materials[7,11].

11.4.5 Printing Plate Recycling: Potential for Occupational Exposure and Environmental Release

Recycling of aluminum printing plates is a relatively straightforward process as little physical activity is involved in preparing the plates for recycling. Manufacturing waste and plates that have been damaged in print shops are collected in Gaylord boxes by a recycler and transferred in bulk to a smelter operation. Some operations may shred metals to be smelted, but one large recycler of printing plates indicated that printing plates were not shredded prior to smelting. Vendors indicate that imaging coatings are not removed from the plates prior to smelting. Smelters use several different types furnaces to melt scrap aluminum, but it is common to melt scrap in a standard reverabatory furnace using gas or oil and air/oxygen heating with application of the flame directly to the scrap[10]. Incineration of high Btu fuels in a burner typically results in flame temperature from 2500 to over 3500° F, which is sufficient to destroy PFAS materials[7,11]. In addition to the heat of fuel combustion, the coatings on the plates are subjected to the heat absorbed by the plates during the smelting process, which requires 71 Kcal/mole of aluminum[10]. This temperature is more than sufficient to degrade the C-S bond in most PFAS molecules that probably have bond energies in the range of <20 to <78 Kcal/mol[7,11]. The fact that coatings are spread in a thin layer on the aluminum printing plates and the plates must melt completely in the furnace assures an even and minimum distribution of heat for combustion of the imaging coatings.

Employee exposure to PFAS materials is expected to be zero to negligible because the plate handling provides minimal opportunity for contact with the plates. No environmental release is expected as incineration temperatures are hot enough to thermal degrade PFAS materials[7,11].

11.4.5.1 Response to Incineration Question

Agency Query: The Agency indicated that in Section 11.4.5, it is stated that the PFAS coatings on printing plates would be destroyed during the aluminum recycling process because the flame temperature in the furnace would range from 2500 to 3500° F, and the coatings on the plates would be subjected to the heat absorbed by the plates during the smelting process, which, since it requires 71 Kcal/mole of aluminum to melt aluminum, would exceed the bond energy of the carbon-sulfur bond in a PFAS molecule, estimated in the range of <20 to <78 Kcal/mole in your Schnobrich reference[7]. However, the Dixon reference[11], which you also cite on the same point, considers the key bond energy for PFAS to be the carbon-fluorine bond, which is estimated at approximately 120 Kcal/mole. The Agency indicted it would appear that the C-F bond and its associated energy requirement would need to be addressed to determine whether the temperature and the time in residence at that temperature would suffice to destroy the compound.

Response to Query: Thermal breakdown of PFAS materials can be looked at from two points of view 1) does the thermal process create PFOS from a parent PFAS material and 2) if PFOS is not generated, does the process generate incomplete products of combustion. The first issue is addressed by comparing the bond energy required to break the C-S bond (<20 to 78 Kcal/mole) to the energy required to melt aluminum (71 Kcal/mole). Since the minimum temperature within the printing plate must be hot enough to melt all of the plates, the distribution of heat among the plates and the time necessary to reach internal plate energy, should be sufficient to break the C-S bond which means that PFOS will not be a combustion product of PFAS thermal degradation in the smelter. The second issue can be addressed by considering how the aluminum plates are heated. In the smelting process the flame is applied directly to the plates at a temperature (flame temperature range 2500 to 3500^{0}F) that is sufficient to break the C-F bond since the PFAS is on the surface of the plates where the flame is applied. Other considerations are the uniformity of the heating process and residence time. In order to melt the aluminum plates the fuel combustion flame must uniformly heat the entire mass of plates so that they all melt; otherwise, the smelting process will not work. In uniformly melting the plates, the PFAS materials will also be uniformly exposed to the thermal process. The time that it takes for all of the plates to reach internal temperatures sufficient to cause melting are expected to be in excess of the time required (several seconds) to break the C-F bonds in the PFAS molecules.

To provide additional data on incineration efficiency, we searched the TSCA 8(e) database and contacted the 3M Corporation for information about ongoing studies designed to further assess PFAS incineration issues. However, these sources did not provide new information. Additionally, we searched available EPA databases for information suggesting that secondary aluminum smelting activities had been identified by the Agency as sources of reactive perfluorinated emissions. While the emissions from secondary aluminum reverberatory furnaces have been studied, there did not appear to be any evidence that these units were likely sources of emissions of incomplete combustion of PFAS materials. Finally we contacted D. Dixon and J. Cudahy who authored the cited references[7,11]; however, they were not able to provide additional specific information about secondary aluminum smelting operations.

Even if there were some inefficiencies in the incineration of the PFAS, the maximum amount of PFOS that could be released is very small. The PFAS materials used in the manufacture of printing plates are all polymeric materials. For those shown on Table 1, the PFOS content is on the order of 5-7%; thus if all the PFOS that was used to manufacture printing plates (300 kg/yr) were released, the released amount would be less than 15-21 kg/yr. Even this later amount is an exaggeration of the amount released through aluminum smelting because not of the PFAS used in manufacturing enters the smelting process.

11.4.6 Film Recycling: Potential for Occupational Exposure and Environmental Release

Recycling of film is typically conducted with two potential goals in mind: recovery of silver and recovery of film base material (polyethylene terephthalate or PET). Film that is not on a PET base (virtually all from manufacturing waste) is incinerated at high temperature to produce a silver-rich ash that is collected and used for recovery of silver.

The life cycle for film products from manufacture to recycling is virtually a closed loop process. Small amounts of movie film, once used, are kept for archival purposes but the remainder is gathered by a small number of brokers who are responsible for the secure destruction of the film. To assure complete destruction of the films and recovery of the residual precious metal and raw material value of the film, brokers sell the film for recycling. Likewise, hospitals and commercial users (i.e., industrial x-ray, graphics arts, and printers) collect and sell film that is not archived to brokers and recyclers. Estimates of the size of this market, based on information received from recyclers, is that the market is between 36-45 x 10^6 kg/yr. If the following assumptions are made:

- Movie film comprises 10% of the recycled material[12],
- Movie film is 3 mil thick,
- X-ray and other commercial films are 7 mil thick, and
- PET has a density of 1.33.

Then the amount of film recycled in the USA is approximately 190-230 x 10^6 m^2.

The recycling process can be broken down into two main segments 1) emulsion washing which is intended to remove the silver bearing coatings from the surface of the film base (which can then be recycled itself) and 2) silver recovery (incineration and refining of the sludge formed during the washing process). Some recyclers perform only the washing operation, others only perform silver recovery, whereas others perform both washing and silver recovery. In all situations, both silver and PET are recovered as saleable products even when recycling is completed at two different sites.

Film is typically collected in Gaylord or bulk containers and handled in bulk form as much as possible. The first step in the washing process includes a size reduction step during which film products are cut to a maximum dimension of approximately 1.7 cm. The cut film is than placed in wash tanks to remove the coatings. The wash process may involve application of caustic, enzymes, or solvents to remove the coatings from the PET. The most common technique used is partial enzyme digestion and the least common technique is solvent washing (about 5% of the material recycled). Following enzymatic digestion or caustic wash, alum is added as a flocculent and the slurry is precipitated. The washed film base is removed from the wash tank and the silver-rich sludge is decanted. The liquids are then placed in settling basins to recover additional solids. All of the silver-rich solids recovered during decanting and settling are collected for silver refining.

Waste solvents are incinerated in hazardous waste incinerators operating at high temperature.

To treat wastewaters, most recyclers have primary treatment facilities on-site so as to maximize silver recovery; sludges from primary treatment facilities are collected and used for silver recovery. Recycling operations located at manufacturing sites also have secondary wastewater treatment systems where sludges are collected and incinerated at high temperatures (1650-1700° F).

PET, with the coatings removed, is typically processed through a methanolysis process to recover the raw materials for repolymerization to PET sheet film.

The silver-rich materials recovered from the wash tanks, settling basins, and wastewater treatment systems are transferred to a roaster. As the sludge enters the roaster there is a main burner with a head temperature of 2700-2900° F. The sludge spends about 45 minutes in the roaster at a bulk temperature of 950° F. There is an after-burner maintained at 1650° F at the end of the roasting step. Following roasting, there is a quenching step to quickly bring the temperature down. Materials are collected from the quench step and are directed to the stream that will go to the smelter. To complete the process, the roasted and quenched sludge is sent for smelting. The surface temperature of the smelter is maintained at 2200° F; the interior temperature of the molten silver is hotter than the surface temperature.

The opportunity for occupational exposure to PFAS during film recycling processes is considered to be minimal. Handling of film during recycling operations is typically a bulk handling operation with minimal opportunity for contact with film. Typically, gloves are worn during film handling to prevent skin cuts. During the film chopping operation, there is the potential for generating dust as there is with any cutting operation. However, the film is cut to a relative large size (approximately 1.7 cm) and dust masks are available for use to reduce the potential for exposure to dust further.

The localization of PFAS materials in recycling and wastewater handling systems is problematic for reasons that are discussed by Moody and Field[13] including lack of general availability of analytical methods for specific materials, lack of specificity of some methods of detection, confounding interferences, and lack of knowledge of some of the specific structures for some PFAS materials. Nonetheless, based on discussions with an expert working on the transport of PFAS substances in wastewater treatment systems and other indirect information, we are of the opinion that the small amounts of PFAS materials that are in film are collected with the silver-rich sludge and destroyed by combustion during the silver refining process.

The reasons for this conclusion include:

- A number of the PFAS materials used in film products are in a polymeric form, are not highly water soluble, and are expected to partition to sludge;

- The PFAS materials are likely to bind to the coating matrices and are unlikely to be displaced during the washing process; and

---

- Inorganic fluorine that is the likely degradation product of PFAS materials has been detected in the air effluent from silver-rich sludge roasting.

Environmental release of PFAS materials during film recycling is anticipated to be minimal as PFAS materials are expected to be destroyed during combustion of silver-rich sludges and wastewater treatment sludges.

12.0 Additional Controls That Can Be Used To Reduce Exposure and Release

The potential exposure to PFAS materials from imaging materials is considered to be minimal. The small amounts of PFAS materials used for imaging purposes and the extensive recycling programs for imaging products also minimizes environmental release of PFAS materials. In responding to the challenges resulting from the new information that has become available, the companies in the imaging industry began programs in mid-2000 to reduce and replace PFAS materials. Reductions in PFAS are being made on a worldwide basis, and go beyond materials regulated by TSCA and the proposed SNUR. The industry has aggressively reduced PFAS requirements through voluntary efforts that have already produced significant reductions (83%) in PFAS requirements.

As the voluntary PFAS reduction program continues, future reduction in PFAS use is expected.

The industry is highly competitive and through quality programs is driving manufacturing waste and photoprocessing solution waste down. This reduction in waste will reduce PFAS releases further.

Some of the products that have not been reformulated will be discontinued as changes in imaging technology make them obsolete.

13.0 Summary

The voluntary withdrawal efforts now underway by the imaging companies has reduced the amount of PFAS subject to the proposed SNUR by about 83% to approximately 3,000 kg/yr in the USA. In terms of PFOS equivalents, the amount of PFAS used for imaging products is at least one-third less or 2000 kg/yr based on the highest PFOS-containing chemical listed on Table 1. Additional reductions are anticipated, with replacement of PFAS materials for dry processed film expected before year-end 2002, but complete replacement of PFAS materials may take 5-7 years while alternative chemicals and processes are being developed and tested. In response to the Agency's question about potential for human exposure, there is very little to no exposure expected to the small amounts of material used in the imaging processes. With regard to environmental release, there is a potential to release small amounts of PFAS materials to wastewater treatment systems. The imaging companies, in their routine waste handling practices, have already captured as much of the potential environmental releases as is technically possible and will use their voluntary reduction efforts to eliminate future releases.

Recommendations

To take into account the elimination of certain PFAS uses, clarify the wording of the requested exemption, and limit the exemption to critical uses, the following wording is recommended:

" **iv.** ***Use in coatings for surface tension, static discharge, and adhesion control for analog and digital imaging films, papers, and printing plates or as a surfactant in mixtures used to process imaging films.***"

In addition the imaging industry is recommending that that the proposed exemption "***iii. Use as an intermediate only to produce other chemical substances to be used solely for the uses listed in Unit III.2.i or ii***" be expanded to include imaging uses identified in the proposed rule as ***III.2.iv.***

If the Agency has questions about these comments or further questions about the uses of PFAS materials covered by this proposed rule, please feel free to contact me.

Sincerely,

John L. O'Donoghue, VMD, PhD
Director, Health and Environment Laboratories
Vice President, Health, Safety, and Environment
For I3A companies
JOD

cc: Document Control Office, Office of Pollution Prevention and Toxics
(Docket No. OPPTS-50639C)

Citations

1. O'Donoghue, John. Letter to Document Control Office, Comments on Proposed Rule: Perfluorooctyl Sulfonates; Proposed Significant New Use Rule" (65 FR 62319, October 18, 2000). November 15, 2000.

2. O'Donoghue, John. PFOS and Imaging. Presentation of Photographic and Imaging Manufacturers Association at EPA Public Meeting. Washington, DC. March 27, 2001.

3. O'Donoghue, John. Letter to Charles M. Auer, Follow-up to the March 27, 2001 Public Meeting. Rochester, NY. April 24, 2001.

4. Dominiak, Mary. PFOS Public Meeting Summary and Attendee List. USEPA/OPPT/CCD. Washington, DC. April 27, 2001.

5. US Environmental Protection Agency, Perfluoroalkyl Sulfonates; Proposed Significant New Use Rule, March 11, 2002 (67 FR 11014).

6. Giesy John P. and Kannan Kurunthachalam (2002). Perfluorochemical Surfactants in the Environment. Environ. Sci. Technol. 36: 146A-152A.

7. Cudahy, J (2001). Report to D. Schnobrich. Thermal stability of perfluorinated alkyl sulfonyl compounds. Focus Environmental, Inc., Knoxville, TN. TSCA 8(e) Docket (Control Number OPPTS –50639C).

8. Kodak Park Environmental Annual Report (2001). Eastman Kodak Company, Rochester, NY.

9. The Fujifilm Environmental Report (2001). Fuji Photo Film Company, Ltd., Minami Ashigara-shi, Japan.

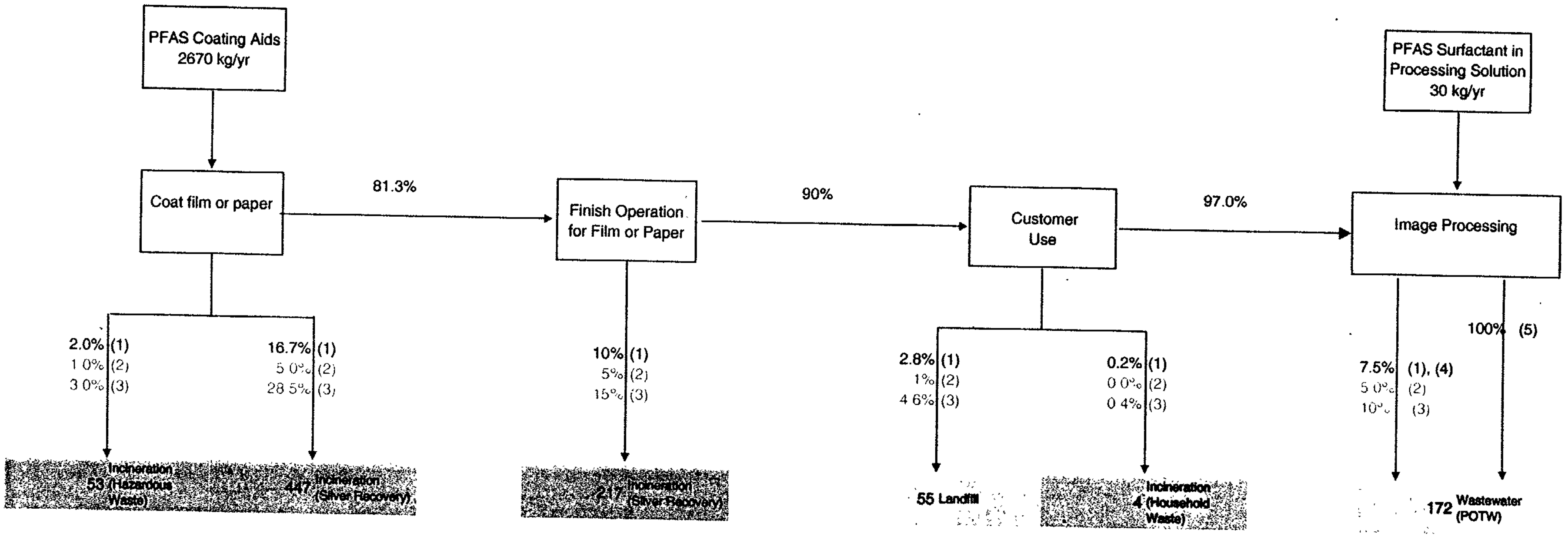
10. Richardson, H. Wayne (1996). Nonferrous metals. In: **Kirk-Othmer Encyclopedia of Chemical Technology.** Fourth edition, Vol. 20, John Wiley & Sons, New York, pp 1106-1126.

11. Dixon, David A. (2001). Fluorochemical Decomposition Process: Theory, Modeling, and Simulation. Pacific Northwest Laboratory, Richland, WA. TSCA 8(e) Docket (Control Number OPPTS –50639C).

12. OECD (2002). **Emission Scenario Document on Photographic Industry** (Draft). OECD Environmental Health and Safety Publications Paris.

13. Moody Cheryl A. and Field Jennifer A. (2000). Perfluorinated surfactants and the environmental implications of their use in fire-fighting foams. Environ. Sci. Technol. 34: 3864-3870.

Figure 1
Life Cycle Assessment Model: Film and Paper



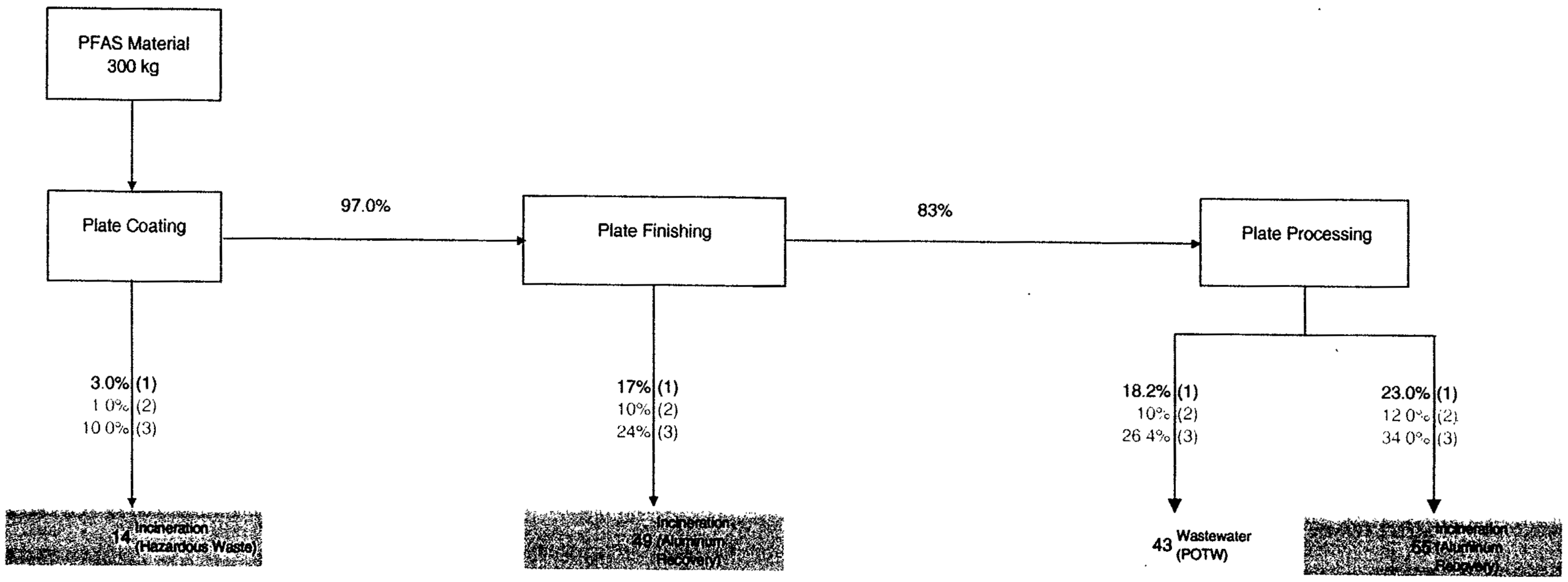
Summary Table: Monte Carlo Analysis (kg/yr)

	Minimum	Maximum	Average	% of Total PFAS Material
Incineration (Hazardous Waste)	27	80	53	2%
Incineration (Silver Recovery)	505	1002	664	25%
Incineration (Household Waste)	0	9	4	0.1%
Wastewater (POTW)	114	246	172	6%
Landfill	18	101	55	2%
Totals			948	36%

Incineration household is municipal incineration.
Wastewater POTW is treatment at municipal WTP.
Landfill is disposal at a municipal landfill.
(1) Most likely or average value
(2) Minimum value
(3) Maximum value
(4) Release from coatings (142 kg/yr)
(5) Release from photoprocessing solution (Use 6) 30 kg/yr

Coating waste includes waste from PFAS containers as well as from coatings.
Finish waste includes PFAS included in materials sent for recycling.
Customer use includes purchased film that is not processed.
Processing includes PFAS that may be removed during photoprocessing.

Figure 2
Life Cycle Assessment Model: Printing Plates



Summary Table: Monte Carlo Analysis (kg/yr)

	Minimum	Maximum	Average	% of Total PFAS Material
Incineration (Hazardous Waste)	3	30	14	5%
Incineration (Aluminum Recovery)	63	136	103	34%
Wastewater (POTW)	23	66	43	14%
			160	53%

Wastewater POTW is treatment at municipal Wastewater Treatment Plant.
(1) Most likely or average value
(2) Minimum value
(3) Maximum value

Coating waste includes waste from PFAS containers as well as from coating.

MN 60097

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MATERIAL SAFETY DATA SHEET

3M
3M Center
St. Paul, Minnesota
55144-1000
1-800-364-3577 or (651) 737-6501 (24 hours)

DIVISION: 3M SPECIALTY MATERIALS
TRADE NAME:
FC-135 FLUORAD Brand Fluorochemical Surfactant
ID NUMBER/U.P.C.:
98-0211-0558-4 00-51135-09262-0 98-0211-0559-2 00-51135-09263-7
98-0211-0898-4 00-51135-09369-6 98-0211-7220-4 00-51135-10635-8
ISSUED: March 29, 2000
SUPERSEDES: February 29, 2000
DOCUMENT: 10-3807-4

1. INGREDIENT	C.A.S. NO.	PERCENT
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C8)	1652-63-7	40 44
ISOPROPYL ALCOHOL	67-63-0	33
WATER	7732-18-5	17
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C6)	68957-58-4	1 - 5
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C7)	67584-58-1	1 - 4
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C4)	67939-95-1	1 - 4
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C5)	68957-57-3	0.1 - 2
RESIDUAL ORGANIC FLUOROCHEMICALS	Mixture	0 - 1
METHYL IODIDE	74-88-4	0.1

The components of this product are in compliance with the chemical notification requirements of TSCA. All applicable chemical ingredients in this material are listed on the European Inventory of Existing Chemical Substances (EINECS), or are exempt polymers whose monomers are listed on EINECS.

This product contains the following toxic chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Emergency Planning and Community Right-To-Know Act of 1986 and 40 CFR Part 372:
METHYL IODIDE

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

CONTAIN NO CBI

2. PHYSICAL DATA

BOILING POINT	82 C (Initial)
VAPOR PRESSURE	ca. 24 mmHg Calc. @ 20 C
VAPOR DENSITY:......	ca. 1.2 Air=1
EVAPORATION RATE:...	< 1.0 BuOAc=1
SOLUBILITY IN WATER:	complete
SPECIFIC GRAVITY:...	ca. 1.2 Water=1
PERCENT VOLATILE:...	ca. 50 % by wt
pH:.................	3 - 5
VISCOSITY:..........	N/D
MELTING POINT:......	N/A

APPEARANCE AND ODOR:
Liquid, dark amber color with Isopropyl alcohol odor

3. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT	22 C PMCC ASTM D93
FLAMMABLE LIMITS - LEL:.	N/D
FLAMMABLE LIMITS - UEL:.	N/D
AUTOIGNITION TEMPERATURE	N/D

EXTINGUISHING MEDIA:
Water, Carbon dioxide, Dry chemical Foam

SPECIAL FIRE FIGHTING PROCEDURES:
Wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
See Hazardous Decomposition section for products of combustion

NFPA HAZARD CODES: HEALTH: 1 FIRE: 3 REACTIVITY
UNUSUAL REACTION HAZARD: none

REACTIVITY DATA

STABILITY Stable

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

4. REACTIVITY DATA (continued)

INCOMPATIBILITY - MATERIALS/CONDITIONS TO AVOID
Not Applicable

HAZARDOUS POLYMERIZATION Hazardous polymerization will

HAZARDOUS DECOMPOSITION PRODUCTS:
Carbon Monoxide and Carbon Dioxide, Oxides of Nitrogen, Oxides of Sulfur, Hydrogen Fluoride, Toxic Vapors, Gases or Particulates.

5. ENVIRONMENTAL INFORMATION

SPILL RESPONSE:
Refer to other sections of this MSDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment. Ventilate area. Extinguish all ignition sources. Contain spill. Evacuate unprotected personnel from hazard area. Cover with absorbent material. Cover spill area with Light Water Brand or other ATC foam. (For further information on ATC foam usage, contact 3M Fire Protection Systems.) Collect using non-sparking tools. Clean up residue with water. Place in an approved metal container. Seal the container.

RECOMMENDED DISPOSAL:
Incinerate in a permitted hazardous waste incinerator Combustion products will include HF.

ENVIRONMENTAL DATA:
BIODEGRADATION DATA:
Chemical Oxygen Demand (COD): 1.3 g/g
Biochemical Oxygen Demand, 5-day (BOD5) 0.5 g/g

AQUATIC TOXICITY:
Fathead Minnow (Pimephales promelas) 96-HR LC50 60 mg/L

NOTE: composite COD, BOD, and aquatic toxicity data were calculated from component data

REGULATORY INFORMATION:
Volatile Organic Compounds: 396 gms/liter calculated per SCAQMD rule 443.1.
VOC Less H2O & Exempt Solvents N/A gms/liter

Since regulations vary, consult applicable regulations or authorities before disposal. In the event of an uncontrolled release of this material, the user should determine if the release qualifies as a reportable quantity. U.S. EPA Hazardous Waste Number = D001 (Ignitable)

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

5. ENVIRONMENTAL INFORMATION (continued)

The components of this product are in compliance with the chemical registration requirements of TSCA, EINECS, CDSL, AICS, MITI and KTCCL.

OTHER ENVIRONMENTAL INFORMATION:
This product contains one or more organic fluorochemicals that have the potential to resist degradation and persist in the environment.

EPCRA HAZARD CLASS
FIRE HAZARD: Yes PRESSURE: No REACTIVITY No ACUTE: Yes CHRONIC: Yes

SUGGESTED FIRST AID

EYE CONTACT:
Immediately flush eyes with large amounts of water. Get immediate medical attention.

SKIN CONTACT:
Flush skin with large amounts of water If irritation persists, get medical attention.

INHALATION:
If signs/symptoms occur, remove person to fresh air If signs/symptoms continue, call a physician.

IF SWALLOWED:
If swallowed, call a physician immediately. Only induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.

PRECAUTIONARY INFORMATION

EYE PROTECTION:
Avoid eye contact with vapor, spray, or mist Wear vented goggles.

SKIN PROTECTION:
Avoid skin contact. Wear appropriate gloves when handling this material. A pair of gloves made from the following material(s) are recommended: butyl rubber, natural rubber. Use one or more of the following personal protection items as necessary to prevent skin contact: coveralls.

RECOMMENDED VENTILATION:
If exhaust ventilation is not adequate, use appropriate respiratory protection. Provide ventilation adequate to control vapor concentrations below recommended exposure limits and/or control spray

PRECAUTIONARY INFORMATION (continued)

or mist

RESPIRATORY PROTECTION:
Avoid breathing of airborne material. Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: half-mask organic vapor and acid gas respirator, full-face organic vapor and acid gas respirator.

PREVENTION OF ACCIDENTAL INGESTION:
Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Wash hands after handling and before eating.

RECOMMENDED STORAGE:
Store away from areas where product may come into contact with food or pharmaceuticals. Store away from heat. Store out of direct sunlight. Keep container closed when not in use. Keep container in well-ventilated area.

FIRE AND EXPLOSION AVOIDANCE:
Keep container tightly closed. Keep away from heat, sparks, open flame, and other sources of ignition. Prevent all sources of ignition. Extremely flammable liquid and vapor. Ground containers securely when transferring contents. Wear low static or properly grounded shoes. No smoking while handling this material.

OTHER PRECAUTIONARY INFORMATION:
No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS.

HMIS HAZARD RATINGS HEALTH: 1 FLAMMABILITY: 3 REACTIVITY: 0
PERSONAL PROTECTION: X (See precautions, section 7.)

EXPOSURE LIMITS

INGREDIENT	VALUE	UNIT	TYPE	AUTH	SKIN*
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C8)........................	0.1	MG/M3	TWA	3M	Y
ISOPROPYL ALCOHOL....................	400	PPM	TWA	ACGIH	
ISOPROPYL ALCOHOL....................	500	PPM	STEL	ACGIH	
ISOPROPYL ALCOHOL....................	400	PPM	TWA	OSHA	
ISOPROPYL ALCOHOL....................	500	PPM	STEL	OSHA	
WATER................................	NONE	NONE	NONE	NONE	
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C6)........................	0.1	MG/M3	TWA	3M	Y
FLUOROALKYL QUATERNARY AMMONIUM					

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

EXPOSURE LIMITS (continued)

INGREDIENT	VALUE	UNIT	TYPE	AUTH	SKIN*
IODIDE (C7).......................	0.1	MG/M3	TWA	3M	Y
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C4)..................	0.1	MG/M3	TWA	3M	Y
FLUOROALKYL QUATERNARY AMMONIUM IODIDE (C5)..................	0.1	MG/M3	TWA	3M	Y
RESIDUAL ORGANIC FLUOROCHEMICALS	0.1	MG/M3	TWA	3M	Y
METHYL IODIDE..................	2	PPM	TWA	ACGIH	Y
METHYL IODIDE..................	2	PPM	TWA	OSHA	Y

* SKIN NOTATION: Listed substances indicated with 'Y' under SKIN refer to the potential contribution to the overall exposure by the cutaneous route including mucous membrane and eye, either by airborne or, more particularly, by direct contact with the substance. Vehicles can alter skin absorption.

SOURCE OF EXPOSURE LIMIT DATA:
- 3M: 3M Recommended Exposure Guidelines
- ACGIH: American Conference of Governmental Industrial Hygienists
- OSHA: Occupational Safety and Health Administration

- NONE None Established

8. HEALTH HAZARD DATA

EYE CONTACT:
Mild Eye Irritation signs/symptoms can include redness swelling, pain, and tearing.

SKIN CONTACT:
Mild Skin Irritation: signs/symptoms can include redness, swelling, and itching.

May be absorbed through the skin and produce effects similiar to those caused by inhalation and/or ingestion.

INHALATION:
Single overexposure, above recommended guidelines, may

Central Nervous System Depression: signs/symptoms can include headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

Irritation (upper respiratory): signs/symptoms can include soreness of the nose and throat coughing and sneezing.

IF SWALLOWED:
Animal studies conducted on organic fluorochemicals which are present in this product indicate effects including liver disturbances, weight loss, loss of appetite, lethargy, and neurological, pancreatic,

8. HEALTH HAZARD DATA (continued)

adrenal and hematologic effects. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

WHILE THE FOLLOWING EFFECTS ARE ASSOCIATED WITH ONE OR MORE OF THE INDIVIDUAL INGREDIENTS IN THIS PRODUCT AND ARE REQUIRED TO BE INCLUDED ON THE MSDS BY THE U.S. OSHA HAZARD COMMUNICATION STANDARD, THEY ARE NOT EXPECTED EFFECTS DURING FORESEEABLE USE OF THIS PRODUCT

Irritation of Gastrointestinal Tissues: signs/symptoms can include pain, vomiting, abdominal tenderness, nausea, blood in vomitus, and blood in feces.

Central Nervous System Depression: signs/symptoms can include headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue, blurred vision, slurred speech, giddiness, tremors and convulsions.

Ingestion may cause

> Aspiration Pneumonitis: signs/symptoms can include coughing, difficulty breathing, wheezing, coughing up blood and pneumonia which can be fatal.

CANCER:
WARNING: Contains a chemical which can cause cancer 74-88-4)
(Calif. Proposition 65)

OTHER HEALTH HAZARD INFORMATION:
A Product Toxicity Summary Sheet is available

This product contains one or more organic fluorochemicals that have the potential to be absorbed and remain in the body for long periods of time, either as the parent molecule or as metabolites, and may accumulate with repeated exposures. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

The presence of organic fluorochemicals in the blood of the general population and subpopulations, such as workers, has been published dating back to the 1970's. 3M's epidemiological study of its own workers indicates no adverse effects.

SECTION CHANGE DATES

PHYSICAL DATA	SECTION CHANGED SINCE February 29, 2000 ISSUE
FIRE AND EXPL.	SECTION CHANGED SINCE February 29, 2000 ISSUE
ENVIRONMENTAL INFO	SECTION CHANGED SINCE February 29, 2000 ISSUE
PRECAUTIONARY INFO	SECTION CHANGED SINCE February 29, 2000 ISSUE

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

The information in this Material Safety Data Sheet (MSDS) is believed to be correct as of the date issued. 3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of use or application. Given the variety of factors that can affect the use and application of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for user's method of use or application.

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P-96-1262

3M GENERAL OFFICES

3M CENTER
ST. PAUL, MN 55144-1000
1-800-364-3577 OR (651)737-6501 (24 HOURS)

10-46
26876, 26877, 26878, 26879, 26880, 26881,

(INTERMEDIATE)

3M

DIVISION: SPECIALTY MATERIALS DIVISION

MATERIAL: FLUOROCHEMICAL POLYMER R-52850 R-23179

ISSUED: JANUARY 18, 1999
SUPERSEDES: OCTOBER 20, 1998

DOCUMENT: 06-9020-6

--1 INGREDIENT ------

	C.A.S. NO.	PERCENT
SUBSTITUTED POLYOXYETHYLENEAMINE SULFONATE	UNKNOWN	72 - 77
METHYL ETHYL KETONE	78-93-3	23 - 28
RESIDUAL ORGANIC FLUOROCHEMICALS	TRADE SECRET	UNKNOWN

NOTE:
THE COMPONENTS OF THIS PRODUCT ARE IN COMPLIANCE WITH THE CHEMICAL

NOTIFICATION REQUIREMENTS OF TSCA. PMN HAS BEEN REVIEWED BY THE EPA, NOC NEEDS TO BE SUBMITTED.

THIS PRODUCT CONTAINS THE FOLLOWING TOXIC CHEMICAL OR CHEMICALS SUBJECT TO THE REPORTING REQUIREMENTS OF SECTION 313 OF TITLE III OF THE EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT OF 1986 AND 40 CFR PART 372: METHYL ETHYL KETONE

------2. PHYSICAL DATA

BOILING POINT: 175 F

VAPOR PRESSURE: CA. 3 PSIA @ 68F

VAPOR DENSITY: N/D

EVAPORATION RATE: N/D

SOLUBILITY IN WATER SLIGHT

SP. GRAVITY: 1.2 WATER = 1

PERCENT VOLATILE: 23-28 %

PH: 4-7

VISCOSITY: 200-500 CPS

MELTING POINT: N/D

APPEARANCE AND ODOR:
CLEAR, OILY, PALE YELLOW LIQUID WITH METHYL ETHYL KETONE ODOR.

------3. FIRE AND EXPLOSION HAZARD DATA ------

FLASH POINT: 30 F

FLAMMABLE LIMITS - LEL: 1.8 %
FLAMMABLE LIMITS - UEL: 11.5 %

AUTOIGNITION TEMPERATURE: 960 F

EXTINGUISHING MEDIA:
WATER SPRAY, CARBON DIOXIDE, DRY CHEMICAL, ALCOHOL-TYPE FOAM

SPECIAL FIRE FIGHTING PROCEDURES:
WEAR FULL PROTECTIVE CLOTHING, INCLUDING HELMET, SELF-CONTAINED, POSITIVE PRESSURE OR PRESSURE DEMAND BREATHING APPARATUS, BUNKER COAT AND PANTS, BANDS AROUND ARMS, WAIST AND LEGS, FACE MASK, AND PROTECTIVE COVERING FOR EXPOSED AREAS OF THE HEAD. WATER MAY NOT EFFECTIVELY EXTINGUISH FIRE; HOWEVER, IT SHOULD BE USED TO KEEP FIRE-EXPOSED CONTAINERS AND SURFACES COOL AND PREVENT EXPLOSIVE RUPTURE. FOR LEAKS OR SPILLS WHICH HAVE NOT IGNITED,

WATER SPRAY CAN BE USED TO DISPERSE THE FLAMMABLE VAPOR AND PROTECT PERSONNEL ATTEMPTING TO STOP THE LEAK.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
SEE HAZARDOUS DECOMPOSITION SECTION FOR PRODUCTS OF COMBUSTION. VAPORS MAY TRAVEL LONG DISTANCES ALONG THE GROUND OR FLOOR TO AN IGNITION SOURCE AND FLASH BACK. OSHA FIRE HAZARD CLASS: CLASS IB FLAMMABLE LIQUID

------4. REACTIVITY DATA ------

STABILITY: STABLE

INCOMPATIBILITY - MATERIALS TO AVOID: STRONG OXIDIZING AGENTS.

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

HAZARDOUS DECOMPOSITION PRODUCTS:
CARBON MONOXIDE AND CARBON DIOXIDE, OXIDES OF NITROGEN, OXIDES OF SULFUR, HYDROGEN FLUORIDE.

------5. ENVIRONMENTAL INFORMATION ------

SPILL RESPONSE:
REFER TO OTHER SECTIONS OF THIS MSDS FOR INFORMATION REGARDING PHYSICAL AND HEALTH HAZARDS, RESPIRATORY PROTECTION, VENTILATION, AND PERSONAL PROTECTIVE EQUIPMENT. VENTILATE AREA. EXTINGUISH ALL IGNITION SOURCES. CONTAIN SPILL. EVACUATE UNPROTECTED PERSONNEL FROM HAZARD AREA. COVER WITH ABSORBENT MATERIAL. COVER SPILL AREA WITH LIGHT WATER BRAND OR OTHER ATC FOAM. (FOR

FURTHER INFORMATION ON ATC FOAM USAGE, CONTACT 3M FIRE PROTECTION SYSTEMS.) COLLECT USING NON-SPARKING TOOLS. CLEAN UP RESIDUE WITH AN APPROPRIATE SOLVENT SUCH AS METHYL ETHYL KETONE. EXTINGUISH ALL IGNITION SOURCES AND VENTILATE AREA. FOLLOW THE MSDS RECOMMENDATIONS FOR THE CLEANUP SOLVENT. PLACE IN AN APPROVED METAL CONTAINER. SEAL THE CONTAINER.

RECOMMENDED DISPOSAL: INCINERATE IN A PERMITTED HAZARDOUS WASTE INCINERATOR.

ENVIRONMENTAL DATA: NOT DETERMINED.

REGULATORY INFORMATION:
VOLATILE ORGANIC COMPOUNDS: N/D.
VOC LESS H2O & EXEMPT SOLVENTS: N/D.

SINCE REGULATIONS VARY, CONSULT APPLICABLE REGULATIONS OR AUTHORITIES BEFORE DISPOSAL. IN THE EVENT OF AN UNCONTROLLED RELEASE OF THIS MATERIAL, THE USER SHOULD DETERMINE IF THE RELEASE QUALIFIES AS A REPORTABLE QUANTITY. U.S. EPA HAZARDOUS WASTE NUMBER = D001 (IGNITABLE) D035 (METHYL ETHYL KETONE)

OTHER ENVIRONMENTAL INFORMATION:
THIS PRODUCT MAY CONTAIN ONE OR MORE ORGANIC FLUOROCHEMICALS THAT HAVE THE POTENTIAL TO RESIST DEGRADATION AND PERSIST IN THE ENVIRONMENT.

EPCRA HAZARD CLASS:
FIRE HAZARD: YES

PRESSURE: NO
REACTIVITY: NO
ACUTE: YES
CHRONIC: NO

------6. SUGGESTED FIRST AID ------

EYE CONTACT:
IMMEDIATELY FLUSH EYES WITH LARGE AMOUNTS OF WATER. GET IMMEDIATE MEDICAL ATTENTION.

SKIN CONTACT: WASH AFFECTED AREA WITH SOAP AND WATER.

INHALATION:
REMOVE PERSON TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GET IMMEDIATE MEDICAL ATTENTION.

IF SWALLOWED: DRINK TWO GLASSES OF WATER. CALL A PHYSICIAN.

------7. PRECAUTIONARY INFORMATION ------

EYE PROTECTION:
AVOID EYE CONTACT. THE FOLLOWING SHOULD BE WORN ALONE OR IN COMBINATION, AS APPROPRIATE, TO PREVENT EYE CONTACT: WEAR UNVENTED GOGGLES DURING OPERATIONS IN WHICH EXPOSURE IS LIKELY. WEAR FULL-FACE SHIELD.

SKIN PROTECTION:
AVOID SKIN CONTACT. WEAR APPROPRIATE GLOVES WHEN HANDLING THIS MATERIAL. USE ONE OR MORE OF THE FOLLOWING PERSONAL PROTECTION ITEMS AS NECESSARY TO PREVENT SKIN CONTACT: APRON.

VENTILATION PROTECTION:
USE WITH APPROPRIATE LOCAL EXHAUST VENTILATION. PROVIDE SUFFICIENT VENTILATION TO MAINTAIN EMISSIONS BELOW RECOMMENDED EXPOSURE LIMITS. IF EXHAUST VENTILATION IS NOT ADEQUATE, USE APPROPRIATE RESPIRATORY PROTECTION.

RESPIRATORY PROTECTION:
AVOID BREATHING OF VAPORS, MISTS OR SPRAY. SELECT ONE OF THE FOLLOWING NIOSH APPROVED RESPIRATORS BASED ON AIRBORNE CONCENTRATION OF CONTAMINANTS AND IN ACCORDANCE WITH OSHA REGULATIONS: HALF-MASK ORGANIC VAPOR RESPIRATOR, FULL-FACE ORGANIC VAPOR RESPIRATOR, FULL-FACE SUPPLIED AIR RESPIRATOR.

PREVENTION OF ACCIDENTAL INGESTION:

WASH HANDS AFTER HANDLING AND BEFORE EATING. DO NOT INGEST.

RECOMMENDED STORAGE:
KEEP CONTAINER CLOSED WHEN NOT IN USE. KEEP CONTAINER IN WELL-VENTILATED AREA.

FIRE AND EXPLOSION AVOIDANCE:
KEEP CONTAINER TIGHTLY CLOSED. FLAMMABLE LIQUID AND VAPOR. KEEP AWAY FROM HEAT, SPARKS, OPEN FLAME, AND OTHER SOURCES OF IGNITION. GROUND CONTAINERS

SECURELY WHEN TRANSFERRING CONTENTS. WEAR LOW STATIC OR PROPERLY GROUNDED SHOES. VAPORS MAY IGNITE EXPLOSIVELY.

INGREDIENTS	EXPOSURE LIMITS VALUE	UNIT	TYPE	AUTH	SKIN*
SUBSTITUTED POLYOXYETHYLENEAMINE SULFONATE	NONE	NONE	NONE	NONE	
METHYL ETHYL KETONE	200	PPM	TWA	OSHA	
METHYL ETHYL KETONE	300	PPM	STEL	OSHA	
METHYL ETHYL KETONE	200	PPM	TWA	ACGIH	
METHYL ETHYL KETONE	300	PPM	STEL	ACGIH	
RESIDUAL ORGANIC FLUOROCHEMICALS	0.1	MG/M3	TWA	3M	Y

*SKIN NOTATION:
LISTED SUBSTANCES INDICATED WITH "Y" UNDER SKIN REFER TO THE POTENTIAL CONTRIBUTION TO THE OVERALL EXPOSURE BY THE CUTANEOUS ROUTE INCLUDING MUCOUS MEMBRANE AND EYE, EITHER BY AIRBORNE OR, MORE PARTICULARLY, BY DIRECT CONTACT WITH THE SUBSTANCE. VEHICLES CAN ALTER SKIN ABSORPTION.

SOURCE OF EXPOSURE LIMIT DATA:
-ACGIH: AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS
-OSHA: OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
-3M: 3M MEDICAL DEPARTMENT GUIDELINE
-NONE: NONE ESTABLISHED

------8. HEALTH HAZARD DATA ------

EYE CONTACT:
MODERATE EYE IRRITATION: SIGNS/SYMPTOMS CAN INCLUDE REDNESS, SWELLING, PAIN, TEARING, AND HAZY VISION.

SKIN CONTACT:
MODERATE SKIN IRRITATION (AFTER PROLONGED OR REPEATED CONTACT):
SIGNS/SYMPTOMS CAN INCLUDE REDNESS, SWELLING, ITCHING, AND DRYNESS.

INHALATION:
CENTRAL NERVOUS SYSTEM DEPRESSION: SIGNS/SYMPTOMS CAN INCLUDE HEADACHE, DIZZINESS, DROWSINESS, INCOORDINATION, SLOWED REACTION TIME, SLURRED SPEECH, GIDDINESS AND UNCONSCIOUSNESS.

IRRITATION (UPPER RESPIRATORY):
SIGNS/SYMPTOMS CAN INCLUDE SORENESS OF THE NOSE AND THROAT, COUGHING AND SNEEZING.

WHILE THE FOLLOWING EFFECTS ARE ASSOCIATED WITH ONE OR MORE OF THE INDIVIDUAL INGREDIENTS IN THIS PRODUCT AND ARE REQUIRED TO BE INCLUDED ON

THE MSDS BY THE U.S. OSHA HAZARD COMMUNICATION STANDARD, THEY ARE NOT EXPECTED EFFECTS DURING FORESEEABLE USE OF THIS PRODUCT.

LIVER EFFECTS:

SIGNS/SYMPTOMS CAN INCLUDE YELLOW SKIN(JAUNDICE) AND TENDERNESS OF UPPER ABDOMEN.

IF SWALLOWED: INGESTION IS NOT A LIKELY ROUTE OF EXPOSURE TO THIS PRODUCT.

ANIMAL STUDIES CONDUCTED ON ORGANIC FLUOROCHEMICALS WHICH MAY BE PRESENT IN THIS PRODUCT INDICATE EFFECTS INCLUDING LIVER DISTURBANCES, WEIGHT LOSS, LOSS OF APPETITE, LETHARGY, AND NEUROLOGICAL, PANCREATIC, ADRENAL AND HEMATOLOGIC EFFECTS. THERE ARE NO KNOWN HUMAN HEALTH EFFECTS FROM ANTICIPATED EXPOSURE TO THESE ORGANIC FLUOROCHEMICALS WHEN USED AS INTENDED AND INSTRUCTED.

INGESTION MAY CAUSE:

IRRITATION OF GASTROINTESTINAL TISSUES:
SIGNS/SYMPTOMS CAN INCLUDE PAIN, VOMITING, ABDOMINAL TENDERNESS, NAUSEA, BLOOD IN VOMITUS, AND BLOOD IN FECES.

CENTRAL NERVOUS SYSTEM DEPRESSION:
SIGNS/SYMPTOMS CAN INCLUDE HEADACHE, DIZZINESS, DROWSINESS, MUSCULAR WEAKNESS, INCOORDINATION, SLOWED REACTION TIME, FATIGUE, BLURRED VISION, SLURRED SPEECH, GIDDINESS, TREMORS AND CONVULSIONS.

OTHER HEALTH HAZARD INFORMATION:
THIS PRODUCT IS NOT KNOWN TO CONTAIN ANY SUBSTANCES REGULATED UNDER CALIFORNIA PROPOSITION 65.

THIS PRODUCT MAY CONTAIN ONE OR MORE ORGANIC FLUOROCHEMICALS THAT HAVE THE POTENTIAL TO BE ABSORBED AND REMAIN IN THE BODY FOR LONG PERIODS OF TIME, EITHER AS THE PARENT MOLECULE OR AS METABOLITES, AND MAY ACCUMULATE WITH REPEATED EXPOSURES. THERE ARE NO KNOWN HUMAN HEALTH EFFECTS FROM ANTICIPATED EXPOSURE TO THESE ORGANIC FLUOROCHEMICALS WHEN USED AS INTENDED AND INSTRUCTED.

THE PRESENCE OF ORGANIC FLUOROCHEMICALS IN THE BLOOD OF THE GENERAL POPULATION AND SUBPOPULATIONS, SUCH AS WORKERS, HAS BEEN PUBLISHED DATING BACK TO THE 1970'S. 3M'S EPIDEMIOLOGICAL STUDY OF ITS OWN WORKERS INDICATES NO ADVERSE EFFECTS.

------SECTION CHANGE DATES ------

INGREDIENTS	SECTION CHANGED SINCE OCTOBER 20, 1998 ISSUE

ABBREVIATIONS:
N/D - NOT DETERMINED
N/A - NOT APPLICABLE
CA - APPROXIMATELY

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET (MSDS) IS BELIEVED TO BE CORRECT AS OF THE DATE ISSUED. 3M MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR COURSE OF PERFORMANCE OR USAGE OF TRADE. USER IS RESPONSIBLE FOR DETERMINING WHETHER THE 3M PRODUCT IS FIT FOR A PARTICULAR PURPOSE AND SUITABLE FOR USER'S METHOD OF USE OR APPLICATION. GIVEN THE VARIETY OF FACTORS THAT CAN AFFECT THE USE AND APPLICATION OF A 3M PRODUCT, SOME OF WHICH ARE UNIQUELY WITHIN THE USER'S KNOWLEDGE AND CONTROL, IT IS ESSENTIAL THAT THE USER EVALUATE THE 3M PRODUCT TO DETERMINE WHETHER IT IS FIT FOR A PARTICULAR PURPOSE AND SUITABLE FOR USER'S METHOD OF USE OR APPLICATION.

3M PROVIDES INFORMATION IN ELECTRONIC FORM AS A SERVICE TO ITS CUSTOMERS. DUE TO THE REMOTE POSSIBILITY THAT ELECTRONIC TRANSFER MAY HAVE RESULTED IN ERRORS, OMISSIONS OR ALTERATIONS IN THIS INFORMATION, 3M MAKES NO REPRESENTATIONS AS TO ITS COMPLETENESS OR ACCURACY. IN ADDITION, INFORMATION OBTAINED FROM A DATABASE MAY NOT BE AS CURRENT AS THE INFORMATION IN THE MSDS AVAILABLE DIRECTLY FROM 3M.

MATERIAL SAFETY DATA SHEET

3M
3M Center
St. Paul, Minnesota
55144-1000
1-800-364-3577 or (651) 737-6501 (24 hours)

DIVISION: 3M SPECIALTY MATERIALS
TRADE NAME:
FC-430 FLUORAD Brand Coating Additive
ID NUMBER/U.P.C.:
98-0207-0207-6 - - - ZF-0002-0997-1
ZF-0002-1041-7 - - - ZF-0002-1064-9
ZF-0002-1065-6 - - - ZF-0002-1237-1
ZF-0002-1313-0 - - -
ISSUED: December 03, 2001
SUPERSEDES: April 11, 2001
DOCUMENT: 10-3858-7

1. INGREDIENT

INGREDIENT	C.A.S. NO.	PERCENT
FLUOROALIPHATIC POLYMERIC ESTERS +(5049P)	TradeSecret	95 - 99
RESIDUAL ORGANIC FLUOROCHEMICALS	Mixture	< 3
TOLUENE	108-88-3	< 1.5
FLUOROCHEMICAL MONOMER	TradeSecret	< 1.2

The components of this product are in compliance with the chemical notification requirements of TSCA. All applicable chemical ingredients in this material are listed on the European Inventory of Existing Chemical Substances (EINECS), or are exempt polymers whose monomers are listed on EINECS.

New Jersey Trade Secret Registry (EIN) 04499600-+

This product contains the following toxic chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Emergency Planning and Community Right-To-Know Act of 1986 and 40 CFR Part 372:
TOLUENE

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

. PHYSICAL DATA

BOILING POINT:......	... > 148 C
VAPOR PRESSURE:.....	... N/D
VAPOR DENSITY:......	... N/D
EVAPORATION RATE:...	... < 1.0 BuOAc=1
SOLUBILITY IN WATER:	... complete
SPECIFIC GRAVITY:...	... ca. 1.1 Water=1
PERCENT VOLATILE:...	... < 1.5 %
pH:................	... ca. 7 (1% Aqueous)
VISCOSITY:...	... N/D
MELTING POINT	... N/A

APPEARANCE AND ODOR:
Liquid, clear amber with slight Mercaptan odor.

3. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:...........	> 100 C Setaflash
FLAMMABLE LIMITS - LEL:..	N/A
FLAMMABLE LIMITS - UEL:..	N/A
AUTOIGNITION TEMPERATURE:	N/A

EXTINGUISHING MEDIA:
Water, Carbon dioxide, Dry chemical, Foam

SPECIAL FIRE FIGHTING PROCEDURES:
Wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
See Hazardous Decomposition section for products of combustion.

NFPA HAZARD CODES HEALTH: 1 FIRE: 0 REACTIVITY: 0
UNUSUAL REACTION HAZARD: none

4. REACTIVITY DATA

STABILITY: Stable

INCOMPATIBILITY - MATERIALS/CONDITIONS TO AVOID
Not Applicable

HAZARDOUS POLYMERIZATION: Hazardous polymerization will not occur.

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

4. REACTIVITY DATA (continued)

HAZARDOUS DECOMPOSITION PRODUCTS:
Carbon Monoxide and Carbon Dioxide Hydrogen Fluoride, Toxic Vapors, Gases or Particulates.

ENVIRONMENTAL INFORMATION

SPILL RESPONSE:
Observe precautions from other sections. Ventilate area. Contain spill. Cover with absorbent material. Collect spilled material. Clean up residue with water. Place in a closed container.

RECOMMENDED DISPOSAL:
Incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF.

ENVIRONMENTAL DATA:
SUPPORTING DATA:

BIODEGRADATION:
Chemical Oxygen Demand (COD): Nil (0.04 g/g)
20-Day Biochemical Oxygen Demand (BOD20): 1.7 g/g

AQUATIC TOXICITY:
Fathead minnow (Pimephales promelas) 96-hr LC50: 399 mg/L
Activated Sludge Respiration Inhibition 3-hr EC50: >1000 mg/L

REGULATORY INFORMATION:
Volatile Organic Compounds: 16 gms/liter.
VOC Less H2O & Exempt Solvents: 16 gms/liter

Since regulations vary, consult applicable regulations or authorities before disposal. In the event of an uncontrolled release of this material, the user should determine if the release qualifies as a reportable quantity. U.S. EPA Hazardous Waste Number = None (Not U.S. EPA Hazardous).

The components of this product are in compliance with the chemical registration requirements of: TSCA, EINECS, CDSL, AICS, MITI, KTCCL, PICCS, CICS.

OTHER ENVIRONMENTAL INFORMATION:
This substance did not degrade significantly in a ready biodegradation test.

This compound is completely fluorinated (perfluorinated), or it contains perfluorinated portions. Perfluoroalkyl groups resist degradation in most natural environments.

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

5. ENVIRONMENTAL INFORMATION (continued)

This substance has minimal toxicity to aquatic organisms (100 mg/L < Lowest LC50, EC50, or IC50 < or = 1000 mg/L).

Bioassays have been run on organisms from less than three phyla Organisms from taxa that were not tested may show greater sensitivity.

This substance has insignificant toxicity to wastewater treatment system organisms (sludge respiration IC50 > 1000 mg/L).

This substance is unlikely to bioconcentrate because it has a molecular weight greater than 1000 and therefore is unlikely to diffuse or pass into biological systems.

This product contains one or more organic fluorochemicals that have the potential to resist degradation and persist in the environment.

EPCRA HAZARD CLASS:
FIRE HAZARD: No PRESSURE: No REACTIVITY: No ACUTE: Yes CHRONIC: Yes

SUGGESTED FIRST AID

EYE CONTACT:
Immediately flush eyes with large amounts of water. Get immediate medical attention.

SKIN CONTACT:
Flush skin with large amounts of water. If irritation persists, get medical attention.

INHALATION:
Remove person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, get immediate medical attention.

IF SWALLOWED:
If swallowed, call a physician immediately. Only induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.

7. PRECAUTIONARY INFORMATION

EYE PROTECTION:
Avoid eye contact with vapor spray, or mist Wear vented goggles

SKIN PROTECTION:
Avoid skin contact. Wear appropriate gloves when handling this material. A pair of gloves made from the following material(s) are recommended: butyl rubber, natural rubber.

RECOMMENDED VENTILATION:
If exhaust ventilation is not adequate, use appropriate respiratory protection. Provide ventilation adequate to control vapor concentrations below recommended exposure limits and/or control spray or mist.

RESPIRATORY PROTECTION:
Avoid breathing of airborne material. Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: half-mask organic vapor respirator.

PREVENTION OF ACCIDENTAL INGESTION:
Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Wash hands after handling and before eating.

RECOMMENDED STORAGE:
Store away from areas where product may come into contact with food or pharmaceuticals. Keep container closed when not in use. Keep container in well-ventilated area.

FIRE AND EXPLOSION AVOIDANCE:
Keep container tightly closed Nonflammable

OTHER PRECAUTIONARY INFORMATION:
No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS.

HMIS HAZARD RATINGS HEALTH: 1 FLAMMABILITY: 0 REACTIVITY: 0
PERSONAL PROTECTION: X (See precautions, section 7.)

EXPOSURE LIMITS

INGREDIENT	VALUE	UNIT	TYPE	AUTH	SKIN*
FLUOROALIPHATIC POLYMERIC ESTERS +(5049P)...........................	NONE	NONE	NONE	NONE	
RESIDUAL ORGANIC FLUOROCHEMICALS.....	0.1	MG/M3	TWA	3M	Y
TOLUENE.............................	50	PPM	TWA	ACGIH	Y

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

EXPOSURE LIMITS (continued)

INGREDIENT	VALUE	UNIT	TYPE	AUTH	SKIN*
TOLUENE................	100	PPM	TWA	OSHAV	
	OSHA VACATED PEL				
TOLUENE	150	PPM	STEL	OSHAV	
	OSHA VACATED PEL				
TOLUENE...............	200	PPM	TWA	OSHA	
TOLUENE...............	300	PPM	CEIL	OSHA	
TOLUENE...............	75	PPM	STEL	CMRG	
FLUOROCHEMICAL MONOMER	NONE	NONE	NONE	NONE	

* SKIN NOTATION: Listed substances indicated with 'Y' under SKIN refer to the potential contribution to the overall exposure by the cutaneous route including mucous membrane and eye, either by airborne or, more particularly, by direct contact with the substance. Vehicles can alter skin absorption.

SOURCE OF EXPOSURE LIMIT DATA:
- 3M: 3M Recommended Exposure Guidelines
- ACGIH: American Conference of Governmental Industrial Hygienists
- CMRG: Chemical Manufacturer Recommended Exposure Guidelines
- OSHA: Occupational Safety and Health Administration
- OSHAV: Occupational Safety and Health Administration Vacated PEL. Vacated Permissible Exposure Limits (PEL) are enforced as the OSHA PEL in some states. Check with your local regulatory authority.

NONE None Established

8. HEALTH HAZARD DATA

EYE CONTACT:
Contact with the eyes during product use is not expected to result in significant irritation.

SKIN CONTACT:
Mild Skin Irritation (after prolonged or repeated contact) signs/symptoms can include redness, swelling, and itching.

INHALATION:
Single overexposure, above recommended guidelines, may cause

Central Nervous System Depression: signs/symptoms can include headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

Irritation (upper respiratory): signs/symptoms can include soreness of the nose and throat, coughing and sneezing.

WHILE THE FOLLOWING EFFECTS ARE ASSOCIATED WITH ONE OR MORE OF THE INDIVIDUAL INGREDIENTS IN THIS PRODUCT AND ARE REQUIRED TO BE

8. HEALTH HAZARD DATA (continued)

INCLUDED ON THE MSDS BY THE U.S. OSHA HAZARD COMMUNICATION STANDARD, THEY ARE NOT EXPECTED EFFECTS DURING FORESEEABLE USE OF THIS PRODUCT

Prolonged or repeated overexposure above recommended guidelines, may cause:

Liver Effects: signs/symptoms can include yellow skin(jaundice) and tenderness of upper abdomen.

IF SWALLOWED:

Animal studies conducted on organic fluorochemicals which are present in this product indicate effects including liver disturbances, weight loss, loss of appetite, lethargy, and neurological, pancreatic, adrenal and hematologic effects. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

Irritation of Gastrointestinal Tissues: signs/symptoms can include pain, vomiting, abdominal tenderness, nausea, blood in vomitus, and blood in feces.

Central Nervous System Depression: signs/symptoms can include headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue, blurred vision, slurred speech, giddiness, tremors and convulsions.

Ingestion may cause:

Aspiration Pneumonitis: signs/symptoms can include coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.

REPRODUCTIVE/DEVELOPMENTAL TOXINS:

WARNING: Contains a chemical which can cause birth defects (108-88-3)

OTHER HEALTH HAZARD INFORMATION:

A Product Toxicity Summary Sheet is available

This product contains one or more organic fluorochemicals that have the potential to be absorbed and remain in the body for long periods of time, either as the parent molecule or as metabolites, and may accumulate with repeated exposures. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

The presence of organic fluorochemicals in the blood of the general population and subpopulations, such as workers, has been published dating back to the 1970's. 3M's epidemiological study of its own workers indicates no adverse effects.

HEALTH HAZARD DATA (continued)

SECTION CHANGE DATES

HEADING SECTION CHANGED SINCE April 11, 2001 ISSUE

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

MATERIAL SAFETY DATA SHEET

3M
3M Center
St. Paul, Minnesota
55144-1000
1-800-364-3577 or (651) 737-6501 (24 hours)

DIVISION: 3M SPECIALTY MATERIALS
TRADE NAME:
FC-431 FLUORAD Brand Coating Additive
ID NUMBER/U.P.C.:
98-0207-0212-6 00-51135-09061-9 98-0207-0213-4 00-51135-09062-6
98-0207-0214-2 00-51135-09063-3 98-0211-0899-2 00-51135-09370-2
98-0211-7224-6 00-51135-10639-6 ZF-0002-1040-9 - - -
ISSUED: December 17, 1999
SUPERSEDES: May 25, 1999
DOCUMENT: 10-3859-5

1. INGREDIENT

1. INGREDIENT	C.A.S. NO.	PERCENT
ETHYL ACETATE....................	141-78-6	50.0
FLUOROALIPHATIC POLYMERIC ESTERS +(5050P)......................	TradeSecret	50.0
RESIDUAL ORGANIC FLUOROCHEMICALS	Mixture	0 - 1

The components of this product are in compliance with the chemical notification requirements of TSCA. All applicable chemical ingredients in this material are listed on the European Inventory of Existing Chemical Substances (EINECS), or are exempt polymers whose monomers are listed on EINECS.

New Jersey Trade Secret Registry (EIN) 04499600-+

2. PHYSICAL DATA

BOILING POINT:.................	ca. 77 C (Initial)
VAPOR PRESSURE:................	ca. 73 mmHg @ 20 C.
VAPOR DENSITY:.................	ca. 3 Air=1 Calc. @ 20 C.
EVAPORATION RATE:..............	> 1.0 BuOAc=1
SOLUBILITY IN WATER:...........	moderate
SPECIFIC GRAVITY:..............	ca. 1.0 Water=1
PERCENT VOLATILE:..............	ca. 50 %

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

2 PHYSICAL DATA (continued)

pH:.	ca. 7 (1% Aqueous)
VISCOSITY:......	N/D
MELTING POINT:..	N/A

APPEARANCE AND ODOR:
Amber liquid with odor of Ethyl Acetate

3. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:..	. ca. -3 C Setaflash ASTM D-3278-96
FLAMMABLE LIMITS - LEL:..	. N/D
FLAMMABLE LIMITS - UEL:..	. N/D
AUTOIGNITION TEMPERATURE:	. N/D

EXTINGUISHING MEDIA:
Dry chemical, Foam

SPECIAL FIRE FIGHTING PROCEDURES:
Wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
See Hazardous Decomposition section for products of combustion.

NFPA HAZARD CODES HEALTH: 2 FIRE: 3 REACTIVITY.
UNUSUAL REACTION HAZARD: none

4. REACTIVITY DATA

STABILITY Stable

INCOMPATIBILITY - MATERIALS/CONDITIONS TO AVOID:
Nitrates, strong oxidizers, strong acids and alkalines

HAZARDOUS POLYMERIZATION: Hazardous polymerization will not occur

HAZARDOUS DECOMPOSITION PRODUCTS:
Carbon Monoxide and Carbon Dioxide, Hydrogen Fluoride, Toxic Vapors Gases or Particulates.

5. ENVIRONMENTAL INFORMATION

SPILL RESPONSE:

Refer to other sections of this MSDS for information regarding physical and health hazards, respiratory protection, ventilation, and personal protective equipment. Ventilate area. Extinguish all ignition sources. Contain spill. Evacuate unprotected personnel from hazard area. Cover with absorbent material. Cover spill area with Light Water Brand or other ATC foam. (For further information on ATC foam usage, contact 3M Fire Protection Systems.) Collect using non-sparking tools. Clean up residue with water. Place in an approved metal container. Seal the container.

RECOMMENDED DISPOSAL:

Incinerate in a permitted hazardous waste incinerator. Combustion products will include HF.

ENVIRONMENTAL DATA:

COD-Product=1.3 g/g, Solids=1.0 g/g; BOD20-Product=0.56 g/g, Solids= <0.019 g/g; TOC=0.34 g/g; 96-Hr. LC50, Fathead minnow(Pimephales promelas)= 943 mg/l.

REGULATORY INFORMATION:

Volatile Organic Compounds: 500 gms/liter South Coast Air Quality Mgmt Dist Method Calc. @ 20 C..
VOC Less H2O & Exempt Solvents 500 gms/liter South Coast Air Quality Mgmt Dist Method Calc. @ 20 C..

Since regulations vary, consult applicable regulations or authorities before disposal. In the event of an uncontrolled release of this material, the user should determine if the release qualifies as a reportable quantity. U.S. EPA Hazardous Waste Number = D001 (Ignitable)

The components of this product are in compliance with the chemical registration requirements of: TSCA, EINECS, CDSL, AICS, MITI, KTCCL

OTHER ENVIRONMENTAL INFORMATION:

This product contains one or more organic fluorochemicals that have the potential to resist degradation and persist in the environment.

EPCRA HAZARD CLASS:

FIRE HAZARD: Yes PRESSURE No REACTIVITY: No ACUTE: Yes CHRONIC: No

6. SUGGESTED FIRST AID

EYE CONTACT:

Immediately flush eyes with large amounts of water for at least 15 minutes. Get immediate medical attention.

SUGGESTED FIRST AID (continued)

SKIN CONTACT:
Flush skin with large amounts of water If irritation persists, get medical attention.

INHALATION:
If signs/symptoms occur, remove person to fresh air signs/symptoms continue, call a physician.

IF SWALLOWED:
If swallowed, call a physician immediately. Only induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.

7. PRECAUTIONARY INFORMATION

EYE PROTECTION:
Avoid eye contact with vapor, spray, or mist Wear vented goggles

SKIN PROTECTION:
Avoid skin contact. Wear appropriate gloves when handling this material. A pair of gloves made from the following material(s) are recommended: butyl rubber.

RECOMMENDED VENTILATION:
If exhaust ventilation is not adequate, use appropriate respiratory protection. Provide ventilation adequate to control vapor concentrations below recommended exposure limits and/or control spray or mist.

RESPIRATORY PROTECTION:
Avoid breathing of airborne material. Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: half-mask organic vapor respirator, full-face organic vapor respirator.

PREVENTION OF ACCIDENTAL INGESTION:
Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Wash hands after handling and before eating.

RECOMMENDED STORAGE:
Store away from areas where product may come into contact with food or pharmaceuticals. Store in a cool place. Store away from heat. Store out of direct sunlight. Keep container closed when not in use Keep container in well-ventilated area.

7. PRECAUTIONARY INFORMATION (continued)

FIRE AND EXPLOSION AVOIDANCE:
Keep container tightly closed. Keep away from heat, sparks, open flame, and other sources of ignition. Prevent all sources of ignition. Extremely flammable liquid and vapor. Ground containers securely when transferring contents. Wear low static or properly grounded shoes. No smoking while handling this material. Vapors may ignite explosively. Avoid static discharge.

OTHER PRECAUTIONARY INFORMATION:
No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS.

HMIS HAZARD RATINGS HEALTH: 2 FLAMMABILITY: 3 REACTIVITY: 0
PERSONAL PROTECTION: X (See precautions, section 7.)

EXPOSURE LIMITS

INGREDIENT	VALUE	UNIT	TYPE	AUTH	SKIN*
ETHYL ACETATE........................	400	PPM	TWA	ACGIH	
ETHYL ACETATE........................	400	PPM	TWA	OSHA	
FLUOROALIPHATIC POLYMERIC ESTERS +(5050P)...........................	NONE	NONE	NONE	NONE	
RESIDUAL ORGANIC FLUOROCHEMICALS.....	0.1	MG/M3	TWA	3M	Y

* SKIN NOTATION: Listed substances indicated with 'Y' under SKIN refer to the potential contribution to the overall exposure by the cutaneous route including mucous membrane and eye, either by airborne or, more particularly, by direct contact with the substance. Vehicles can alter skin absorption.

SOURCE OF EXPOSURE LIMIT DATA:
- 3M: 3M Recommended Exposure Guidelines
- ACGIH: American Conference of Governmental Industrial Hygienists
- OSHA: Occupational Safety and Health Administration

NONE None Established

8. HEALTH HAZARD DATA

EYE CONTACT:
Moderate Eye Irritation: signs/symptoms can include redness, swelling pain, tearing, and hazy vision.

8. HEALTH HAZARD DATA (continued)

SKIN CONTACT:
Mild Skin Irritation (after prolonged or repeated contact) signs/symptoms can include redness, swelling, and itching.

INHALATION:
Single overexposure, above recommended guidelines may cause

Central Nervous System Depression: signs/symptoms can include headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

Irritation (upper respiratory): signs/symptoms can include soreness of the nose and throat coughing and sneezing.

IF SWALLOWED:
Animal studies conducted on organic fluorochemicals which are present in this product indicate effects including liver disturbances, weight loss, loss of appetite, lethargy, and neurological, pancreatic, adrenal and hematologic effects. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

WHILE THE FOLLOWING EFFECTS ARE ASSOCIATED WITH ONE OR MORE OF THE INDIVIDUAL INGREDIENTS IN THIS PRODUCT AND ARE REQUIRED TO BE INCLUDED ON THE MSDS BY THE U.S. OSHA HAZARD COMMUNICATION STANDARD, THEY ARE NOT EXPECTED EFFECTS DURING FORESEEABLE USE OF THIS PRODUCT

Irritation of Gastrointestinal Tissues: signs/symptoms can include pain, vomiting, abdominal tenderness, nausea, blood in vomitus, and blood in feces.

Central Nervous System Depression: signs/symptoms can include headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue, blurred vision, slurred speech, giddiness, tremors and convulsions.

Ingestion may cause

Aspiration Pneumonitis: signs/symptoms can include coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.

OTHER HEALTH HAZARD INFORMATION:
A Product Toxicity Summary Sheet is available

This product contains one or more organic fluorochemicals that have the potential to be absorbed and remain in the body for long periods of time, either as the parent molecule or as metabolites, and may accumulate with repeated exposures. There are no known human health effects from anticipated exposure to these organic fluorochemicals

8. HEALTH HAZARD DATA (continued)

when used as intended and instructed

The presence of organic fluorochemicals in the blood of the general population and subpopulations, such as workers, has been published dating back to the 1970's. 3M's epidemiological study of its own workers indicates no adverse effects.

SECTION CHANGE DATES

PRECAUTIONARY INFO. SECTION CHANGED SINCE May 25, 1999 ISSUE

Abbreviations: N/D Not Determined N/A - Not Applicable CA - Approximately

MATERIAL SAFETY DATA SHEET

3M
3M Center
St. Paul, Minnesota
55144-1000
1-800-364-3577 or (651) 737-6501 (24 hours)

DIVISION: 3M SPECIALTY MATERIALS
TRADE NAME:
FC-125 FLUORAD(TM) Fluorochemical Surfactant
ID NUMBER/U.P.C.:
98-0212-1002-0 00-51135-45028-4 98-0212-1003-8 00-51135-45029-1
98-0212-1004-6 - - - 98-0212-1005-3
98-0212-1006-1 00-51135-45032-1
ISSUED: February 28, 2000
SUPERSEDES: May 03, 1999
DOCUMENT: 08-2103-3

1 INGREDIENT	C.A.S. NO.	PERCENT
WATER	7732-18-5	89.5 - 91.5
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C8)	2991-51-7	8 - 10
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C6)	67584-53-6	
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C4)	67584-51-4	
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C7)	67584-62-7	
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C5)	67584-52-5	

The components of this product are in compliance with the chemical notification requirements of TSCA. All applicable chemical ingredients in this material are listed on the European Inventory of Existing Chemical Substances (EINECS), or are exempt polymers whose monomers are listed on EINECS.

2 PHYSICAL DATA

BOILING POINT:................. ca. 100 C
VAPOR PRESSURE:................. ca. 18 mmHg @ 20C
VAPOR DENSITY:................. N/D
EVAPORATION RATE:.............. N/D

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

2. PHYSICAL DATA (continued)

SOLUBILITY IN WATER:	apprec.
SPECIFIC GRAVITY:...	ca. 1.0 Water=1
PERCENT VOLATILE:...	85 - 95 %
pH:................	ca. 8
VISCOSITY:..........	< 10 centipoise
MELTING POINT:......	N/A

APPEARANCE AND ODOR
Amber liquid.

3. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:.............	. NONE
FLAMMABLE LIMITS - LEL:..	. N/A
FLAMMABLE LIMITS - UEL:..	. N/A
AUTOIGNITION TEMPERATURE:	. N/D

EXTINGUISHING MEDIA:
Non-combustible. Choose material suitable for surrounding fire

SPECIAL FIRE FIGHTING PROCEDURES:
Wear full protective clothing, including helmet, self-contained, positive pressure or pressure demand breathing apparatus, bunker coat and pants, bands around arms, waist and legs, face mask, and protective covering for exposed areas of the head.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
See Hazardous Decomposition section for products of combustion

REACTIVITY DATA

STABILITY: Stable

INCOMPATIBILITY - MATERIALS/CONDITIONS TO AVOID
None known.

HAZARDOUS POLYMERIZATION: Hazardous polymerization will not

HAZARDOUS DECOMPOSITION PRODUCTS:
Carbon Monoxide and Carbon Dioxide, Hydrogen Fluoride.

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

5. ENVIRONMENTAL INFORMATION

SPILL RESPONSE:
Observe precautions from other sections. Ventilate area. Contain spill. Cover with absorbent material. Collect spilled material. Clean up residue with water. Place in a closed container.

RECOMMENDED DISPOSAL:
Incinerate in an industrial or commercial facility in the presence of a combustible material. Combustion products will include HF.

ENVIRONMENTAL DATA:
Not determined.

REGULATORY INFORMATION:
Volatile Organic Compounds: N/A.
VOC Less H20 & Exempt Solvents: N/A.

Since regulations vary, consult applicable regulations or authorities before disposal. U.S. EPA Hazardous Waste Number = None (Not U.S. EPA Hazardous).

The components of this product are in compliance with the chemical registration requirements of: TSCA, EINECS, CDSL, AICS, MITI, PICCS

OTHER ENVIRONMENTAL INFORMATION:
This product contains one or more organic fluorochemicals that have the potential to resist degradation and persist in the environment.

EPCRA HAZARD CLASS:
FIRE HAZARD: No PRESSURE: No REACTIVITY: No ACUTE: Yes CHRONIC: No

6 SUGGESTED FIRST AID

EYE CONTACT:
Immediately flush eyes with large amounts of water Get immediate medical attention.

SKIN CONTACT:
Flush skin with large amounts of water If irritation persists, get medical attention.

INHALATION:
If signs/symptoms occur, remove person to fresh air If signs/symptoms continue, call a physician.

IF SWALLOWED:
If swallowed, call a physician immediately. Only induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

6. SUGGESTED FIRST AID (continued)

7. PRECAUTIONARY INFORMATION

EYE PROTECTION:
Avoid eye contact with vapor, spray, or mist Wear vented goggles

SKIN PROTECTION:
Avoid skin contact. Wear appropriate gloves when handling this material. A pair of gloves made from the following material(s) are recommended: butyl rubber. Use one or more of the following personal protection items as necessary to prevent skin contact: apron, coveralls.

RECOMMENDED VENTILATION:
If exhaust ventilation is not adequate, use appropriate respiratory protection. Provide ventilation adequate to control vapor concentrations below recommended exposure limits and/or control spray or mist.

RESPIRATORY PROTECTION:
Avoid breathing of airborne material. Select one of the following NIOSH approved respirators based on airborne concentration of contaminants and in accordance with OSHA regulations: Half-mask organic vapor respirator with dust/mist prefilter.

PREVENTION OF ACCIDENTAL INGESTION:
Do not eat, drink or smoke when using this product. Wash exposed areas thoroughly with soap and water. Wash hands after handling and before eating.

RECOMMENDED STORAGE:
Store away from areas where product may come into contact with food or pharmaceuticals. Store at room temperature. Store out of direct sunlight. Keep container closed when not in use.

FIRE AND EXPLOSION AVOIDANCE
Not applicable.

OTHER PRECAUTIONARY INFORMATION:
No smoking: Smoking while using this product can result in contamination of the tobacco and/or smoke and lead to the formation of the hazardous decomposition products mentioned in the Reactivity Data section of this MSDS.

HMIS HAZARD RATINGS: HEALTH: 1 FLAMMABILITY: 0 REACTIVITY: 0
PERSONAL PROTECTION: X (See precautions, section 7.)

7. PRECAUTIONARY INFORMATION (continued)

EXPOSURE LIMITS

INGREDIENT	VALUE	UNIT	TYPE	AUTH	SKIN*
WATER................................	NONE	NONE	NONE	NONE	
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C8)..................	0.1	MG/M3	TWA	3M	Y
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C6)..................	0.1	MG/M3	TWA	3M	Y
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C4)..................	0.1	MG/M3	TWA	3M	Y
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C7)..................	0.1	MG/M3	TWA	3M	
POTASSIUM PERFLUOROALKYL CARBOXYLATE (C5)..................	0.1	MG/M3	TWA	3M	Y

* SKIN NOTATION: Listed substances indicated with 'Y' under SKIN refer to the potential contribution to the overall exposure by the cutaneous route including mucous membrane and eye, either by airborne or, more particularly, by direct contact with the substance. Vehicles can alter skin absorption.

SOURCE OF EXPOSURE LIMIT DATA:
- 3M: 3M Recommended Exposure Guidelines

NONE None Established

8. HEALTH HAZARD DATA

EYE CONTACT:
Mild Eye Irritation: signs/symptoms can include redness, swelling, pain, and tearing.

SKIN CONTACT:
Mild Skin Irritation: signs/symptoms can include redness, swelling, and itching.

May be absorbed through the skin and produce effects similiar to those caused by inhalation and/or ingestion.

INHALATION:
Single overexposure above recommended guidelines, may cause

Irritation (upper respiratory): signs/symptoms can include soreness of the nose and throat, coughing and sneezing.

8 HEALTH HAZARD DATA (continued)

IF SWALLOWED:
Animal studies conducted on organic fluorochemicals which are present in this product indicate effects including liver disturbances, weight loss, loss of appetite, lethargy, and neurological, pancreatic, adrenal and hematologic effects. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

Ingestion may cause:

Aspiration Pneumonitis: signs/symptoms can include coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.

OTHER HEALTH HAZARD INFORMATION:
This product contains one or more organic fluorochemicals that have the potential to be absorbed and remain in the body for long periods of time, either as the parent molecule or as metabolites, and may accumulate with repeated exposures. There are no known human health effects from anticipated exposure to these organic fluorochemicals when used as intended and instructed.

The presence of organic fluorochemicals in the blood of the general population and subpopulations, such as workers, has been published dating back to the 1970's. 3M's epidemiological study of its own workers indicates no adverse effects.

SECTION CHANGE DATES

PHYSICAL DATA SECTION CHANGED SINCE May 03 1999 ISSUE

Abbreviations: N/D - Not Determined N/A - Not Applicable CA - Approximately

INDUSTRIAL HYGIENE REPORT FOR FC-135

SUBJECT:	Air Monitoring for FC-135 and Residual Fluorochemicals (Perfluorooctane, N-Methylperfluorooctanesulfonamide, N-Ethylperfluorooctanesulfonamide,Perfluoroctanesulfonamide, and 2-(N-Ethylperfluorooctanesulfonamido)-ethyl alcohol.

SUMMARY

In May 2000,3M announced that it was phasing out its manufacture and use of perfluorooctanyl chemistry. The reason for 3M's phase out of this product line is that these materials have been shown to be widely distributed and very persistent in the environment and appear to bioaccumulate. While this chemistry is persistent and tends to bioaccumulate, it seems to have minimal toxicity at the low levels currently detected in the general population. Part of the response to this issue included sharing this information with management and employees who work with these materials and performing monitoring in areas which the chemical of concern is used.

Personal and area monitoring results show that all samples are below the detection limit of 0.013 mg/m3 for each of the five Residual Fluorochemicals associated with FC-135.

See Table 1 for a summary of the results.

PURPOSE/DISCUSSION

The purpose of this monitoring was to quantify airborne concentrations of Residual Flourochemicals while dispensing FC-135 and making mixtures. Personal and area monitoring was performed during 3 operations. In the first operation, the raw material (FC-135) is dispensed into smaller containers for delivery to the making areas. In a second operation, FC-135 is mixed with N-propyl alcohol (NPL) and water to make a 21% solution. In a third operation, an .8% dilution of FC-135 is made. These makes are handled in a similar manner, the operator adds water to the main kettle, pours a known amount of FC-135 into the kettle, rinses the FC-135 bottle with N-propyl alcohol (NPL), then pours the rinse into the kettle. The remainder of NPL is then added to the kettle and brought up to volume with water. Each make kettle is fitted with a kettle cover and elephant trunk exhaust fitted on the back section of the cover. Operators wear black neoprene gloves and safety glasses while handling this chemical. The department requires face protection while handling this chemical also, the operators are given a choice between a chemical faceshield or an airline supplied bullard hood respirator.

METHODS

ELF continuous flow air pumps were fitted with MTO-ORBO tubes and calibrated to 1 L/min. Analysis was conducted by Centre Analytical Laboratories following Standard Operating Procedures CAL-24FHE/1, CAL-24FGM/1, and CAL-24FLM/1.

The sample tubes were separated into three fractions and each section was extracted with 1ml of acetone and analyzed by liquid chromatography / mass spectrometry (LC/MS).

RESULTS

See Table 1. The results show that airborne concentrations are below detectable levels, however the 3M Exposure Guideline of 0.1 mg/m3 (8 hour Time Weighted Average-skin) has a skin designation. The skin designation was established to emphasize the importance of avoiding skin contact to minimize the potential for skin absorption and accumulation of organic fluorine compounds in the body.

CONCLUSIONS

Personal and area samples show air concentrations of Residual Fluorochemicals, while dispensing FC-135, making mixtures, are below detectable levels.

RECOMMENDATIONS

- Skin contact continues to be the main source of exposure to this class of chemicals. The department should stress the use of proper personal protective equipment to protect the hands, eyes, face and skin from contact with this chemical.
- This report should be shared with all employees.
- If there are any changes to concentrations, procedures or processes which affect how this chemical is handled a formal health, safety and environmental review should be held before any of these changes are instituted.
- If there are any questions regarding the information contained in this report contact the area industrial hygienist.

TABLE 1

Title: Residual Fluorochemical Sampling

Agent: FC-135: PFOS, PFOSMA, PFOSSEA, PFOSA, and EtFOSE-OH
Method & Method #: LC/MS, CAL-24FHE/1, CAL-24FGM/1, and CAL-24FLM/1
Study Date: 9/13/2000
Exposure Guideline: 0.1 mg/m3 8-hour Time Weighted Average - Skin

Date	Sample #	Sample Description	PFOS (mg/m3)	PFOSA (mg/m3)	PFOSMA (mg/m3)	PFOSEA (mg/m3)	EtFOSE-OH (mg/m3)
9/13/00	2770-1	Employee KM (1ss) FC-135	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
	711-2	Area at scale (1ss) FC-135	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
	14277-1	Area at kettle.	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
	703-1	Area at kettle 1	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
	15076-1	Employee ML	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012
	Blank 1	N/A	N.D.	N.D.	N.D.	N.D.	N.D.
	Blank 2	N/A	N.D.	N.D.	N.D.	N.D.	N.D.
	Blank 3	N/A	N.D.	N.D.	N.D.	N.D.	N.D.

Industrial Hygiene Report for Fluorochemical P-96-1262

SUBJECT:	Exposure Evaluation for 3M Fluorochemical Polymer (P-96-1262) and Other Fluorochemical Compounds
STUDY DATES:	November 16, 2000

SUMMARY

Residual fluorochemical exposure monitoring indicates air concentrations are well below the 3M exposure guideline of 0.1 mg/m3 (8-hour Time Weighted Average – Skin) during dispensing and addition of Fluorochemical Polymer P-96-1262. Skin contact must be avoided to minimize the potential for absorption and accumulation of organic fluorine compounds in the body.

PURPOSE

The purpose of this study is to evaluate potential employee exposures to fluorochemical compounds and residual fluorochemical materials during a film manufacturing process.

OVERVIEW

In May 2000, 3M announced that it was phasing out manufacture and use of its perfluorooctanyl chemistry. The reason for 3M's phase out of this product line is that these materials have been shown to be widely distributed and very persistent in the environment and appear to bioaccumulate. While this type of chemistry is persistent and tends to bioaccumulate, it seems to have minimal toxicity at the low levels currently detected in the general population.

Part of the company's response to this issue has included sharing this information with management and employees who work with these materials. In addition, areas in which materials containing perfluoro-related chemistry are used are performing exposure evaluations and air monitoring (if necessary).

A search of the facility's chemical inventory listing and discussions with on-site process engineers and health professionals reveals the only significant use of fluorochemical compounds occurs with the production of a film coating.

PROCESSS DECRIPTION

Fluorochemical Polymer P-96-1262 is received from 3M in 55 gallon steel drums. The material is suspended in a 25% methyl ethyl ketone (MEK) solution and appears as a clear, oily, amber liquid with a strong MEK odor. The material is pre-weighed into three 5 gallon containers in the Pre-Weigh Area using a scale and pneumatic drum pump. The containers are covered with plastic "bonnet" lids and held in the Pre-Weigh area on a cart prior to addition. The dispensing area is equipped with a small slot exhaust hood. Operators wear long sleeve blue coveralls, half-face catridge respirator with HEPA/OV/AG cartridge, double thin latex gloves, safety glasses, safety shoes and a face shield during the pre-weigh activity.

At the appropriate time, the pre-weighed Fluorochemical Polymer P-96-1262 is added to the batch mixing vessel. Approximately 100 lbs. of the compound is added per batch for a solution concentration of approximately one (1) percent. The mixing vessel is equipped with a flexible exhaust trunk and operators wear the same personal protective equipment (PPE) described above.

METHOD

ELF continuous flow air pumps were fitted with MTO-ORBO tubes and calibrated to approximately one (1) L/min. Analysis was conducted by Centre Analytical Laboratories following Standard Operating Procedures CAL-24FHE/1, CAL-24FGM/1 and CAL-24FLM/1. The sample tubes were separated into three fractions and each section was extracted with 1ml of acetone and analyzed by liquid chromatography / mass spectrometry (LC/MS).

Based on information provided by 3M, the samples were analyzed for the following three (3) fluorochemical target compounds:

Perfluorooctane Sulfonate (PFOS)
N-Ethylperfluorooctanesulfonamide (PFOSEA)
2-(N-Ethylperfluorooctanesulfonamido)-ethyl alcohol (EtFOSE-OH)

RESULTS

Air sampling results are detailed in Table 1 below. The results indicate that airborne exposures to employees are below detectable levels. A headspace sample was obtained from a covered, five (5) gallon container of the fluorochemical compound. This sample is intended to represent a "worst case" condition. Sampling results indicate the presence of only one of the three target compounds perfluorooctane sulfonate (PFOS), at levels well below the 3M exposure guideline.

CONCLUSIONS AND RECOMMENDATIONS

Personal and area samples show air concentrations of residual fluorochemicals well below the 3M exposure guideline of 0.1 mg/m3 (8-hour Time Weighted Average – Skin) during dispensing and addition of Fluorochemical Polymer P-96-1262. However, the 3M exposure guideline also carries a skin designation. The skin designation was established to emphasize the importance of avoiding skin contact to minimize the potential for skin absorption and accumulation of organic fluorine compounds in the body.

- Based on the chemical hazard information gathered to date, skin contact continues to be the main source of exposure to this class of chemicals. The department should continue to strictly enforce the use of skin protective equipment. In addition, the department should consider the use of a more substantial chemical glove to replace the thin, latex gloves currently in use.
- The results of this study should be shared with all affected employees.
- The department should continue to evaluate alternative materials to replace the fluorochemical compounds. In addition, if process changes result in increased potential for exposure (i.e. increased concentrations, changes to handling methods, etc.) the department should conduct a follow-up exposure evaluation.

TABLE 1

Title: Results of Air Sampling for Residual Fluorochemical Materials

Agent: Fluorochemical Polymer P-96-1262
[Residual Fluorochemicals PFOS, PFOSEA and EtFOSE-OH]
Method & Method #: LC/MS, CAL-24FHE/1, CAL-24FGM/1 and CAL-24FLM/1
Study Date: 11/16/2000
Exposure Guideline: 0.1 mg/m3 8-hour Time Weighted Average – Skin (3M)

Date	Sample #	Sample Description	PFOS (mg/m3)	PFOSEA (mg/m3)	EtFOSE-OH (mg/m3)
11/16/00	WC001	Employee JL Dispensing and mock add	<0.011	<0.011	<0.011
11/16/00	WC002	Headspace sample placed inside 5 gallon container	0.0017	<0.0026	<0.0026
11/16/00	WC003	Field Blank	ND	ND	ND

ND = Not detected at or above reporting limit (per analytical report)

Please contact area industrial hygienist with any questions regarding the information in this report.

INDUSTRIAL HYGIENE REPORT FOR FC-430 (CAS 11114-17-3) AND FC-431 (CAS 12707-52-7)

SUBJECT:	Air Monitoring for FC-430 , FC-431 and Residual Fluorochemicals (Perfluorooctane, N-Methylperfluorooctanesulfonamide, N-Ethylperfluorooctanesulfonamide,Perfluorooctanesulfonamide, and 2-(N-Ethylperfluorooctanesulfonamido)-ethyl alcohol) in Film Coating
STUDY DATES:	09/13/00 – 09/14/00

PURPOSE/DISCUSSION

The purpose of this monitoring was to quantify airborne concentrations of residual fluorochemicals while handling FC-430 and FC-431 in coating solution and emulsion making areas.

Samples were collected as the chemicals were handled in the chemical handling, pre-weigh and processing areas. Operators in the chemical handling area transfer the FC-430 and FC-431 into 5-gallon containers. In the pre-weigh area, the quantity needed for each batch of coating solution is dispensed from one container into another. In the processing areas, the solution is then added to the coating solution that is being prepared.

Chemical-resistant gloves are worn when both FC-430 and FC-431 are handled. Air-supplied respirators are worn when handling FC-430.

METHODS

MSA battery operated sampling pumps were fitted with MTO-ORBO tubes and calibrated to 1 L/min. The analysis was conducted by Centre Analytical Laboratories following Standard Operating Procedures CAL-24FHE/1, CAL-24FGM/1, and CAL-24FLM/1. MSA pumps were calibrated before and after use. Calibration records are in the CQS Industrial Hygiene Laboratory.

The sample tubes were separated into three fractions and each section was extracted with 1ml of acetone and analyzed by liquid chromatography / mass spectrometry (LC/MS).

RESULTS

See Table 1. The results show that airborne concentrations are below detectable levels.

CONCLUSIONS

The 3M Exposure Guideline of 0.1 mg/m3 (8 hour Time Weighted Average-skin) also has a skin designation component. The skin designation was established to emphasize the importance of avoiding skin contact to minimize the potential for skin absorption and accumulation of organic fluorine compounds in the body.

The personal protective equipment worn when FC-430 and FC-431 were handled was appropriate.

RECOMMENDATIONS

- Skin contact continues to be the main source of exposure to this class of chemicals. The department should stress the use of proper personal protective equipment to protect the skin from contact with this chemical.
- Periodic hazard awareness should be conducted until the supplies of FC-430 and FC-431 are depleted.
- This report should be shared with all employees.
- If there are any changes to concentrations, procedures, or processes that affect how this chemical is handled, a formal health, safety and environmental review should be held before any of these changes are instituted.

For further information, contact area industrial hygienist

TABLE 1

Title: Residual Fluorochemicals Sampling
Location: Coating solution and and emulsion making area
Agents: FC-430 (10040779) and FC-431 (10052733): PFOS, PFOSMA, PFOSSEA, PFOSA, and EtFOSE-OH*
Method & Method #: LC/MS, CAL-24FHE/1, CAL-24FGM/1, and CAL-24FLM/1
Study Dates: 9/13/00 – 9/14/00
Exposure Guideline: 0.1 mg/m3 8-hour Time Weighted Average – Skin, 3M Exposure Guideline

Date	Operator name	Sample Description	PFOS mg/m3	PFOSA mg/m3	PFOSMA mg/m3	PFOSEA mg/m3	EtFOSE-OH mg/m3
9/13/00	Employee MD	Chemical handling: pumping FC-431 from drum to container	< 0.0076	< 0.0076	< 0.0076	< 0.0076	< 0.0076
9/13/00	Employee RG	Preweigh: dispensing 1000g of FC-431 into containers	< 0.011	< 0.011	< 0.011	< 0.011	< 0.011
9/13/00	Employee RG	Preweigh: transferring FC-430 from drum to container	< 0.0076	< 0.0076	< 0.0076	< 0.0076	< 0.0076
9/14/00	Employee RG	Preweigh: dispensing FC-430 into containers	< 0.013	< 0.013	0.013	< 0.013	< 0.013
9/13/00	Employee JF	Processing: manual addition of 573g of FC-431 to coating solution	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013

< - Results below the limit of detection for the method used.

* perfluorooctane sulfonate, n-methylperfluorooctanesulfonamide, n-ethylperfluorooctanesulfonamide, perfluorooctanesulfonamide, 2-(n-ethylperfluorooctanesulonamido)-ethyl alcohol

INDUSTRIAL HYGIENE REPORT FOR FC-431

SUBJECT:	Air Monitoring for FC-431 and Residual Fluorochemicals (Perfluorooctane, N-Methylperfluorooctanesulfonamide, N-Ethylperfluorooctanesulfonamide,Perfluoroctanesulfonamide, and 2-(N-Ethylperfluorooctanesulfonamido)-ethyl alcohol)

SUMMARY

In May 2000, 3M announced that it was phasing out its manufacture and use of perfluorooctanyl chemistry. The reason for 3M's phase out of this product line is that these materials have been shown to be widely distributed and very persistent in the environment and appear to bioaccumulate. While this chemistry is persistent and tends to bioaccumulate, it seems to have minimal toxicity at the low levels currently detected in the general population. Part of the company's response to this issue included sharing this information with management and employees who work with these materials and performing monitoring in areas which the chemical of concern is used.

Personal and area monitoring results show that all samples are below the detection limit of 0.013 mg/m3 for each of the five Residual Fluorochemicals associated with FC-431.

See Table 1 for a summary of the results.

PURPOSE/DISCUSSION

The purpose of this monitoring was to quantify airborne concentrations of Residual Flourochemicals while dispensing FC-431 to make a film coating.

Personal and area monitoring was performed during the dispensing and addition of FC-431 to the coating. The FC-431 was dispensed into a bucket until 11 pounds was obtained. Neoprene gloves and safety glasses were worn during this activity.

The FC-431 is added to a mixer containing methylene chloride. After the FC-431, a second componenet of the coating is also added to the solution. During both additions, an airline supplied bullard hood respirator and neoprene gloves were worn.

METHODS

MSA battery operated sampling pumps were fitted with MTO-ORBO tubes and calibrated to 1 L/min. The analysis was conducted by Centre Analytical Laboratories following Standard Operating Procedures CAL-24FHE/1, CAL-24FGM/1, and CAL-24FLM/1. MSA pumps were calibrated before and after use. Calibration records are in the CQS Industrial Hygiene Laboratory.

The sample tubes were separated into three fractions and each section was extracted with 1ml of acetone and analyzed by liquid chromatography / mass spectrometry (LC/MS).

RESULTS

See Table 1. The results show that airborne concentrations are below detectable levels, however the 3M Exposure Guideline of 0.1 mg/m3 (8 hour Time Weighted Average-skin) has a skin designation. The skin designation was established to emphasize the importance of avoiding skin contact to minimize the potential for skin absorption and accumulation of organic fluorine compounds in the body.

CONCLUSIONS

Personal and area samples show air concentrations of Residual Fluorochemicals, while dispensing FC-431 and making solvent t-coat, are below detectable levels.

Personal protective equipment worn during this task was appropriate.

RECOMMENDATIONS

- Skin contact continues to be the main source of exposure to this class of chemicals. The department should stress the use of proper personal protective equipment to protect the hands, eyes, face and skin from contact with this chemical.
- This report should be shared with all employees.
- If there are any changes to concentrations, procedures, or processes that affect how this chemical is handled, a formal review should be held before any of these changes are instituted.

For further information, contact area industrial hygienist.

TABLE 1

Title: Residual Flourochemical Sampling

Agent: FC-431 (10052733): PFOS, PFOSMA, PFOSSEA, PFOSA, and EtFOSE-OH
Method & Method #: LC/MS, CAL-24FHE/1, CAL-24FGM/1, and CAL-24FLM/1
Study Date: September 27, 2000
Exposure Guideline: 0.1 mg/m3 8-hour Time Weighted Average - Skin

Date	Sample #	Sample Description	PFOS (mg/m3)	PFOSA (mg/m3)	PFOSMA (mg/m3)	PFOSEA (mg/m3)	EtFOSE-OH (mg/m3)
9/27/00	1	Area at dispensing and weigh stations	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
9/27/00	2	Employee JB)	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013
9/27/00	3	Area at mixer	< 0.014	< 0.014	< 0.014	< 0.014	< 0.014
9/27/00	4	Blank/Background	< 0.013	< 0.013	< 0.013	< 0.013	< 0.013

< - Results below the limit of detection for the method used.

3M Product Toxicity Summary Sheet

Form 15594-3

Attachment 10
Page 1 of 2

Product Name
FC-135 FLUORAD BRAND FLUOROCHEMICAL SURFACTANT

Issue Date
Dec 28, 1995

Below is a summary of the study data giving an indication of the relative toxicity of the product. (Definitions of test procedures are found on the reverse side of this sheet.) This summary is the data for the precautionary use information provided with the product.

Relative toxicity of a material is only one factor that is important in determining the degree of hazard in handling a chemical or product. Other considerations to include are physical properties of the chemical, extent and frequency of use or exposure, intended use, and possible misuse of the product. For additional information regarding safe handling of the product, please reference the Material or Product Safety Data Sheet.

PERFORMANCE CHEMICALS & FLUIDS DIV - FIRE & ENVIRONMENTAL
ACN: 12249
Global MSDS ID: 10-3807-4

Supersedes Dec 05, 1995

ACUTE ORAL TOXICITY (RAT): PRACTICALLY NON-TOXIC. Ten albino rats (five male, five female, Sherman-Wister strain) each received an oral dose of FC-135 equivalent to 5 ml/kg (6 grams/kg). There were no pharmacotoxic signs. There were no deaths. Weight gains were normal. At necropsy no lesions were observed. FC-135 is considered practically non-toxic orally.

PRIMARY SKIN IRRITATION: SLIGHTLY IRRITATING. Six albino rabbits received 0.5 ml applications of FC-135 on intact and abraded skin test sites. The sites were occluded for a period of 24 hours. Upon removal of the wrap, the sites were evaluated for irritation. The sites were reread 48 hours later. Results show nearly all animals reacted with grade 1 redness and swelling at intact and abraded sites at the initial reading. By the second reading all sites were free of irritation. The primary skin irritation score is 1.0/8.0. FC-135 is considered slightly irritating.

EYE IRRITATION: MINIMALLY IRRITATING. Six albino rabbits received 0.1 ml instillations of FC-135 into the conjunctival sac of the right eye. The left eyes served as contralateral controls. The eyes were evaluated for irritation at one hour and 1, 2, 3, 5 and 7 days. Results show FC-135 elicited minimal conjunctival irritation at the one hour reading only. The maximum mean irritation score is 5.0/110.0. FC-135 is considered minimally irritating dermally.

ACUTE DERMAL TOXICITY (RABBIT): PRACTICALLY NON-TOXIC. Twenty rabbits (10 males, 10 females, New Zealand White strain) each received 5 grams per kilogram of body weight application of FC-135. The site was occluded for 24 hours and then the test material was removed. The animals were held for a period of 28 days. No pharmacotoxic signs or deaths were observed. Weight gains were noted for all females and 8/10 males. The two males which lost weight during the first week after dosing gained during the remaining period but failed to achieve their starting weights. At necropsy no visible lesions were observed. FC-135 can be considered practically non-toxic dermally.

Attachment 10
Page 2 of 2

3M Product Toxicity Summary Sheet

Form 15594 - J

Product Name

FC-135 FLUORAD BRAND FLUOROCHEMICAL SURFACTANT

Issue Date

Dec 28, 1995

Below is a summary of the study data giving an indication of the relative toxicity of the product. (Definitions of test procedures are found on the reverse side of this sheet.) This summary is the data for the precautionary use information provided with the product.

Relative toxicity of a material is only one factor that is important in determining the degree of hazard in handling a chemical or product. Other considerations to include are physical properties of the chemical, extent and frequency of use or exposure, intended use, and possible misuse of the product. For additional information regarding safe handling of the product, please reference the Material or Product Safety Data Sheet.

PERFORMANCE CHEMICALS & FLUIDS DIV FIRE & ENVIRONMENTAL   Supersedes Dec 05, 1995
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During this study blood samples were drawn from the animals at various times after dermal administration of the test material and the samples were analysized for organofluoride. Male rabbits were found to have 2.3 and 7.6 parts fluorine per million parts of blood at day 1 and day 28, respectively. Female rabbits were found to have 6.9 and 20.8 parts fluorine per million parts of blood at day 1 and day 28, respectively. The test material appears to absorbed dermally and to persist in the test animals.