

Perfluorobutanesulfonic acid and its direct precursors: Environment tier II assessment

13 February 2015

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36913-91-4, 375-72-4.**



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Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit: www.nicnas.gov.au.

Disclaimer

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Acronyms & Abbreviations

Grouping Rationale

This Tier II assessment considers the environmental risks associated with the industrial uses of five closely related perfluorinated chemicals including perfluorobutanesulfonic acid and two simple inorganic salts of this acid, the anhydride of perfluorobutanesulfonic acid and perfluorobutanesulfonyl fluoride:

- 1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro- (Perfluorobutanesulfonic acid)
- 1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, potassium salt (potassium PFBS)
- 1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, ammonium salt (ammonium PFBS)
- 1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, anhydride (PFBS anhydride)
- 1-Butanesulfonyl fluoride, 1,1,2,2,3,3,4,4,4-nonafluoro- (PFBSF)

The chemicals in this group are short chain perfluorinated chemicals containing four perfluorinated carbons terminated with a sulfonate group. The risk assessment of these chemicals has been conducted as a group because all five substances are structurally related compounds each of which has the potential to hydrolyse and/or dissociate into the environmentally persistent perfluorobutanesulfonate anion (PFBS).

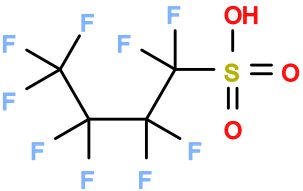
Chemicals based on PFBS were introduced as alternatives to the longer chain perfluoroalkyl sulfonates (PFAS) (containing carbon chain lengths of 6 or higher) including substances which may be a source of the hazardous perfluorooctanesulfonate anion (PFOS) in the environment (UNEP, 2013). Perfluorooctanesulfonic acid and certain PFOS-related substances have recently been identified as Persistent Organic Pollutants under Annex B of the *Stockholm Convention on Persistent Organic Pollutants*. These substances are also listed on Annex III of the *Rotterdam Convention on the Prior Informed Consent*

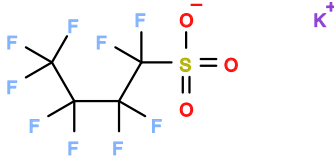
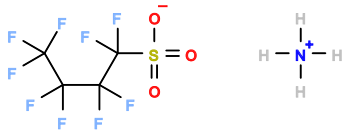
Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Further information on PFOS can be found in the Environment Tier II Assessment of the Direct Precursors to Perfluorooctanesulfonate (PFOS) group (see NICNAS, 2015a).

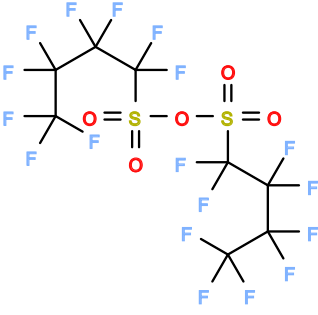
The assessment of these chemicals as a group also provides additional relevant information for the risk assessment of more complex derivatives of PFBS which may degrade to this perfluorinated anion in the environment. These more complex derivatives of PFBS have been assessed separately as the Indirect Precursors of Perfluorobutanesulfonate (PFBS) group.

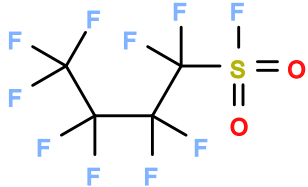
Chemical Identity

In this assessment, "PFBS" is used to denote the conjugate base anion of perfluorobutanesulfonic acid (i.e. the perfluorobutanesulfonate anion). However, it is noted that this descriptor is commonly used in relation to a range of substances which may easily form the anion in water, such as the parent acid and salts of the acid.

CAS RN	375-73-5
Chemical Name	1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-
Synonyms	Perfluorobutanesulfonic acid 1,1,2,2,3,3,4,4,4-nonafluorobutane-1-sulfonic acid
Structural Formula	
Molecular Formula	C ₄ HF ₉ O ₃ S
Molecular Weight (g/mol)	300.10
SMILES	C(F)(F)(C(F)(F)C(F)(F)C(F)(F)F)S(=O)(=O)O
CAS RN	29420-49-3
Chemical Name	1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, potassium salt

Synonyms	potassium PFBS potassium perfluorobutanesulfonate potassium 1,1,2,2,3,3,4,4,4-nonafluorobutane-1-sulfonate
Structural Formula	
Molecular Formula	C ₄ F ₉ KO ₃ S
Molecular Weight (g/mol)	338.19
SMILES	C(F)(F)(C(F)(F)C(F)(F)C(F)(F)F)S(=O)(=O)[O-].[K+]
CAS RN	68259-10-9
Chemical Name	1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, ammonium salt
Synonyms	ammonium PFBS ammonium perfluorobutanesulfonate ammonium 1,1,2,2,3,3,4,4,4-nonafluorobutane-1-sulfonate
Structural Formula	
Molecular Formula	C ₄ H ₄ F ₉ NO ₃ S

Molecular Weight (g/mol)	317.13
SMILES	<chem>C(F)(F)(C(F)(F)C(F)(F)C(F)(F)F)S(=O)(=O)[O-].[NH4+]</chem>
CAS RN	36913-91-4
Chemical Name	1-Butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, anhydride
Synonyms	PFBS anhydride Perfluorobutanesulfonic anhydride 1,1,2,2,3,3,4,4,4-nonafluorobutylsulfonyl 1,1,2,2,3,3,4,4,4-nonafluorobutane-1-sulfonate
Structural Formula	
Molecular Formula	$C_8F_{18}O_5S_2$
Molecular Weight (g/mol)	582.18
SMILES	<chem>C(F)(F)(C(F)(F)C(F)(F)C(F)(F)F)S(=O)(=O)OS(=O)(=O)C(F)(F)C(F)(F)C(F)(F)C(F)(F)F</chem>
CAS RN	375-72-4

Chemical Name	1-Butanesulfonyl fluoride, 1,1,2,2,3,3,4,4,4-nonafluoro-
Synonyms	PFBSF Perfluorobutanesulfonyl fluoride 1,1,2,2,3,3,4,4,4-nonafluorobutane-1-sulfonyl fluoride
Structural Formula	
Molecular Formula	C ₄ F ₁₀ O ₂ S
Molecular Weight (g/mol)	302.09
SMILES	C(F)(F)(C(F)(F)C(F)(F)C(F)(F)F)S(=O)(=O)F

Physical and Chemical Properties

Available physical and chemical property data for PFBSF and potassium PFBS are presented below (ECHA, 2015; NICNAS, 2005):

Chemical	PFBSF	potassium PFBS
Physical Form	Liquid	Solid
Melting Point	< -75°C (exp.)	270°C (exp.)
Boiling Point	64°C (exp.)	Not available

Vapour Pressure	16 665 Pa (exp.)	$< 1.22 \times 10^{-5}$ Pa (exp.)
Water Solubility	< 0.3 mg/L (exp.)	52.6-56.6 mg/L (exp.)

Limited data are available for the physical and chemical properties of perfluorobutanesulfonic acid. However, the perfluoroalkyl sulfonic acids as a group are known to be very strong acids in water and also to be surface active (Gramstad and Haszeldine, 1957). These acids are also known to be somewhat volatile (Gramstad and Haszeldine, 1957; Herzke, et al., 2007).

The alkali metal salts of perfluoroalkyl sulfonic acids with short carbon-chains (with up to four carbon atoms) have significant water solubility. The solubility of these salts decreases as the length of the perfluorinated carbon chain increases, although the decrease in water solubility is associated with an increase in surface activity (Gramstad and Haszeldine, 1957). Based on the data available for potassium PFBS, the two salts in this group are expected to have moderate water solubility, low volatility, and significant surface activity (NICNAS, 2005).

No experimental data were identified for the properties of PFBS anhydride. However, the simplest perfluoroalkyl sulfonic anhydride, trifluoromethanesulfonic anhydride (CAS RN: 358-23-6), is known to be a volatile and reactive substance that is rapidly hydrolysed (Burdon, et al., 1957). Based on the properties of this analogue substance, PFBS anhydride is expected to be rapidly hydrolysed to PFBS in water.

The sulfonyl fluoride (PFBSF) is only very slightly soluble in water and is a very highly volatile substance. The rate of hydrolysis of perfluoroalkyl sulfonyl fluorides is relatively slow in water under acid and neutral conditions, and the rate of hydrolysis decreases with increasing carbon chain length (Gramstad and Haszeldine, 1957). The half-life for hydrolysis of PFBSF into PFBS has been reported as 73 hours at pH 7 and 23°C (ECHA, 2015). A measured octanol-water partition coefficient (K_{OW}) value was not available for this chemical.

Import, Manufacture and Use

Australia

The 3M company is the primary manufacturer of substances based on PFBS technology internationally (Poulsen, et al., 2005; UNEP, 2013). 3M Australia have recently confirmed that they are not directly introducing the chemicals in this group to Australia.

Information collected by NICNAS in 2005 indicated that potassium PFBS was not manufactured or used in Australia. Additionally, it was reported that no PFBS derivatives were manufactured in Australia (NICNAS, 2005).

It is noted that some of the chemicals in this group may be present in the environment due to historic use, or due to release from articles or the use of chemicals not covered by this assessment.

International

The use of PFBS derivatives as an alternative to the use of PFOS has been identified for the following uses (Poulsen, et al., 2005; UNEP, 2013):

- impregnation of textiles, leather and carpets;
- industrial and commercial cleaning products;
- surface coatings, paints and varnishes;
- oil production and mining;

- semiconductor industry; and
- electroplating.

Potassium PFBS is marketed as a flame retardant for polycarbonate resins (OECD, 2013a).

The sulfonyl fluoride, PFBSF, is reported to be used as a chemical intermediate in Europe (ECHA, 2015).

No specific industrial uses have been identified for PFBS anhydride.

Environmental Regulatory Status

Australia

The use of the chemicals in this group is not subject to any specific national environmental regulations.

United Nations

No chemicals in this group are currently identified as a Persistent Organic Pollutant (UNEP, 2001), ozone depleting substance (UNEP, 1987), or hazardous substance for the purpose of international trade (UNEP & FAO, 1998).

OECD

Potassium PFBS was identified as a High Production Volume (HPV) chemical by the OECD in 2007. This indicates that this chemical was used at more than 1000 tonnes per annum in at least one member country or region (OECD, 2013b).

None of the chemicals in this group have been sponsored for assessment under the Cooperative Chemicals Assessment Programme (OECD, 2013b).

Canada

Potassium PFBS and ammonium PFBS are listed on the Canadian Domestic Substances List (DSL). During the Categorization of the DSL, these two chemicals were found to be Persistent (P), not Bioaccumulative (Not B) and not Inherently Toxic to the Environment (Not iT_E). These chemicals were not prioritised for further assessment.

The remaining chemicals in this group are not listed on the Canadian DSL. In 2006 it was concluded that significant new activity in the use of PFBSF would result in the substance becoming toxic as defined under the *Canadian Environmental Protection Act, 1999* (Government of Canada, 2006).

European Union

Only PFBSF is registered for use in the European Union under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation (ECHA, 2015). The remaining chemicals in this group have been pre-registered, but have not undergone the full registration process, under the REACH legislation (ECHA, 2014).

United States of America

The United States Environmental Protection Agency (US EPA) published an Existing Chemical Action Plan for long-chain perfluorinated chemicals in 2009 (US EPA, 2009). However, the action plan does not include perfluoroalkyl sulfonic acids with less than six perfluorinated carbon atoms (US EPA, 2013).

Environmental Exposure

The substances in this group are not expected to be used as industrial chemicals in Australia. Therefore, direct release of these chemicals to the environment in Australia as a result of current industrial uses is considered unlikely.

The perfluorobutanesulfonic acid anion may be released to the environment from disposal of imported articles treated with chemicals in this group. However, this exposure route is beyond the scope of this assessment. Indirect releases of PFBS as a result of environmental degradation of other industrial perfluorobutane chemicals listed on the Inventory is considered under the Environment Tier II Assessment of the Indirect Precursors of Perfluorobutanesulfonate (PFBS) group (NICNAS, 2015b).

The potassium and ammonium cations present as counterions in the two salts of this group are ubiquitous, naturally occurring inorganic species that are essential for many biological functions. The environmental fate and effects of these cations are not further considered in this assessment.

Environmental Fate

Dissolution, Speciation and Partitioning

The dissolved perfluorobutanesulfonic acid anion is the dominant form of these substances in the aquatic compartment.

Perfluorobutanesulfonic acid is a very strong acid in water and under environmental conditions the acid will exist predominantly as the conjugate base anion (i.e. PFBS). As salts of a strong acid, the potassium and ammonium salts of PFBS will dissociate into their constituent ions in water. The partitioning behaviour of the acid and its salts in the aquatic compartment will be influenced by the surface activity of the perfluorinated anion, which is the dominant species under environmental conditions. Generally, PFBS is expected to be poorly adsorbed to soil and sediments, and will likely remain in the water compartment (NICNAS, 2005).

The sulfonyl fluoride of this group, PFBSF, is less soluble in water than the other members, and very highly volatile. Based on the available experimental data, the chemical is predicted to have a very high Henry's Law constant and thus to be highly volatile from water. Therefore, this chemical should be expected to partition overwhelmingly to the atmosphere if it were released into the aquatic compartment. However, release to the aquatic compartment is an unlikely scenario as this highly volatile chemical has a specific industrial use as a chemical intermediate in the manufacture of other fluorochemicals (ECHA, 2015).

Degradation

The PFBS component of the chemicals in this group is highly resistant to degradation.

Data available for a range of analogous perfluorinated substances indicate that PFBS will be resistant to hydrolysis, aqueous photolysis and biodegradation (NICNAS, 2005). The perfluorobutanesulfonate anion together with analogous perfluorinated acids are generally considered to be exceptionally resistant to degradation by natural processes in the environment.

The fate of PFBSF in the atmosphere is relatively more important than for the others members of this group because of the very high volatility of this substance and the consequent potential for it to partition to the air compartment if released into the environment. However, no data have been identified in this assessment regarding the fate of PFBSF in the atmosphere. Based on the known atmospheric oxidation pathways for a volatile sulfonamide derivative of PFBS (*N*-methylperfluorobutanesulfonamidoethyl alcohol, CAS RN: 34454-97-2), atmospheric oxidation of PFBSF may be comparatively slow and result in the formation of perfluorobutanesulfonic acid and perfluoroalkyl carboxylic acid degradation products (D'eon, et al., 2006; NICNAS, 2015b).

Bioaccumulation

Based on available information, the chemicals in this group are not expected to pose a bioaccumulation hazard.

Perfluorinated chemicals have been observed to bioaccumulate by binding to proteins in plasma and liver, rather than the more conventional partitioning to fatty tissue (NICNAS, 2015a). However, a study conducted using potassium PFBS found bioconcentration factors (BCFs) for various tissues (including blood and liver) of the fish *Lepomis macrochirus* to be less than one, indicating low bioaccumulation potential. It was estimated that 50% clearance of the chemical was achieved within three days. An additional dietary accumulation study in the fish *Oncorhynchus mykiss* has reported a bio-half life of 3.3 days (NICNAS, 2005).

Data for other perfluorinated chemicals have indicated mammals (particularly marine mammals) may be more susceptible than fish to the bioaccumulation of these substances. It has been suggested that this is due to the comparatively poor elimination of the substance in these organisms (Environment Canada, 2010). However, data available for PFBS show the elimination of the substance in monkeys, cows and humans is faster than that of other perfluorinated substances (Kowalczyk, et al., 2013; Lau, et al., 2007). Therefore, currently available data suggest that PFBS will also have low bioaccumulation potential in mammals.

Transport

The PFBS component of the chemicals in this group has the potential to become a globally distributed pollutant.

The PFBS component of the chemicals in this group is water soluble and surface-active, and is therefore expected to be mobile in the aquatic compartment. Some studies have identified PFBS in remote locations. For example, Zhao et al., (2012) detected PFBS in 24% of water samples taken from the Greenland Sea in concentrations up to 65 pg/L. There is currently no consensus regarding the mechanism for transport of the chemical to such locations. However, the persistence and water solubility of PFBS is consistent with transport in surface water or ocean currents. In addition, transport to remote locations may occur in the form of volatile precursors to PFBS (NICNAS, 2005).

Predicted Environmental Concentration (PEC)

The chemicals in this group are not expected to have current industrial use in Australia and PEC values have therefore not been calculated.

Nevertheless, PFBS may be present in the environment due to past industrial use of other perfluorochemicals contaminated with this substance, use in articles, or from the use of derivatives of PFBS which degrade to this substance in the environment (NICNAS, 2015b). In Australia, PFBS has recently been detected in the Parramatta River (main tributary of Sydney Harbour) with a mean concentration of 1.4 ng/L (Thompson, et al., 2011). Sampling of the Brisbane River following a major flooding event in 2011 also revealed PFBS contamination at Jindalee, Oxley Creek, West End and Bulimba. The chemical was detected in all samples obtained at these sites (excluding one sample from Oxley Creek at high tide) in concentrations ranging between 0.39 and 30 ng/L (Gallen, et al., 2014).

Due to the use of PFBS-based chemicals as alternatives to PFOS-based chemicals, and the potential for these replacement chemicals to release PFBS, the concentrations of PFBS in the environment are expected to increase over time (NICNAS, 2015b).

Environmental Effects

Effects on Aquatic Life

The chemicals in this group will release PFBS in the environment, which is not expected to have high toxicity to aquatic organisms.

Toxicity of Potassium PFBS

No aquatic toxicity data were available for the other chemicals in this group. As potassium PFBS dissociates to release PFBS in water, the below data have been read-across to characterise the aquatic toxicity of the other group members.

The following measured median effective concentration (EC50) and median lethal concentration (LC50) values for model organisms across three trophic levels were reported in the 2005 Existing Chemical Hazard Assessment Report for Potassium PFBS (NICNAS, 2005). All organisms are freshwater species except for the marine species *Mysidopsis bahia*:

Taxon	Endpoint	Method
Fish	96 h LC50 = 1938 mg/L	Experimental <i>Pimephales promelas</i> (Fathead minnow) OECD TG 203; static Measured concentrations
Invertebrates	48 h LC50 = 2183 mg/L	Experimental <i>Daphnia magna</i> (Water flea) OECD TG 202; static Measured concentrations
	96 h LC50 = 372 mg/L	Experimental <i>Mysidopsis bahia</i> (Mysid shrimp) US EPA OPPTS 850.1035 Measured concentrations
Algae	96 h EC50 = 5733 mg/L	Experimental <i>Selenastrum capricornutum</i> (Green algae) OECD TG 201 Measured concentrations Reduced growth rate observed

The following no-observed-effect-concentration (NOEC) values for model organisms across two aquatic trophic levels were reported in the 2005 Existing Chemical Hazard Assessment Report for Potassium PFBS (NICNAS, 2005):

Taxon	Endpoint	Method

Taxon	Endpoint	Method
Invertebrates	21 d NOEC = 502 mg/L	Experimental <i>Daphnia magna</i> (Water flea) OECD TG 211; semi-static Measured concentrations
Algae	96 h NOEC = 1077 mg/L	Experimental <i>Selenastrum capricornutum</i> (Green algae) OECD TG 201 Measured concentrations Reduced growth rate observed

The above data available from standard ecotoxicity testing indicate that PFBS has low toxicity to aquatic organisms. However, data available for other perfluorinated chemicals suggest that this class of substances may cause intergenerational developmental toxicity in fish when parent generations are exposed to concentrations as low as 0.01 mg/L (NICNAS, 2015a). No intergenerational toxicity studies were identified for any of the chemicals in this group. Nevertheless, some studies have considered the comparative long term toxicity of various perfluorinated chemicals. Hagenaaers et al. (2011) found the developmental toxicity of PFBS in fish to be over 1000 times lower than that of PFOS, with similar results obtained by Ulhaq et al. (2013). This is consistent with the overall lower toxicity of PFBS compared to PFOS. Based on this information, it is concluded that current data do not suggest the chemicals in this group will have high chronic toxicity to aquatic organisms.

Effects on Terrestrial Life

The chemicals in this group are not expected to have high toxicity to birds.

Toxicity of Potassium PFBS

No terrestrial toxicity data were available for the other chemicals in this group. The below data have been read-across to characterise the toxicity of the other group members to birds.

The following LC50 values for two bird species were reported in the 2005 Existing Chemical Hazard Assessment Report for Potassium PFBS (NICNAS, 2005):

Taxon	Endpoint	Method
Birds	10 d LC50 > 10 000 mg/kg	Experimental <i>Colinus virginianus</i> (Bobwhite quail) OECD TG 205; dietary exposure

Taxon	Endpoint	Method
	8 d LC50 > 10 000 mg/kg	Experimental <i>Anas platyrhynchos</i> (Mallard duck) OECD TG 205; dietary exposure

The following NOEC value for one bird species was reported in the 2005 Existing Chemical Hazard Assessment Report for Potassium PFBS (NICNAS, 2005):

Taxon	Endpoint	Method
Birds	21 w NOEC = 900 mg/kg	Experimental <i>Colinus virginianus</i> (Bobwhite quail) OECD TG 206; dietary exposure Reduction in eggs laid observed

Predicted No-Effect Concentration (PNEC)

A PNEC was not calculated for the chemicals in this group as these substances are not expected to be released to the environment as a result of current industrial use.

Categorisation of Environmental Hazard

The categorisation of the environmental hazards of 1-butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro- (perfluorobutanesulfonic acid); 1-butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, potassium salt (potassium PFBS); 1-butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, ammonium salt (ammonium PFBS); 1-butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, anhydride (PFBS anhydride); and 1-butanesulfonyl fluoride, 1,1,2,2,3,3,4,4,4-nonafluoro- (PFBSF) according to domestic environmental hazard thresholds is presented below (EPHC, 2009; NICNAS, 2013):

Persistence

Persistent (P). Based on the expected non-degradability of PFBS, and the expectation that all chemicals in this group will release PFBS in the environment, all chemicals in this group are categorised as Persistent.

Bioaccumulation

Not Bioaccumulative (Not B). Based on the available measured BCF values in fish for potassium PFBS, and data which indicate comparatively rapid elimination of PFBS in mammals, all chemicals in this group are categorised as Not Bioaccumulative.

Toxicity

Not Toxic (Not T). Based on the measured aquatic ecotoxicity values for potassium PFBS, and data which indicate comparatively low developmental toxicity of PFBS in fish, all chemicals in this group are categorised as Not Toxic.

Summary

All chemicals in this group are categorised as:

- P
- Not B
- Not T

Risk Characterisation

Risk quotients (RQs) have not been calculated for these chemicals. The chemicals in this group are not expected to have significant current industrial use in Australia.

However, it is noted that the common PFBS component of the chemicals in this group may be present in the environment due to its release from articles or due to release from related chemicals not covered by this assessment. The perfluorobutanesulfonate anion is highly persistent and environmental levels may continue to increase over time due to indirect release pathways. The scale and time frame of such an increase, and its relevance to characterising the long term environmental risk profile of PFBS, currently remain unknown.

Key Findings

The chemicals in this group are not expected to have significant current industrial use in Australia. However, if released to the environment, the chemicals in this group are all expected to release PFBS. This perfluorinated organic anion is highly persistent and mobile and, as a result, has the potential to become globally distributed. Nevertheless, currently available data indicate that PFBS is not expected to be highly bioaccumulative or toxic to aquatic organisms.

The chemicals in this group are not PBT substances according to domestic environmental hazard criteria.

Recommendations

The chemicals in this group are not prioritised for further assessment under the IMAP Framework.

However, further assessment may be necessary if information becomes available indicating that these chemicals are introduced into Australia in significant quantities, or if hazard data become available indicating adverse effects on the environment.

Environmental Hazard Classification

In addition to the categorisation of environmental hazards according to domestic environmental thresholds presented above, the classification of the environmental hazards of 1-butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-; 1-butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, potassium salt; 1-butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, ammonium salt; 1-butanesulfonic acid, 1,1,2,2,3,3,4,4,4-nonafluoro-, anhydride; and 1-butanesulfonyl fluoride, 1,1,2,2,3,3,4,4,4-nonafluoro- according to the third edition of the United Nations' Globally Harmonised System of Classification and Labelling of Chemicals (GHS) is presented below (UNECE, 2009):

Hazard	GHS Classification (Code)	Hazard Statement
Acute Aquatic	-	Not classified
Chronic Aquatic	-	Not classified

The classification of the chemicals in this group has been performed based on the ecotoxicity data and BCF values presented in this assessment. Acute ecotoxicity data indicate that the chemicals in this group should not be expected to meet acute aquatic classification criteria, as toxicity is greater than 100 mg/L. Acute ecotoxicity data for fish, in addition to the chronic ecotoxicity data for invertebrates and algae, similarly indicate that the chemicals in this group should not be expected to meet chronic aquatic classification criteria, as toxicity is greater than 100 mg/L. The chemicals in this group were not classified as Chronic Category 4 ("safety net classification"), as experimental BCF values less than 500 and chronic NOEC values greater than 1 mg/L are available.

References

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