The Chemical Class Concept Catching On: Healthier Products, People, Planet

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Research Associate in Chemistry, UC Berkeley

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For a Circular Economy, Avoid Hazardous Substances

Products with toxics should be land filled or destroyed.
Regrettable Substitution

Decabromodiphenyl ether
Concerns:
• Persistence
• Bioaccumulation
• Toxicity

Decabromodiphenyl ethane
Concerns:
• Persistence
• Bioaccumulation
• Toxicity
EVALUATING TENS OF THOUSANDS OF INDIVIDUAL CHEMICALS IS UNWORKABLE
BUT ADDRESSING SIX GROUPS OF CHEMICALS OF CONCERN IS MANAGEABLE
Six Classes Videos
An innovative approach to reducing toxics

1. Highly Fluorinated
2. Antimicrobials
3. Flame Retardants
4. Bisphenols + Phthalates
5. Some Solvents
6. Certain Metals

VIEW and SHARE: www.SixClasses.org
Healthier products, healthier people in four minutes!
Is it necessary?

Is it worth it?

Is there a safer alternative?
PFAS
(Per- and polyfluoroalkyl substances)

Carbon-Fluorine bond strength:
• Leads to oil and water repellency
• “Forever chemicals” -- last for geologic time!

PFOA (C8)
PFOS (C8)

Courtesy: Dr. Jennifer Field
Ohio River Valley: West Virginia Manufacturing Plant

- PFOA used to manufacture Teflon
- Releases to water & air
- 70,000+ residents with contaminated drinking water
- C8 Health Study
Dark Waters

- The film story of attorney Rob Bilott, who became “DuPont’s Worst Nightmare” after uncovering massive PFOA contamination from a DuPont factory
PFAS exposure is a health concern

Exposure linked to health risks:
- Cancer
- Elevated cholesterol
- Obesity
- Immune suppression
- Endocrine disruption

(Ref: Lewis et al., 2015; Grandjean et al., 2012; Braun et al., 2016; Barry et al., 2013)

Courtesy, Cindy Hu, Harvard University
“Regrettable” Substitution?

Long chain:
- Extreme persistence
- Bioaccumulation
- Toxicity

Short chain:
- Extreme persistence
- Build-up in plants
- Suspected toxicity
- More mobile
- Clean up more difficult
- Harder to measure & monitor
AGC – THE FIRST COMPANY TO FULLY CONVERT TO PFOA-FREE* WATER AND OIL REPELLENT

AsahiGuard® E Series is a fluorinated water and oil repellent providing sustainable alternatives for many applications, including paper packaging, textiles, apparel, non-wovens, natural and synthetic leathers and home furnishings based on proven AGC C6 chemistry. AsahiGuard E-Series offers high performance

- “C6 polymers are proven safe for their intended use”
- “Evaluated by regulators, showing they are safe and effective”
- “C6 polymers cannot break down to C8”

https://www.agcce.com/asahiguard-e-series/
May 2015  The Madrid Statement on Highly Fluorinated Chemicals

“We call on the international community to cooperate in limiting the production and use of PFASs and in developing safer non-fluorinated alternatives.”

Signed by 230 scientists from 40 countries

2015: Environmental Health Perspectives
EPA Lifetime Health Advisory Level of 70 ng/L PFOA + PFOS

Hydrological units with detectable PFASs

Drinking Water Health Guidelines
(parts per trillion)

- **DuPont**
  - PFOA: 5000
  - 1987

- **DuPont**
  - PFOA: 1000
  - 1991

- **U.S. EPA**
  - PFOA: 400
  - PFOS: 200
  - 2009

- **U.S. EPA**
  - PFOA: 70
  - PFOS: 70

- **New Jersey**
  - PFOA: 14
  - PFOS: 70
  - May 2016

- **New York**
  - PFOA: 10
  - PFOS: 10
  - Nov. 2017
  - Dec. 2018
Polymer Problems

1. Polymer production (Teflon, Gortex etc.) is a major source of air & water contamination.

2. Side chain polymers can break off and cause harm.
PFAS Polymers Breakdown

Abiotic Hydrolysis of Fluorotelomer-Based Polymers as a Source of Perfluorocarboxylates at the Global Scale

John W. Washington* † and Thomas M. Jenkins‡

†USEPA, National Exposure Research Laboratory, 960 College Station Road, Athens, Georgia 30605-2700, United States
‡USEPA, Senior Environmental Employment Program, Athens, Georgia 30605-2700, United States

Supporting Information

Fluoropolymer breakdown leads to PFAS in the environment.
Michigan

- Wolverine treated leather with Scotchguard (PFOS)
  - Leather scrap dumped
  - Sludge applied to fields

- PFOA + PFOS level up to 58,000 ppt
  842 times EPA health advisory level!
New Mexico

- Cannon Air Force Base
  - Firefighting foam entered groundwater
  - PFAS migrated from base to dairy wells to cows to milk
  - Farmer: “I can’t sell the milk. I can’t sell beef. I can’t sell the cows. I can’t sell crops on my property.”

- PFOS level up to 12,000 ppt
  171 times EPA health advisory level!
Maine

- Paper mill sludge led to contamination of
  - Local municipal supply well
  - Milk at dairy

- Maine DEP:
  - All biosolids must now be tested for PFAS prior to use
  - Initial testing: nearly all biosolids exceed state screening levels for PFOS and/or PFOA (5.2 and 2.5 ng/g)

See also: Venkatesan and Halden, J. Hazard Mater., 2013

https://theintercept.com/2019/06/07/pfas-chemicals-maine-sludge/
Airway Heights, Washington

Contamination Levels:\(^1\):  
• Near Fairchild Air Force Base: up to 5,700 ppt  
• Levels up to 80x greater than the EPA’s Health Advisory Level  
• Current access to Spokane water  
• Some residents being studied for levels of PFAS in their blood and urine beginning October 2019  
• Needs a long term plan for clean drinking water

Distribution of bottled water to residents May 2017.
Water Treatment Costs: North Carolina

Brunswick County: reverse osmosis filtration for 25,000 customers:
- $99M to build
- $2.9M to operate

Cape Fear Public Utility Authority activated carbon filtration plant:
- $46M to build
- $2.7M to operate each year

Wilmington Star News, May 9th and 10th, 2018
PFAS are Problematic & Difficult to Clean Up

Prevention is Preferable!
Recommendation:

Only use PFAS in products when essential.
From Surfer Shorts to Surgical Drapes:  
The concept of essential use
Ian Cousins, Gretta Goldenman, et al., June 17, 2019

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th>PFAS examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Uses that are not essential for health and safety, and the functioning of society. The use of substances is driven by market opportunity.</td>
<td>Dental floss, water repellent surfer shorts, ski waxes</td>
</tr>
<tr>
<td>2</td>
<td>Uses regarded as essential by society because they perform important functions, but where alternatives have now been developed that have equivalent functionality.</td>
<td>Most uses of AFFFs, certain water-resistant textiles</td>
</tr>
<tr>
<td>3</td>
<td>Uses considered essential for health or safety or for important purposes and for which alternatives are not yet established. There should be a constant search for alternatives to move these uses into Category 2</td>
<td>Certain medical devices, occupational protective clothing</td>
</tr>
</tbody>
</table>
2020 National Defense Authorization Act

- Require military to phase PFAS out of firefighting foams
- USGS nationwide water sampling
- Require reporting from PFAS manufacturers
- Authorize Air Force to compensate for contaminated agricultural lands
- Prohibit fluorinated packaging in meals ready to eat
- Continue funding health studies in impacted communities
NDAA – What’s not there?

- EPA regulation of:
  - Drinking water under Safe Drinking Water Act
  - Water emissions under Clean Water Act
  - Contaminated sites under CERCLA (hazardous substances designation)
RCRA Petition for PFAS regulation

Filed on 1/15/20 by UC Berkeley Law on behalf of:

Benefits:
1. Ensure safe management of PFAS wastes
2. Automatic CERCLA listing to speed site clean-ups
Europe to adopt total PFAS drinking water standard

• 2020: group standard for 20 PFAS

• Next 3 years: develop analytical method for total fluorine

• Testing to begin in 2021-2022
PFAS Phase-out Gaining Traction in Europe

• Proposal from Sweden, Netherlands, Germany, Denmark:

• Take action “on the EU-level to phase out PFASs at the latest by 2025, to be in effect by 2030.”

• “A broad restriction under REACH covering all PFAS would be the preferred option.”
Moving away from PFAS in food packaging

Jan. 10, 2020: Taco Bell phasing out PFAS

Denmark bans all PFAS in paper and paperboard food packaging

- “I do not want to accept the risk of harmful [PFAS] migrating from the packaging and into our food. These substances represent such a health problem that we can no longer wait for the EU.”

- Danish Food Minister Mogens Jensen

PFAS and Carpet

- PFAS-treated carpet linked to high PFAS blood levels
Moving away from PFAS in carpet

• Major manufacturers phasing out PFAS
  • 2014 – Interface
  • 2017 – Tarkett
  • 2019 – Engineered Floors
  • 2019 – Shaw

Home Depot plans to phase out selling rugs and carpets containing PFAS

By VIRGINIA GORDAN • SEP 17, 2019

The Home Depot announced Tuesday that it will stop buying from its suppliers any rugs and carpets that contain PFAS chemicals.

"Excluding PFAS from the carpets and rugs we sell is another example of our shared commitment to building a better future for our customers and the planet,"

Ron Jarvis, The Home Depot’s vice president for environmental innovation, said in a written statement.

Michigan Radio, Sept. 17, 2019
BRANDS ARE ELIMINATING HIGHLY FLUORINATED CHEMICALS

IKEA  H&M  Crate&Barrel  LEVI STRAUSS & CO.

PUMA  benetton  ESPRIT  adidas

MARKS & SPENCER  MANGO  BURBERRY  ZARA
San Francisco City Carpet Regulation

(courtesy Jen Jackson)

NO
PFAS
Flame Retardants
Antimicrobials
(among other sustainability provisions)
Moving away from PFAS
PFAS Central: sharing notable news, scientific papers & events

NEWS
PFAS Chemicals to be Banned in Firefighting Foam Used on Military Bases
U.S. Senator Kirsten Gillibrand today announced that a provision she cosponsored to prohibit the Department of Defense from procuring firefighting foam that contains per- and polyfluoroalkyl substances (PFAS) passed the Senate Armed Services Committee as part of the annual National Defense Authorization Act (NDAA).
LEARN MORE

SCIENCE
Larval amphibians rapidly bioaccumulate poly- and perfluoroalkyl substances.
Toxic frogs lead to bioaccumulation in predator species.
LEARN MORE

POLICY
The Cost of Inaction: A socioeconomic analysis of environmental and health impacts linked to exposure to PFAS
A recent Nordic Council study, The Cost of Inaction: A socioeconomic analysis of environmental and health impacts linked to exposure to PFAS, estimates the very high cost of harm to human health and the environment from PFAS exposure in Europe.
LEARN MORE

Although useful, PFAS or highly fluorinated chemicals are associated with serious health harm and can remain in the environment forever.
LEARN MORE
Class 3 Flame retardants

Updating 1970s Flammability Standards

• Children’s sleepwear -- 1976
• Furniture and baby product foam -- 2014
• Foam building insulation
• Electronics cases

GREEN SCIENCE POLICY INSTITUTE
GreenSciencePolicy.org
Flammability Standards Drive FR Use:

Technical Bulletin 117

Furniture foam to withstand a small open flame for 12 seconds

- Smolder vs. open flame fires—6:1 death ratio
- Slow response in ionizing smoke detectors

ASTM E84

All insulation must pass Steiner tunnel test

- Behind thermal barrier?
- Beneath a concrete foundation?
Furniture foam flame retardant (PentaBDE) associations with human health problems

Increased time to pregnancy
Altered thyroid hormone
Thyroid disease in women

Impaired attention
Poorer coordination
Lower IQ
Developmental toxicity
Baby boys’ genital problems
Lower birth weight
Delayed puberty in girls
Earlier puberty in boys

Main et al. 2007; Goodyer et al. 2017;
From Products to People
TB117 Fire Safety Benefit?

TB117 foam ~ Non - TB117 foam

“No significant, consistent difference...”

Babrauskas et al. 2011; Talley 1995; Mehta (CPSC) 2012
Increased fire safety without flame retardants
A DEADLY MISTAKE

Help stop the bill that will ban material used to make flame resistant products.
CALL YOUR STATE SENATOR TODAY AND TELL THEM TO VOTE NO ON AB 706

Call State Senator Tom Torlakson at 916-651-4007 and tell him to VOTE NO on AB 706.

DON’T LET THE SACRAMENTO POLITICIANS BAN THE USE OF PROVEN FLAME RETARDANTS — IT COULD BE A DEADLY MISTAKE

Paid for by Californians for Fire Safety:

- Albemarle
- Chemtura
- Israel Chemicals LTD (ICL)

GREEN SCIENCE POLICY INSTITUTE
GreenSciencePolicy.org
Playing with fire

A deceptive campaign by industry brought toxic flame retardants into our homes and into our bodies. And the chemicals don't even work as promised.

By Patricia Callahan and Sam Roe
Tribune reporters

D ean David Heinbach knew how to tell a story. Before California lawmakers last year, the noted burn surgeon drew gasps from the crowd as he described a 3-week-old baby girl who was burned in a fire started by a candle while she lay on a pillow that lacked flame retardant chemicals.

"Now this is a tiny little person, no bigger than my Italian greyhound at home," said Heinbach, gesturing to approximate the baby's size. "Half of her body was severely burned. She ultimately died after about three weeks of pain and misery in the hospital."

Heinbach's testimony for the baby's death made the long-term health concerns about flame retardants voiced by doctors, environmentalists and even firefighters sound abstract and petty.

But there was a problem with his testimony: It wasn't true. Records show there was no dangerous pillow or candle fire. The baby he described didn't exist.

Neither did the 9-week-old patient who Heinbach told California legislators died in a candle fire in 2006. Nor did the 6-week-old patient who he told Alaska lawmakers was fatally burned in her crib in 2006. Heinbach is not just a prominent burn doctor. He is a star witness for the manufacturers of flame retardants.

His testimony, the Tribune found, is part of a decades-long campaign of deception that has clouded the furniture and electronics industry with pounds of toxic chemicals linked to cancer, neurological deficits, developmental problems and impaired fertility.

The tactics started with Big Tobacco, which wanted to shift focus away from cigarettes as the cause of fire deaths, and continued as chemical companies worked to preserve a lucrative market for their products, according to a Tribune review of thousands of government, scientific and internal industry records.

The chemical industry stoked the public's fear of fire and helped organize and steer an association of top fire officials that spent more than a decade campaigning for their cause.

Today, scientists know that some flame retardants escape from household products and settle in dust. That's why the toxics, who play on the floor and put things in their mouths, generally have far higher levels of these chemicals in their bodies than their parents.

Blood levels of certain widely used flame retardants doubled in adults every two to five years between 1970 and 2004. More recent studies show levels haven't declined in the U.S. even though some of the chemicals have been pulled from the market. A typical American baby is born with the highest recorded concentrations of flame retardants among infants in the world.

People might be willing to accept the health risks if the chemicals even worked, but they don't. And the industry knows it.
California TB117-2013
California Bans Flame Retardants in furniture, children’s products & mattress foam
Signed September 30, 2018

“Toxic flame retardant chemicals have put consumers, children, and firefighters at risk for decades. Today we say no more.”

-AB 2998, Sponsor: Assemblyman Bloom
PETITION: U.S. Consumer Product Safety Commission

Products with the class of Organohalogen Flame Retardants

Declare as “banned hazardous substances”:

• Children’s products
• Residential furniture
• Mattresses & mattress pads
• Plastic electronics enclosures

containing additive, non-polymeric organohalogen FRs

GRANTED --2017
PETITION: U.S. Consumer Product Safety Commission

UPDATE: May 15, 2019

• National Academy of Science advisory Committee to Develop Scoping Plan Report

• OFRs can be divided into 14 subclasses subclasses for hazard assessment

“Although the challenges to a class approach might appear daunting, the alternative—individual assessments of hundreds of chemicals—is unrealistic. The only possible practical approach for a set of chemicals as large as the OFRs is a class approach.”
EU Ban on Flame Retardants in Electronics Cases

Ecodesign directive bans the class of organohalogen flame retardants

- In cases and stands of electronic displays and TVs
- Unanimously approved by 24 member states
- Effective March 2020
- Motivation: plastic recycling in the Circular Economy

4. Halogenated flame retardants

The use of halogenated flame retardants is not allowed in the enclosure and stand of electronic displays.

Brussels, XXX
D059740/02
[...](2019) XXX draft
California Hall of Fame

Six Classes Videos

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4. Bisphenols + Phthalates
5. Some Solvents
6. Certain Metals

www.SixClasses.org
For monthly e-newsletters, give Arlene your card or sign our mailing list.

This talk will be under Past Events at www.GreenSciencePolicy.org.
By limiting use of the Six Classes

We can have a healthier world.

For more information: Greensciencepolicy.org