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ADELAIDE 2019

PFAS - FOREVER CHEMICAL GLOBAL RISK AND RESPONSE

8-12 September 2019

- **What we know so far of PFAS**
 - Environmental and human health impact
 - Current PFAS removal and treatment technology and methodology
 - Policy and regulation from a global perspective – Australia, US, EU, Stockholm Convention PoPs, Singapore, Malaysia etc
- **What we don't know**
- **What else we need to know and do**

What we know so far of PFAS

1. PFOS PFOA ubiquitous in the environment and humans at various values
2. Persistent in the environment
 - PFOS $\frac{1}{2}$ life - water > 41 years (ATSDR 2009), humans range 2.4 to 21.7 years (Olsen et al. 2007)
 - PFOA $\frac{1}{2}$ life - water 92 years (Vierke1 et al 2012), human range 2.3 –3.8 years (Olsen et al., 2007; Bartell et al., 2010; Brede et al., 2010)
3. Main toxicological pathway is ingestion and inhalation
4. PFOA and PFOS bioaccumulate in serum, cross the placenta, and are excreted into breastmilk and others
5. PFOS and PFOA do not metabolise, oxidize, photooxidise, reduce or undergo abiotic or biotic degradation
6. Transformation of PFAS precursors to PFSA (such as PFOS) and PFCA (such as PFOA)
7. Presents environmental and human health impact
8. Get into food crop – plants, fisheries, animals
9. Many sources e.g. firefighting loams, landfill leachates, WWTP etc
10. Beginning to know more of PFAS removal and treatment
11. Increasing liability and class actions

Policy and Regulation

- Stockholm Convention on POPs 2009 Annex B – PFOS and Annex A PFOA (COP9 April 2019)
- Australia
 - July 2016 – Queensland Department of Environment and Heritage Policy Environmental Management of Firefighting Foam
 - 30 January 2018 - South Australia Environment Protection (Water Quality) Policy 2015 – blanket ban on foams with PFAS to come in place 2 years time
 - PFAS NEMP Version 2 - March 2019
- US
 - Feb 2018 - US State of Washington 65th Legislature 2018 Regular Session SUBSTITUTE HOUSE BILL 2793 foam with PFAS cannot be used to come in place 1 January 2020
 - 23 May 2019 Gillibrand-Shaheen Amendment to Ban PFAS Chemicals in Firefighting Foam Used On Military Bases Passes Senate Armed Services Committee as Part of Annual Defense Bill
 - June 2019 - Maine House and Senate legislation that would allow the Department of Environmental Protection to prohibit usage of PFAS as well as phthalates in food packaging sold in Maine by January 2022
 - USEPA SW-846 Method 8327 24 PFASs
- EU REACH restriction of PFOS and PFOA usage
- Denmark National Food Authority to ban all PFAS from food contact materials to take effect in July 2020

Lowering of PFAS drinking water values

	PFOS ppt
USEPA	70
Australia PFAS NEPM	70
New Jersey DEP	13
NY Dept Health Environment Conservation	10
Michigan Dept Health Human Services	8
California OEHHA	6.5

USEPA screening groundwater values	40 ppt
Sweden 6:2 FTS	90 ppt

GEN – X	
Michigan	370 ppt
North Carolina	140 ppt



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Analytical methods

- ▶ LC-MS MS
- ▶ TOPA
- ▶ Total Organic Fluorine
- ▶ Commercial labs 28 – 30 PFAS classes analysed
- ▶ New USEPA SW-846 Method 8327 for 24 PFASs

- ▶ More advanced techniques
 - ▶ LC QTOF (Quadruple Time of Flight) MS MS
 - ▶ FAB (fast atom bombardment) - MS
 - ▶ PIGE or Particle Induced Gamma-ray Emission
 - ▶ X-ray photoelectron spectroscopy (XPS)

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Many type of PFAS used in foams

- PFASs found in Firefighting foams – C6 – C14:
 - PFSA e.g. PFOS, PFHxS
 - PFCA e.g. PFOA
 - Perfluoroalkyl sulfonamide amino carboxylate
 - Perfluoroalkyl sulfonamido amines
 - Fluorotelomer thio amido sulfonates
 - Fluorotelomer thio hydroxyl ammonium
 - Fluorotelomer sulfoamide betaines
 - Fluorotelomer sulfonamido amines
 - Fluorotelomer sulfonates (6:2 FTS, 8:2 FTS, 10:2 FTS etc)
 - Fluorotelomer betaine
 - Other PFASs and PFAS precursors
- Consumer products
 - PFSA, PFCA, Fluorotelomers and all types of PFASs

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Cannot or fully removal by conventional waste water treatment methodology

Class Actions and Pay Out

- DuPont Chemours pay out US\$670 M class actions – Feb 2017
- 3 M \$850 million settlement with Minnesota for damage the company's chemicals caused to the state's drinking water – Feb 2018
- Class action launched against Department of Defence over PFAS exposure in Katherine, Willamtown and Oakey – 2018
- Firefighter is leading class action against 3M, Archroma, Arkema, Asahi Glass, Chemours, Daikin, Dyneon, DuPont (now officially DowDuPont), and Solvay – Oct 2018
- New Jersey ordered — 3M, DuPont, DowDuPont, Chemours, and Solvay to fund the cleanup of chemicals used at manufacturing sites that contaminated drinking water – March 2019
- 3M will pay the West Morgan East Lawrence Water and Sewer Authority \$35 million in a lawsuit settlement – April 2019
- North Carolina sued Chemours, resulting in a \$12 million settlement in early 2019 amid agreement on cleanup of the river, groundwater and air around the factory.

What we DON'T know about PFAS

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PFAS

Detail understanding of PFAS physiochemical properties still unknown and challenging to model

Co-contaminant interferences and interaction with PFAS adsorption and ionic exchange still not fully understood

New PFASs been made and use – their impacts upon the environment and human health

Health

- Does PFAS cause cancer?
- What is the mechanism to cause human health impact
- The toxicity and impact of other PFAS classes besides PFOS, PFOA and PFHxS
- Co-factors and synergistic effects of other toxicants
- Human PFOS and PFOA blood level risk values
- By products of PFAS breakdown
- Chronic impact

Policy/Legislation

- Australia
 - Will Commonwealth and state regulators adopt Qld or SA foam policy and regulation
 - When will Australia ratify Annex 2 Stockholm Convention
 - Will the 99% ecological risk guidance values for freshwater/marine water be increased or decreased
 - What will be the contaminated site remediation clean up closure values
 - Will state take class actions or prosecute
- US
 - MCL values for PFAS
- EU
 - Will EU restrict short chain PFAS
 - What will be the 'safe' blood PFAS health values

New Challenges /Directions

Emerging PFAS concerns

- ▶ Gen X or HFPO - DA - hexafluoropropylene oxide dimer acid – alternative to PFOA
- ▶ Ether PFAS e.g. F-53B - 6:2 chlorinated polyfluorinated ether sulfonate - alternative to PFOS
- ▶ Cyclic PFOS e.g. 3M product FC-98 contains a mixture of cyclic perfluorinated acid surfactants
- ▶ Perfluoroether carboxylic acids PFECA e.g. PFO₄DA, PFO₅DoDA
- ▶ ADONA (dodecafluoro-3H-4,8-dioxanonanoate)
- ▶ Methyl siloxanes not PFAS used in firefighting foams

New Challenges /Directions

- ▶ Beyond Firefighting foams
 - ▶ Food in contact with PFAS
 - ▶ People in contact with PFAS treated materials
 - ▶ EU Drinking Water Directive
 - ▶ Materials in contact with drinking water
 - ▶ Access to water
 - ▶ Dutch using environmental mobility to list GEN-X as SVHC
 - ▶ New thinking - PMTs (persistent, mobile, toxic) and vPvMs (very persistent, very mobile substances)
 - ▶ Microbial cleavage of C–F bonds in per- and polyfluoroalkyl substances via dehalorespiration

New Challenges

- ▶ Media now knows more and asking the right questions
- ▶ Community now know more and asking the right questions – they Google
- ▶ Lawyers and activist now know more hence more class actions to be expected
- ▶ Politicians ?