Inhance Technologies EPA Discussion

August 5, 2021

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Proposed Agenda

- Inhance Technologies Overview
- Technology & Process Overview
- Fluorination Barrier Packaging Benefits
- Data Examination and Quantification
- Anvil 10+10 Screening Assessment
- Potential Mechanisms for Formation
- Inhance Technologies Internal Efforts to Date
- Summary and Discussion

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Overview

Inhance Technologies

We are a provider of polymer material science solutions.

For more than 40 years, we have been developing innovative technologies and solutions that drive global change and reduce environmental impact.

Inhance Technologies

Barrier Packaging

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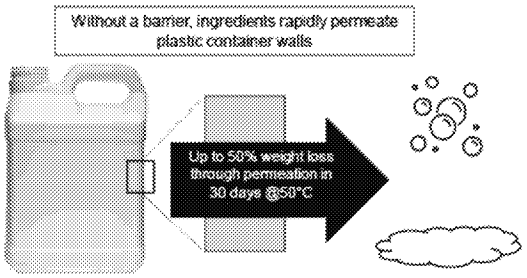
The Need for Barrier Packaging

- Barrier packaging is a necessity for many applications
- Many products cannot be packaged in conventional plastics, due to rapid permeation of numerous classes of ingredients through container walls:
  - Hazardous chemistries
  - Solvents
  - Adjuvants
  - Organic ingredients
  - Active ingredients
- Barrier packaging prevents ingredient permeation:
  - Protecting the environment and public health
  - Maintains product efficacy and ensures regulatory compliance



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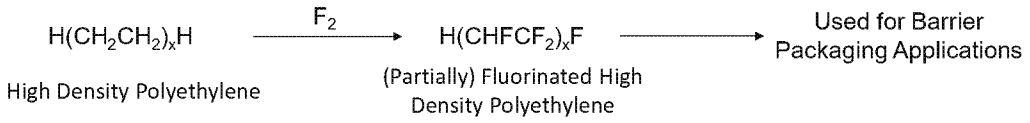
Inhance's Barrier Technology



- Inhance does not produce blow molded packaging articles, but is a service provider to impart barrier properties to ordinary plastic packaging
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- Only the surface of the plastic article is modified, and it is not detachable
- No PFAS utilized in any of our processes

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Fluorinated Barrier Packaging Benefits

- Non-barrier packaging is not suitable for <u>many</u> products due to issues with ingredient permeation
- In the production of fluorinated barrier packaging:
  - No PFAS is used
  - No greenhouse gas emissions are generated
  - No water waste is generated
- Fluorinated barrier packaging:
  - Prevents environmental pollution
  - Safeguards human health
  - Ensures regulatory compliance and safety
  - Maintains product efficacy and quality, extends shelf-life
  - Maintains package integrity (e.g., prevents paneling/bottle collapse, improves label security)

Fluorinated Barrier Packaging Prevents Pollution

Globally, ~100 million gallons of packaging volume is produced using fluorinated barrier packaging

- For volatile solvent formulations (such as toluene or xylene), fluorinated barrier packaging permeation is <0.1% vs. 50%+ with traditional HDPE
  - ✓ Over 200,000 metric tons of ingredient release prevented due to packaging permeation, annually
- For less volatile solvent formulations (such as Aromatic 100 or Mineral spirits), fluorinated barrier packaging permeation is <0.01% vs. 6%+ with traditional HDPE
  - ✓ Over 25,000 metric tons of ingredient release prevented due to packaging permeation, annually

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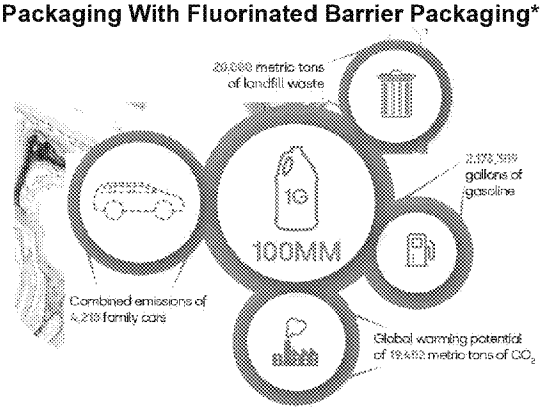
Fluorinated Barrier Packaging is the Most Sustainable Barrier Packaging Choice

- Fluorinated barrier packaging has the lowest lifecycle impacts compared to alternative barrier packaging technologies
- Compared to multilayer/co-extruded barrier packaging, fluorinated barrier packaging offers significant benefits:
  - 100% fully recyclable – unlike multilayer plastics
  - 27% less Global Warming Potential ("GWP")
  - 22% less fossil fuel consumption
  - 54% less ozone depletion
- Compared to metal, plastic packaging uses at least 60% less GHG and 40% less water

Offsets by Replacing 100 Million Multilayer Packaging With Fluorinated Barrier Packaging*



*Calculated using EPA guidelines

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Fluorinated Barrier Packaging is a Critical Technology for the Supply Chain

- Prevents significant environmental pollution
- Safeguards human health
- Diverts plastic packaging from landfills or incineration, supporting the Circular Economy (100% fully recyclable)
- Inhance's fluorinated barrier packaging is certified and recognized as fully recyclable by:
  - Association of Plastics Recyclers (APR HDPE-CG-01 Critical Guidance)
  - Plastics Recyclers Europe (Design for Recycling Guidelines)
  - Croplife/ACRC
  - Cleanfarms Canada
  - DrumMuster Australia
  - Campo Limpo Brazil
  - Campo Limpio Mexico
  - Ellen MacArthur Foundation

The Association of Plastic Recyclers

RecyClass

cleanfarms drummuster

inpEV

Global Commitment

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EPA Data Examination and Quantification

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The Cumulative PFAS in All Fluorinated Barrier Packaging is Extremely Small

- Inhance assessed potential PFAS in fluorinated barrier packaging using EPA data
- Assumptions:
  - 50–60 million gallons of fluorinated barrier packaging volume in US
  - Packaged in 1-gallon containers
  - 1–5 ng (ppb) PFAS/g of polymer
- Annual total potential PFAS in fluorinated barrier packaging is 7–45 gms (cf. annual PFAS (<C20) production – 47,500 Metric Tons)
- Compliant with REACH Annex XVII to Regulation (EC) No 1907/2006 – 25 ppb of PFOA including its salts or 1,000 ppb of one or a combination of PFOA-related substances

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PFAS in Fluorinated Packaging

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Sources of PFAS Detected in Fluorinated Barrier Packaging

- Potential sources:
  - PFAS added to HDPE resin
  - Fluorination of HDPE components – stabilizers, antioxidants, processing aids, etc.
  - Fluorination of hydrocarbon waxes potentially generated during blow molding container production
- Not understood to be a source:
  - Degradation of polyethylene during fluorination process
  - Degradation of the fluorinated barrier packaging

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Anvil 10+10 Assessment

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Many of the PFAS in Anvil 10+10 are Not Attributable to Fluorinated Barrier Packaging

- 13 PFAS species were 'detected' by EPA, Mass DEP and PEER in product Anvil 10+10
- Some PFAS species found only in product Anvil 10+10
- PEER has reported PFAS detected in products stored in non-fluorinated packaging (metal and non-fluorinated HDPE)
  - FMC Talstar P → non-fluorinated packaging – 23.6 ppb
  - Permanone 30 30 → metal packaging – 4.13 ppb
- Clearly, fluorinated barrier packaging is not the sole source of PFAS in pesticides

Summary of PEER, Mass DEP and EPA Published Data

Compound Detected in Anvil 10+10	Abbreviation	Max Concentration in Anvil MADEP (ng/L or ppt)	EPA detected in fluorinated packaging	EPA detected in nonfluorinated packaging
Perfluorooctanesulfonic Acid	PFOS	141		
6:2 Fluorotelomer sulfonic acid	6:2 FTS	31.6 (J)		
HFPODA	GenX	50 (ND)		
Perfluorohexanesulfonic Acid	PFHxS	59.2 (J)		
Perfluoroheptanesulfonic Acid	PFHpS	138		
Perfluoroundecanoic Acid	PFUdA/PFUnA	184	X	
Perfluorodecanoic Acid	PFDA	50 (ND)	X	
Perfluorononanoic Acid	PFNA	50 (ND)	X	
Perfluorooctanoic Acid	PFOA	25.7 (J)	X	
Perfluoroheptanoic Acid	PFHpA	53.4 (J)	X	X
Perfluorohexanoic Acid	PFHxA	132	X	X
Perfluorobutanoic Acid	PFBA	716	X	X
Perfluoropentanoic Acid	PFPeA	296	X	X

ND = non-detect; J = detected above detection limit, but less than quantification limit

Highest detection limit (50 ng/L) assumed for compounds not analyzed by MADEP, but detected in PEER or EPA rinsate data

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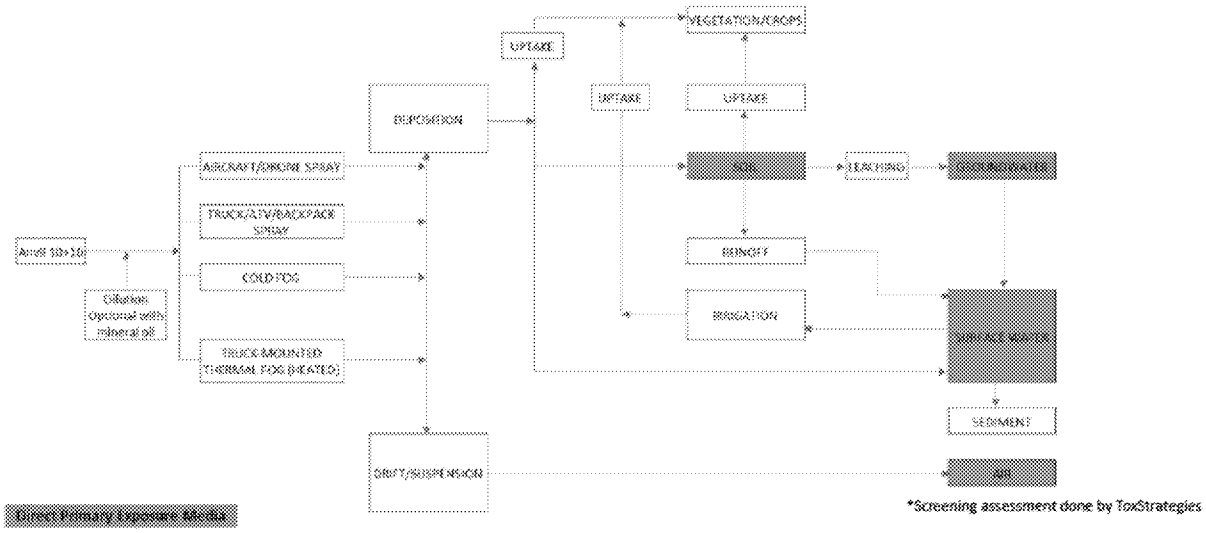
Anvil 10+10 Conceptual Exposure Model*



*Screening assessment done by ToxStrategies

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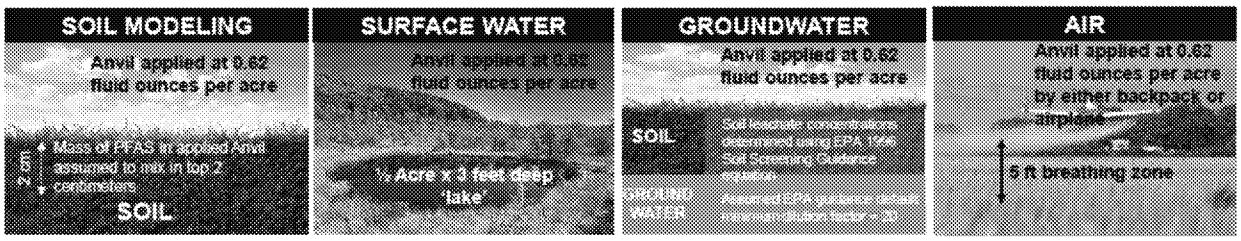
Anvil 10+10 Screening Assessment Approach

- A screening assessment was carried out on the 13 PFAS species 'detected' in product Anvil 10+10
- Exposure-Point Concentration (EPC) modeling under conditions of use for:
  - Soil
  - Groundwater
  - Surface water and
  - Air



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"Worst-case" Assumptions Used for Modeling

- Highest concentration or maximum detection limit used
- No loss from soil erosion, runoff, leaching, abiotic or biotic degradation, pick up by vegetation or volatilization, or between multiple applications
- No loss based on environmental conditions
- No degradation of PFAS over time (accumulative)
- All PFAS deposited on soil would leach into groundwater
- Most conservative (lowest) "safe" screening values used

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Screening Assessment Modeling Results

- Depending on PFAS species, millions/billions of years to reach established screening values in all media
- For example, to reach established screening values:
  - Millions to billions of applications to soil required at the maximum 28 applications per year
  - Over 300,000 years (84 million applications) to exceed surface or drinking water criteria, when product used as directed
  - Over 45 million applications (1.6 million years) required to exceed air health-based criteria for breathing zone exposures
- One application results in concentrations 6-12 orders of magnitude lower than background PFAS across all media
- Therefore, Anvil 10+10 when packaged in fluorinated barrier packaging and used as directed is:
  - Not a significant contributor to PFAS levels across all media
  - Not a significant source of PFAS to the environment

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Anvil 10+10 in Fluorinated Barrier Packaging is Not a Significant Source of PFAS

- Concentrations of PFAS reported in rinsates or in Anvil 10+ 10 do not equate to environmental levels in various media or to potential "dose" to humans. Transport and fate must be factored in
- "Worst Case Assumptions" significantly overstate expected environmental concentrations. Actual additions to environmental background levels of PFAS will be significantly smaller
- Therefore, under actual conditions of use, PFAS levels attributable to Anvil 10+10 in fluorinated packaging will be insignificant, and likely unmeasurable
- Mark Smith from Massachusetts DEP stated: **"I've done some worst-case calculations to determine what levels might land in a drinking water reservoir, and the results wouldn't be measurable"**

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Total PFAS Contribution from All Fluorinated Barrier Packaging Used for Agrochemicals is Infinitesimal

- Extension of risk assessment methodology to all agrochemical products packaged in fluorinated barrier packaging reveals miniscule PFAS contr bution to the environment

US Acres of arable land (USDA Link)	Total PFAS from fluorinated barrier packaging in soil (ng/g soil, ppb) per year	Total PFAS from fluorinated barrier packaging compared to background* PFAS in soil (ng/g soil, ppb) per year
311 Million	0.000008 (0.008 ppt)	0 000128%
150 Million	0 00002 (0.02 ppt)	0 000256%

- Assumptions
  - 100% of PFAS in packaging transfers to liquid
  - No dissipation or degradation of PFAS
  - 20 applications/year
  - Agrochemical used at 50% dilution
  - 1 acre foot of soil weighs 2000 tons (USDA Link)
  - 47MM gallons of fluorinated barrier packaging for agrochemicals that require barrier packaging

*Dalahmeh S, Tirgani S, Komakech AJ, Niwagaba CB, Ahrens L. 2018. Per- and polyfluoroalkyl substances (PFASs) in water, soil and plants in wetlands and agricultural areas in Kampala, Uganda. Sci Total Environ. 631-632 660-667. doi: 10.1016/j.scitotenv.2018.03.024. Epub 2018 Mar 16. PMID: 2953959

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Summary

Summary

- Barrier packaging is required for many products for product performance and pollution prevention
- Fluorinated barrier packaging provides a variety of very significant environmental benefits
- [redacted]
- If ALL PFAS from fluorinated barrier packaged agrochemicals migrated into the product, the amount of PFAS released into the soil would be infinitesimal
- Inhance wants to proactively work with the EPA to further demonstrate the appropriateness of fluorinated barrier packaging

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Thank you for your time