

Claigan PFAS Submission #3

PFAS in Drinking Water

Summary of News Articles and Related Science Papers

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Page 1 of 18

Table of Contents

Table of Contents	2
1. Summary	4
2. PFAS News Articles and Related Science Papers (2021 to 2023)	6
3. Links to PFAS News Articles and Related Science Papers (2021 to 2023)	9
4. Definitions	13
4.1. Article	13
4.2. Year	13
4.3. Paper	13
4.4. PFAS Detected in Water or Blood/Serum	13
4.5. High conc. or correlated PFAS	13
4.6. Fluoropolymer (Y/N)	13
4.7. PFOA (Y/N)	13
4.8. Links (Articles)	13
4.9. Links (Paper)	13
5. Related documents	13
5.1. Claigan PFAS Submission #1 - PFAS in Articles	13
5.2. Claigan PFAS Submission #2 - PFOA in Articles	13
5.3. Claigan PFAS Submission #4 - PFAS Substitutes and Alternatives	14
5.4. Claigan PFAS Submission #5 - PFAS Derogations and Justifications	14
6. High Risk Materials for PFAS in Drinking Water / Humans	15
6.1. Definitions	15
6.2. Risk of Creating PFAS in Drinking Water or Human	15
7. Examples of Misinterpretations of Journalists	16
7.1. Example	16
7.2. Misinterpretation	16

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Claigan PFAS Submission #3 - PFAS in Drinking Water

Prepared by Claigan Environmental Inc.

Page 2 of 18

7.3.	Corrected news articles	16
8.	Conclusions from review of papers	17
8.1.	PFAS are only perfluorocarboxylates and persulfonates	17
8.2.	Fluoropolymers	17
8.3.	Reducing PFAS	17
8.4.	Side note - PFHxS	17

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Claigan PFAS Submission #3 - PFAS in Drinking Water

Prepared by Claigan Environmental Inc.

Page 3 of 18

1. Summary

This report is submission #3 of 5 by Claigan Environmental Inc. (Claigan) on behalf of the EU PFAS Restriction Submission Project ("PFAS Submission Project"). The PFAS submission project is made up of dozens of companies from a wide range of industries (consumer, professional, industrial, medical, oil and gas, laboratory equipment, textiles, electronic components, and retail sales).

The PFAS Submission Project is focused primarily on the needs of complex products (articles). Claigan is both a restricted materials consultancy and high volume restricted materials testing laboratory. Each of the PFAS Submission Project submissions is based on contributions from all major sectors of industry and 2023 PFAS testing data of complex products.

This report (#3) is a review of news articles on PFAS in drinking water and in humans for 2021 to 2023 and the related scientific papers referenced in the news articles. Included are examples of misinterpretations of the scientific papers by journalists, summaries of the scientific data, and general conclusions.

This report include

- A. Names and links to news articles
- B. Names and links to related scientific paper
- C. Summary of PFAS detected in scientific paper
- D. Identification of whether PFAS detected were fluoropolymers (like PTFE) or fluorosalts (like PFOA)
- E. Example misinterpretation of the scientific data by journalists
- F. General conclusions of scientific data (**a must read**)
- G. Materials ranked by risk of producing the PFAS measured in the drinking water or humans in the scientific articles.

Important notes - the scientific journals were very consistent in identifying perfluorocarboxylates (PFOA family) and persulfonates (PFOS family in drinking water) with no detection of fluoropolymers. Any regulation on PFAS should focus on materials that provide a risk of perfluorocarboxylates and persulfonates in the environment or humans. Other PFAS are not related to the issues presented in the scientific paper.

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Claigan PFAS Submission #3 - PFAS in Drinking Water

Prepared by Claigan Environmental Inc.

Page 4 of 18

Additional note - the scientific papers identifying PFHxS in drinking water and humans do not match product data. PFHxS is not observed in products and firefighting foaming, while 6:2 FTS is measured in the same products at very high concentration. There is some concern that the reported PFHxS is artificial. 6:2 FTS would generally be 1,000X higher concentration than the reported PFHxS in the situation described in the papers above. There is concern that part of a peak common to both 6:2 FTS and PFHxS (such as 80 m/z) is being partially attributed to PFHxS when only 6:2 FTS is present in very high concentration.

At a minimum it is strongly recommended that the EU review any PFHxS data in the context of 6:2 FTS.

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Claigan PFAS Submission #3 - PFAS in Drinking Water

Prepared by Claigan Environmental Inc.

Page 5 of 18

2. PFAS News Articles and Related Science Papers (2021 to 2023)

Article	Year	Paper	PFAS Detected in Water or Blood/Serum	High conc. or correlated PFAS	Fluoro polymer (Y/N)	PFOA (Y/N)
'Forever chemicals' linked to infertility in women	2023	Exposure to perfluoroalkyl substances and women's fertility outcomes in a Singaporean population-based preconception cohort	PFDA, PFOS, PFOA, PFHpA	PFDA	N	Y
Study links in utero 'forever chemical' exposure to low sperm count and mobility	2022	Maternal Exposure to Per- and Polyfluoroalkyl Substances (PFAS) and Male Reproductive Function in Young Adulthood: Combined Exposure to Seven PFAS		PFHxS, PFHpA, PFOA, PFOS, PFNA, PFDA, PFUnDA	N	Y
'Forever chemicals' and acids used in plastic production connected to poor pregnancy outcomes: study	2023	Extending Nontargeted Discovery of Environmental Chemical Exposures during Pregnancy and Their Association with Pregnancy Complications—A Cross-Sectional Study	PFNA, PFOA, PFOS, PFDeA, PFUdA, PFHxS - detected in food and food packaging	PFOS, PFHxS	N	Y

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Tap water study detects PFAS 'forever chemicals' across the US U.S. Geological Survey	2023	Per- and polyfluoroalkyl substances (PFAS) in United States tapwater: Comparison of underserved private-well and public-supply exposures and associated health implications	PFBA, PFBS, PFHxA, PFHxS, PFOA, PFOS, PFPeA, PFPeS	PFBS, PFHxS and PFOA	N	Y
"Forever Chemicals" Detected in Blood of Dogs and Horses in PFAS Hotspot	2023	Domestic Dogs and Horses as Sentinels of Per- and Polyfluoroalkyl Substance Exposure and Associated Health Biomarkers in Gray's Creek North Carolina	PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFPeS, PFBS, PFHxS, PFHpS, PFOS, PMPA, PEPA, PFO2HxA	PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFPeS, PFBS, PFHpS, PFOS, PMPA, PEPA, PFO2HxA	N	Y
Child growth and development hampered by PFAS in blood, study says	2023	Metabolic Signatures of Youth Exposure to Mixtures of Per- and Polyfluoroalkyl Substances: A Multi-Cohort Study	PFOS, PFHxS, PFHpS, PFOA, PFNA, and PFDA	PFOS, PFOA	N	Y
Exposure to PFAS during pregnancy linked to increased risk of obesity in children	2023	Associations of Gestational Perfluoroalkyl Substances Exposure with Early Childhood BMI z -Scores and Risk of Overweight/Obesity: Results from the ECHO Cohorts	PFOA, PFOS, PFNA, PFHxS, PFDA, PFUnDA, NMFOSAA	PFOA, PFOS, PFNA, and PFHxS	N	Y

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'Am I going to regret it?': forever chemicals dilemma for breastfeeding mothers	2021	Estimated Exposures to Perfluorinated Compounds in Infancy Predict Attenuated Vaccine Antibody Concentrations at Age 5-Years	PFOS, PFOA, PFHxS, PFNA, PFDA	PFOA	N	Y
PFAS has more effect than type of diet on weight gain: Study	2023	Weight loss relapse associated with exposure to perfluorinated alkylate substances	PFHxS, PFOS, PFOA, PFNA, PFDA	PFOA, PFHxS	N	Y
Research: 'Forever Chemicals' Disrupt Vital Body Processes	2023	Metabolic Signatures of Youth Exposure to Mixtures of Per- and Polyfluoroalkyl Substances: A Multi-Cohort Study	PFOS, PFHxS, PFHpS, PFOA, PFNA, and PFDA	PFDA	N	Y

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3. Links to PFAS News Articles and Related Science Papers (2021 to 2023)

Article	Year	Paper	Link (article)	Link (paper)
'Forever chemicals' linked to infertility in women	2023	Exposure to perfluoroalkyl substances and women's fertility outcomes in a Singaporean population-based preconception cohort	https://www.theguardian.com/environment/2023/apr/06/forever-chemicals-infertility-women-pfas-blood	https://www.sciencedirect.com/science/article/abs/pii/S0048969723008835?via%3Dihub
Study links in utero 'forever chemical' exposure to low sperm count and mobility	2022	Maternal Exposure to Per- and Polyfluoroalkyl Substances (PFAS) and Male Reproductive Function in Young Adulthood: Combined Exposure to Seven PFAS	https://www.theguardian.com/society/2022/oct/05/pfas-sperm-count-mobility-testicle-development	https://ehp.niehs.nih.gov/doi/full/10.1289/EHP10285
'Forever chemicals' and acids used in plastic production connected to poor pregnancy outcomes: study	2023	Extending Nontargeted Discovery of Environmental Chemical Exposures during Pregnancy and Their Association with Pregnancy Complications—A Cross-	https://thehill.com/policy/equilibrium-sustainability/4103949-forever-chemicals-and-acids-used-in-plastic-production-connected-to-poor-pregnancy-outcomes-study/	https://ehp.niehs.nih.gov/doi/10.1289/ehp11546

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		Sectional Study		
Tap water study detects PFAS 'forever chemicals' across the US U.S. Geological Survey	2023	Per- and polyfluoroalkyl substances (PFAS) in United States tapwater: Comparison of underserved private-well and public-supply exposures and associated health implications	https://www.usgs.gov/news/national-news-release/tap-water-study-detects-pfas-forever-chemicals-across-us	https://www.sciencedirect.com/science/article/pii/S0160412023003069?via%3Dihub
"Forever Chemicals" Detected in Blood of Dogs and Horses in PFAS Hotspot	2023	Domestic Dogs and Horses as Sentinels of Per- and Polyfluoroalkyl Substance Exposure and Associated Health Biomarkers in Gray's Creek North Carolina	https://www.technologynetworks.com/applied-sciences/news/forever-chemicals-detected-in-blood-of-dogs-and-horses-in-pfas-hotspot-375085	https://pubs.acs.org/doi/10.1021/acs.est.3c01146
Child growth and development hampered by PFAS in blood, study says	2023	Metabolic Signatures of Youth Exposure to Mixtures of Per- and Polyfluoroalkyl	https://www.cnn.com/2023/03/20/health/pfas-children-wellness/index.html	https://ehp.niehs.nih.gov/doi/10.1289/EHP11372

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Claigan PFAS Submission #3 - PFAS in Drinking Water

Prepared by Claigan Environmental Inc.

Page 10 of 18

		Substances: A Multi-Cohort Study		
Exposure to PFAS during pregnancy linked to increased risk of obesity in children	2023	Associations of Gestational Perfluoroalkyl Substances Exposure with Early Childhood BMI z -Scores and Risk of Overweight/Obesity: Results from the ECHO Cohorts	https://www.news-medical.net/news/20230607/Exposure-to-PFAS-during-pregnancy-linked-to-increased-risk-of-obesity-in-children.aspx	https://ehp.niehs.nih.gov/doi/10.1289/EHP11545
'Am I going to regret it?': forever chemicals dilemma for breastfeeding mothers	2021	Estimated Exposures to Perfluorinated Compounds in Infancy Predict Attenuated Vaccine Antibody Concentrations at Age 5-Years	https://www.theguardian.com/us-news/2021/feb/15/forever-chemicals-breastfeeding-contamination-pfas	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6190594/
PFAS has more effect than type of diet on weight gain: Study	2023	Weight loss relapse associated with exposure to perfluorinated alkylate substances	https://www.ehn.org/pfas-weight-gain-obesity-2659877152.html	https://onlinelibrary.wiley.com/doi/pdfdirect/10.1002/oby.23755

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Research: 'Forever Chemicals' Disrupt Vital Body Processes	2023	Metabolic Signatures of Youth Exposure to Mixtures of Per- and Polyfluoroalkyl Substances: A Multi-Cohort Study	https://www.miragenews.com/research-forever-chemicals-disrupt-vital-body-954859/	https://ehp.niehs.nih.gov/doi/full/10.1289/EHP11372?ref=tomecontroldesusalud.com
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Articles last accessed September 18 2023.

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Claigan PFAS Submission #3 - PFAS in Drinking Water

Prepared by Claigan Environmental Inc.

Page 12 of 18

4. Definitions

- 4.1. Article
 - 4.1.1. News article discussing PFAS
- 4.2. Year
 - 4.2.1. Year of the Article
- 4.3. Paper
 - 4.3.1. Name of the scientific paper referenced in the article
- 4.4. PFAS Detected in Water or Blood/Serum
 - 4.4.1. What perfluoroalkyl carboxylates were detected in drinking water or human blood/serum.
- 4.5. High conc. or correlated PFAS
 - 4.5.1. What PFAS substance was most correlated to the conclusion or health concern of the scientific paper.
- 4.6. Fluoropolymer (Y/N)
 - 4.6.1. Was a fluoropolymer detected in the drinking water or human blood/serum in the scientific paper?
- 4.7. PFOA (Y/N)
 - 4.7.1. Was a perfluorocarboxylate (PFOA family) or perfluorosulfonate (PFOS family) detected in drinking water or human blood/serum in the scientific paper?
- 4.8. Links (Articles)
 - 4.8.1. Links to the news article
- 4.9. Links (Paper)
 - 4.9.1. Links to the scientific paper

5. Related documents

- 5.1. Claigan PFAS Submission #1 - PFAS in Articles
 - 5.1.1. Comprehensive 2023 test data regarding locations and uses of PFAS in articles.
- 5.2. Claigan PFAS Submission #2 - PFOA in Articles
 - 5.2.1. 2022 and 2023 test data regarding PFOA (and other perfluorocarboxylates and perfluorosulfonates in articles)

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Claigan PFAS Submission #3 - PFAS in Drinking Water

Prepared by Claigan Environmental Inc.

Page 13 of 18

5.3. Claigan PFAS Submission #4 - PFAS Substitutes and Alternatives

1.1.1. A review of pros and cons of fluoropolymers and their potential substitutes.

5.4. Claigan PFAS Submission #5 - PFAS Derogations and Justifications

1.1.2. Requested derogations and related justifications for necessary uses of PFAS.

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Page 14 of 18

6. High Risk Materials for PFAS in Drinking Water / Humans

6.1. Definitions

6.1.1. Overall

6.1.1.1. Based on product testing and scientific papers.

6.1.2. Very high risk

6.1.2.1. Materials that likely produce significant concentrations of PFAS in drinking water or human blood/serum

6.1.3. High risk

6.1.3.1. Materials that likely produce concentrations of PFAS in drinking water or human blood/serum

6.1.4. Low risk

6.1.4.1. Materials that may contain and may produce small concentrations of PFAS in drinking water or human blood/serum. These materials are unlikely to be significant contributors to measured PFAS in drinking water or human blood/serum

6.1.5. No risk

6.1.5.1. Materials that have no potential to produce PFAS in drinking water or humans.

6.2. Risk of Creating PFAS in Drinking Water or Human

6.2.1. **Very High risk**

6.2.1.1. Fluoroalkyl phosphates

6.2.1.1.1. Examples - cosmetics

6.2.2. **High risk**

6.2.2.1. Fluoroalkyl acrylates (external)

6.2.2.1.1. Examples - fluoroacrylates in clothings

6.2.2.2. Fluoroelastomers in drinking water

6.2.2.2.1. If containing 6:2 FTS based surfactant

6.2.3. **Low risk**

6.2.3.1. Fluoroalkyl acrylates (internal)

6.2.3.1.1. Examples - fluoroacrylates internal to electronics

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6.2.3.2. PFA, fluoroelastomers, perfluoroelastomers, irradiated PTFE, ePTFE,

6.2.3.2.1. Examples - electronics wiring, professional seals, water membranes, and other applications of the materials above.

6.2.4. No risk

6.2.4.1. PTFE (standard - unirradiated)

6.2.4.1.1. Examples - cookware, PTFE seals

6.2.4.2. PVDF, ETFE, FEP

6.2.4.2.1. Examples - fluid transport components

7. Examples of Misinterpretations of Journalists

7.1. Example

7.1.1. News article - 'Forever chemicals' linked to infertility in women

7.1.2. Science paper - Exposure to perfluoroalkyl substances and women's fertility outcomes in a Singaporean population-based preconception cohort

7.2. Misinterpretation

7.2.1. PFAS in the blood of women primarily PFDA.

7.2.2. PFDA is a specific C10 fluorocarboxylate not commonly found in products

7.2.2.1. PFDA is only found in high concentration in

7.2.2.1.1. Cosmetics using C9-C15 fluoroalkyl phosphate, and

7.2.2.1.2. To a lesser extent - fluoroacrylate coated clothing

7.2.2.2. PFDA is found in low concentrations in

7.2.2.2.1. PFA and irradiated PTFE in electronics

7.3. Corrected news articles

7.3.1. Original article title

7.3.1.1. **'Forever chemicals' linked to infertility in women, study shows'**

7.3.2. More accurate theoretical article title

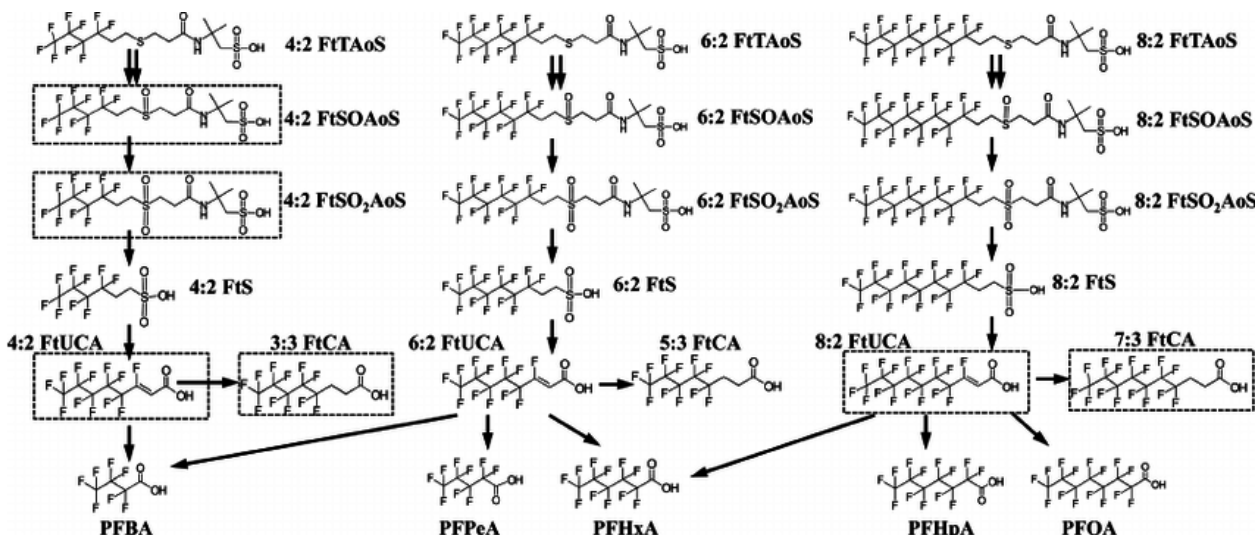
7.3.2.1. **'Biomarker related to heavy makeup use linked to infertility in women, study shows'**

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8. Conclusions from review of papers

- 8.1. PFAS are only perfluorocarboxylates and persulfonates
 - 8.1.1. **All PFAS in all the science papers are perfluorocarboxylates and perfluorsulfonates, none are fluoropolymers.**
- 8.2. Fluoropolymers
 - 8.2.1. Drinking water and humans are not affected by any PFAS that does not contain perfluorocarboxylates.
- 8.3. Reducing PFAS
 - 8.3.1. **All PFAS in drinking water would be reduced by enforcing and expanding restrictions that already exist.**
 - 8.3.2. The current restrictions for perfluorocarboxylates under POP and REACH regulations would greatly limit PFAS in drinking water and humans if enforced. An increase in regulation of sulfonates would limit the other PFAS in drinking water and humans.
 - 8.3.3. Regulation of PFAS unrelated to perfluorocarboxylates or persulfonates would have no effect on drinking water and human health.
- 8.4. Side note - PFHxS
 - 8.4.1. PFHxS is commonly reported in the science papers above but has not been measured in products in 2022/2023. It is possible that the reported PFHxS is actually 6:2 FTS, which is a C6 sulfonate but is not PFHxS.
 - 8.4.2. A common mis-statement is that PFHxS is derived from AFFF fire fighting foams. However, AFFF material degrades into 6:2 FTS then into perfluorocarboxylates such as PFHxA, not PFHxS.
 - 8.4.3. PFHxS is not a normal degradation product of fluorotelomer sulfonate surfactants. When the 'telomer' C-C section (the :2 in 6:2) degrades, it takes the sulfur with it - making the presence of PFHxS less unlikely.
 - 8.4.4. Example degradation path of AFFF foam (and other fluorotelomer sulfonate surfactants) from "Aerobic Biotransformation of Fluorotelomer Thioether Amido Sulfonate (Lodyne™) in AFFF-Amended Microcosms"

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2015. Note no PFHxS in the degradation path of C6 AFFF (middle column in the diagram).

- 8.4.4.1. The 6:2 fluorosurfactant 6:2 FtTAoS degrades primarily into 6:2 FTS, which degrades into perfluorocarboxylates (PFBA, PFPeA, and PFHxA) not PFHxS.
- 8.4.5. Papers that test for 6:2 FTS separately from PFHxS have very different results. See - "Per- and polyfluoroalkyl substances (PFASs) in contaminated coastal marine waters of the Saudi Arabian Red Sea: a baseline study" - 2020.
- 8.4.6. It is strongly recommended that drinking water data is re-reviewed in context of the presence of high concentrations of 6:2 FTS.

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