

Claigan PFAS Submission #1

Locations of PFAS in Complex Articles

Based on 2023 Test Data

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Prepared by Claigan Environmental Inc.

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1. Summary

This report is submission #1 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 a high volume restricted materials testing laboratory. Each of the PFAS Submission Project submissions are based on contributions from all major sectors of industry and 2023 PFAS testing data of complex products.

This report (#1) is a detailed review of standard PFAS situations detected by Claigan using Wavelength Dispersive X-Ray Fluorescence (WD-XRF) in 2023. The reported percentages are approximate and based on general testing data in 2023. This data is based on a high level review of approximately two hundred (200) complex articles averaging between 20 and 1,000 components each.

Note 1 - WD-XRF is a very effective method for measuring fluorine concentration including fluorocoatings on the surfaces of other materials.

Claigan conducted a detailed comparison of WD-XRF to Combustion Ion Chromatography (C-IC) in 2023. WD-XRF was very effective at measuring fluorine concentration down to 50 ppm. C-IC was unable to detect surface coatings below 10,000 ppm (surface fluorine concentration). Based on those results, and a summary of 2023 WD-XRF testing data, C-IC would not be able to detect 30% of PFAS situations in complex products (articles).

Full data is available upon request including a controlled experiment of standard aerosol mold release fluoro spray being applied in various thicknesses to coffee cups. C-IC was not able to detect the spray until the concentration rose above 10,000 ppm F.

Note 2 - Examples provided in this report are representative and not of any specific tested product.

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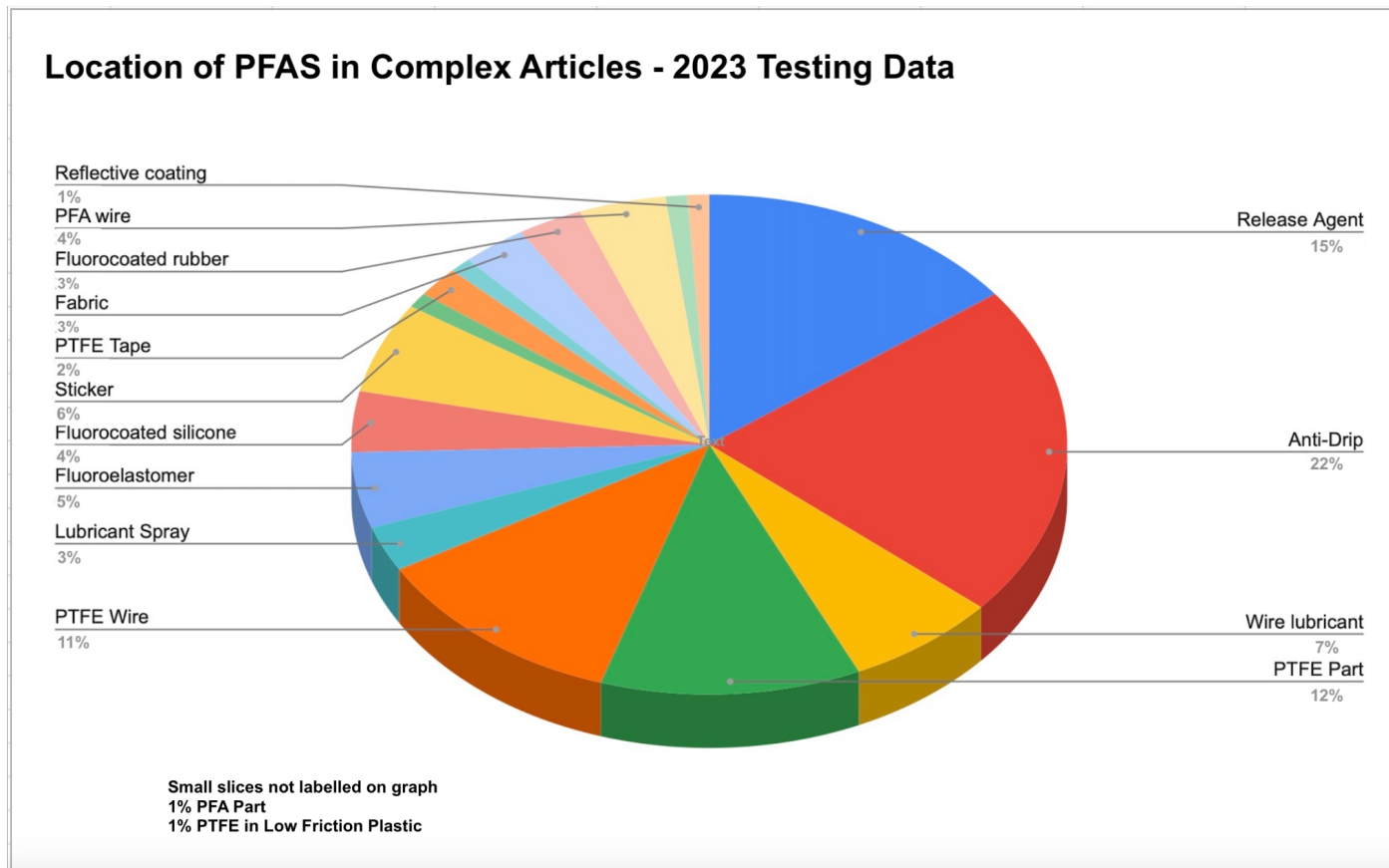
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2. Locations of PFAS in Complex Articles



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3. Definitions

3.1. Description

3.1.1. A general description of each detected (by testing and engineering evaluation) use

3.2. Forever chemical risk

3.2.1. Does the use contain measurable perfluorocarboxylates (PFOA family) or perfluorosulfonates (PFOS family) in the finished article.

3.2.1.1. **Never** - Not expected to contain perfluorocarboxylates (PFOA family) or perfluorosulfonates (PFOS family).

3.2.1.2. **Rarely** - Rarely contains perfluorocarboxylates (PFOA family) or perfluorosulfonates (PFOS family). Not the standard case.

3.2.1.3. **Commonly** - Normally contains perfluorocarboxylates (PFOA family) or perfluorosulfonates (PFOS family).

3.2.1.4. Note - additional details to be provided in the case that presence is possible.

4. Anti-Drip (22% of measured occurrences)

4.1. Description

4.1.1. Flame retardant additive to prevent 'dripping' of hot plastic during burning.

4.1.2. Many plastics, such as ABS and PC, often drip during burning. To meet high flame retardancy ratings, such as UV94 V-0, plastics must not drip when exposed to a flame. PTFE (added up to ~1% concentration) when it burns, forms a 'webbing' preventing the main plastic from burning.

4.1.3. More common in plastic housings of electronics requiring high flame retardancy.

4.1.4. Note - a small percentage of these parts may be PTFE added to plastic for reduced friction / wear and belong in the PTFE in low friction plastics category. The specific use in some situations is not clear under standard testing or the material could enable both applications.

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4.2. Forever chemicals

4.2.1. Never

5. Mold Release (15% of measured occurrences)

5.1. Description

5.1.1. Aerosol fluoro coating spray (often fluorosilicone but can be dry PTFE spray) applied to molds and other industrial equipment to aid with the release of the rubber or plastic part from the mold.

5.1.2. Very common for o-rings, gaskets, and foam.

5.2. Forever chemicals

5.2.1. Never

6. Wire lubricant spray (7% of measured occurrences)

6.1. Description

6.1.1. Aerosol fluoro coating spray (often fluorosilicone) applied to internal wiring or their assembly equipment. The spray reduces the friction of PVC or XLPE wires improving cable flexibility and durability.

6.1.2. Very common for hookup wires in flexible cables.

6.2. Forever chemicals

6.2.1. Never

7. Lubricant Spray (3% of measured occurrences)

7.1. Description

7.1.1. This listing is for aerosol lubricant spray except for on wires.

7.1.1.1. The use of lubricant spray on wires is very common and listed separately.

7.1.1.2. The actual spray for mold release, wire lubrication, and general part lubrication are usually the same source aerosol (normally fluorosilicone).

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- 7.1.2. Fluoro lubricant spray is used on a variety of parts with mechanical wear (metal and plastic).

7.2. Forever chemicals

- 7.2.1. Never

8. PTFE Parts (5% of measured occurrences)

8.1. Description

- 8.1.1. This listing is a general listing for PTFE used in a solid part (non coating) in a product (excluding wires and tape).
- 8.1.2. PTFE parts are very common in applications requiring low friction or high temperature performance.

8.2. Forever chemicals

- 8.2.1. Never

9. PTFE Wire (11% of measured occurrences)

9.1. Description

- 9.1.1. This listing is for the specific use of PTFE for wiring insulation.
- 9.1.2. Common in low friction applications, or in high temperature applications unsuitable for other materials.
- 9.1.3. Transformer wires are very common uses of PTFE wire.

9.2. Forever chemicals

- 9.2.1. Never
- 9.2.2. Note - 'PTFE' wires that measure perfluorocarboxylates (PFOA) family during testing are normally found to be PFA insulated (not PTFE) wires upon detailed investigation.

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10. Fluoroelastomers (5% of measured occurrences)

10.1. Description

- 10.1.1. This listing is for a wide range fluoroelastomers (FKM) and perfluoroelastomers (FFKM) - and also include fluorosilicone rubber.
- 10.1.2. A very common fluoroelastomer for high temperature or high acidity environments. FKM is also used in consumer applications with high human contact (sweat and oil exposure) because of the poor oil and stain resistance of silicone.

10.2. Forever chemicals

- 10.2.1. Commonly
 - 10.2.1.1. Commonly has 6:2 FTS > 1 ppm
 - 10.2.1.2. Rarely has short chain perfluorocarboxylates (PFHpA and smaller) ~ 100 ppb

11. Fluoro-coated Silicone (3% of measured occurrences)

11.1. Description

- 11.1.1. This listing is for fluorocoatings over silicone rubber.
- 11.1.2. Fluorocoatings over silicone rubber are very common in applications where silicone would come into contact with oil or require reduced friction. The fluorocoating provides the silicone with surface properties of fluoropolymers.

11.2. Forever chemicals

- 11.2.1. Never

12. Fluoro-coated Rubber (4% of measured occurrences)

12.1. Description

- 12.1.1. This listing is for fluorocoating over nitrile (or similar) rubber. This listing excludes fluorocoated silicone.
- 12.1.2. Fluorocoatings over nitrile rubber are common in applications where nitrile rubber would come into contact with acids or requires low friction. The fluorocoating provides the nitrile rubber with surface properties of

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fluoropolymers but not the full advantages and wear resistance of fluoroelastomers.

- 12.1.3. Fluorocoated nitrile is common in the medical and pharmaceutical industry.

12.2. Forever chemicals

- 12.2.1. Never

13. Stickers (6% of measured occurrences)

13.1. Description

- 13.1.1. PFAS in stickers can be present in one (1) of two (2) situations
 - 13.1.1.1. Fluorocoating on front of the sticker for environmental / water resistance, or
 - 13.1.1.2. PFAS in the adhesive on back side of the sticker
- 13.1.2. Fluorocoatings on the front of stickers are relatively high concentration fluorocoatings to protect the sticker from water or other environmental conditions
- 13.1.3. PFAS in the adhesive can be from two (2) different sources
 - 13.1.3.1. Residual fluorosilicone from the fluorosilicone release paper from which the sticker was peeled, or
 - 13.1.3.2. Low concentration fluoro surfactant used to reduce the surface tension of the adhesive allowing it to penetrate cracks and features better - improving adhesion
- 13.1.4. Fluorocoatings are more common in exterior stickers but can be on any type of sticker which requires durability including stickers on hard drives.
- 13.1.5. PFAS in the adhesive can be on any type of sticker that uses release paper/liner including silicone thermal pads used for heat dissipation in electronics.

13.2. Forever chemicals

- 13.2.1. Due to the complexity of different sources of PFAS in stickers, work is still ongoing surrounding the risk of perfluorocarboxylates and perfluorosulfonates in PFAS on stickers.

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14. PTFE Tape (2% of measured occurrences)

14.1. Description

- 14.1.1. PTFE tape is used primarily to join fluid or gas transporting components. However, PTFE has many uses including wrapping of internal wires in a cable for environmental resistance or sealing joints.
- 14.1.2. PTFE tape is not uniformly one material as it can be manufactured through a skiving process (blade peeling process) or extrusion (extruded into a PTFE rope and then calendered (rolled) into a flat tape). These two processes produce very different materials with very different risks of forever chemicals.

14.2. Forever chemicals

- 14.2.1. Extruded PTFE tape commonly contains the entire range of perfluorocarboxylate (PFOA) family lengths (from C4 to C14) at ~ 100 ppb. This is likely from irradiation of the original PTFE powder to improve 'rubberiness' to aid in extrusion and calendering.
- 14.2.2. PTFE tape can be both extruded or skived without forever chemicals, but the majority of extruded PTFE tape contains perfluorocarboxylates.

15. Fabric (3% of measured occurrences)

15.1. Description

- 15.1.1. Fluoroacrylate coating of fabric for water and oil/stain resistance.
- 15.1.2. Fluoroacrylates are the most common outdoor fabric waterproof coating, but the most commonly fluoroacrylic coated fabrics are the washing instructions or country of origin fabric tags in most garments.

15.2. Forever chemicals

- 15.2.1. Commonly has a full range of perfluorocarboxylates (PFOA family) from C4-C14 at > 100 ppb per substance.

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16. PFA Wire (4% of measured occurrences)

16.1. Description

- 16.1.1. Perfluoroalkoxy alkane (PFA) insulated hookup wire.
- 16.1.2. PFA hook up wire is one of the most common PFAS insulations as it has superior temperature resistance compared to other wire insulations and significant flexibility advantages over PTFE.
- 16.1.3. PFA wire is very common in dense electronics and in invasive or implantable medical devices.

16.2. Forever chemicals

- 16.2.1. Commonly has a full range of perfluorocarboxylates (PFOA family) from C4-C14 at ~100 ppb per substance.

17. Anti-reflective coating (1% of measured occurrences)

17.1. Description

- 17.1.1. Anti-reflective and/or anti-smudge coating on optical surfaces such as displays or eyewear.

17.2. Forever chemicals

- 17.2.1. Work is ongoing to determine the risk of forever chemicals.

18. PFA Part (1% of measured occurrences)

18.1. Description

- 18.1.1. This listing is a general listing for PFA used in a solid part (non coating) in a product (excluding wires).
- 18.1.2. PFA parts are very common in applications requiring low friction or high temperature performance - in particular in situations requiring superior chemical resistance.

18.2. Forever chemicals

- 18.2.1. Commonly has a full range of perfluorocarboxylates (PFOA family) from C4-C14 at ~100 ppb per substance.

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19. PTFE in Low Friction Plastic (1% of measured occurrences)

19.1. Description

- 19.1.1. PTFE powder is added to another polymer (such as nylon) to reduce friction and wear of the plastic part.
- 19.1.2. PTFE added to low friction plastic parts are generally in applications requiring reduced friction or wear such as a valve or other moving part.

19.2. Forever chemicals

- 19.2.1. Never

20. Other PFAS occurrences

20.1. Description

- 20.1.1. Other PFAS in articles has been identified during testing but either cannot be tested for safety reasons (example - lithium batteries) or did not produce statistically significant numbers of occurrences (example - fluoro coatings of food contact materials)
- 20.1.2. Examples
 - 20.1.2.1. Fluorobinder (usually PVDF) inside lithium batteries or super / ultra capacitors
 - 20.1.2.2. Fluoroacrylate coating of food contacting paper or paperboard.
 - 20.1.2.3. ePTFE in membrane filters

20.2. Forever chemicals

- 20.2.1. PVDF binders would not normally be expected to contact forever chemicals.
- 20.2.2. Fluoroacrylate food coatings commonly contain perfluorocarboxylates.
- 20.2.3. ePTFE membrane filters commonly contain perfluorocarboxylates.

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