

Remediation of Perfluorinated Chemicals at a Former Fire Fighting Training Area

Lindsay Paterson, MSc, PAg
Tara Siemens Kennedy, MET, AAg
Doug Sweeney, MSc, PEng
SLR Consulting (Canada) Ltd.



Overview

- History and Use of Perfluorinated Chemicals (PFCs)
- History of Site and Project
- Development of Risk-based Remedial Targets
- Preliminary Remediation Results
- Summary

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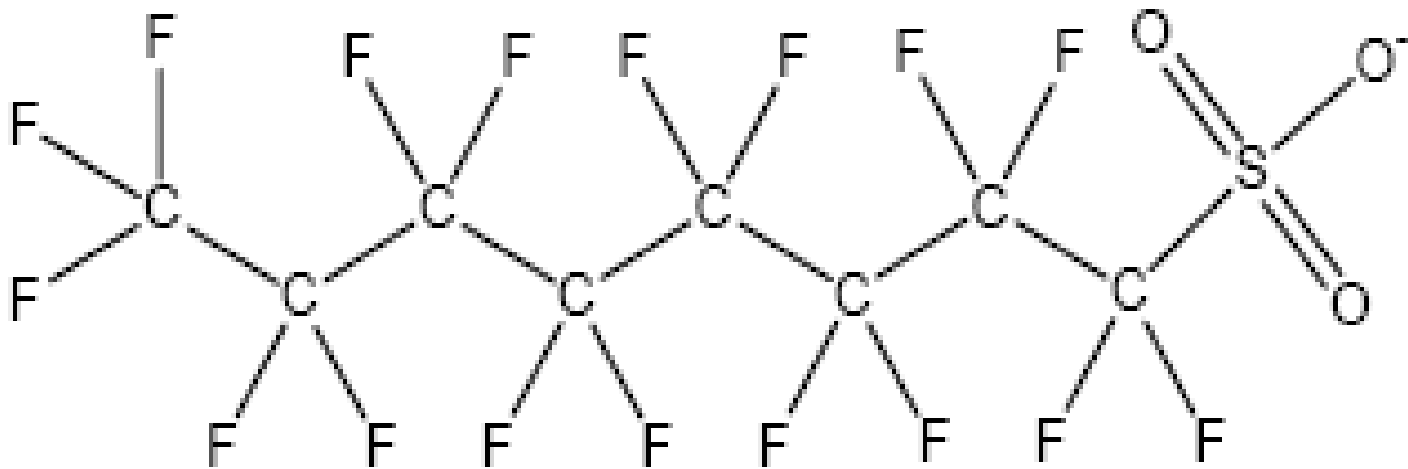
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History and Use of PFCs

- Family of man-made, fluorinated compounds including perfluorinated sulphonates and carboxylates



Chemical Structure of Perfluorooctane Sulphonate (OECD, 2002)



It seems more convincing to argue, independently of anything to do with the case, that groups in general are more likely to be conservative than individuals are. There are probably two main reasons. (1) Groups are subject to the herd effect. (2) Groups are subject to the law of the few. Both of these tend to bring smaller groups

[illegible]

SCOTCHGARD
STAIN REPELLER

Source: Minnesota Historical Society (Minnesota Public Radio)

History and Use of PFCs

- Consumer Product Examples:
 - stain/water repellency products
 - non-stick coatings
 - food packaging coatings
- Industrial Product Examples:
 - suppression of Cr^{6+} volatilization in electroplating
 - surfactants for use in Class B fire fighting foams

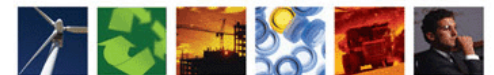
PFCs – Why the Concern?

- Widely distributed in the global environment
- C-F bond is a very strong bond
- C8 compounds are extremely persistent
 - Do not hydrolyze
 - Do not photolyze
 - Do not biodegrade

PFCs – Why the Concern?

- C8 compounds found to be toxic & bioaccumulative
 - Do not partition to lipids, bind to serum proteins
 - Half-life in humans ~ 4-6 years
 - Liver, thyroid and gastrointestinal effects
 - Carcinogenic?
- Perfluorooctane Sulphonate = CEPA toxic substance

Site History



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Site History

- Simulated aircraft fuselage (e.g. metal culverts) flooded with fuel
- Fuel ignited and exercises conducted from moving truck
- Aqueous Film Forming Foam (AFFF) utilized in exercises
- Estimate: 2000-2700 L AFFF applied annually over 20 year period

Fire Training Area



Project History

- Remedial system installed in 2005.
- Risk assessment approach adopted in 2006.
- Potential for PFC contamination highlighted in 2006.
- Soil and groundwater investigations conducted in 2006 and 2007.
- No provincial or federal guidelines for PFCs.
- Risk-based remedial targets developed for PFOS.

Risk-Based Remedial Targets - PFOS

- Commercial Workers - 20 mg/kg
- Construction Workers - 4 mg/kg
- Residential Drinking Water - 0.4 ug/L
- Terrestrial Ecological Receptors - 1.3 mg/kg
- Aquatic Ecological Receptors - 50 ug/L



Minnesota Department of Health Drinking Water Targets

- PFOS: 0.3 ug/L
- PFOA: 0.5 ug/L, proposed reduction to 0.3 ug/L
- PFBA: 7 ug/L
- MDH Website:
www.health.state.mn.us/divs/eh/hazardous/topics/pfcshealth.html

PFC Remediation



PFCs - Remediation Challenges

- Chemical properties limit remedial options:
 - Low volatility
 - Do not biodegrade, photolyze or hydrolyze
- Adsorb to GAC and anionic resins
 - carboxylates < sulphonates
 - C4 < C8
- Destruction via incineration at 1200 °C

Site Remediation

- Original system configuration: Groundwater treated through two 110 kg GAC vessels.
- Spring 2008: Three 225 kg GAC vessels added.



PFC Remediation



2008 PFC Treatment Results (ug/L)

Sample	Date	PFBA	PFOA	PFHxS	PFOS	Total PFCs
Influent	May 22	13	16	4	< 0.3	247
Effluent		< 0.001	< 0.001	< 0.002	< 0.002	< 0.02
Influent	July 8	16	22	105	28	418
Effluent		0.004	< 0.001	0.004	< 0.002	0.03
Influent	August 27	1	0.6	1	< 0.06	13
Effluent		0.002	< 0.001	< 0.002	< 0.002	0.02
Risk-Based Remedial Target (Human Health)					0.4	0.4

Remediation Results

- Approximately 100 g of PFCs recovered in 2007-08.
- Delineation of soil contamination underway, extent estimated to be ~ 1500 m² / fire training area.
- Alternatives to active remediation being evaluated:
 - Fate and Transport Modeling
 - Administrative Controls
 - Receptor Controls (if necessary)

Summary

- Point sources of PFCs can be found at airports, refineries, military bases, chrome plating facilities and other industrial operations.
- Remedial options are limited:
 - Groundwater extraction and GAC treatment
 - Administrative and receptor controls
 - Dig and contain
 - Import cap (?)

Questions?

Lindsay Paterson

Email: lpaterson@slrconsulting.com



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