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DuPont Fluorotelomer Product Stewardship Update

Presented to

The United States Environmental Protection
Agency

November 25, 2002

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Chemical Solutions Enterprise

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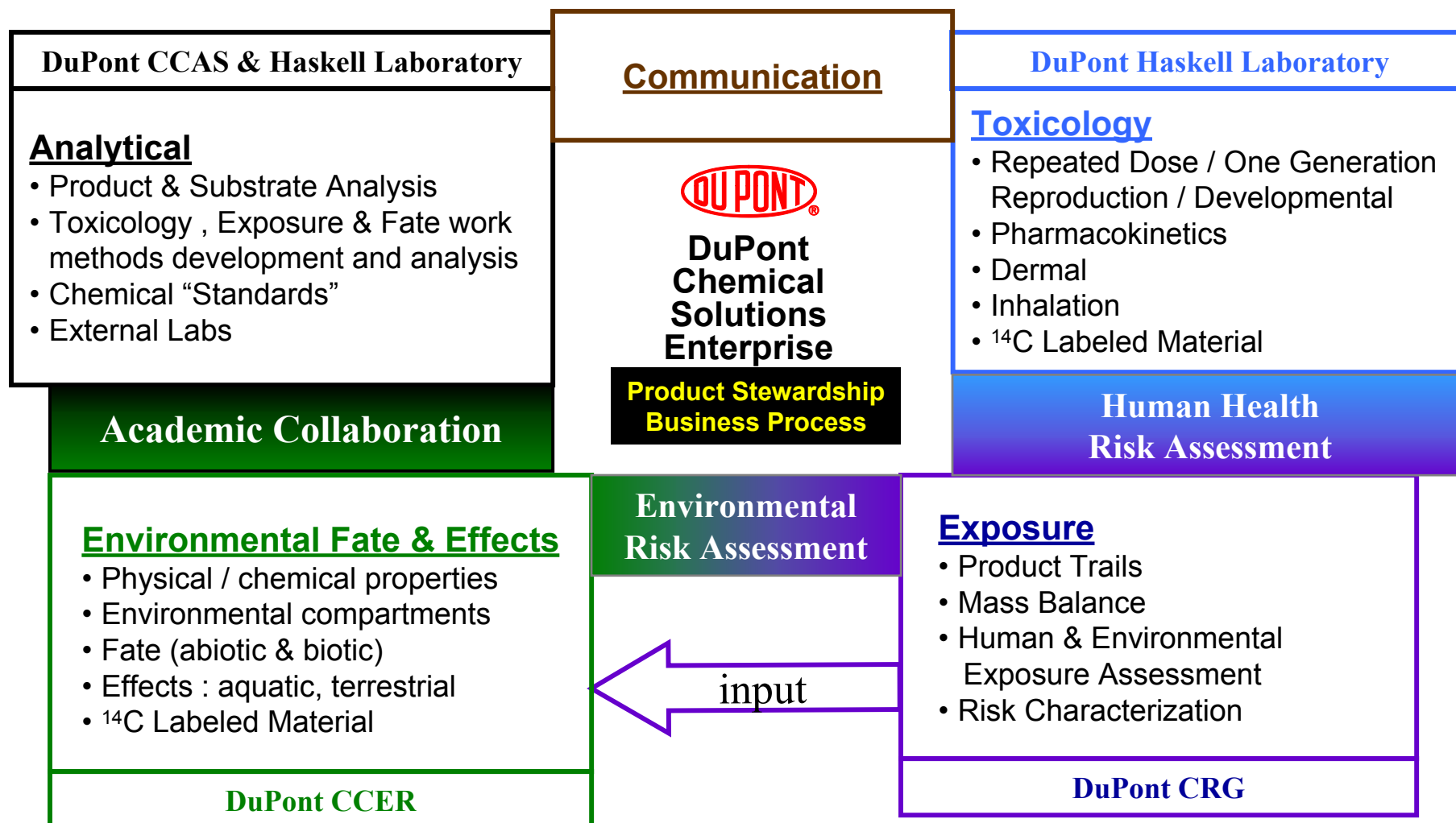
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Presentation Outline

- Introduction
 - Agenda, desired outcomes
 - Research approach overview
 - Overall DuPont Timeline & Milestones
- Toxicology & Descriptive Biology Update
 - Intermediate : Telomer BA
 - Polymers : Telomer Urethane, Telomer Acrylate
 - Surfactants : Telomer Phosphate
 - Overall Summary & Draft Hazard Assessment
- Exposure & Risk Characterization
 - Consumer & Occupational Exposure
 - Risk Characterization
- Environmental Fate & Effects
 - Environmental Compartments
 - Environmental Effects
 - Environmental Fate
- Summary, Conclusions, Discussion & Questions



DuPont PS Effort : *Product Focused*



DuPont Product Stewardship

Key Communications 2001 - Present

2001 :

Feb : DuPont meets with U.S. EPA to review Tox & EFE Plans & Results

April : DuPont presents Tox Studies at Society of Toxicology (SOT) Annual meeting
DuPont meets with Environment & Health Canada

May : DuPont meets with DEFRA, UK Env. Agency

Oct : DuPont presents initial data at Soc. Of Env. Tox & Chemistry (SETAC) Meeting

Dec : DuPont meets with U.S. EPA

2002 :

April : DuPont presents Tox Study Data at SOT Annual meeting

May : DuPont meets with UK Env. Agency; Dutch RIKZ / Univ. Amsterdam

June : DuPont meets with Environment & Health Canada

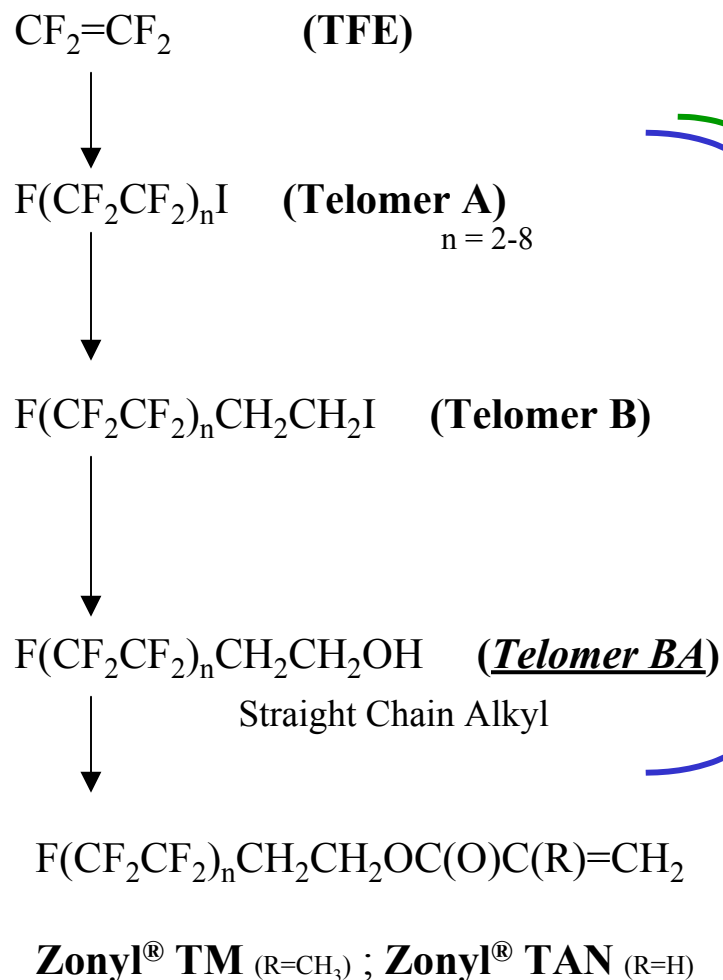
Nov. : DuPont presents at North America SETAC Meeting

DuPont meets with U.S. EPA



DuPont Fluorotelomer Product Groups: Intermediates, Surfactants, Polymers

1) Intermediates



Sales Products

2) Surfactants / "Molecules"

- Anionic - Phosphate, Carboxylate, Sulfonate
- Nonionic - Ethoxylate
- Betaine

3) Polymers

- Acrylic
- Ester
- Amide
- Urethane
- Urea

5 Test Compounds
 Represent Large Per
 Cent of Product
 Line



Repeated-Dose Study Plan Overview

5 Test Compounds

Structures
Represent
Majority of
DuPont
Product Line

Products

Intermediate

- Telomer BA

Polymer

- Telomer Urethane
- Telomer Acrylate

Surfactant

- Telomer Phosphate
- Telomer Ethoxylate

Repeated-Dose Studies

Rat Model

- 90 Day Subchronic Oral Study
- One-Generation Reproduction
- Developmental Toxicity

We continue to fill in our database, as we committed 1 May 2001.



DuPont Toxicology Studies Timeline*

Test Material	Work	2000		2001				2002				2003			
		3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Telomer Urethane Polymer	90 Day Oral Repeat Dose, 1Gen Repro (Rat)														
	Developmental Study (Rat)														
	Dermal Permeation (Rat)														
	90-Day Follow-Up Study														
Telomer BA Intermediate	90 Day Range-Finding Study														
	90 Day Oral Repeat Dose + 1Gen Repro (Rat)														
	Developmental Study Rangefinder														
	Genetic Toxicity: <i>In Vitro</i> Chrom Ab														
	Developmental Study (Rat)														
Telomer Ethoxylate Surfactant	90 Day Range Finding														
	90 Day Oral Repeat Dose, 1Gen Repro (Rat)														
	Developmental Study Rangefinder														
	Developmental Study (Rat)														
Telomer Phosphate Surfactant	90 Day Range Finding														
	90 Day Oral Repeat Dose (Rat)														
	1Gen Reproduction Study (Rat)														
	Developmental Range Finder														
	Developmental Study (Rat)														
	28 Day Dermal Repeat Dose (Rat)														
	14-Day Inhalation Repeat Dose (Rat)														
Telomer Acrylate Polymer	90-Day Range Finding														
	90 Day Oral Repeat Dose, 1Gen Repro (Rat)														
	Developmental Study Rangefinder														
	Developmental Study (Rat)														

Work Complete

Work Underway

Projected Timing

* This is a proposed timeline and subject to change.

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DuPont Toxicity Studies : Rat Model

Multiple Routes of Exposure

- Oral
 - 90-day subchronic, reproductive, and developmental toxicity
 - Dosing by gavage, male and female rats
 - Full battery of tissues examined
- Dermal
 - *In vitro* tests for dermal penetration – rat and human skin
 - *In vivo* tests – 28 day study, male rats
- Inhalation
 - 14/28 day study, male rats



Intermediate : Telomer BA Study Summary & Timeline



Test Material	Study	2000		2001			
		3Q	4Q	1Q	2Q	3Q	4Q
Telomer BA Intermediate	90 Day Range-Finding Study						
	90 Day Oral Repeat Dose + 1Gen Repro (Rat)						
	Developmental Study Rangefinder						
	Genetic Toxicity: <i>In Vitro</i> Chrom Ab						
	Developmental Study (Rat)						

Work Complete

- 90 Day Subchronic Oral :**
Dose Levels : 25, 100, 250 mg/kg/day
NOEL 25 mg/kg/day
Primary Target : Teeth
- Reproductive Toxicity :**
Dose Levels : 25, 100, 250 mg/kg/day
NOEL 25 mg/kg/day
not a selective reproductive toxin
- Developmental Toxicity :**
Dose Levels : 25, 200, 500 mg/kg/day
NOEL 200 mg/kg/day
not a selective developmental toxin



Polymer : Telomer Urethane

Study Summary & Timeline



Telomer Urethane Polymer

Aqueous Dispersion with surfactant

Test Material	Work	2000		2001				2002				2003			
		3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Telomer Urethane Polymer	90 Day Oral Repeat Dose + 1Gen Repro (Rat)														
	Developmental Study (Rat)														
	Dermal Permeation (Rat)														
	Nasal Lesion - Follow-Up Study														

Work Complete Work Underway

- **90 Day Subchronic Oral:** LOEL 50mg/kg/day
Dose Levels : 50, 250, 1000 mg/kg/day Primary Target : Nose
- **Reproductive Toxicity:** No effects on reproduction at any dose
Dose Levels : 50, 250, 1000 mg/kg/day *not a selective reproductive toxin*
- **Developmental Toxicity:** No abnormalities or birth defects at any dose
Dose Levels : 50, 250, 1000 mg/kg/day *not a selective developmental toxin*

Polymer : Telomer Urethane

90 Day Oral Study (Rat) : Follow-Up

Purpose: to determine the cause and establish a no-effect level for nasal lesions (olfactory epithelial degeneration and necrosis)

Primary questions to address

- Are the lesions caused by telomer urethane polymer or surfactant? Reproducible?
- Can a NOEL be established?

Study Design

- 3 dose groups: telomer urethane polymer product, surfactant, and control
- Animals dosed with equivalent of high dose in 90 day study
- Sacrifice and evaluate nasal tissue at 2, 4 and 13 weeks as needed
- Follow with 3 dose level study with either surfactant or polymer

Study started: 11/01/02

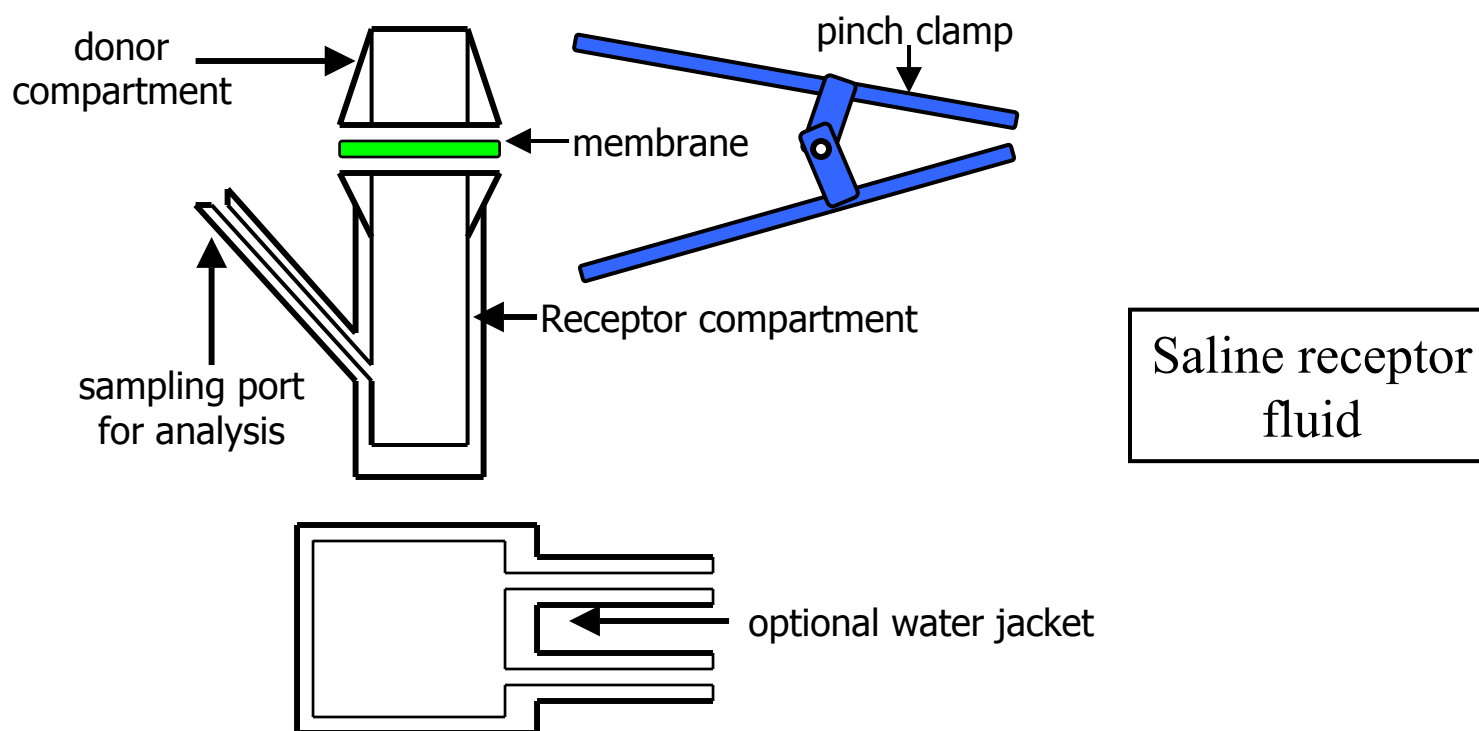


In Vitro Dermal Permeation with Telomer Urethane

- Purpose: To determine the permeability of the agent through rat and human skin
- Draft Guideline: OECD, 1999; ECETOC, 1993
- *In vitro* technique employing glass (static) diffusion cells have been shown to predict percutaneous absorption of various chemicals *in vivo*



Static Diffusion Cell : *In Vitro* Dermal Permeation



Polymer : Telomer Urethane *In-vitro* Dermal Permeation

Methods

- 20 μ l product solution was applied to rat epidermal membrane
- Total of 1234 μ g fluorine in contact with rat skin for 6 hours
- 3 ml receptor fluid analyzed for total fluorine using Wickbold torch method

Results

- Total fluorine in receptor fluid was below the limit of detection (LOD) of 0.052 ppm; less than 0.013 % of urethane polymer permeated the rat skin
- Input for exposure and risk characterization



Polymer : Telomer Acrylate Chemistry

- Aqueous emulsion polymerization of monomer composition :
 - $\text{F}(\text{CF}_2\text{CF}_2)_n\text{CH}_2\text{CH}_2\text{OC}(\text{O})\text{CH}=\text{CH}_2$ $n = 4 - 6$

CBI Information has been redacted

- $\text{MW} > 40,000$
- Test Substance for Acute Studies : product = aqueous dispersion of polymer in water with surfactants
- Test Substance for Repeated Dose Studies:
 - solid polymer washed free of surfactants, composition before and after washing verified as the same



Polymer : Telomer Acrylate

Toxicology Information

Acute Toxicity*:

- Oral Rat: ALD > 11,000 mg/kg
- Inhalation Rat: 4 hr: ALC = 590 mg/m³
- Skin Irritation: Non-irritating
- Eye Irritation: Moderate, reversible irritation
- Sensitization: Not an irritant or sensitizer in multiple human patch tests

Aquatic Toxicity*

- Rainbow Trout : 96Hr. LC₅₀ = 181 mg/L
- Daphnia Magna : 48Hr. EC₅₀ = 234 mg/L
- Algae : 72Hr. EC₅₀ = 36.2 mg/L

* data generated on aqueous dispersion product



Polymer : Telomer Acrylate Subchronic Oral Study Range-Finder

- Test material: Telomer Acrylate Polymer Solids in water vehicle
- Doses:
 - 0, 1, 10, 100, 1000 mg/kg/day
 - 100% active test substance
- No clinical signs or body weight effects after 45 days at any dose
- Total fluorine levels assessed, steady-state appears to occur around 20 days into dosing
- Fluorine levels in blood are low



Polymer : Telomer Acrylate

Study Summary & Timeline

Test Material	Work	2002				2003			
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Telomer Acrylate Polymer	90-Day Range Finding								
	90 Day Oral Repeat Dose, 1 Gen Repro (Rat)								
	Developmental Study Rangefinder								
	Developmental Study (Rat)								

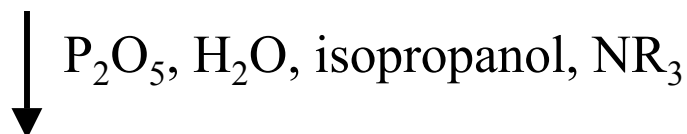
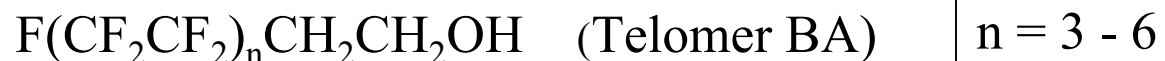
Work Complete

Work Underway

- 90 Day Subchronic Oral: In Progress
Dose Levels : 10, 100, 1000 mg/kg/day
- Reproductive Toxicity: In Progress
Dose Levels : 10, 100, 1000 mg/kg/day
- Developmental Toxicity: In Progress
Dose Levels : 10, 100, 1000 mg/kg/day
- Genetic Toxicity : Negative Ames, Chom Ab



Surfactant : Telomer Phosphate Chemistry



- Products by Process
- BL, B Telomer Distributions tailored to end-use
- Mixture of Mono-, Bis- and Pyro- Phosphate Esters
- Study material contains 25 wt% isopropanol as co-solvent



Surfactant : Telomer Phosphate

Timeline

Test Material	Work	2000		2001				2002				2003			
		3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Telomer Phosphate Surfactant	90-Day Range Finding														
	90 Day Oral Chronic Repeat Dose (Rat)														
	1Gen Reproduction Study (Rat)														
	Developmental Range Finder														
	Developmental Study														
	28 Day Dermal Repeat Dose (Rat)														
	14 Day Inhalation Repeat Dose (Rat)														

Work Complete

Work Underway

- 90 Day Subchronic Oral:
 - Dose Levels : 10, 60, 300 mg/kg/day (35% a.i.)
 - Female NOEL = 60 mg/kg/day
 - Male : NOEL < 10 mg/kg/day
 - Target : liver
- Reproductive Toxicity:
 - Dose Levels : 75, 500, 3500 mg/kg/day (20% a.i.)
 - In Progress
- Developmental Toxicity:
 - Dose Levels : 625, 1250, 2500 mg/kg/day (20% a.i.)
 - In Progress
- Genetic Toxicity :
 - Negative Ames

Surfactant : Telomer Phosphate Toxicology Information

Acute Toxicity*

- Oral Rat: ALD > 17,000 mg/kg; LD₅₀ > 25,000 mg/kg
- Inhalation Rat: 4 hr: ALC = 57 mg/m³
- Skin Irritation: Not a skin irritant
- Eye Irritation: Minimal irritant
- Sensitization: Not an irritant or sensitizer

Aquatic Toxicity*

- Rainbow Trout : 96Hr. LC₅₀ > 1,000 mg/L
- Daphnia Magna : 48Hr. EC₅₀ > 1,000 mg/L
- Algae : 1Q2003

Biodegradability* : OECD 301 70%

* studies conducted on 35% active test material containing isopropanol



Surfactant : Telomer Phosphate Repeated-Dose Toxicology (Rat) : Summary

(35% a.i.; with isopropanol)

- **90 Day Subchronic Oral :**
Dose Levels : 10, 60, 300 mg/kg/day
(IPA containing, 35% a.i.)
Female NOEL = 60 mg/kg/day
Male : NOEL < 10 mg/kg/day
Pathology peer review in progress
- **Inhalation (Two Week) :**
Dose Levels : 0.2, 2.0, 20 mg/m³
- **Dermal (28 Day) :**
Dose Levels : 10, 100, 1000 mg/kg/day
Study Started 29 Oct. 2002

(20% a.i.; no isopropanol)

- **Reproductive Toxicity :**
Dose Levels : 75, 500, 3500 mg/kg/day
Report in Progress
- **Developmental Toxicity :**
Dose Levels : 625, 1250, 2500 mg/kg/day
Report in Progress



*Surfactant : Telomer Phosphate**

90 Day Oral Study Results

Study Conclusion: Female (F) : NOEL = 60 mg/kg/day

Male (M) : NOEL < 10 mg/kg/day

300 mg/kg/day (35% active, with isopropanol)

- low body weight, food parameters (M)
- decreased red cell mass (M)
- liver: elevated enzymes, increased weights, necrosis (M&F)
- kidney: increased weights, hypertrophy (M)
- thyroid: hypertrophy (M&F)

60 mg/kg/day

- liver: elevated enzymes, increased weights, necrosis (M)
- kidney: increased weights, hypertrophy (M)
- thyroid: hypertrophy (M)

10 mg/kg/day

- liver: elevated enzymes, necrosis (M)

* study conducted on 35% active test material containing isopropanol

NOTE: Minimally elevated Beta Oxidation at 60 and 300 mg/kg/day



Surfactant : Telomer Phosphate Reproduction Study Results

Study Conclusion: Report in Progress

(20% a.i., no isopropanol)

Study Design

- Doses : 75, 500, 3500 mg/kg/day
- P1 Pathology
 - the same target organs identified from 90-Day Subchronic Study with isopropanol-containing test material will be evaluated
- In-life Parameters
 - observed body weight effects (M & F) only at the high dose

Study Report Complete: January 2003



Surfactant : Telomer Phosphate Developmental Study Results

Study Conclusion : Report in progress
(20% a.i., no isopropanol)

Study Design

- Doses : 625, 1250, 2500 mg/kg/day

Study Report Complete: December 2002



Surfactant : Telomer Phosphate Two-Week Inhalation Study

Study Status: Report in preparation

Concentrations: 0.2, 2, and 20 mg/m³

Exposures: 6 hrs/day x 9 days, 2-week recovery

Animals: 10 male rats/group

Additional Blood Analysis : total fluorine

- In-life: observed reduced body weight only at high dose
- Necropsy: No increased organ weights at any dose
- Microscopic findings: respiratory tract appears to be the most sensitive target

Study Report Complete : 1Q 2003



Surfactant : Telomer Phosphate 28 Day Dermal Study

Study Status: Study started 29 October 2002

- **Doses:** 10, 100, 1000 mg/kg/day
- **Application:** 6 hrs/day for 28 days
- **Animals:** 10 male rats/group
- **Tissues:** Skin and target tissues identified from oral study
- **Additional Blood Analysis :** total fluorine



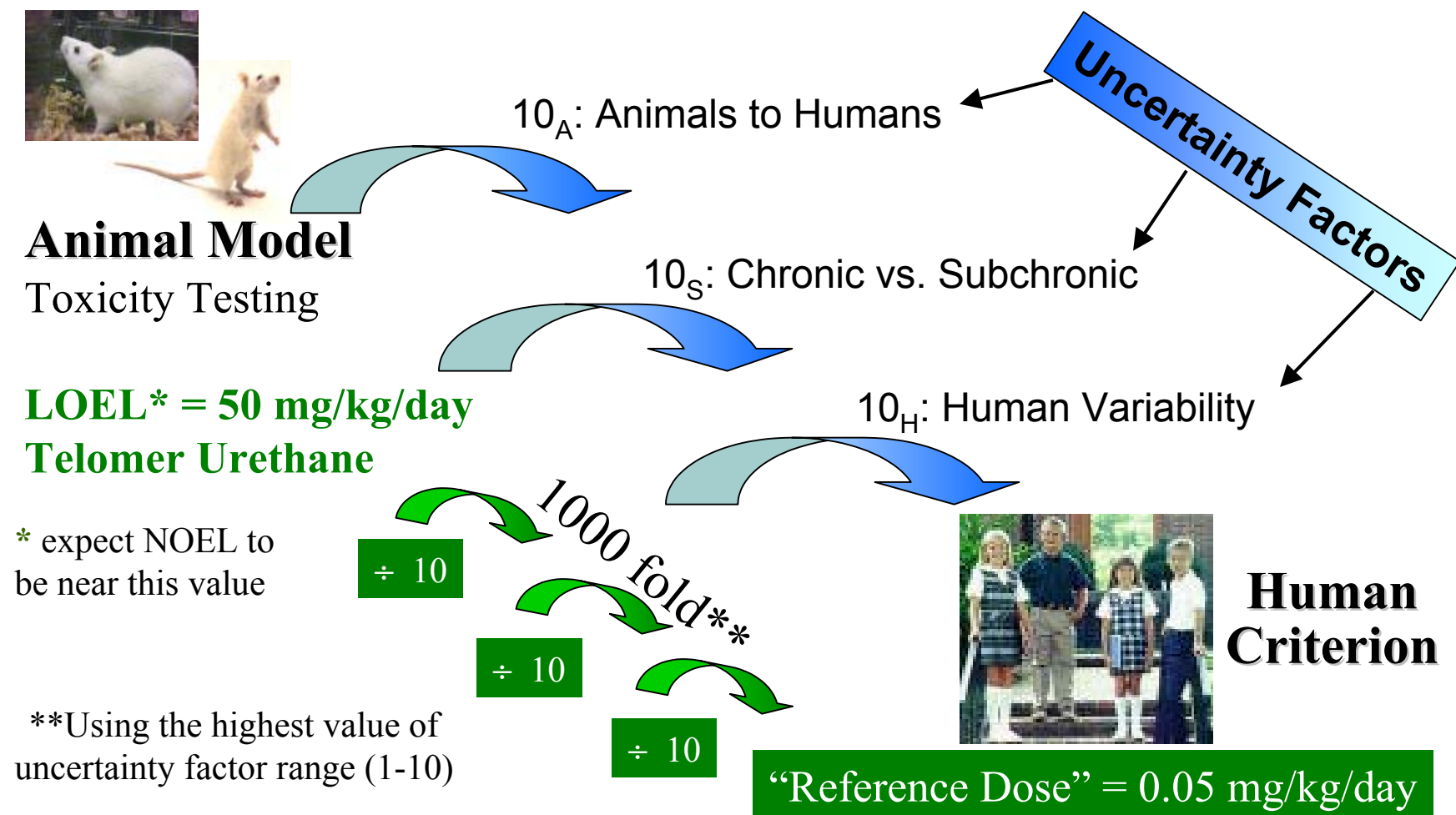
Fluorotelomer Products Repeated-Dose Study Observations

- Common across all DuPont Telomer Product Studies :
 - liver and thyroid hypertrophy : physiological response
 - in the rat : males more sensitive than females
- Target endpoints are unique to each test material
- Plasma and Urine Fluoride values indicate that test materials are processed differently
 - *functionality* appears to drive the observed unique endpoints

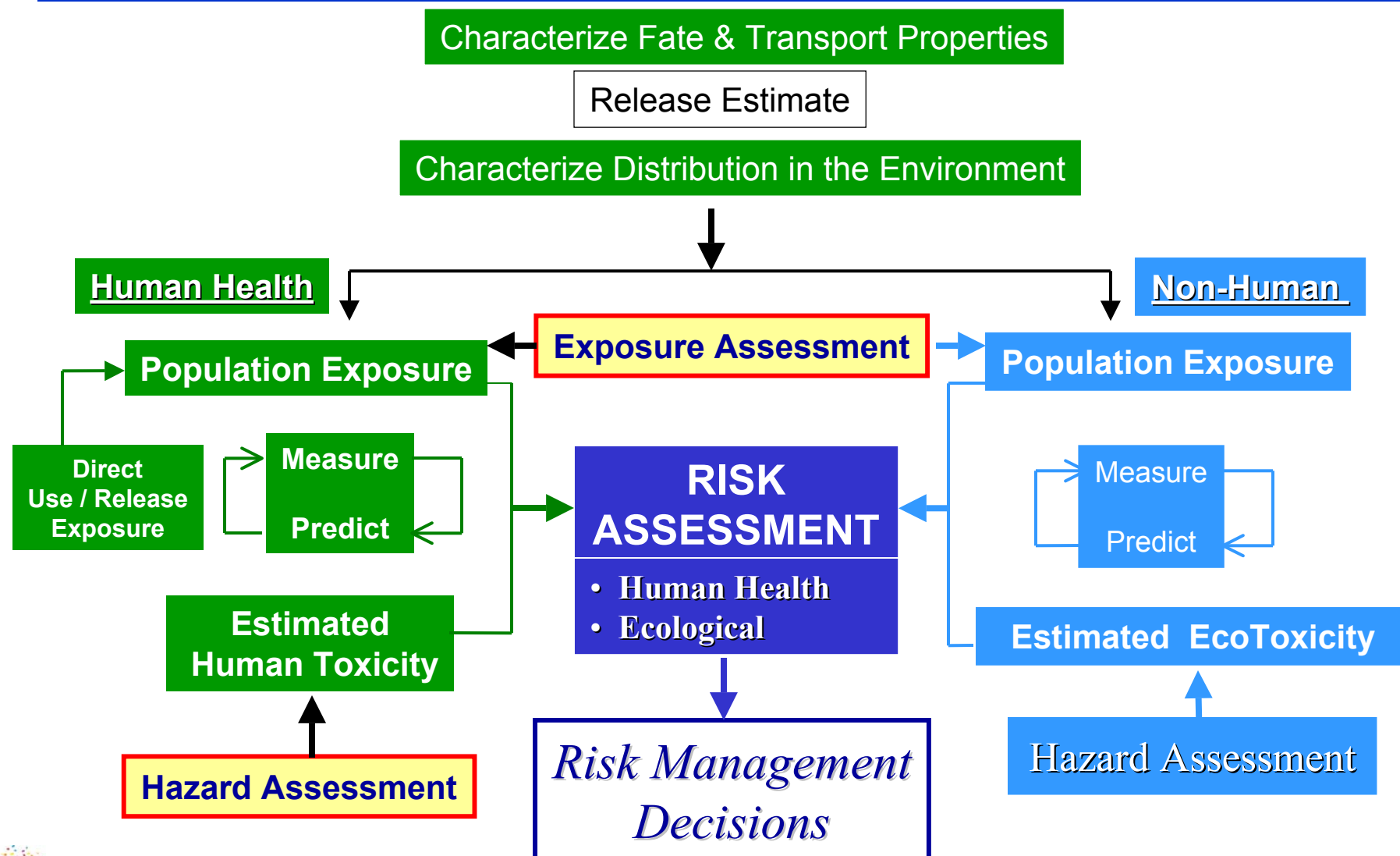


Hazard Assessment Example - "Reference Dose"

- This translates the animal data to a proposed "safe" human exposure level



Risk Assessment Framework



How Did We Approach the Analysis?

- What types of products do we sell?
- Who buys our products?
- What consumer products contain our products?
- How do our customers use our products? In what form?
- How do consumers come in contact with our products?
- What is the magnitude of potential consumer exposure? How much? How often?
- How does exposure compare to what we know about potential hazard? $\Rightarrow$ ***Risk Characterization***



Exposure Assessment Overview

Potentially Exposed Subpopulation	Food Wrap Paper	Carpets	Apparel
Consumer	* Ingestion	* Dermal * Indirect Ingestion	* Dermal

Potentially Exposed Subpopulation	Medical Fabric	Paints	Cleaning Products
Occupational			
Medical Worker	* Dermal		
Garment Worker	* Dermal		
Painter		* Dermal * Inhalation	
Custodial Worker			* Dermal



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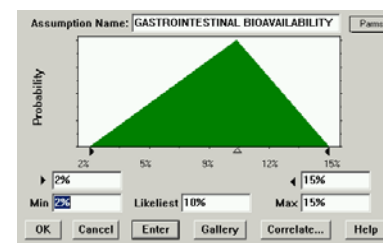
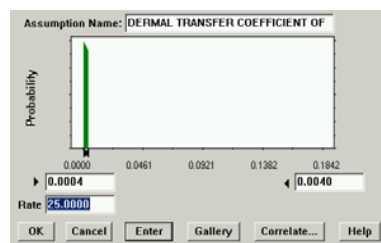
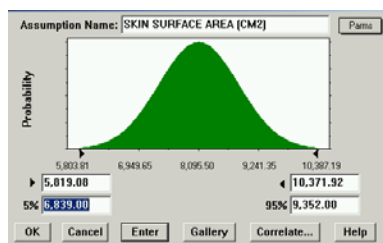
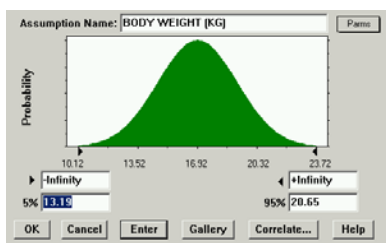
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Critical Exposure Variables

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- Developed point estimates for all necessary variables:
 - (1) Concentration of telomer urethane
 - (2) Loss of polymer over time
 - (3) Exposure period
 - (4) Skin surface area
 - (5) Dermal transfer coefficient
 - (6) Body weight
 - (7) Food surface area
 - (8) Bioavailability of the telomer urethane
- Also developed probabilistic inputs for key parameters in the analysis:



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Exposure Assessment Summary

- We have a great deal of confidence in this assessment and the process we are using.
- We believe that this information supports our belief that our products are safe for their intended uses.
- We are working to develop information with regard to community, ecological and integrated exposure
- We are using this process to identify data needs and to focus our research efforts
- We welcome your feedback on our initial efforts and your support in helping us to move forward



DuPont

Environmental Fate & Effects Work Plan

- We began with Physical-Chemical Property characterization for Telomer B and Telomer B Alcohol Intermediates
- Methods development progress now enables us to begin fate work on products
- Environmental Fate & Effects Study Plans : Product Focus
 - Physical- Chemical Properties
 - Environmental Effects :
 - Acute Data, BCF Screen , Chronic Fish ELS
 - Environmental Fate
 - Intermediate
 - Surfactants
 - Polymers



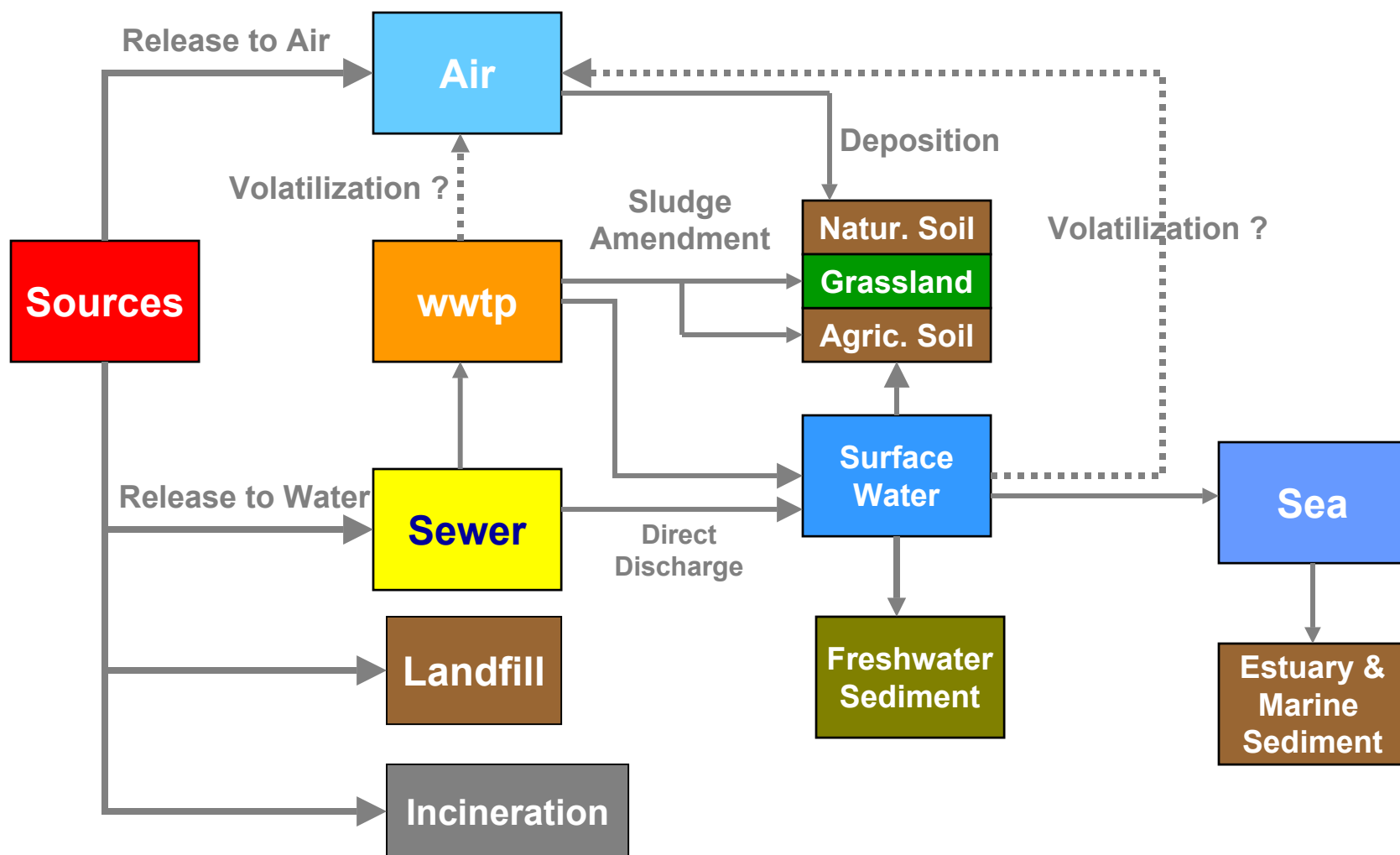
Physical - Chemical Properties : Water Solubility 6-2, 8-2 Telomer B Alcohols & Iodides

	Solubility			
	<u>12°C</u>	<u>25°C</u>	<u>37°C</u>	<u>60°C</u>
C ₆ F ₁₃ CH ₂ CH ₂ OH	12 ppm			17 ppm
C ₈ F ₁₇ CH ₂ CH ₂ OH	130 ± 30 ppb	140 ± 50 ppb	318 ± 176 ppb	225 ± 50 ppb
C ₆ F ₁₃ CH ₂ CH ₂ I	9 ppb			
C ₈ F ₁₇ CH ₂ CH ₂ I				< 10 ppb (LOQ)

- pH 3, 7, 9 ; T = 12, 25, 37, 60°C in deionized water
- see no differences in solubility versus pH
- Telomer Iodide water solubility very low; have decided not to pursue further testing and focus on products



Release, Fate and Effects Compartments



Potential Environmental Routes of Entry

	Intermediates	Surfactants	Polymers
Air	Particle adsorbed or vapor phase?	Fugitive emissions from WWTP?	
Soil	Air Deposition Soil - Landfill Land applied sludge	Landfill Land applied sludge	Landfill Land applied sludge
Sediment	WWTP Air Deposition direct discharge	WWTP direct discharge	Direct discharge - point source
Water	WWTP & Septic direct discharge surface presence?	WWTP & Septic direct discharge surface presence?	WWTP & Septic



DuPont : Acute Environmental Effects Data Summary

	Acute Fish mg/L	Acute Daphnid mg/L	Acute Algae mg/L
Telomer Alcohol Intermediate	96Hr LC ₅₀ = 316 fathead minnow	48Hr EC ₅₀ = 965	72Hr EC ₅₀ = 1,000
Telomer Phosphate Surfactant	96Hr LC ₅₀ > 1,000 rainbow trout	48Hr EC ₅₀ > 1,000	1Q2003
Telomer Ethoxylate Surfactant	96Hr TL ₅₀ = 100-140 rainbow trout	48Hr EC ₅₀ = 72	1Q2003
Telomer Urethane* Polymer	96Hr LC ₅₀ > 4,000 fathead minnow	48Hr EC ₅₀ = 500-5,000	72Hr EC ₅₀ = 870
Telomer Acrylate* Polymer	96Hr LC ₅₀ = 181 fathead minnow	48Hr EC ₅₀ = 234	72Hr EC ₅₀ = 36.2

* tested as sales product including hydrocarbon surfactants



Aquatic Bioconcentration Screening Study

Objective: To conduct *screening* studies evaluating the bioconcentration potential fluorotelomer-based products in fish

Methods:

- Juvenile fathead minnows, flow-through design
- Test Substances (consistent F concentration)
 - Negative Control
 - Positive control : PFOS
 - Surfactants : Telomer Phosphate; Telomer Ethoxylate
 - Intermediate : Telomer Alcohol
 - Polymer : Telomer Urethane
- Stock concentrations and tissue residues analysis – (total Fluorine)
 - Uptake phase – days 0, 2, 5, 7, 9, 12, 14
 - Depuration phase – days 16, 19, 21, 23, 26 28
- In-life complete, data evaluation on-going (complete 1Q2003)



Telomer Phosphate Aquatic Chronic Fish (ELS) Toxicity Test

Objective: To determine a chronic LOEC (lowest observed effect concentration) and a chronic NOEC (no observed effect concentration).

Methods:

- OECD TG 210, OPPTS 850.1400, (90-d trout ELS)
- Dose response - dilution water and solvent (IPA) controls, 0.63, 1.25, 2.5, 5, and 10 mg/L Telomer Phosphate (a complex mixture)
- Analytical confirmation of test concentrations
- Analysis by LC/MS

Start Date : 8 November 2002

Est. Completion Date (in-life): 8 February 2003



DuPont Fluorotelomer-based Products Environmental Effects Studies Timeline*

Test Materials	Work	2002				2003			
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
8-2& 6-2 B, BA	Physical Properties								
Multiple Compounds Intermediate, Surfactant and Polymer	Bioconcentration Factor (BCF) Screen (Fathead Minnow) I								
Phosphate Surfactant	90 Day Fish ELS (GLP)								
	72Hr Algae (GLP)								
Ethoxylate Surfactant	90 Day Fish ELS (GLP)								
	72Hr Algae (GLP)								
Acrylate Polymer	Acute Aquatic Study Set								

Work Complete

Work Underway

Work Planned

* This is a proposed timeline and subject to change.



E-Fate Studies Approach

	Intermediates	Surfactants	Polymers
Abiotic	• Photolysis - Air • Photolysis - Water • Hydrolysis • Adsorption-Desorption (Kd) • Aging / Sequestration	• Hydrolytic Stability • Adsorption-Desorption • Aging / Sequestration	• Hydrolytic Stability
Biotic	• Aerobic : Ready, Inherent • Anaerobic	• Respiration Inhibition • Aerobic : Ready, Inherent	• Respiration Inhibition • Aerobic : Ready, Inherent • Anaerobic ?
	Telomer Research Program 8-2 Telomer B Alcohol	DuPont Focus on Products	



Telomer-Based Surfactants & Polymers

Abiotic Transformation : Hydrolytic Stability

Surfactants

Phosphate, Ethoxylate

Polymers

Urethane, Acrylate

- Reactions in water are one of the most common means of non-biological degradation of substances in the environment.
- Aqueous stability tests should be performed at environmentally and biologically relevant pH's and temperatures.
 - pH 4, 7, 9 @ 50°C
 - pH 1.2 @ 37°C
- Four replicates at 0 and 5 Days

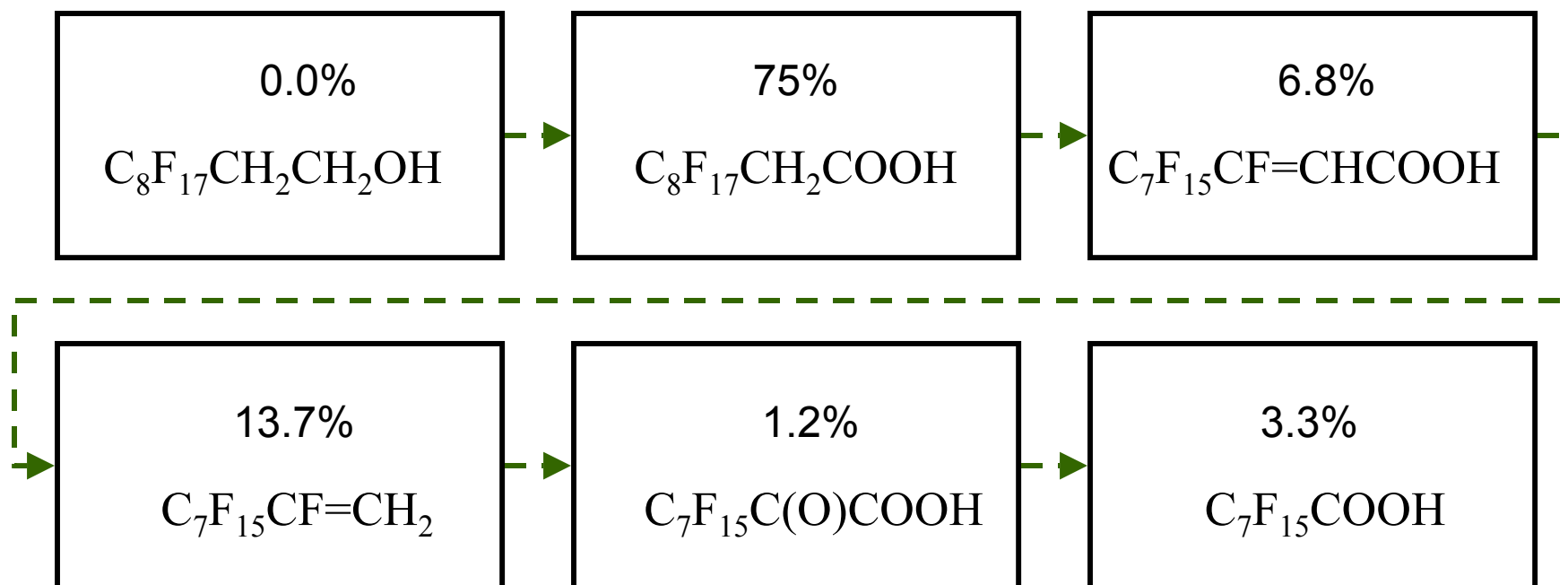
8-2 Telomer B Alcohol Biodegradation Studies

- “Ready” Biodegradability Screening
- “Inherent” Accelerated Biodegradability Screening
- “Cold” Study material
- Qualitative Identification & Analysis
- Enable method development



CATABOL Biodegradation Prediction

$C_8F_{17}CH_2CH_2OH$



- The sum of the % values = 100
- The model *predicts* this will be the distribution of transformation products

Accelerated Biodegradation Screening

Acclimated Municipal Sludge : $C_8F_{17}CH_2CH_2OH$ (8-2TBA)

Growth Medium:

E2-BSMYE buffer and minerals plus 20 g/L yeast extract as organic nutrient. Incubated at room temperature (21-25°C)

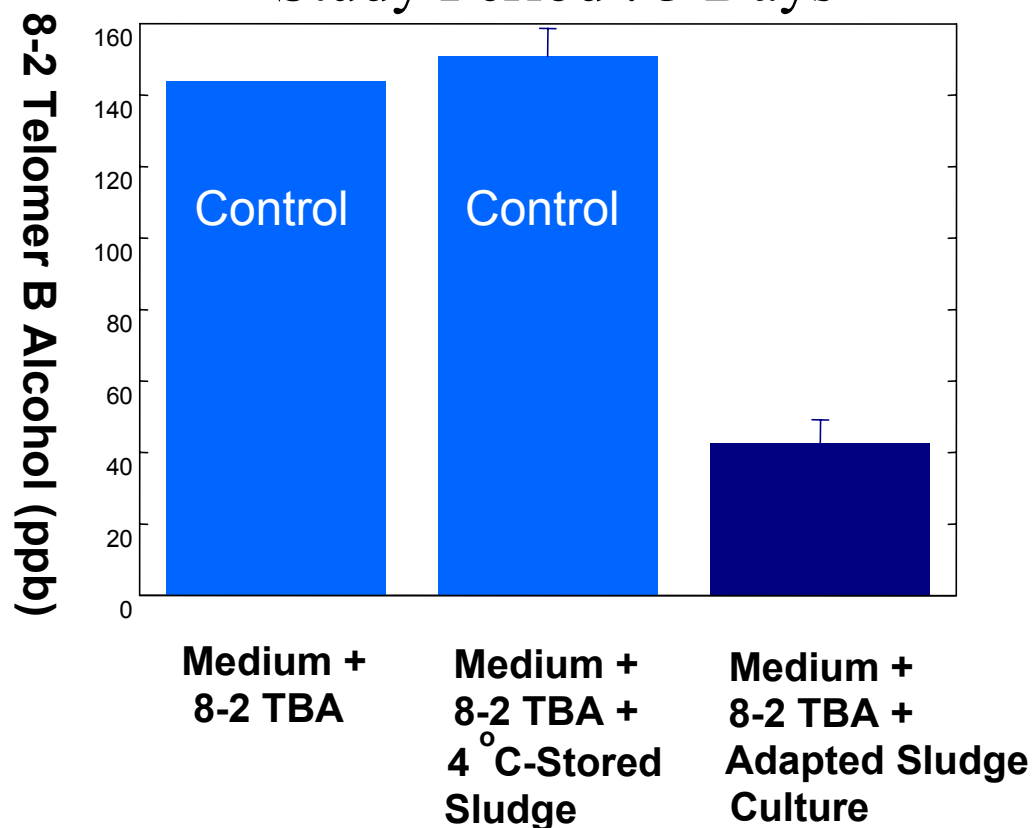
Inoculum source:

Municipal POTW (Incubated for 3 days)

Conclusion

- Test material is transformed with adapted sludge

Study Period : 3 Days



Modified "Ready" Aerobic Biodegradation Screening with Non-acclimated Municipal Sludge : $C_8F_{17}CH_2CH_2OH$

Growth medium:

OECD 301D mineral medium
+ 4 mg/L yeast extract as
organic nutrient

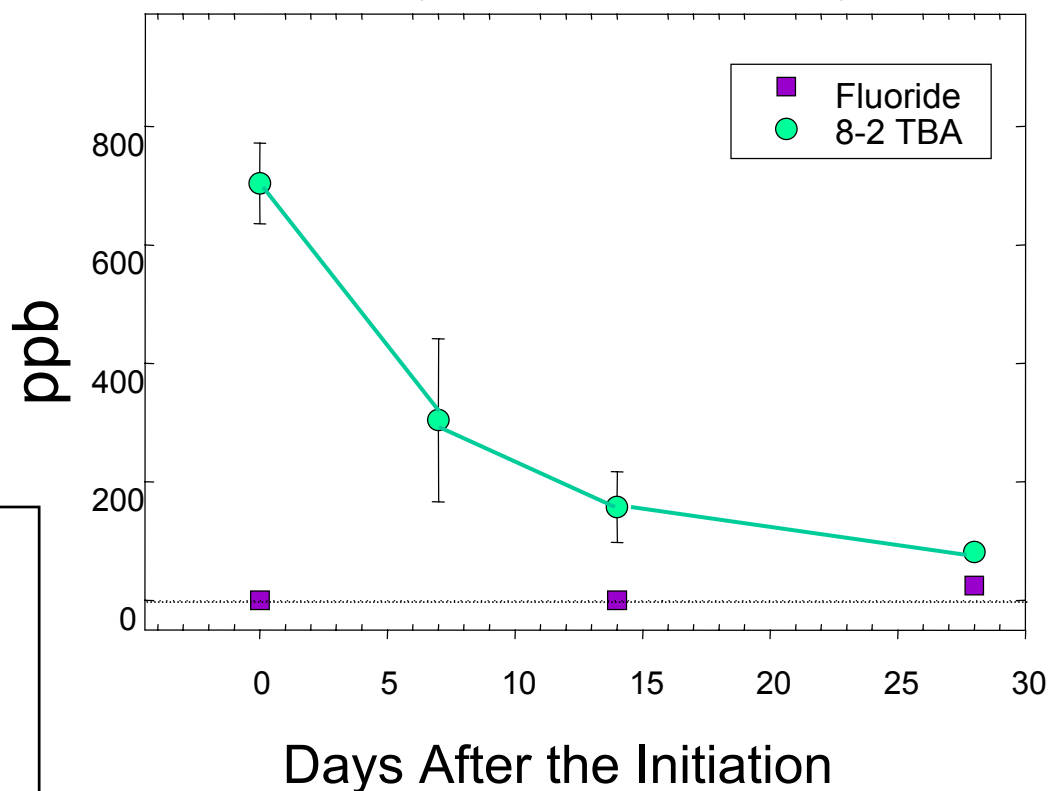
Inoculum source:

Municipal POTW, fresh
sludge; non-acclimated
(Incubated for 0 - 28 days)

Conclusion

- Test material decreases
- No significant fluoride concentration increase

Study Period : 28 Days



Accelerated Aerobic/Anaerobic Biodegradation Screening

Acclimated Industrial Sludge : $C_8F_{17}CH_2CH_2OH$

- 8-2 TBA + Fresh Sludge
- CONTROL : 8-2 TBA, Sludge, 2 mM NaCN

Growth Medium:

E2-BSMYE (1 g/L yeast extract as organic nutrient)

Inoculum source:

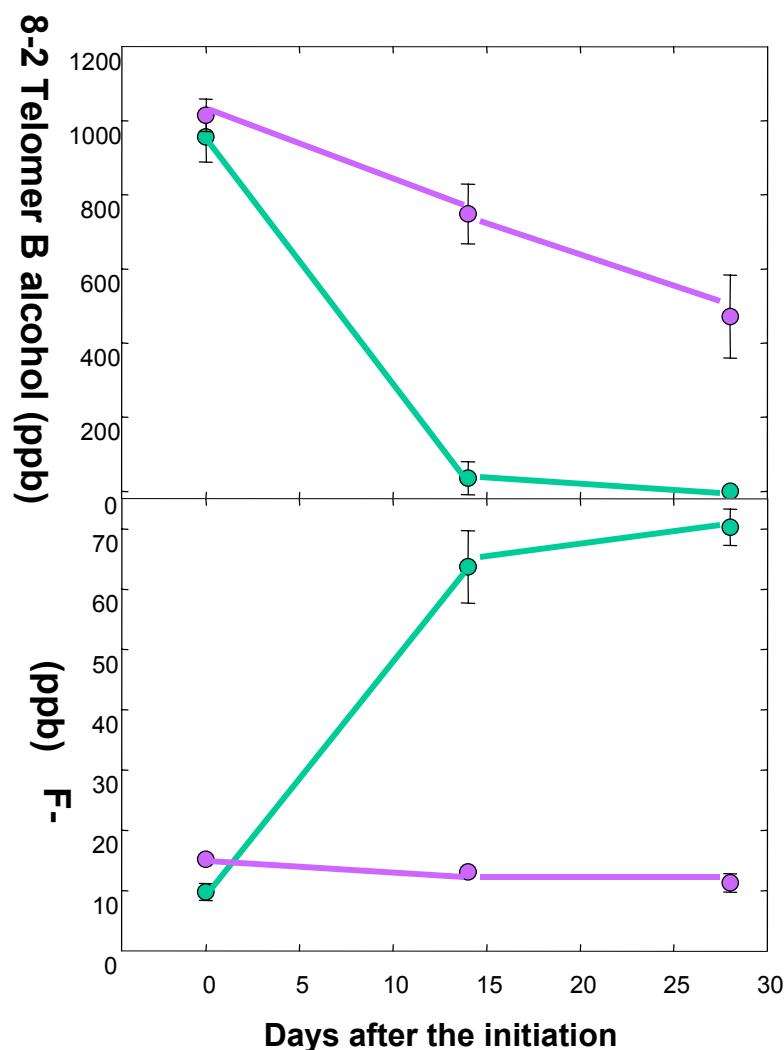
Industrial WWTP; acclimated (28 days)

Extraction Efficiency (%):

115.8 ± 11.0

Conclusion

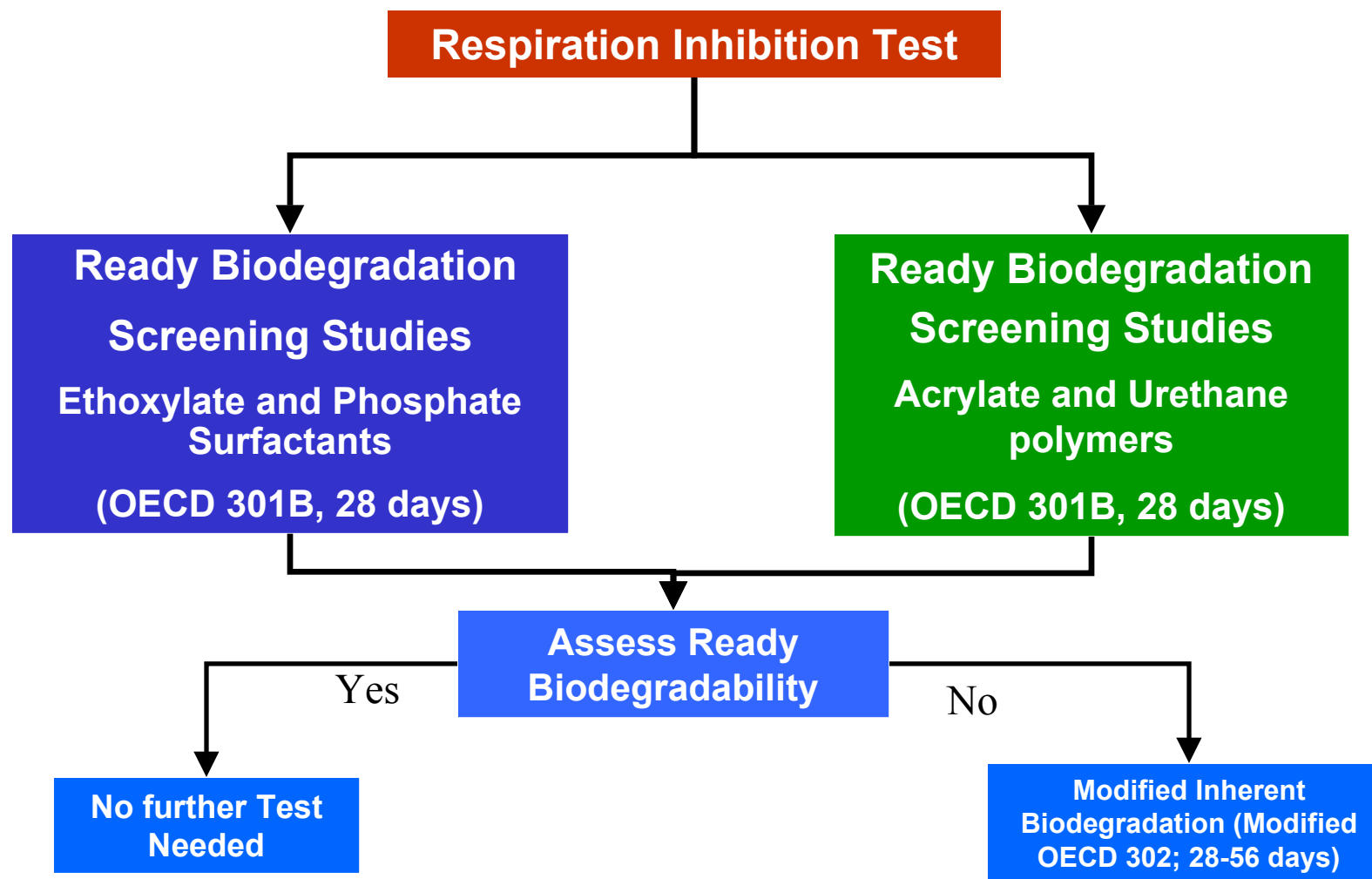
- Test material is readily transformed
- Significant fluoride formation



8-2 Telomer B Alcohol Biodegradation Screening Studies Summary

- Under modified “ready biodegradability” conditions, little de-fluorination occurred and $\text{C}_8\text{F}_{17}\text{CH}_2\text{COOH}$ appears to be the primary metabolite.
- Under modified accelerated conditions, transformation is rapid
 - Primary transformation products observed are :
 - $\text{C}_8\text{F}_{17}\text{CH}_2\text{COOH}$
 - $\text{C}_7\text{F}_{15}\text{CF}=\text{CHCOOH}$
 - Mass balance <50%; Other products/losses?
- On-going studies to understand controls, incomplete recoveries, and other transformation products

Telomer-based Surfactants & Polymers Biodegradation Studies



Telomer-based Surfactants & Polymers **Aerobic "Ready" Biodegradation**

Measured End Points:

- Time course of CO₂ evolution rate
- Time course of [F⁻] increase
- Total fluorine at the beginning and the end of the experiment
- Dissolved Organic Carbon (DOC) at zero (0) and 28 days

- Prework:
 - Total Organic Carbon (TOC) determination on test substance



DuPont Fluorotelomer-based Products Environmental Fate Studies Timeline*

Test Materials	Work	2002				2003			
		1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
C₈F₁₇CH₂CH₂OH	Respiration Inhibition								
	"Ready" Biodegradation Screening								
	"Inherent" Biodegradation Screening								
Telomer Phosphate Surfactant	Hydrolytic Stability								
	Respiration Inhibition								
	Biodegradation Screening								
Telomer Ethoxylate Surfactant	Hydrolytic Stability								
	Respiration Inhibition								
	Biodegradation Screening								
Telomer Urethane Polymer	Hydrolytic Stability								
	Respiration Inhibition								
	Biodegradation Screening								
Telomer Acrylate Polymer	Hydrolytic Stability								
	Respiration Inhibition								
	Biodegradation Screening								
		Work Complete				Work Underway		Work Planned	

* This is a proposed timeline and subject to change.



Chemical Standards

- To achieve quantitative precision in transformation studies
- **Isotopically - Labeled Standards**
 - M+5 : $\text{C}_7\text{F}_{15}^{13}\text{CF}_2\text{CD}_2\text{CD}_2\text{OH}$ (internal standard)
 - M+2 : $\text{C}_6\text{F}_{13}^{13}\text{CF}_2^{13}\text{COOH}$
- **“Cold” Standards**
 - $\text{C}_8\text{F}_{17}\text{CH}_2\text{COOH}$
 - $\text{C}_7\text{F}_{15}\text{CF}=\text{CHCOOH}$

DuPont Fluorotelomer-Based Products

Product Stewardship Summary

- *We have been proactive and diligent* in meeting our commitments to better understand toxicity, environmental fate & effects and exposure.
- *We are taking a comprehensive approach* to understanding exposure.
- *We are confident* that our products are safe for their intended uses.
- *We have programs in place* to learn more about our products: Toxicology, Environmental Fate & Effect, Exposure
- *We will continue to have an open & frequent dialogue* with Regulators, Customers, and Employees



Reflections, Discussion, Questions

