

# Industry Perspective on Alternatives to Long- Chain PFCs

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# Summary

- The short chain fluorinated alternatives
  - Are effective and efficacious
  - Have received approvals by regulatory agencies
  - Display improved environmental and biological profiles
- Many – but NOT all – downstream users have embraced the short-chain alternatives
- Beyond the OECD countries, however, transition from long chain PFAS products has been very slow
- Products, raw materials and potential degradation products have been well studied following OECD guidelines and GLP
- Much data are available in peer-reviewed scientific literature
- Non-fluorine containing alternatives and non-chemical alternatives fill market niches

# Transition Strategy

- Early: Reducing emissions and product content
- Replacing long chain PFAS products with alternatives:
  - Polymerization aids (direct substitution)
  - Telomer-based products (addressing precursors)
- Now: Applying emissions and product content reduction technologies to the new short chain fluorinated alternatives

# Technology Aspect of Transition

- Replacing long chain PFAS technology has been a major challenge
  - Decade of research and substantial investments
  - Companies investigated a large universe of options
- For full adoption and use commercial products must:
  - Meet or approximate performance of the long chain technology
  - Provide acceptable value in use – relative to cost
  - Receive approval for safety by regulatory agencies
- Few options that meet these criteria exist
  - The industry has produced its best available alternatives
  - Few applications have found a suitable non-fluorinated alternative without reducing product benefits that can be offered to the public and customers
  - Health and safety data for non-fluorinated alternatives are not extensive

# Commercially Available Alternatives to Long-Chain PFAS

Three types of alternatives are available:

- Substances with shorter per- or polyfluorinated carbon chains\*
- Non-fluorine-containing substances
- Non-chemical techniques

\* “The [OECD/UNEP Global PFC] Group distinguishes between long-chain perfluorinated compounds (LC PFCs) and short-chain perfluorinated compounds (SC PFCs), based on the toxicity and bioaccumulation differences between LC PFCs and SC PFCs. (See “Box 1” of Synthesis Paper: [https://www.oecd.org/env/ehs/risk-management/PFC\\_FINAL-Web.pdf](https://www.oecd.org/env/ehs/risk-management/PFC_FINAL-Web.pdf))

# Substances with Shorter Per- or Polyfluorinated Carbon Chains

1. Short-chain (i.e., 6:2) fluorotelomer-based chemicals
2. Perfluorobutane sulfonyl fluoride (PBSF)-based derivatives
3. Mono- and polyfluorinated-ether-functionality compounds
4. Fluorinated oxetanes
5. Other fluorinated polymers

# Non-fluorine Containing Substances

- “Non-fluorinated chemistries, such as different hydrocarbon surfactants and silicone products, have been identified.... however,... in most cases or at least in larger application areas, other fluorinated compounds are used instead.... non-fluorinated alternatives do not work as well, especially in situations, where extreme low surface tension is needed.” (Danish EPA, 2006).

# Health and Environmental Profiles of Short Chain Fluorinated Alternatives

- A large body of study data for the short chain fluorinated alternatives exists
- “Alternatives to long-chain PFASs [primarily substances with shorter per- or polyfluorinated carbon chains] undergo regulatory review in some countries, where companies are required to submit specific information which may include information on the health and environmental profiles (such as bioaccumulation potential, (eco)toxicity, bio-degradability, etc.) of alternatives. For example, the U.S. Environmental Protection Agency (US EPA) has reviewed (and approved) over 150 alternatives.”

OECD(2013), OECD/UNEP Global PFC Group, Synthesis paper on per- and polyfluorinated chemicals (PFCs), Environment, Health and Safety, Environment Directorate, OECD.  
([https://www.oecd.org/env/ehs/risk-management/PFC\\_FINAL-Web.pdf](https://www.oecd.org/env/ehs/risk-management/PFC_FINAL-Web.pdf))



# Available Data on Short-chain PFAS

- Current Activity of OECD/UNEP Global PFC Group to make literature references available on the OECD web portal:  
<http://www.oecd.org/ehs/pfc/informationonshort-chainpfcsotheralternatives.htm>
- “Assessment of POP Criteria for Specific Short-Chain Perfluorinated Alky Substances”  
<http://chm.pops.int/TheConvention/POPsReviewCommittee/Meetings/POPRC9/POPRC9Followup/PFOSSubmission/tabid/3565/Default.aspx>
  - Data on raw materials
    - 6:2 Fluorotelomer Alcohol
    - 6:2 Fluorotelomer Acrylate
    - 6:2 Fluorotelomer Methacrylate
  - Data on key product class
    - Methacrylate Polymer
  - Data on potential degradation product/unintended byproduct
    - PFHxA

# Alternatives Should Be Properly Assessed

- **Information to include in assessment of ALL alternatives:**
  - Environmental and Health Data
    - For raw materials, impurities, products and potential degradation products
  - Technical Performance
    - Needs to meet or approximate performance of incumbent technology
  - Socio-economic Relevance
- **Benefits of C6/Short-chain Alternatives:**
  - Well studied
  - Meet performance requirements
  - Enable production of products relied on by modern society
  - Production of downstream end users of fluorochemistry represents a \$1.2 trillion global market and 625,000 jobs in the EU and U.S.\*

# Thank You!



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