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PFAS in the Environment and Packaging

Per- and Polyfluorinated alkyl substances (PFAS) are represented by over forty-one (41) individual compounds, around thirty (30) of which are under study by the US Environmental Agency (US EPA), various state EPA or Dept. of Environmental Protection (DEP) organizations, private industry, and universities (U Florida, Harvard¹ and others). This family of chemicals has been studied in the environment by EPA, industry, and academia since the later 1990s and early 2000s. PFAS compounds were labeled 'forever chemicals' due to their resistance to chemical or biological breakdown and bioaccumulation in animal and plant tissues. There is extensive environmental and medical literature publicly available detailing direct linkage of long-term exposure of PFAS compounds to various cancers, autoimmune diseases, and birth defects.

Contrary to some allied industry reports, specifically minimizing the extensive presence of PFAS compounds, its presence in the environment including many potable water supplies, foods, and up to 98% of the human tissues and sera sampled confirm its ubiquitousness. The presence of these PFAS compounds in the environment is not a recent development; however, the presence of PFAS in pesticides as a direct result of the fluorination of HDPE packaging is very new having been reported in late 2020. Reference <https://www.epa.gov/pesticides/pfasppackaging>.

To be clear PFAS compounds are not an intentional additive at any step along the manufacturing chain for polyethylenes used in plastic packaging. The presence of PFAS compounds is either the result of post manufacturing fluorination treatment of high-density polyethylene (HDPE) bottles by a secondary fluorination treatment contractor or by what is known in the packaging industry as "in-mold" fluorination during the HDPE extrusion process. Fluorination of HDPE containers used for the transportation and storage of industrial chemicals including pesticides, automotive maintenance products, and volatile organic compounds (VOC's) reduce escape of potentially toxic or flammable materials from seeping through the walls of HDPE containers (aka 'permeation'). Additionally, many fluorinated HDPE containers and packaging are used for food, pharmaceuticals, and personal care products in which the presence of PFAS compounds have direct human exposure at a high level.

The post manufacturing fluorination of HDPE containers is largely the domain of one US company but there are other companies that utilize the "in-mold" fluorination process. Fluorination of HDPE packaging is not a preferred technology in the EU due to the dangers of the process involving fluorine gas (highly toxic). Technology has been developed to remove or minimize PFAS compounds on fluorinated HDPE (fHDPE) but it is expensive and does not account for the safe disposal of the resultant rinse water which contains the PFAS compounds.

It should be noted that this most recent discussion of fluorinated HDPE packaging is based on activities surrounding the work of the US EPA and, in one case, the Massachusetts Department of Environmental Protection (MA DEP) regarding the presence and accumulation of PFAS compounds in the environment and consequent human lifetime exposure. MA DEP confirmed

¹ [Uncovering hidden forever chemicals \(harvard.edu\)](https://www.harvard.edu/news/2020/05/01/uncovering-hidden-forever-chemicals)



the presence of PFAS compounds in a mosquito control pesticide after being alerted by the MA Public Employees for Environmental Responsibility (PEER) in November 2020. Subsequently, MA DEP requested that the US EPA step in and investigate further to confirm presence and determine source of these PFAS compounds.

Initial tests conducted of fluorinated polyethylene (fHDPE) pesticide bottles extracted levels of PFAS compounds in the 20 – 50 parts per billion (ppb) range in the samples analyzed and virtually none in the non-fluorinated control samples. This result from the fluorinated samples is over 700 times the Human Contaminant Level of 0.07 ppb *lifetime* the EPA proposed in a recent Federal Register proposal for water supply regulations. In that some industry reports take these levels as being “small” it should be noted those 20-50 ppb levels still could be 25 times the EPA long term adult exposure (environmental—not direct contact) of 20 nanograms (ng) per kilogram body weight per day.

Further EPA studies (https://www.epa.gov/sites/production/files/2021-03/documents/results-of-rinsates-samples_03042021.pdf) confirmed the 20—50 parts per billion range levels on the outside of the fHDPE pesticide bottles impacting everyone in the supply chain touching those bottles including consumers purchasing these fHDPE containers in retail settings. This direct human contact will have high level of exposure, not secondary ingestion of diluted exposure via water supplies.

Although this one pesticide was the “sample zero” for the recent discovery, it has come to light that other HDPE packaging samples from other chemical manufacturers have shown levels of PFAS compounds both in their products as well as the inner and outer surfaces of the containers. It has been commented that this observation may be overbroad, but we believe the contrary. Federal and State governmental agencies, academia, and private industry are looking in a rather targeted manner at the contribution of fHDPE in the form of packaging to the PFAS environmental burden while the FDA and related State agencies examine food and drug packaging regarding more direct human exposure. To this end, several States have begun banning the presence of PFAS compounds both on plastic and food packaging. Even the EPA recently stated that it recommends users of fHDPE packaging exercise due diligence in finding alternative packaging.

A secondary issue involving fHDPE packaging that has not yet been investigated is the presence of these PFAS compounds in recycled plastic. It seems to reason that since PFAS compounds have been discovered in fHDPE pesticide containers, these ‘forever chemicals’ would travel with the supply chain wherever fluorination has been used. It is estimated that approximately 40% of agricultural chemical containers, e.g., pesticides, are fluorinated. These agchem containers according to Federal Law must be triple rinsed after use and before disposal with the rinsed container now serving as a source for recycled HDPE. <https://www.acrecycle.org/> One of the products made with this recycled plastic is ground water irrigation pipe. Consequently, neither the rinsate from the triple rinse process nor the actual agchem container nor the finished product made of the recycled product had been tested for the presence of PFAS compounds. This leaves a wide-open question of how fHDPE maybe contaminating the environment risking human exposure not only in the initial usage but also thru the whole life of the fHDPE. The US EPA is in the process of taking a closer look and conducting longer term exposure studies, similar to what a product in fHDPE might experience in storage at a store or warehouse. Most of the data presented thus far have been two-minute rinses with methanol to two-hour soaks in methanol or other solvent or commercial product. Longer exposure of the fHDPE to the solvent should yield higher PFAS recovery rates. These data are anticipated first quarter of 2022.



A study of a random sample of HDPE collected by a recycler and reconditioner of packages, including agricultural plastics, was tested by Pace Analytical for various PFAS compounds. The amount of agricultural or other containers that may have been fluorinated was unknown, only that the regrind sample had been collected from an agricultural plastics collection site. Of the dozens sought seven (7) PFAS compounds were found at detectable levels ranging from 0.16 ppb to 20 ppb.

Regulatory Update:

In the fall of 2021, the US EPA designated PFOA and PFOS as CERCLA hazardous substances. This requires the reporting of releases above the reportable quantity for which EPA has established no de minimus—that is any release must be reported. The concern is what will this mean to packaging? Will even empty packaging need to be declared and handled accordingly? Will regrind reuse be prohibited if the original container had PFAS present? Currently the State of Maine requires declaration if the packaging contains PFAS or if any packaging of any ingredients along the supply chain contained PFAS.

A supplier of mosquito control products sowed PFAS in the product and it originated from the packaging. They have truckloads of product and empty bottles sitting in a warehouse that the EPA won't let them use or incinerate.

Path Forward:

There are alternative barrier products for HDPE packaging that offer the equivalent or superior permeation protection while adding prevention from ingress of oxygen and water vapor that can also damage a sensitive product are widely available and cost competitive. They are not made with the intentional addition of fluorine compounds or any of the PFAS family of forty-one (41) + compounds.

Claims that fHDPE is the only 100% recyclable closed loop does not consider these other barriers, most of which are equally recyclable. Polyamide (PA) based barriers carry recycle code 2 which makes them recyclable. Decades of success use and recycling have not indicated any problems for PA based barriers.

Finally, Hollywood's 2019 legal thriller titled ***Dark Waters***, regarding PFAS contamination of a West Virginia town's water supply by DuPont, has increased the public's awareness of the severity of these 'forever chemicals'. PFAS producers have been hit with over \$4 billion dollars in suits². PFAS compounds that are used in firefighting foams are the object of several lawsuits, the last of which was a single \$17.5 million award. While the utility of these compounds over the past decades is not being denied, the recent publicity of fHDPE pesticide containers and the potential for ill effects in human exposure makes it easy to agree with the EPA that alternatives need to be investigated with due diligence and due speed. Neither the EPA nor private industry nor public and private agencies have fully investigated fluorinated HDPE packaging, utilized for over forty years, as a source of environmental contamination and human exposure. As the recent petition filed by Earth Justice

https://earthjustice.org/sites/default/files/files/pfas_pmnm_exemptions_petition_04-27-2021.pdf

argues, no amount of small exposure to PFAS compounds are acceptable and that it is time that these toxic 'forever chemicals' are no longer tolerated to exist either directly or as a byproduct. For these PFAS compounds not only pose a threat to the present, they also pose a threat 'forever.'



Selected PFAS References. Contact Barrier Plastics for additional information or references:

<https://www.seas.harvard.edu/news/2021/03/uncovering-hidden-forever-chemicals>

<https://www.bostonglobe.com/2021/03/09/metro/advocates-urge-ri-regulate-forever-chemicals-drinking-water/>

<https://www.ewg.org/release/ewg-applauds-senate-confirmation-michael-regan-epa-administrator>

<https://www.sinema.senate.gov/sinema-highlights-impact-arizona-veterans-toxic-exposure-during-senate-hearing>

[EPA Releases Testing Data Showing PFAS Contamination from Fluorinated Containers | U.S. EPA News Releases | US EPA](#)

<https://www.eenews.net/stories/1063726787>

[DuPont and spinoffs reach \\$4bn settlement to resolve PFAS liability issues | Business | Chemistry World](#)

[Solvay withheld PFAS toxicity data, group claims \(acs.org\)](#)

<https://www.epa.gov/newsreleases/epa-releases-testing-data-showing-pfas-contamination-fluorinated-containers>

https://public-inspection.federalregister.gov/2021-04184.pdf?utm_campaign=pi+subscription+mailing+list&utm_source=federalregister.gov&utm_medium=email [public-inspection.federalregister.gov]

[Guardian Legal Network | Firefighting Foam Lawsuit \(getguardianlegal.com\)](#)

[Firefighting Foam Cancer Lawsuit - Consumer Safety Watch](#)

[\\$17.5 Million Settlement in 1st Firefighting Foam Lawsuit \(dailyhornet.com\)](#)

[Changes in Reporting Requirements for Per and Polyfluoroalkyl Substances, Community Right-to-Know Toxic Chemical Release Reporting. EPA/OCSPP RIN:2070-AK97, Fall 2021.](#)

<https://www.epa.gov/toxics-releases-inventory-tri-program>

[Perfluorinated Carboxylic Acids in Directly Fluorinated High-Density Polyethylene Material, Rand, Amy A. and Mabury, Scott A. \(2011\) Environmental Science and Technology, 46-8053-8059](#)

[United States Environmental Protection Agency, Memorandum dated March 04, 2021: EPA's Analytical Chemistry Branch PFAS Testing., Rinses from Selected Fluorinated and Non-Fluorinated HDPE Containers](#)

[EPA PFAS Action Sees Much Broader Scope than in the Past. The National Law Review, John Gardella. August 4, 2021, vol XI, No. 216](#)

<https://beyondpesticides.org/dailynewsblog/2022/02/pfas-adds-to-the-legacy-of-persistent-toxics-hurting-generations-of-people-and-the-environment/>

² <https://www.usnews.com/news/us/articles/2021-01-23/dupont-chemours-reach-agreement-over-forever-chemicals>