

# Environmental Issues Affecting Foam Use

Presented by

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**NFPA World Fire Safety Congress**

**May 14, 2001**



**HUGHES ASSOCIATES, INC.**

**FIRE SCIENCE & ENGINEERING**

# The Presentation Today

- Background
  - What the situation is
- EPA Presentation
  - More bad news
  - I'm just the messenger
- What might happen



# Foam in Fire Fighting

- Class B flammable liquid foam
  - AFFF, FFFP, FP, AR
- Aircraft crash rescue
- Aircraft hangers
- Petro-chemical
  - Process, storage tank, distribution
- Flammable liquid warehousing
- Response
  - Municipal, industrial



# Foam Constituents

- Formulations based on performance, not constituents
- UL 162, US Mil-Spec
- Main Ingredients in Foam Solution:
  - WATER - 98%-99%
  - Fluorosurfactants & Hydrocarbon Surfactants: 0.03% – 0.45%
  - Butyl Carbitol (Glycol Ether): 0.5% – 1.1%
  - Ethylene Glycol (Not in all formulations): 0.34% – 0.60%
  - Urea (Not in all formulations): 0.2 – 0.4%
  - Xantham gum (alcohol resistant formulations)



# Foam 'Environmental' Properties

- Biochemical Oxygen Demand and Chemical Oxygen Demand
  - BOD/COD
- Aquatic Toxicity
  - LC50, Killiefish
- Foams
  - Nuisance, unsightly
- Hazardous Air Pollutants (HAPS)
  - Reporting to the EPA
- Disrupts Waste Water Treatment Plants
  - Gets you in big trouble



# Foam Environmental Requirements

- US Mil-Spec has some
  - BOD/COD, minnow LC50
- UL (FM) do not have requirements
- Federal requirements dispersed
  - CAA, CWA
  - Not specific to foam, but to the constituents
- Local requirements may be most restrictive
  - Most difficult to define



# 3M's Announcement

## May 16, 2000

- 3M was a (the) major producer of foam
- Unexpectedly announced manufacturing would be discontinued of “PFOS” based products
- The products affected were many
  - Light Water
  - Scotchguard
  - Scotchban
  - Literally dozens of others
- 2 – 3% of total revenues (\$300,000,000)
- Foam was a small portion of this, about 5%



# Persistence - Bioaccumulation - Toxicity

## Only the Fluorochemical Surfactants (FCS) Are a Concern

- Persistence
  - Doesn't go away in the environment
- Bioaccumulation
  - Builds up in living tissue
- Toxicity
  - Has a negative effect on humans/environment

***“PBT” This is a regulatory and environmentalist target***



# Why Did 3M Do It?

- Persistence is known
- Found chemical all over
  - Humans and animals
- Some new toxicity testing raised concerns

## *PBT*

- Not regulated (yet), Liability?



# What is a Fluorosurfactant? And Why Do We Care?

- The *key* chemical constituent in foam
  - rapid fire knockdown
  - film formation: positive spreading coefficient
  - fuel shedding
  - foaming
  - *FOAM AIN'T FOAM WITHOUT IT!*
    - Only straight protein or synthetics don't have FCS
- Long perfluoronated carbon chain
- No other class of chemicals has the right properties



# Other Foams (not 3M)

- If this was only a 3M problem
  - Supply, compatibility, listings
- But, all FCS (for foam) have a similar chemical backbone
  - A fluorinated carbon chain

This could be the basis of a wider problem



# Fluorochemical Surfactants (FCS)

- 3M
  - Electrochemical fluorination process
  - PFOS “based”
  - The biodegradation product is the PFOS molecule
    - if 8 carbons in the chain
- Other fluorosurfactant suppliers
  - Telomerization process
  - *Not* PFOS “based”
  - The biodegradation product **MAY BE** the PFOA molecule
    - if 8 carbons in the chain



# Who makes FCS?

- 3M made FCS (electrochemical)
  - 3M also formulated their own foams
- Atofina, Clariant, DuPont, Daikin, Asahi (telomerization)
  - They sell intermediates or finished FCS
  - They do not formulate their own foams
    - Ansul, National (Kidde FF), Angus, Chemguard



# **EPA Activities/Issues on Fluorosurfactants**

Mary F. Dominiak

U.S. Environmental Protection Agency

DoD Fire & Emergency Services Workgroup

January 23-24, 2001

# Issues and Status

- Discovery of perfluorooctyl sulfonates (PFOS) in humans and wildlife worldwide.
- Concern: Data indicate PFOS chemicals are persistent, bioaccumulative, and toxic.
- 3M phasing out 90 PFOS chemicals by 2003; EPA proposed regulation to follow voluntary phaseout.
- EPA has concerns on related chemistries (PFOA, telomers); assessment and research are underway.
- PFOS, PFOA, and telomers are used in MilSpec AFFF products.

# Additional Information

- PFOS levels found
  - general population: 0 – 100 ppb
  - 3M production workers: 1 – 10 ppm
  - toxic effects seen in tests: 100 – 1000 ppm
- Unknown how it gets in people/wildlife
  - Scotchgard, stain repellent
  - Scotchban, grease treatment with food contact
  - specialty applications, like foam



# Status of PFOS Rulemaking

- EPA published Proposed Significant New Use Rule (SNUR) on 90 PFOS chemicals (65 FR 62319, 10/18/2000), consonant with 3M phaseout.
- Proposed SNUR is not a ban:
  - Would require companies to file notice with EPA 90 days before beginning new manufacture or import of listed PFOS chemicals. EPA could grant, deny, or impose conditions on intended use.
  - Would not affect continued use of stocks of chemicals obtained before the end of the phaseout period.
- Comment period extended to 1/1/2001.
- Public meeting in February 2001 in DC.

# Status of PFOS Rulemaking

- 25 comments filed.
- Most comments challenge legal basis of proposed SNUR; also request exemptions for specific uses of PFOS chemicals as being essential, low volume, and low exposure.
- Claimed essential uses include photoresists in semiconductor manufacture; aviation hydraulic fluids; and some photolithography.
- Comments currently under review.

# UPDATE

- Public meeting on SNUR held on March 27
  - Final rule has been delayed while more data comes in
  - How will legal challenge be handled?
- Presentations for exemptions
  - relatively low use compared to foam
  - relatively little exposure to humans
  - most PFOS is ultimately incinerated, not released
- If these exemptions are not granted, foam would have tough time with an exemption



# Related Chemistry Concerns

- PFOA & telomer chemicals raise similar concerns:
  - Known persistence.
  - PFOA toxicity data in public literature.
  - Question: similar bioaccumulative potential?
  - Question: similar fate and transport?
  - Question: similar widespread exposure?
- EPA hazard assessment on PFOA underway; preliminary conclusions likely by June 2001.
- Telomer producers began voluntary testing in 2000; data to be available in 2002.

# Future EPA Actions

- PFOS:
  - Assess and respond to comments on proposed SNUR for 90 3M phaseout PFOS chemicals.
  - Consider need/options for action on other PFOS chemicals.
- PFOA:
  - Complete preliminary hazard assessment by June 2001.
  - Identify needs/options for action.

# Future EPA Actions

- **Telomers:**
  - Begin EPA review of existing data.
  - Review submissions from voluntary industry testing program in 2001-2002.
- **International Activities:**
  - Participate in initial assessment of PFOS by Organization for Economic Cooperation and Development, January 2001; further action to be determined.

# ADDITIONAL INFORMATION

- If Telomers biodegrade to PFOA then
  - PFOA decisions impact on telomers
    - do not need to wait 2 years for telomer data
  - EPA actions will affect both
- PFOA has been found in blood samples and wildlife
  - But lower levels and less widespread than PFOS



# Future EPA Actions

- Regulatory actions available under the Toxic Substances Control Act include:
  - Testing requirements (section 4).
  - SNURs, new chemical reviews (section 5).
  - Manufacturing, use, disposal rules (section 6).
  - Information submission (section 8).
- TSCA uses an “unreasonable risk” standard balancing hazard, exposure, benefits, costs, availability of alternatives at time of proposal.

# Future Actions

- Voluntary activity may be expected in lieu of or while regulatory activities are pending.
  - If assessments raise liability concerns, more companies may elect to discontinue chemicals.
  - New chemicals are being submitted to EPA for review as potential substitutes for PFOS/PFOA.
    - Presence of new chemical alternatives may affect TSCA “unreasonable risk” determinations.

# AFFF Implications

- Current EPA activities would *not* restrict continued use of PFOS-based AFFF stocks obtained prior to the 12/31/2002 phaseout.
- Current EPA activities *would* prevent manufacture or import of PFOS after phaseout, *including* PFOS-based AFFF, *unless* 90-day notice filed and approved.

# ADDITIONAL INFORMATION

- 3M has stated they will stop production for foam before the 2002 phaseout
  - Production currently limited to ATC and military
- 3M has stated they will not ask for an exemption for foam (nor would they use one)
- It is not believed that PFOS FCS are imported for foam



# AFFF Implications

- Non-PFOS-based AFFF products formulated with PFOA or telomers *may be affected* by ongoing EPA reviews of these related chemistries, and *may be subject* to future regulatory or voluntary risk management actions.
  - Persistence is known: information on toxicity, bioaccumulative potential being assessed or collected.
  - Initial assessments will be completed in 2001-2002.
  - Regulatory proceedings average 2-5 years.

# AFFF Implications

- A program to seek, test, and consider long-range alternatives to current fluorosurfactant-based AFFF would be prudent.
  - Health and environmental concerns generally argue for a move away from persistent chemicals where possible.
  - Ongoing EPA activities provide a multi-year window for development, evaluation, and qualification of alternatives, while still allowing access to and use of stocks of currently accepted chemicals.

# ADDITIONAL INFORMATION

- EPA's posture has evolved rapidly
  - Summer of 2000
    - Glad 3M voluntarily got out - faster than regulations
    - Will look at related chemicals
    - No action needed
  - Fall of 2000
    - PFOS is gone, it really is bad
    - Related chemicals are a concern, but too early to tell
    - No action needed soon
  - Winter of 2001
    - PFOS regulations being done to insure its gone
    - Related chemicals look bad
    - Time to get alternatives



# For Further Information

- Mary F. Dominiak, 202-260-7768,  
dominiak.mary@epa.gov
- Karen Lannon, 202-260-2797,  
lannon.karen@epa.gov
- For data CDs from PFOS file (AR-226),  
TSCA NCIC, 202-260-7099, Monday-  
Friday, noon to 16:00 Eastern time.

# Summary

## ■ 3M

Electrochemical process -> FC surfactant -> PFOS = “PBT”

- Persistence is accepted
- Bioaccumulation has been found
- Toxicity issues exist

## ■ Others

Telomerization process -> FC surfactant -> ? PFOA (or PFOA homologues) = ?

- Persistence is well established
- Bioaccumulation is being studied,
  - but PFOA *IS* found in human blood and wildlife
- Toxicity is in the open literature



# Summary

- Electrofluorination (3M, Meteni, ?)
- Creates PFOS and PFOA
  - And derivatives of both
- These are used to create FCS
- These biodegrade back down to PFOS and PFOA
- PFOS and PFOA are problems



# Summary

- Telomerization (non-3M foams)
- Telomers and derivatives
  - 6, 8, and 10 carbon chains
- Generally, only the 6 carbon chain is used for foam FCS
- Biodegradation product not established yet
  - Believed to be the carboxylic acid
  - If 8 carbon chain, this would be PFOA



# Summary

- FCS are unique and vital to foam
- 3M “PFOS” is over
  - 3M will stop producing for foam
  - EPA is generating regulations to keep others out
- Telomer FCS are being examined
  - EPA may generate regulations in the future
  - International issue
  - Lawyers and environmentalists are “watching”



# What Near Term Impact Does This Have?

- 3M foam availability
- Use of existing foam stocks
- What to purchase tomorrow



# 3M Formulations

- No regulatory restrictions
- Supply chain still has stocks that can be purchased
  - Production of ATC and foam for military on-going
- Re-fill of fixed systems with non-3M foam
  - Concentrate compatibility
  - UL Listings
- Other agents have similar performance
  - QPL/UL includes several manufacturers
  - These are not PFOS based products



# Use of existing stocks of foam

- This includes ALL foams with FCS
- Limited unnecessary releases
  - Don't want to add to the loading of persistent chemicals
  - For other environmental reasons
  - System testing, Training, Accidental releases
- Limit unnecessary human exposure
- *Do* fight fires
  - A long way from not allowing fire fighting



# What to purchase tomorrow

- No regulatory restrictions on commercially available foams
- Only FCS based foams provide high level of performance
  - Non-FCS synthetics DO NOT perform as well
    - Knockdown
    - Burnback
  - Straight protein foam generally requires 60% higher application rates
- In the future, buyer beware



# What long term impact does this have?

- Best case
- Worst case
- “Guess” case



# Best Case

- Telomers are clean
  - Unlikely
- Foam not a significant contributor
  - Maybe - tight use restrictions helpful
  - Reduction of FCS levels
- Son of AFFF appears
  - ?????
  - Now is the time, don't hold back!



# Worst Case

- Other FCS suppliers pull a 3M
  - unlikely
  - need the data on telomer/PFOA
    - 6 to 18 months
  - supply chain will take time to drain
    - conservation efforts important
- No foam of equal performance available



# “Guess” Case

- Telomer/PFOA data comes in
  - nominally 6-12 months
  - not generally favorable
  - some suppliers stop, some don't
- Regulation/negotiation ensues
  - EPA takes several years
  - some production continues
- Small production allowed for critical uses
  - highly regulated and likely very expensive
- Fire protection adapts



# A little good news

- Research efforts being proposed
  - DoD funding appears to be coming
  - Commercial interest is growing
- Tremendous interest in new technology
  - Reduced levels of FCS in high performance foam
    - 30%-60% reduction
  - Non-FCS containing foams
  - New FCS that are not PBT
  - New technology, outside the box



# Conclusion

## Telomer FCS Foams

- Do not contain PFOS or PFOA
- Formulations at relatively low FCS levels
- Biodegradation products are not established
  - Telomer Research Program (TRP) Group
  - 2 year multi-million dollar study



# Conclusions

- New products show up
  - No truly environmentally benign foam
  - Foaming itself is an environmental problem
- How to define (test) environmental acceptability?
- Must be careful not to drive it to the lowest fire performance but best environmental properties
- Trade off between
  - environmental properties
  - fire performance capability



# **Keep Your Eye on the Goal**

*Excellent Fire Protection Provided  
in an  
Environmentally Responsible Manner*

