



Technical Data Bulletin

Environmental, Health, Safety, and Regulatory (EHSR) Profile of Perfluorobutane Sulfonate (PFBS)

3M is developing a new line of fluorochemical surfactants based on perfluorobutane sulfonate (PFBS). PFBS refers collectively to perfluorobutane sulfonyl compounds including perfluorobutane sulfonates. PFBS-based surfactants are potential replacements for perfluorooctane sulfonate (PFOS) based surfactants. PFBS has an excellent EHSR profile. 3M believes PFBS-based surfactants, with only four perfluorinated carbon atoms, are a sustainable alternative to PFOS-based surfactants with eight perfluorinated carbon atoms.

Common Questions

Are these new surfactants PFAS (Perfluoroalkane sulfonate)? ***YES, they fall in the broad category defined by PFAS (carbon chain length from C₁ to C₂₀ or greater) but they have very different environmental and toxicity properties than PFOS-based surfactants (see below). PFAS environmental, health, and safety characteristics need to be reviewed on an individual basis as these properties vary significantly depending on the carbon chain length.***

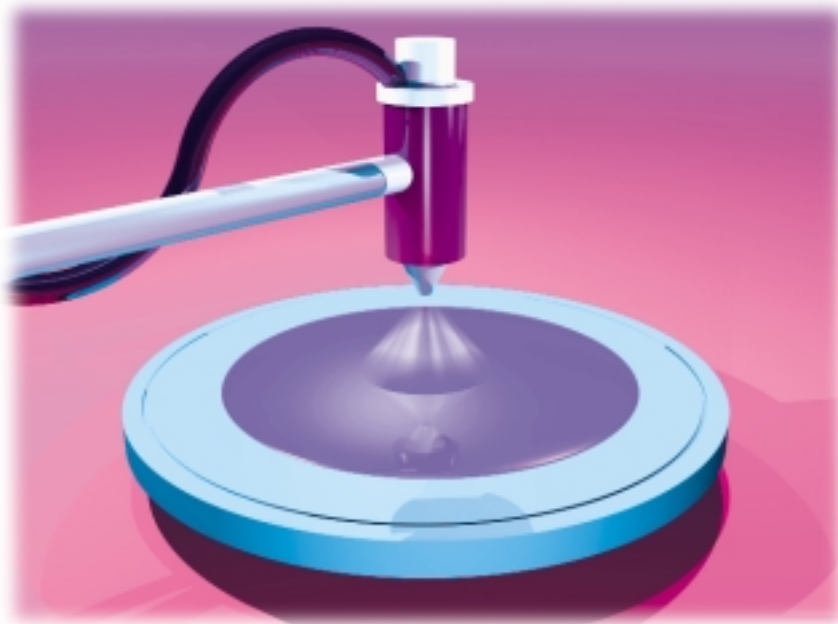
Are these new surfactants considered PBTs (persistent, bioaccumulative and toxic) under the U.S. EPA's PBT Chemical Policy? ***NO***

PFBS EHS Summary

- Practically non-toxic
 - Low mammalian toxicity
 - Low ecotoxicity
- Bioconcentration factor <1

PFBS Regulatory Summary

- Not considered persistent, bioaccumulative and toxic (PBT) under the U.S. Environmental Protection Agency's (EPA) PBT chemical Policy
- First series of PFBS-based surfactants produced by 3M have been reviewed by the U.S. EPA and placed on the TSCA inventory
- PFBS-based surfactants have been commercialized by 3M in the U.S. and in Europe; commercialization in other countries is being pursued
- PFBS and PFBS-based surfactants are not included in the U.S. EPA's PFAS Final Significant New Use Rule (SNUR 67 FR 11008) or Supplemental Proposed Significant New Use Rule (SNUR 67 FR 11014)



EHS Data

Acute Ecotoxicity

	Test	PFBS
Microbial (OECD 209)	3-hr. EC ₅₀ (mg/l)	> 1000
<i>Selenastrum capricornutum</i> (algae)	96-hr. EC ₅₀ Growth rate (mg/l) Cell density (mg/l) Area under curve (mg/l)	> 1000 > 1000 > 1000
<i>Daphnia magna</i>	48-hr. EC ₅₀ (mg/l)	> 1000
<i>Mysidopsis bahia</i> (small salt water shrimp)	96-hr. EC ₅₀ (mg/l)	100-1000
Bluegill Sunfish	96-hr. LC ₅₀ (mg/l)	> 1000
Fathead minnow	96-hr. LC ₅₀ (mg/l)	> 1000

EC₅₀ = Concentration at which 50% of the population show effects (i.e. growth rate or movement)

LC₅₀ = Concentration which is lethal for 50% of the population

NIOSH and European Union Acute Toxicity Classifications for Fish/Daphnia/Algae

Toxicity Value (mg/l)	NIOSH	European Union
> 1000	Insignificant hazard	---- ← PFBS
100-1000	Practically non-toxic	----
10-100	Slightly toxic	Harmful
1-10	Moderately toxic	Toxic
< 1	Highly toxic	Very toxic

Based on the above data, PFBS is classified as an insignificant hazard by the U.S. National Institute of Occupational Safety and Health (NIOSH) and requires no label warning by the European Union.

EHS Data (continued)

Mammalian Toxicity

	PFBS
Skin irritation	Non-irritating
Eye irritation	Moderate
Ames	Negative
Chromosomal aberration	Negative
Teratology	Negative
Acute Oral LD ₅₀ (mg/kg)	> 2000

LD₅₀ = Dosage which is lethal for 50% of the population

U.S. EPA Acute Toxicity Classifications for Rats

Toxicity Value (mg/kg)	U.S. EPA 8(e) Criteria	
> 500	Slightly toxic	← PFBS
50-500	Moderately toxic	
5-50	Highly toxic	
< 5	Extremely toxic	

European Union Acute Toxicity Classifications for Rats

Toxicity Value (mg/kg)	European Union	
> 2000	No hazard statement	← PFBS
200-2000	Harmful	
25-200	Toxic	
< 25	Very toxic	

Based on the above data, PFBS acute oral LD₅₀ is well below the U.S. EPA's lowest toxicity classification of "slightly toxic" and does not require a hazard statement by the European Union.

Chronic Mammalian Toxicity

Study	PFBS
2-Generation Reproduction—Rat (NOEL, mg/kg/day)	> 1000

NOEL = No Observable Effect Level

Based on the above data, PFBS is considered practically non-toxic in multi-generation reproduction.

Bioconcentration

Bioconcentration Factor in Rainbow Trout*

PFAS	Liver	Blood
PFBS (C ₄)	< 1	< 1
PFHS (C ₆)	54	59
PFOS (C ₈)	2,900	3,100

Perfluorinated Carboxylic Acids	Liver	Blood
PFFOA (C ₈)	12	25
PFDA (C ₁₀)	1,100	1,900
PFUNA (C ₁₁)	3,800	5,500
PFDOA (C ₁₂)	11,000	18,000
PFTA (C ₁₄)	8,700	20,000

Bioconcentration factor (BCF) = concentration in fish/concentration in water

* Martin JW, Mabury SA, Solomon KR, Muir DCG. 2001. Bioconcentration and tissue distribution of perfluorinated acids in rainbow trout (*oncorhynchus mykiss*). Submitted to *Environ. Toxicol. Chem.*

PFBS, with four perfluorinated carbon atoms, has a dramatically lower bioconcentration factor (BCF) than PFOS, which has eight perfluorinated carbon atoms. This relationship of chain length to bioconcentration factor also holds true for perfluorinated carboxylic acids.

BCF Regulatory Criteria

Program	BCF Value	
U.S. EPA TSCA Pre-Manufacturing Notice (PMN) Review	100-1000	Medium concern
	1000	High concern
Canadian Programs	> 500	Medium concern
	> 1000	High concern
	> 5000	Highest concern
U.S. EPA PBT Policy	> 1000	High concern— Additional review
	> 5000	Deny commercialization pending testing
Great Lakes Water Quality Initiative	> 1000	Considered chemicals of concern

A BCF of <1 is 100 to 1000 times lower than levels that are a concern to the U.S. EPA, Canadian Programs and the Great Lakes Water Quality Initiative. A BCF of <1 is 1000 times lower than levels that trigger additional review under the U.S. EPA PBT policy.

Persistence

PFBS is persistent, but persistence in and of itself is not a concern if a material is practically non-toxic and does not bioconcentrate. However, to minimize the exposure to the environment, 3M is limiting sales of PFBS-based surfactants to non-dispersive applications or applications with low emissions to the environment.

Prior to commercialization, 3M performs an extensive Lifecycle Management Review of each new product and application paying particular attention to worker and environmental exposure.

Regulatory Profile

The U.S. EPA has reviewed the first series of 3M's PFBS-based surfactants and placed these substances on the TSCA inventory. They have been commercialized in the U.S. and in Europe. Commercialization in other countries is being pursued.

PFBS and PFBS-based surfactants as single components are not included in the U.S. EPA's PFAS Final Significant New Use Rule (SNUR 67 FR 11008) or Supplemental Proposed Significant New Use Rule (SNUR 67 FR 11014).

Commercial Availability

Please call 3M Specialty Materials or contact your local 3M Specialty Materials sales representative for the latest information.

In the U.S. call: **1-800-810-8513**

Environmental Principles

3M has recognized the necessity for responsible environmental management and conservation of resources. 3M has also recognized the global nature of environmental matters and the importance of industry's constructive cooperation in achieving international environmental conservation. Over the years, 3M has established a record of many significant environmental improvement projects at its facilities worldwide.

3M environmental policy will continue to recognize and exercise its responsibility to:

- Solve its own environmental pollution and conservation problems
- Prevent pollution at the source wherever and whenever possible
- Develop products that will have a minimum effect on the environment.
- Conserve natural resources through the use of reclamation and other appropriate methods.
- Assure that its facilities and products meet and sustain the regulations of all federal, state, and local environmental agencies.
- Assist, wherever possible, governmental agencies and other official organizations engaged in environmental activities.

Resources

PFBS-based surfactants are supported by a global network of sales offices, and by technical and customer service resources. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues.

For more information on PFBS-based surfactants, please call 3M Specialty Materials: **1-800-810-8513**, or contact your local 3M representative.

For information on additional 3M Electronic Materials products, visit our web site at **www.3m.com/electronicmaterials**

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