

AIRBORNE POLYFLUORINATED SULFONAMIDES AND TELOMER ALCOHOLS IN TORONTO:

A LONG-TERM STUDY

Naomi L. Stock*, Derek C.G. Muir†, and Scott A. Mabury*

Department of Chemistry, University of Toronto* and National Water Research Institute, Environment Canada†



High Volume Air Sampler

ABSTRACT

A long-term sampling campaign for airborne polyfluorinated telomer alcohols and sulfonamides was conducted in downtown Toronto, ON beginning February 2002. Samples were collected using a high-volume air sampler and analyzed via gas chromatography-mass spectrometry. Polyfluorinated telomer alcohols and sulfonamides were detected throughout the study period at concentrations ranging from non-detect to 650 pg/m³. N-methyl perfluorooctane sulfonamidoethanol (NMeFOSE) was the dominant sulfonamide observed throughout the study. C₄ sulfonamides and telomer alcohols were also observed and reported here for the first time. Results indicate that the concentrations of the polyfluorinated telomer alcohols may be increasing throughout the sampling period. Gas:particle partitioning was investigated: sulfonamides were observed in both the gas and particle phases and partitioning was temperature dependent, while telomer alcohols were found predominantly in the gas phase.

INTRODUCTION

Polyfluorinated telomer alcohols and sulfonamides are of interest due to their hypothesized ability to undergo long-range transport and degradation to perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS) (1). Both classes of contaminants have previously been detected in the North American troposphere, with average total airborne concentrations ranging from approximately 10 to 400 pg/m³ (1,2,3). Although detected in the troposphere, previous studies were of short duration and as such, little is understood about the temporal variability of these contaminants.

The primary objectives of the study are to:

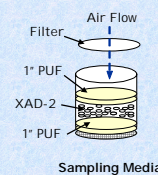
- investigate the temporal distribution of polyfluorinated telomer alcohols and sulfonamides
- investigate the gas:particle partitioning of these contaminants, and
- determine if airborne concentrations of the polyfluorinated sulfonamides are decreasing as a result of being phased out of the market, by the major manufacturer, beginning in 2000.

Analytes of Interest	COMPOUND	ACRONYM	MOLECULAR FORMULA
C ₈ Sulfonamides	N-ethyl perfluorooctane sulfonamide	NEtFOSA	C ₈ F ₁₇ SO ₂ N(CH ₂ CH ₃)H
	N-ethyl perfluorooctane sulfonamidoethanol	NEtFOSE	C ₈ F ₁₇ SO ₂ N(CH ₂ CH ₃)CH ₂ CH ₂ OH
	N-methyl perfluorooctane sulfonamidoethanol	NMeFOSE	C ₈ F ₁₇ SO ₂ N(CH ₃)CH ₂ CH ₂ OH
	perfluorooctane sulfonamide	PFOSA	C ₈ F ₁₇ SO ₂ NH ₂
C ₄ Sulfonamides	N-ethyl perfluorobutane sulfonamidoethanol	NEtFBSE	C ₄ F ₉ SO ₂ N(CH ₂ CH ₃)CH ₂ CH ₂ OH
	N-methyl perfluorobutane sulfonamidoethanol	NMeFBSE	C ₄ F ₉ SO ₂ N(CH ₃)CH ₂ CH ₂ OH
Telomer Alcohols	4:2 fluoro telomer alcohol	4:2 FTOH	C ₆ F ₉ CH ₂ CH ₂ OH
	6:2 fluoro telomer alcohol	6:2 FTOH	C ₆ F ₁₃ CH ₂ CH ₂ OH
	8:2 fluoro telomer alcohol	8:2 FTOH	C ₆ F ₁₇ CH ₂ CH ₂ OH
	10:2 fluoro telomer alcohol	10:2 FTOH	C ₁₀ F ₂₁ CH ₂ CH ₂ OH

MATERIALS AND METHODS

Sample Collection

- Samples were collected from a roof top in downtown Toronto approximately every 2 weeks throughout 2002-2003, employing a high volume air sampler.
- Average sample size was 1500 m³ (96-hour sample; sampler operated with a flow rate of 200-300 L/min).
- Pre-cleaned sampling media consisted of a quartz fiber filter and a polyurethane foam (PUF)-XAD sandwich.



Sampling Media

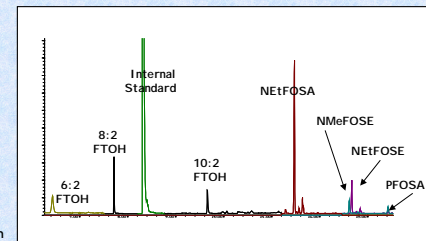
Sample Extraction

- Samples were extracted in a Clean Laboratory facility employing a solvent soak in methanol and ethyl acetate.
- Final sample volume (200 µL) was obtained following rotary and nitrogen evaporation.
- Particle (filter) and gas phases (PUF-XAD sandwich) were extracted separately so that partitioning could be investigated

Instrumental Analysis

- Samples were analyzed via gas chromatography-mass spectrometry (GC-MS) operating in chemical ionization and single ion modes, and employing a DB-wax column (1,2)
- Confirmation of analytes was determined using negative chemical ionization; positive chemical ionization was used for quantitation.
- Analysis of samples from 2004-2005 is underway.

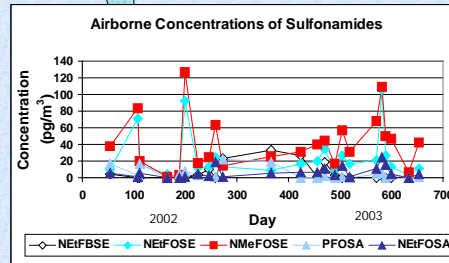
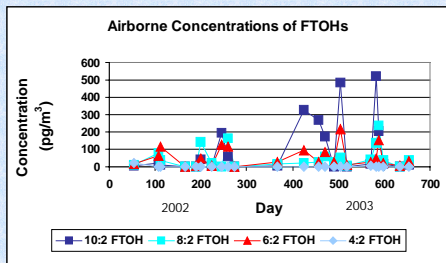
Sample Chromatogram Of PUF/XAD Sample



RESULTS AND DISCUSSION

Polyfluorinated sulfonamides and telomer alcohols were detected throughout the sampling period at concentrations similar to those reported in previous studies (1,2,3):

- Airborne concentrations (combined results of filter samples and PUF-XAD samples) of individual telomer alcohols ranged from non-detect to 650 pg/m³. In the latter half of the study, 10:2 FTOH was the dominant telomer alcohol observed.
- Airborne concentrations of individual sulfonamides ranged from non-detect to 125 pg/m³. Throughout the sampling period, MeFOSE was the dominant sulfonamide observed.
- It appears airborne concentrations of FTOHs may be increasing throughout the sampling period.



CONCLUSIONS

- Polyfluorinated sulfonamides and telomer alcohols were detected throughout the sampling period. Concentrations ranged from non-detect to 650 pg/m³ and are similar to those reported in earlier studies.
- The observation of 4:2 FTOH and C₄ sulfonamides is reported here for the first time.
- MeFOSE was the dominant sulfonamide observed throughout the sampling period.
- It appears that concentrations of the polyfluorinated telomer alcohols may be increasing throughout the sampling period.
- Gas:particle partitioning behaviour is different between the two classes of analytes. Sulfonamides were observed in both gas and particles phases and was temperature dependent; telomer alcohols were observed predominantly in the gas phase
- Meteorological conditions play an important role and warrant further consideration

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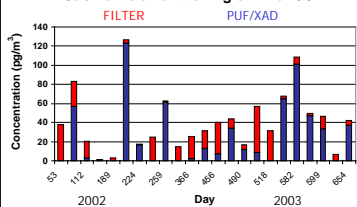
ACKNOWLEDGEMENTS

- The authors wish to thank Trevor Bujas for his assistance with sample extraction; and all who assisted with sample collection: Julia Bonin, Amila DeSilva, Suzanne Gauthier, Monica Lam, Mike Wilson, and Cora Young
- Funding for this research was provided by the Natural Science and Engineering Council of Canada (NSERC)

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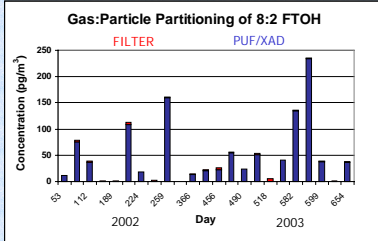
nstock@chem.utoronto.ca

Gas:Particle Partitioning of NMeFOSE



Polyfluorinated sulfonamides and telomer alcohols displayed different gas:particle partitioning behaviour:

- Sulfonamides were observed in both the gas and particle phases; gas:particle partitioning appears to be temperature dependent



- FTOHs were observed predominantly in the gas phase; gas:particle partitioning of the FTOHs appears to be independent of temperature (although higher concentrations of FTOHs were observed at higher ambient temperatures)

