Flame Retardants, PFAS and Firefighters

Graham Peaslee
University of Notre Dame

February 8, 2020
Plus ça change, plus la mème chose...

- 9 years ago...
- Flame retardants...
- Do something...
PIXE For Flame Retardant Detection

flame retardants: by detecting Br, Cl
FOR IMMEDIATE RELEASE:
Monday, June 18, 2012

Governor Brown Directs State Agencies to Revise Flammability Standards
What makes PFAS so good?

These compounds are used everywhere:

<table>
<thead>
<tr>
<th>Bond</th>
<th>Energy (kJ/mol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H—H</td>
<td>432</td>
</tr>
<tr>
<td>H—F</td>
<td>565</td>
</tr>
<tr>
<td>H—Cl</td>
<td>427</td>
</tr>
<tr>
<td>H—Br</td>
<td>363</td>
</tr>
<tr>
<td>H—I</td>
<td>295</td>
</tr>
<tr>
<td>C—H</td>
<td>413</td>
</tr>
<tr>
<td>C—C</td>
<td>347</td>
</tr>
<tr>
<td>C—Si</td>
<td>301</td>
</tr>
<tr>
<td>C—N</td>
<td>305</td>
</tr>
<tr>
<td>C—O</td>
<td>358</td>
</tr>
<tr>
<td>C—P</td>
<td>264</td>
</tr>
<tr>
<td>C—S</td>
<td>259</td>
</tr>
<tr>
<td>C—F</td>
<td>453</td>
</tr>
<tr>
<td>C—Cl</td>
<td>339</td>
</tr>
<tr>
<td>C—Br</td>
<td>276</td>
</tr>
<tr>
<td>C—I</td>
<td>216</td>
</tr>
</tbody>
</table>
The carbon-fluorine bond is very hard to break—these compounds have environmental lifetimes \( \approx 100 \)'s of years or more!

Many have no known biotic or abiotic degradation pathways....

**ENVIRONMENTAL PERSISTENCE**

The “forever chemicals” ...
These are only the US sites to date...

https://www.ewg.org/interactive-maps/2019_pfas_contamination/map/
PFAS and Firefighters

AFFF – Class B Foams

Foam Agent at Work

- Oxygen
- Aqueous Film or Polymeric Membrane
- Foam Blanket
- Fuel
DoD extensive use...
A U.S. Air Force airman blows firefighting foam that was unintentionally released in an aircraft hangar at Travis Air Force Base, Calif., in 2013. Toxic chemicals in the foam have contaminated private wells in Box Elder and municipal wells in Sioux Falls.
DoD extensive use...
PFAS Exposure sources:
Active fire event
Decon post event
Aerosolized foam & combustion products
Drinking water contamination***
Are there other PFAS exposure sources?
PIGE Analysis of Fluorine

Fig. 3: PFAS-coated paper sample compared with uncoated paper. Irradiation time of 180 second with 9 nA of 3.4 MeV protons.

---

Graph showing gamma ray counts per second and energy levels.
1. Are PFAS in all gear?
2. Do PFAS come off?
3. Do PFAS get into FF?
The First Sustainable DWR Finish for PPE Fabrics

Safety Components, a division of Elevate Textiles, enjoys a long history of developing fabric technologies that move the industry forward. With patented, high performance flame resistant outer shell fabrics like PBI Max™ and Armor AP™, thermal liners like Glide Ice™ and Prism™, and wildland/tech rescue fabrics like Sigma — more large metro cites specify and wear materials made by Safety Components than any other.
Partner with medical cyclotron manufacturer:
- Use GENTrace cyclotron (100,000 samples/yr)
  Run 3 L of water through GAC felt filter
  (minutes in field)
  Dry filters  (hours)
  Send filters for PIGE analysis
  (1-2 minutes per sample)
  Identify all sum of all PFAS present

Screening method: **No F, no PFAS....**
Acknowledgements

John Wilkinson, Sean McGuinness, Meghanne Tighe, Ashabari Majumdar, Nick Caterisano, Matt Roddy, Alec Gonzales, Seryoeng Lee, Chase Miller