FORM FOR NOTIFICATION
OF FINAL REGULATORY ACTION TO BAN OR SEVERELY RESTRICT A CHEMICAL

Country: Canada

SECTION 1 IDENTITY OF CHEMICAL SUBJECT TO THE FINAL REGULATORY ACTION

1.1	**Common name**	**2-Propenoic acid, 2-methyl-, 2-methylpropyl ester, polymer with butyl 2-propenoate and 2,5 furandione, gamma-omega-perfluoro-C8-14-alkyl esters, tert-Bu benzenecarboperoxoate-initiated**
1.2	**Chemical name according to an internationally recognized nomenclature (e.g. IUPAC), where such nomenclature exists**	**2-Propenoic acid, 2-methyl-, 2-methylpropyl ester, polymer with butyl 2-propenoate and 2,5 furandione, gamma-omega-perfluoro-C8-14-alkyl esters, tert-Bu benzenecarboperoxoate-initiated**
1.3	**Trade names and names of preparations**	**Fluorotelomer-based substance; 2-Propenoic acid, 2-methyl-, 2-methylpropyl ester, polymer with butyl 2-propenoate and 2,5 furandione, gamma-omega-perfluoro-C8-14-alkyl esters, tert-Bu benzenecarboperoxoate-initiated**

1.4 Code numbers

1.4.1	CAS number	459415-06-6
1.4.2	Harmonized System customs code	N/A

1.4.3	Other numbers (specify the numbering system)	New Substances Notification (NSN): 12863

1.5 Indication regarding previous notification on this chemical, if any

1.5.1 ☒ This is a first time notification of final regulatory action on this chemical.

1.5.2 ☐ This notification replaces all previously submitted notifications on this chemical.
Date of issue of the previous notification: _____

SECTION 2 FINAL REGULATORY ACTION

2.1 The chemical is: ☒ **banned** **OR** ☐ **severely restricted**

2.2 Information specific to the final regulatory action

2.2.1 Summary of the final regulatory action

The Prohibition of Certain Toxic Substances Regulations, 2012 prohibit the manufacture, use, sale, offer for sale and import of toxic substances listed in Schedules 1 and 2. This substance is found in Part 2 of Schedule 1, which lists prohibited toxic substances subject to total prohibition, unless present in manufactured items.

2.2.2 Reference to the regulatory document, e.g. where decision is recorded or published

Regulations Amending the Prohibition of Certain Toxic Substances Regulations, 2005 (Four New Fluorotelomer-based Substances) (SOR/2010-211) under the *Canadian Environmental Protection Act, 1999.*
http://canadagazette.gc.ca/rp-pr/p2/2010/2010-10-13/html/sor-dors211-eng.html

The current version of the regulations can be accessed here: *Prohibition of Certain Toxic Substances Regulations, 2012* (SOR/2012-285) under the *Canadian Environmental Protection Act, 1999.*
http://laws-lois.justice.gc.ca/eng/regulations/SOR-2012-285/FullText.html

2.2.3 Date of entry into force of the final regulatory action

October 13, 2010.

2.3 Category or categories where the final regulatory action has been taken

2.3.1 All use or uses of the chemical in your country prior to the final regulatory action

The substance has never been manufactured in Canada. Any import that may have occurred would not have exceeded 1000 kg/yr.

The substance was reported to be used only as a component in coatings.

The uses for fluorotelomer-based polymers which contain perfluorinated alkyl groups are many and varied, including use as a dry soil resistant agent for carpets; as stain and water protection agents for carpeting, leather goods, fabrics, tiles, grout and ceramic surfaces; as leveling agents and flow agents for plastics, paints, automotive finishes and inks; and as dispersant agents for industrial powder coatings. As stain and/or water repellents for carpets and other fabrics, the fluorotelomer-based polymer could be used in consumer products in spray-on and aerosol applications.

Similar perfluorinated copolymers have found applications as sizing agents and wet-strength additives for paper products, including paper towels and paper plates, as well as surface coatings for paper products intended for direct contact with food, such as dog food bags and microwaveable popcorn bags.

Other potential uses:

Similar perfluorinated copolymers have found applications as sizing agents and wet-strength additives for paper products, including paper towels and paper plates, as well as surface coatings for paper products intended for direct contact with food, such as dog food bags and microwaveable popcorn bags.

The notified fluorotelomer-based polymer applies fluorotelomer chemistry and it is this chemistry that is used in products designed to protect carpets, textile, stone and tile, non-wovens, and paper, as well as use in fire-fighting foams, inks, paints and coatings, fluorotelomer-based polymers, adhesives, waxes and polishes, and caulks (DuPont, 2003a; 2004b,c). The New Substances Program anticipates that the notified fluorotelomer-based polymer could be used in applications involving the surface protection of textiles and carpets.

2.3.2 Final regulatory action has been taken for the category ☒ Industrial

Use or uses prohibited by the final regulatory action

The prohibition prevents industry from importing, manufacturing, using, selling and offering for sale these substances, unless they are present in manufactured items.

Use or uses that remain allowed (only in case of a severe restriction)

N/A

2.3.3 Final regulatory action has been taken for the category ☐ Pesticide

Formulation(s) and use or uses prohibited by the final regulatory action

N/A

Formulation(s) and use or uses that remain allowed
(only in case of a severe restriction)

N/A

2.4 Was the final regulatory action based on a risk or hazard evaluation?

☒ **Yes**

☐ **No** (If no, you may also complete section 2.5.3.3)

2.4.1 If yes, reference to the relevant documentation, which describes the hazard or risk evaluation

New Substances Evaluation Report (New Substances Notification 12863). *Canadian Environmental Protection Act, 1999*. Government of Canada.
Available upon request: http://www.ec.gc.ca/subsnouvelles-newsubs/default.asp?lang=En&n=6F22A1D6-1

2.4.2 Summary description of the risk or hazard evaluation upon which the ban or severe restriction was based.

2.4.2.1 Is the reason for the final regulatory action relevant to human health? ☒ **Yes**

☐ No

If yes, give summary of the hazard or risk evaluation related to human health, including the health of consumers and workers

Based on the available information on the physical and chemical properties of the fluorotelomer-based polymer, direct and indirect exposure of the general population to the fluorotelomer-based polymer and its hazardous degradation products is expected to be low at the currently intended annual import quantities.

Based on available data, as well as surrogate data, the fluorotelomer-based polymer is expected to show low acute oral toxicity and low skin and eye irritation potential, and low reproductive and developmental toxicity; however they are likely to display moderate subchronic oral toxicity, with possible effects on the thyroid, liver, and kidney.

The toxicological profile of the anticipated ultimate degradation products of the fluorotelomer-based polymer (i.e., perfluorocarboxylic acids (PFCAs)) is not expected to differ significantly from that of perfluorooctanoic acid (PFOA) and its salts. Based on available data, PFOA and its salts are not genotoxic but are tumourigenic and immunotoxic in rodents, and display moderate reproductive and developmental toxicity in rodents and moderate to high subchronic oral toxicity in rodents and monkeys. As a result, there is reason to suspect that the degradation products of the fluorotelomer-based polymer, in particular the PFCAs, may have the potential to cause adverse health effects in humans.

Direct Exposure to Humans:
Once the applied coatings have dried, the substance will be incorporated into a solid matrix from which it is unlikely to be readily released. Therefore, the potential for direct exposure to the notified fluorotelomer-based polymer in these commercial uses is expected to be negligible.

Expected effect of the final regulatory action

The Regulations prevent the introduction of new sources of PFCAs into Canada, thereby protecting the environment and human health. The prohibition prevents industry from importing, manufacturing, using, selling and offering for sale these substances, unless they are present in manufactured items.

2.4.2.2 Is the reason for the final regulatory action relevant to the environment?

☒ Yes

☐ No

If yes, give summary of the hazard or risk evaluation related to the environment

The assessment has concluded that fluorotelomer alcohols (FTOHs) are released from the fluorotelomer-based polymer as unreacted residuals or as degradation products, and ultimately degrade to the highly persistent perfluorinated carboxylic acids (PFCAs). All of the PFCAs formed are expected to remain in the

environment as there are no known environmental degradation mechanisms.

Although the experimental evidence is not available demonstrating the occurrence, mechanism or rate of degradation from the fluorotelomer-based polymer, the release of the FTOH can be expected based on the chemistry of the substance and substantial empirical evidence demonstrating susceptibility of this chemistry to hydrolysis. The rate of release may be faster or slower than rates observed in surrogate chemicals due to such factors as steric hindrance, however the rate is not considered of significant environmental importance given the exceptional stability of the ultimate degradation product, PFCAs.

Atmospheric long range transport of FTOH can be used to explain the presence of the longer chain PFCAs in biota in remote regions of Canada. It is noted that atmospheric monitoring is limited to shorter chains of fluorotelomer alcohol rather than the longer chain lengths and therefore the measured levels of FTOH may not adequately explain the presence of the long chain PFCAs found in remote regions. Nonetheless, the evidence to support this transport mechanism is provided through experimental evidence demonstrating the volatile nature of FTOH, measurements of related FTOH in the atmosphere, and atmospheric chamber reaction studies demonstrating possible mechanisms. The measurements of longer chain PFCAs in remote regions of Canada give support to this transport mechanism and provides a scientifically defensible explanation of their presence. It is important to emphasize that the presence of PFCAs in remote regions should not be attributed to a single fluorinated substance, single source or single mechanism of transport and local sources of contaminants and emissions from other jurisdictions may also contribute.

Although acute toxicity to aquatic organisms following exposure to the degradation products appears to be low, evidence for chronic effects remains unknown. Toxicity studies to laboratory mammals indicate the potential to cause adverse health effects in wildlife.

In summary, the fluorotelomer-based polymer is expected to degrade, release FTOH, undergo long range atmospheric transport and/or degrade further to PFCAs. Available evidence indicates that the longer chain PFCAs (≥C9) are susceptible to bioaccumulation and biomagnification, have been found in remote regions, and notably exhibit characteristics of persistent organic pollutants (POPs). These unique characteristics combined with the potential for long term adverse effects, warrant concern for the environment.

Expected effect of the final regulatory action

The Regulations prevent the introduction of new sources of PFCAs into Canada, thereby protecting the environment and human health. The prohibition prevents

industry from importing, manufacturing, using, selling and offering for sale these substances, unless they are present in manufactured items.

2.5 Other relevant information regarding the final regulatory action

2.5.1 Estimated quantity of the chemical produced, imported, exported and used

	Quantity per year (MT)	Year
produced	N/A	N/A
imported	N/A	N/A
exported	N/A	N/A
used	N/A	N/A

2.5.2 Indication, to the extent possible, of the likely relevance of the final regulatory action to other states and regions

The substance has never been manufactured in Canada. Any import that may have occurred would not have exceeded 1000 kg/yr. The substance is present and used globally. There is a possibility that the final regulatory action may be slightly relevant and could be used for other states and regions, but because of the available chemical alternatives the impact should be minimal.

2.5.3 Other relevant information that may cover:

2.5.3.1 Assessment of socio-economic effects of the final regulatory action

The substance is not produced in Canada; the Regulations prevent the introduction of this fluorotelomer-based polymer into Canada. Canadian Industry will not be able to introduce the regulated substance into Canada. Thus, industry will not have the opportunity to use this substance in a number of applications. The availability of other fluorotelomer-based substances as well as hydrocarbon-based and silicone-based polymer with similar properties indicates that this lost opportunity will likely result in negligible, if any, incremental costs to the Canadian industry. The number of companies involved with these substances is relatively small. Therefore, Canadian Government costs associated with promoting compliance and enforcing the Regulations are minimal.

2.5.3.2 Information on alternatives and their relative risks, e.g. IPM, chemical and non-chemical alternatives

N/A

2.5.3.3 Basis for the final regulatory action if other than hazard or risk evaluation

N/A

2.5.3.4 Additional information related to the chemical or the final regulatory action, if any

SECTION 3 PROPERTIES

3.1 Information on hazard classification where the chemical is subject to classification requirements

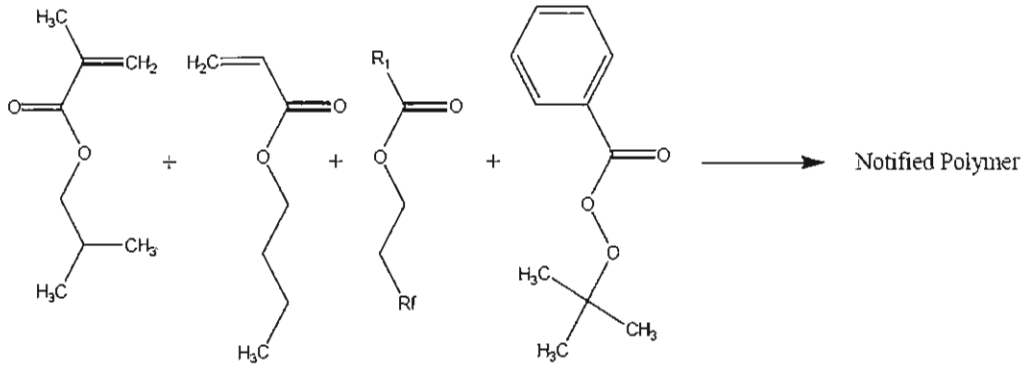
International classification systems e.g. WHO, IARC, etc.	**Hazard class**
N/A	N/A

Other classification systems e.g. EU, USEPA	**Hazard class**
N/A	N/A

3.2 Further information on the properties of the chemical

3.2.1 Description of physico-chemical properties of the chemical

The substance is an acrylic copolymer with pendant gamma-omega-perfluoroalkyl, as well as non-fluorinated iso-butyl and n-butyl chains attached to the polymer backbone via covalent ester bonds. Supplementary data provided for the fluorotelomer-based polymer give a solubility of 195.6 mg/L at pH of 2, whereas the fluorotelomer-based polymer exists as a dispersion at pH 7 and 9.



R_1 = masked component
R_f = perfluoro alkyl moiety

Representative structures of Monomers constituting the notified polymer, NSN# 12863

Physical and chemical properties of the substance (NSN# 12863) in a commercial formulation, as reported in the MSDS:

- Boiling point: Undetermined
- Solubility in water: Not miscible
- Vapour pressure: 340 Pa
- Solids content: 97%
- Form: Liquid
- Density: 1.020 @ 20°C

Reference

New Substances Evaluation Report (New Substances Notification 12863). *Canadian Environmental Protection Act, 1999*. Government of Canada.

Available upon request: http://www.ec.gc.ca/subsnouvelles-newsubs/default.asp?lang=En&n=6F22A1D6-1

3.2.2 Description of toxicological properties of the chemical

In order to fully assess the hazard potential associated with the fluorotelomer-based polymer, the following subsections of this hazard review will lay out some of the available information on the fluorotelomer-based polymer, surrogates, and

potential perfluorinated breakdown products (e.g., FTOHs and PFOA).

Fluorotelomer-based polymer:

The fluorotelomer-based polymer has not been tested in toxicological studies. No toxicity information on the fluorotelomer-based polymer was found in the MSDS provided with the notification or in the published literature.

Surrogate Fluorinated Substances:

Based on toxicological information for similar perfluorinated polymers found in an "inhouse" database, the fluorotelomer-based polymer is expected to show low acute oral toxicity and low skin and eye irritation potential.

In an effort to further characterize the toxicological properties of perfluorinated compounds, toxicity data from five structural analogues were identified. The results from these studies are not completely adequate to ascertain the specific toxicological profile of the fluorotelomer-based polymer; however, some toxicological effects were observed in all the perfluorinated compounds tested.

All five substances contain the same perfluorinated groups as the polymer and have been tested in rats for systemic toxicity (subchronic, developmental, and/or repeated inhalation toxicity). The lowest 90-day oral lowest observed adverse effect level (LOAEL) obtained was 10 mg/kg·bw/day for analogue #4 based on hepatocellular necrosis observed after the 90-day exposure and/or after one and three months of recovery in male rats. The lowest LOAEL for reproductive toxicity was reported to be 25 mg/kg·bw/day for analogue #3 based on prolongation of estrous cycle length observed in P1 rats; the toxicological significance of this effect is unclear. Common signs of toxicity observed across all five substances included:

- consistent slight decreases in red blood count and other haematology parameters,
- increases in liver weight and hypertrophy,
- thyroid hypertrophy, and
- decrease in body weight of the high dose groups.

The fluorotelomer-based polymer notified under NSN# 12863 is an acrylic fluorinated polymer with the closest surrogate being analogue #1, an acrylic fluorinated copolymer. Based on its smaller size and presumably larger proportion of low molecular weight species, the fluorotelomer-based polymer is more likely to be absorbed than the surrogate.

The results from a repeated dose oral toxicity test and a developmental study in

rats conducted with analogue #1 indicate that the substance causes moderate subchronic oral toxicity (NOAEL—100 mg/kg·bw/day), low reproductive toxicity (NOAEL— 1000 mg/kg·bw/day) and low developmental toxicity (NOAEL—1000 mg/kg·bw/day). The toxicological effects described in the studies are limited mainly to the kidney, liver, and thyroid of rats at high doses (e.g., 1000 mg/kg·bw/day). Specific effects observed in the high dose group included mild clinical pathology alterations, increased kidney and liver weights, hepatocellular hypertrophy, and thyroid follicular hypertrophy. Increased levels of hepatic β-oxidation, an indicator of peroxisome proliferation, were also observed in high dose group animals.

Toxicity of Degradation Products:

The fluorotelomer-based polymer contains perfluorinated alkyl groups which are derived from telomer BA, the fluorinated alcohols used as precursors to the monomers used in the fluorotelomer-based polymer. The ultimate degradation products of the fluorotelomer-based polymer is hypothesized to be PFCAs. PFCAs are extremely persistent in the environment and long chain PFCAs (≥C9) are found to be accumulative in animals. As well, some chemicals containing perfluorinated alkyl groups have been found to have very slow elimination rates and to be toxic in animal studies. Therefore, the fluorotelomer-based polymer containing these perfluorinated groups are of concern to human health.

The results of studies conducted on telomer BA will be used as representative for the potential perfluorinated alkyl degradation products of the fluorotelomer-based polymer. In addition, information on the toxicological properties of perfluorooctanoic acid (PFOA) and its ammonium salt (APFO) will be used as surrogate information for the perfluorinated carboxylic acids, PFCAs, the degradation products of the polyfluorinated telomer alcohols (FTOHs).

The following information is based on test data provided by the industry, published in the literature, or used in the USEPA assessment (USEPA, revised Hazard Assessment of Perfluorooctanoic Acid and Its Salts, November, 2002).

Telomer BA:

Two studies were conducted using telomer BA, namely:

1) a 90-day gavage study in rats with one generation reproduction evaluation, and
2) a developmental toxicity study in rats.

In study 1, the subchronic and reproductive NOAELs after 90 days were 25 mg/kg·bw/day, indicative of a moderate hazard. Toxicological endpoints noted at

100 and 250 mg/kg·bw/day dose levels included a decrease in body weight parameters and food efficiency, increased hepatic peroxisomal β-oxidation, and the degeneration and/or disorganization of enamel organ ameloblast cells. Additional findings included increased liver and kidney weights, and thyroid hypertrophy. Reproductive effects observed at 100 and 250 mg/kg·bw/day included decreases in implantation efficiency (number of pups born), number of pups born alive, and number of pups alive on day 4 of lactation, and decreased pup weights.

In the developmental study (study 2), a maternal and developmental NOAEL was evaluated at 200 mg/kg·bw/day. Toxicological findings at the high dose (500 mg/kg·bw/day) included reduced body weight and weight gain, and increased perineal fur staining. Developmental evidence of toxicity was characterized by slightly increased skeletal variations including delayed skull bone and pelvic bone ossification and wavy ribs. Thus, telomer BA is considered to cause moderate developmental toxicity in the rat.

Perfluorooctanoate (PFOA and APFO):

Toxicokinetics:

After absorption, PFOA distributes primarily to plasma, liver, and kidney. The estimated serum half-life values of PFOA range from 1.9 to 24 h in females and 4.4 to 9 days in male rats. PFOA is not metabolized and urine is the major route of excretion in the female rat, while the urine and the faeces are both major routes of excretion in male rats (Vanden Heuvel et al., 1991). There is evidence indicating that urine clearance decreases along with carbon chain length increase, especially in the male rat (Kudo, 2003; 2001).

In humans, PFOA has been detected in industrial workers; the highest arithmetic mean serum PFOA level reported was 6.8 ppm (range 0.0–114.1 ppm). According to a biomonitoring study in the US general population, PFOA has also been detected in the serum of children, adults, and the elderly; the geometric mean serum PFOA concentrations range within 4–5 ppb and were quantifiable in over 90% of the serum samples (cited in Butenhoff et al., 2004a). Based on findings in nine retired factory workers, the median half-life of PFOA in humans was estimated to be 4.37 years (range: 1.50–13.49 years, SD=3.53), indicative of very slow serum clearance.

Systemic Toxicity:

PFOA was administered to rats in the diet for 90 days at doses of 0, 10, 30, 100, 300 and 1000 ppm (corresponding to approximately 0, 0.65, 2.0, 6.65, 20, and 70 mg/kg·bw/day) (Griffith, 1980). The LOAEL was determined to be 30 ppm (approximately 2 mg/kg·bw/day), based on hematopoietic effects (decreased erythrocytes and leukocytes), increased liver weight, and hepatocellular

hypertrophy.

APFO was administered to rats in the diet for 90 days at doses of 0, 1, 10, 30, and 100 ppm (approximately 0, 0.05, 0.47, 1.44, and 4.97 mg/kg·bw/day) (Perkins, 1992). The LOAEL was determined to be 10 ppm (approximately 0.47 mg/kg·bw/day), based on decreased body weight and body weight gain, increased liver weight, and hepatocellular hypertrophy. In addition, increased levels of hepatic β-oxidation, a likely indicator of peroxisome proliferation, were also observed in high dose group animals in this study. The toxicity implications and the significance for humans, of the peroxisome proliferation and the associated toxicity changes observed in rodents, is not fully understood as peroxisome proliferation occurs at a much higher level in rodents than in humans.

In a four-week range finding study, groups of three male monkeys were administered APFO at 2 or 20 mg/kg·bw/day. The control group consisted of two male monkeys. In the treatment groups there were no mortalities, no treatment-related clinical signs, no blood chemistry differences from control animals and no gross or histopathological treatment related findings. One animal in the 20 mg/kg·bw/day group exhibited no or low food consumption throughout the study.

Based on these results, a study was designed in which groups of male monkeys were to be given APFO by oral capsule for six-months at dose levels of 0, 3, 10, and 30 mg/kg·bw/day (6, 4, 6 and 6 animals/group, respectively) followed by a 13-week recovery period. The dosing had to be discontinued in the 30 mg/kg·bw/day group due to systemic signs of toxicity including decreased body weights resulting from low or no food consumption. Treatment was resumed in these animals on Day 22 at a decreased dose level of 20 mg/kg·bw/day. One of these high dose monkeys died on Day 29 and three other monkeys did not complete the scheduled dosing period due to systemic clinical signs which consisted of decreased body weights and no faeces resulting from decreased food consumption. Treatment-related microscopic lesions were observed in the liver; including centrilobular and midzonal hepatocellular degeneration and necrosis; diffuse hepatocellular vacuolation, and hepatocyte basophilia in centrilobular areas (liver regeneration). One monkey dosed at 3 mg/kg·bw/day was sacrificed on Day 137 due to its clinical condition, possibly related to APFO treatment. Clinical signs for this animal included limited use and paralysis of hind limbs, ataxia, hypoactive behaviour, few faeces, and no food consumption. No clear histological findings could be attributed to the test article.

All dose groups, in general, exhibited clinical signs relating to decreased body weight gain (more severe in the high dose group) and animals at all dose levels required veterinary care during the study. The absolute liver weights were

increased by 35, 38, and 50% in the 3, 10, and 30/20 mg/kg·bw/day groups, respectively. Alanine aminotransferase and aspartate aminotransferase were significantly increased in the tested high dose animals correlating to increased liver weights, hepatotoxicity noted in the euthanized/deceased animals and microscopic evidence of an increase in mitochondrial proliferation. All changes were comparable to controls after the recovery period indicating a reversibility of effects.

In an earlier study, groups of four monkeys (two of each sex) were dosed orally with 0, 3, 10, 30 and 100 mg/kg·bw/day for 90 days. All animals of the 100 mg/kg·bw/day group died and three of four animals of the 30 mg/kg·bw/day also died. Clinical signs manifested throughout all groups with increasing severity and intensity at the higher dose levels. Although there were changes in hematology, blood biochemistry and organ weights, histological examinations were not conducted during the study and therefore a biological correlation could not be ascertained for these changes (cited in USEPA, 2002 and Butenhoff et al., 2002).

Reproductive and Developmental Toxicity:

Preliminary results indicate that PFOA is likely to have high developmental toxicity in the rat and rabbit (NOAEL of 3 and 5 mg/kg·bw/day, respectively). In a two generation reproductive toxicity study in rats exposed to 0, 1, 3, 10, and 30 mg/kg·bw/day APFO, the LOAEL for both F0 parental males and F1 generation males was derived at 1 mg/kg·bw/day, based on decreases in body weights and body weight gains, and significant changes in absolute liver and spleen weights and in the ratios of liver, kidney, and spleen weight-to-brain weights, and liver hepatocellular hypertrophy. The NOAEL and LOAEL for both F0 parental females and F1 generation females was 10 and 30 mg/kg·bw/day, respectively, based on statistically significant increases in postweaning mortality, delays in sexual maturation (time to vaginal patency), decreases in body weight and body weight gains and decreases in absolute food consumption. The NOAEL for the F2 generation offspring was 30 mg/kg·bw/day as no treatment-related effects were observed at any doses tested in the study when pups were sacrificed at weaning (Butenhoff et al., 2004b).

Genotoxicity:

APFO has been shown to be non-mutagenic to *Salmonella typhimurium* and *E. coli* bacteria in the presence and absence of metabolic activation in two separate Ames tests. In four separate chromosomal aberration studies (two with human lymphocytes and two with Chinese hamster ovary cells) APFO produced negative results in every assay with the exception of a reproducible positive response in the CHO cells in the presence of metabolic activation. APFO has also been shown to be negative in a cell transformation assay and two separate mouse micronucleus

assays (cited in Kennedy et al., 2004).

Tumourigenicity:

Based on results from a two-year dietary carcinogenicity study in rats, APFO induced significant increases in the incidence of Leydig cell adenoma (males) and of mammary fibroadenoma (females). A mechanistic two-year dietary study in male rats reported an increase in pancreatic acinar cell adenoma/carcinoma (9.2%) and hepatocellular adenoma (13%), in addition to Leydig cell adenoma (11%) (O'Connor, 2001 and unpublished results cited in Butenhoff et al., 2004a). In an unpublished study, dietary treatment of FC-143 (ammonium perfluoroalky carboxylate) at the dose level of 300 or 30 mg/kg·bw/day administered for two years slightly increased the hepatocellular tumor incidence in the high-dose male rats only.

The relevance of the tumourigenicity data to humans is uncertain, but it was postulated that APFO may affect estradiol levels through binding to and activating the PPAR-α receptor in the rat liver thus causing Leydig cell hyperplasia and tumour formation by acting as a mitogen and/or by enhancing growth factor secretion (USEPA, 2002)

Immunotoxicity:

Dietary treatment of PFOA at the dose level of 0.02% (corresponding to approximately 40 mg/kg·bw/day) for up to 10 days resulted in a significant increase, relative to control, in liver weights but decrease in thymus and spleen weights in male mice. The number of thymocytes expressing both CD4 and CD8 decreased by 95%. For the splenocytes, both T cells (CD3) and B cells (CD19) decreased by 75% and 86%, respectively. The decreased numbers of thymocytes was shown to be caused by inhibition of thymocyte proliferation. These findings indicate the potential immunological toxicity of PFOA in mice.

Epidemiological Studies:

PFOA has been detected in the sera of workers as well as in the general population worldwide.

Several epidemiological studies on the effects of PFOA in humans have been conducted on workers at three, 3M factories where PFOA is produced and used; most of the production workers studied were male. Two mortality studies, a morbidity study, and studies examining effects on the liver, pancreas, endocrine system, and lipid metabolism were conducted. In one study, positive associations were seen with increased PFOA exposure during employment and/or high PFOA serum levels for the following: prostate cancer mortality, estradiol levels,

cholesterol and triglyceride levels, and T3 hormone levels in some studies (Gilliland and Mandel, 1993). However, subsequent investigations did not confirm the positive associations (Alexander et al., 2003; Olsen et al., 1998, 2003a,b,c). Negative associations with increased PFOA exposures have been noted for cholecystokinin-33 (CCK) values, and HDL levels (Olsen et al., 2000). Therefore, overall, results of epidemiological studies remain inconclusive.

Health Hazard Summary and Conclusions:

Based on the available information on surrogate perfluorinated polymers, the fluorotelomer-based polymer is likely to have low acute oral toxicity, low potential for skin and eye irritation, and low reproductive and developmental toxicity. They are likely to display moderate subchronic oral toxicity, with effects on the thyroid, liver, and kidney based on observations of high dosing in rats. The significance of the hepatic effects in humans is uncertain, as these effects were correlated with peroxisome proliferation, a phenomenon more profoundly observed in rodents than in humans.

The fluorotelomer-based polymer can be expected to eventually degrade and release the corresponding perfluorinated telomer alcohols (FTOHs), which in turn will be converted into the extremely persistent perfluorinated carboxylic acids (PFCAs). The toxicological profile of the potential ultimate degradation products of the fluorotelomer-based polymer (i.e., PFCAs) is not expected to differ significantly from that of PFOA and its salts. Results of extensive studies indicate that PFOA and its salts are not genotoxic but are tumourigenic and immunotoxic in rodents, and display moderate reproductive and developmental toxicity in rodents and moderate to high subchronic oral toxicity in rodents and monkeys.

Human exposure to PFCAs is expected to increase over time as a result of expanding commercialization and use of their precursors, the perfluorinated polymers and similar substances. As a result, the levels of PFOA and longer chain PFCAs in human blood are expected to increase over time, based on their reported extreme persistence and very slow serum clearance. In fact, it has been reported that serum levels of PFOA in females have increased over the past 25 years (Harada et al., 2004).

Based on the above information, there is reason to suspect that the degradation products of the fluorotelomer-based polymer, in particular the PFCAs, could have the potential to cause adverse health effects in humans.

Reference

New Substances Evaluation Report (New Substances Notification 12863). *Canadian Environmental Protection Act, 1999*. Government of Canada.

Available upon request: http://www.ec.gc.ca/subsnouvelles-newsubs/default.asp?lang=En&n=6F22A1D6-1

3.2.3 Description of ecotoxicological properties of the chemical

Fluorotelomer-based polymer:

By definition, the fluorotelomer-based polymer meets the regulatory criteria for "low concern" polymers under Schedule IX of the *New Substances Notification Regulations*. In general, "low concern" polymers are expected to exhibit low toxicity.

No environmentally relevant toxicity data were provided for the fluorotelomer-based polymer. Available databases do not contain ecotoxicity data on this specific fluorotelomer-based polymer.

Degradation Products:

Polyfluorinated Telomer Alcohols (FTOHs):

Environmental toxicity data on FTOHs are limited.

Perfluorinated Carboxylic Acids (PFCAs):

Toxicity data on the PFCA compounds are lacking with the exception of the C8 carboxylate, PFOA.

A 35-day exposure of a zooplankton community to PFOA through an indoor microcosm resulted in LOECs between 10 and 70 mg/L for the various species, with Daphnia magna being reported as the most sensitive. Over the 35 days, the ecosystem changed from a diverse community dominated by larger species towards a less diverse community dominated by smaller more robust species (Sanderson et al., 2003).

Laboratory animal studies can provide evidence of the effects that may occur in mammalian wildlife following exposure to PFOA. Results of these studies indicate that PFOA and its salts are not genotoxic but are tumourigenic and immunotoxic in rodents, and display moderate reproductive and developmental toxicity in rodents and moderate to high subchronic oral toxicity in rodents and monkeys. The toxicological profiles of degradation products of the fluorotelomer-based polymer (i.e., PFCAs >C8) are likely to be similar to that of PFOA or potentially worse as

they are expected to be more bioaccumulative.

Available evidence indicates low acute toxicity of the fluorotelomer-based polymer and FTOHs to aquatic organisms. Toxicity data on the PFCAs are limited, and restricted to the effects from PFOA. Given the high bioaccumulation potential of the longer chain PFCAs (≥C9) and the limited toxicity data of this group, more chronic data are required to adequately assess the long-term toxicity of this class of substances. Considering the concerns raised through examination of environmental fate, bioaccumulation, persistence, and increasing presence in biota, a predicted no-effects concentration (PNEC) addressing the long term exposure is not possible, nor deemed necessary to quantify for characterization of risk from exposure to the substances and degradation products. The available data demonstrate low acute toxicity; however, based on toxicity data available for laboratory animals the potential exists for long-term damage or adverse effects to the environment.

Reference

New Substances Evaluation Report (New Substances Notification 12863). *Canadian Environmental Protection Act, 1999*. Government of Canada.

Available upon request: http://www.ec.gc.ca/subsnouvelles-newsubs/default.asp?lang=En&n=6F22A1D6-1

SECTION 4 DESIGNATED NATIONAL AUTHORITY

Institution	Environment Canada
Address	351 St. Joseph Blvd. Gatineau, QC, K1A 0H3
Name of person in charge	Ms. Lucie Desforges
Position of person in charge	Director, Chemical Production Division & DNA Industrial Chemicals
Telephone	819-938-4209
Telefax	819-938-4218
E-mail address	Lucie.Desforges@ec.gc.ca

Date, signature of DNA and official seal: 03 FEV. 2015

PLEASE RETURN THE COMPLETED FORM TO:

Secretariat for the Rotterdam Convention
Food and Agriculture Organization
of the United Nations (FAO)
Viale delle Terme di Caracalla
00153 Rome, Italy
Tel: (+39 06) 5705 2188
Fax: (+39 06) 5705 3224
E-mail: pic@fao.org

OR

Secretariat for the Rotterdam Convention
United Nations Environment
Programme (UNEP)
11-13, Chemin des Anémones
CH – 1219 Châtelaine, Geneva, Switzerland
Tel: (+41 22) 917 8296
Fax: (+41 22) 917 8082
E-mail: pic@pic.int

Definitions for the purposes of the Rotterdam Convention according to Article 2:

(a) 'Chemical' means a substance whether by itself or in a mixture or preparation and whether manufactured or obtained from nature, but does not include any living organism. It consists of the following categories: pesticide (including severely hazardous pesticide formulations) and industrial;

(b) 'Banned chemical' means a chemical all uses of which within one or more categories have been prohibited by final regulatory action, in order to protect human health or the environment. It includes a chemical that has been refused approval for first-time use or has been withdrawn by industry either from the domestic market or from further consideration in the domestic approval process and where there is clear evidence that such action has been taken in order to protect human health or the environment;

(c) 'Severely restricted chemical' means a chemical virtually all use of which within one or more categories has been prohibited by final regulatory action in order to protect human health or the environment, but for which certain specific uses remain allowed. It includes a chemical that has, for virtually all use, been refused for approval or been withdrawn by industry either from the domestic market or from further consideration in the domestic approval process, and where there is clear evidence that such action has been taken in order to protect human health or the environment;

(d) 'Final regulatory action' means an action taken by a Party, that does not require subsequent regulatory action by that Party, the purpose of which is to ban or severely restrict a chemical.