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Summary of DuPont Presentations

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Biotransformation of ^{14}C-labeled Fluorotelomer substances by microorganisms from activated sludge or soil.
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ABSTRACT- The environmental fate of chemicals containing perfluorocarbon moieties [$F(CF_2)n$-] is of increasing scientific and public interest. The perfluorocarbon moieties, such as 8-2 Telomer B alcohol [$F(CF_2)_8CH_2CH_2OH$], are building blocks of fluorotelomer-based consumer products. As part of environmental stewardship effort, we are investigating the biodegradation potential and possible biotransformation pathways of fluorotelomer products by activated sludge or by soil microorganisms. To unequivocally identify transformation products and to achieve mass balance of the test materials, ^{14}C-labeled 8-2 Telomer B Alcohol ([$F(CF_2)_7{}^{14}CF_2CH_2CH_2OH$] and ^{14}C-labeled fluorotelomer poly urethane were custom synthesized and were used for the study. The experimental methods, bioavailability of the test materials, observed transformation products, and potential biotransofrmation pathways will be discussed. The potential for microbial defluorination of perfluorinated C-C bonds of the test materials will also be discussed.

The Fate of Fluorotelomer Treated Consumer Articles in a Municipal Waste Incinerator.
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ABSTRACT- The fate of fluorinated substances in the environment and their routes into the environment are areas of regulatory, industrial and academic interest. Textiles and paper are often incinerated when they are disposed. No information regarding emissions from incineration of textiles or paper treated with fluorotelomer-based products is available. This paper reports the first known studies to investigate the thermal degradation behavior of a fabric treated with a fluorotelomer-based acrylic polymer under laboratory conditions conservatively representing typical municipal incineration conditions of time, temperature, and excess air level. Additional laboratory-scale non-flame thermal degradation studies from 600 to 1000 degrees C for gas-phase residence times of 2.0 seconds were conducted to establish the temperature at which 99.9% destruction was achieved. Carbon mass balance was achieved. The thermal reactor effluent was analyzed by in-line GC/MS to identify degradation products. The details of the experimental procedures and results will be presented.

Comparative Acute Toxicity of Three Fluorotelomer Acids to *Pseudokirchneriella subcapitata, Daphnia magna*, and *Oncorhynchus mykiss*.
Hoke, R.[1], Bouchelle, L.[1], Ferrell, B.[1], Buck, R.[2], [1] DuPont, Haskell Laboratory for Health and Environmental Sciences, Newark, DE, USA[2] DuPont, Wilmington, DE, USA
ABSTRACT- Perfluorinated compounds have unique properties and their measurement in various environmental matrices has received increased attention. While PFOS and PFOA have been the focus of much of this attention, fluorotelomer alcohols and acids have also been of interest. We conducted 48, 72 and 96-hour aquatic toxicity tests to evaluate the toxicity of three fluorotelomer acids to the cladoceran, *Daphnia magna*, the green alga, *Pseudokirchneriella subcapitata*, and the rainbow trout, *Oncorhynchus mykiss*, as part of an on-going product stewardship program. The three fluorotelomer acids tested were 2-perfluorooctyl ethanoic acid, 2H-hexadecafluoro-2-decenoic acid, and n-perfluorodecanoic acid. The cladoceran, *Daphnia magna*, was generally the most sensitive species tested followed by the green alga, *Pseudokirchneriella subcapitata*. Rainbow trout were generally less sensitive to the fluorotelomer acids than the other test species. These results suggest that the acute toxicity of these fluorotelomer acids is of low to medium concern from a hazard classification standpoint. When coupled with potential environmental exposure concentrations, these data suggest that the fluorotelomer acids tested pose little risk for acute aquatic toxicity in the environment.

Comparative Toxicity of Two Fluorotelomer-based Surfactants to the Green Alga, *Pseudokirchneriella subcapitata*.
Sloman, T.[1], Hoke, R.[1], Szostek, B.[1], Ferrell, B.[1], Prickett, K.[1], Buck, R.[2], [1] DuPont, Haskell Laboratory for Health and Environmental Sciences, Newark, DE, USA[2] DuPont, Wilmington, DE

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ABSTRACT- Perfluorinated compounds have unique properties and their measurement in various environmental matrices has received increased attention. Their unique properties and use as surfactants, with accompanying potential for environmental release, make aquatic hazard assessment an integral part of product stewardship and risk assessment. The green alga, *Pseudokirchneriella subcapitata,* (aka *Selenastrum capricornutum*) was exposed for 72 hours to each of two fluorotelomer-based surfactants; one anionic and the other nonionic, in regulatory guideline studies conducted using Good Laboratory Practices to assess the potential aquatic hazard of each compound to algae. The 72-hour EC50s based on inhibition of healthy cell count, area under the growth curve, and growth rate were greater than 100 mg/L for both compounds. The lowest 72-hour NOEC for the anionic surfactant was 25 mg/L while the 72-hour NOEC for the nonionic surfactant was 100 mg/L.

Comparative Early Life Stage Toxicity of Two Fluorotelomer-based Surfactants Using Rainbow Trout.
Hoke, R.[1], Turner, Sr., J.[1], Szostek, B.[1], Bouchelle, L.[1], Ferrell, B.[1], Prickett, K.[1], Buck, R.[2], [1] DuPont, Haskell Laboratory for Health and Environmental Sciences, Newark, DE, USA[2] DuPont, Wilmington, DE, USA
ABSTRACT- Perfluorinated compounds have received increased attention because of their unique properties and measurement in various environmental matrices. Their unique properties and use as surfactants, with accompanying potential for environmental release, makes aquatic hazard assessment an integral part of product stewardship and risk assessment. Acute and chronic toxicity tests were performed with fish to assess the aquatic hazard of two fluorotelomer-based surfactants; one anionic and the other nonionic. Non-GLP acute screening studies and GLP rainbow trout early-life stage toxicity tests conducted according to regulatory guideline methods were used to assess the toxicity of both surfactants. The results of the acute and chronic hazard testing are presented along with illustrations of the novel challenges presented in the aquatic toxicity testing and associated chemical analysis of these compounds.

Bacterial Respiration Inhibition Studies of Fluorotelomer-Based Products.
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ABSTRACT- Fluorotelomer-based products provide unique properties to a wide variety of consumer goods. These products may find their way into wastewater treatment plants through normal use and disposal. Bacterial respiration inhibition studies help estimate the effect of the test material on mixed communities of bacteria in aquatic environments, especially in aerobic biological treatment systems. These studies also can be useful to help determine test concentrations to use in biodegradation studies. We studied the inhibition to bacterial growth in activated sludge of municipal wastewater treatment facilities using both guideline and non-guideline methods for a series of fluorotelomer-based products. At the highest test concentration at which they were dosed, 1000 mg L^{-1}, the test substances exhibited no respiration inhibition. The EC_{50}, which is the effective concentration of the test material resulting in a 50% calculated or interpolated inhibition of oxygen consumption compared with a control blank, are estimated to be greater than 1000 mg L^{-1}.

Matrix-effect free analytical methods for determination of perfluorinated carboxylic acids in environmental and biological samples.
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ABSTRACT- The sample matrix can often have significant effects upon the performance of analytical methods for the quantitative determination of perfluorinated carboxylic acids in environmental and biological samples. These effects can include inhibition of the extraction procedure due to binding of residues and suppression or enhancement of the signal obtained in LC/MS/MS determinations. We have developed methods for the determination of perfluorinated carboxylic acids in environmental matrices (soil, sediment and sludge) that address these issues, with limits of quantitation of 1 ppb. Extraction efficiency is demonstrated with fortifications prepared using a procedure that mimics field weathering of the residues. Matrix enhancement and suppression are reduced to a negligible extent using isotopically-labeled internal standards when these analogs are available and novel solid-phase extraction (SPE) procedures when they are not. The same procedures are used to purify extracts from biological matrices with similar success, with limit of quantitation of 1-5 ppb. Quality control data have been developed that demonstrates (1) recovery of laboratory fortifications; (2) freedom from matrix enhancement or suppression; (3) recovery of aged residues and (4) absence of significant background interference.

The Role of Photolysis in the Atmospheric Fate of Perfluorinated Aldehydes: Gas Phase UV and IR Absorption Spectra.

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ABSTRACT- Long-chain perfluoroalkyl carboxylic acids (PFCAs, $C_xF_{2x+1}COOH$, where x = 6 - 12) have been observed in remote locations and are presumed to be the atmospheric degradation products of precursor chemicals. Atmospheric oxidation of fluorotelomer alcohols (FTOHs), $C_xF_{2x+1}CH_2CH_2OH$, has been suggested as a possible source of PFCAs. It is well established that the initial atmospheric oxidation products of FTOHs are perfluorinated aldehydes, but the subsequent fate of these aldehydes is unclear at this time. Since UV photolysis is likely to be an important removal process for perfluorinated aldehydes, we have examined the UV and IR spectra of $C_xF_{2x+1}CHO$ (x=1-4) using computational and experimental techniques. We compare our results with the limited existing literature data and we discuss the relevance of these results to the atmospheric fate of $C_xF_{2x+1}CHO$.