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APFO Use and Exposure Peer Review

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Introductory Reminders

- Legal Considerations
- Focus on Methodology and Assumptions
- Leave prior history at the door

Areas of Focus

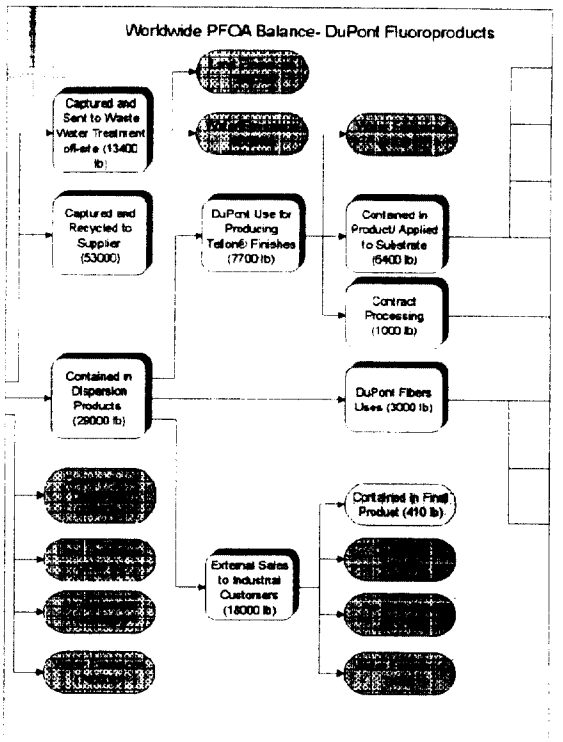
- Mass Balance of APFO in DuPont Fluoroproducts
- DuPont OH practices and results
- Customer issues and practices

Scope of Review

- Worldwide DuPont Fluoropolymers
  - Analysis does not include DDE
- Most examples will be US specific
  - US market of fluoropolymer dispersion mirrors worldwide market
  - DuPont US OH practices are similar to those in the Netherlands and Japan
  - Most data is available for US

DuPont Fluoropolymer Business Overview

- 3 Major Manufacturing Sites
  - Washington Works
  - Dordrecht, The Netherlands
  - Shimizu Japan (50/50 JV)
- 4 Teflon® Finishes Sites
  - Parlin, NJ
  - Mechelen, Belgium
  - Shenzhen, China
  - Madurai, India
- 6 Major Product Lines
  - Homopolymers
    - Granular
    - Fine Powder
    - Dispersions (All contain APFO)
  - CoPolymers
    - FEP (some Dispersions)
    - PFA(some Dispersions)
    - Tefzel®


Worldwide PFOA Balance- DuPont Fluoroproducts
Captured and Sent to Waste Water Treatment off-site (13400 lb)
Captured and Recycled to Supplier (53000)
DuPont Use for Producing Teflon® Finishes (7700 lb)
Contained in Product/ Applied to Substrate (6400 lb)
Contract Processing (1000 lb)
Contained in Dispersion Products (29000 lb)
DuPont Fibers Uses (3000 lb)
External Sales to Industrial Customers (18000 lb)
Contained in Final Product (410 lb)

Mass Balance Assumptions

- **Dry Resin APFO Content**
  - Test measurements in Copolymers (approx. 2ppm)
  - Routine Measurements in Fine Powder (<10ppm)
  - Granular uses very little in recipe, drying removes all
  - Used 7ppm average for mass balance

Mass Balance Assumptions

- Plant Emissions
  - Usage based on cost sheet amounts, recipe formulations; Cross checked with purchases and inventory differences.
  - In Process measurements used to characterize emissions
    - recovery efficiency
  - Engineering calculations based on measurements
  - Waste Characterizations
    - specific to each manufacturing plant
  - Chambers Works WWTP distribution based on one sampling event

Mass Balance Assumptions

- APFO content in dispersions based on:
  - recipes
  - measurements of APFO in some products
  - expected distribution in other products
- 1999 US sales used to calculate total APFO
  - Ratio of US sales to worldwide sales used to calculate total APFO contained in dispersion products

Comparison of DuPont with Fluoropolymer Industry

DuPont		FMG
APFO Use 104Tonnes		200 Tonnes
Emitted 53%		60%
Water	68%	>50%
Air	26%	25%
Land	6%	<25%
Reprocessed 23%		15%
Destroyed 12%		10%
In Products 13%		15%

DuPont Fluoroproducts APFO Containment Policy

- **Scope:** This policy shall be used for developing basic data for APFO containment, use reduction and recycle projects at Fluoropolymer manufacturing facilities. It is not intended to be the Fluoroproducts policy as it relates to customer facilities.
- **Hierarchy of Emission Control:** Sites should use the following hierarchy for considering where to focus resources. More resources should be devoted, where technology exists and where practical, to items higher on the list.
  - Water Emission Reduction
  - Air Emission Reduction
  - Land Emission Reduction (where land emissions cannot be avoided, APFO containing wastes should be handled in secure facilities)
- **Sites should also consider the following methods when developing programs to reduce emissions with use reduction being the most desirable method to control emissions:**
  - Use reduction
  - Recovery for direct recycle
  - Recovery for recycle with purification
  - Capture for destruction

DuPont Fluoroproducts Emission Control Policy (Continued)

- **Emission Control Policy:**
  - DuPont Fluoroproducts will comply with all existing regulations concerning APFO emissions
  - Sites will consider reasonably foreseeable regulations when developing emission reduction programs.
  - Sites will consider any special local issues (beyond regulations) that are important when designing emission reduction programs.
  - Sites will use the best technology that is technological and economically feasible to reduce emissions. It is expected that reductions of 75-90% based on the source mass loading may be achieved for most emission points
- **Emissions reduction activities should be prioritized based on the following criteria:**
  - Regulatory environment and special local issues at the various using sites
  - Amount of mass loading to the environment being abated.
  - The hierarchy of emission control
  - The state of development of the technology to be used.

Fate of APFO in Dispersions

- Experience in Teflon® Finishes used for in-process yield losses:
  - 0.5-1.0% loss to water
- 3 Classes of customer end uses:
  - Dispersion coating with no heating of product (<3%)
  - Dispersion coating with subsequent heating to dry (<5%)
  - Dispersion coating with subsequent sintering of product (>93%)

Fate of APFO in Dispersions

- Dispersion coating with no heating of product
  - All APFO ends up in product
- Dispersion coating with subsequent heating to dry
  - All APFO considered as air emission
- Dispersion coating with subsequent sintering of product
  - All APFO considered destroyed
  - Data from study by Paul Krusic, CR&D

Issues with AFPO Fate Determination in Dispersions

- APFO will sublime on to ducts/stacks if surface is cooler than approx. 120C
  - Air emissions on heating to dry may be lower
- Configuration of sintering ovens may allow APFO to be emitted without going through sintering zone
  - Destruction rate would be considerably lower
- Working with major dispersion customer to understand and sharpen our pencil

Fate of APFO in Teflon® Finishes

- Dispersions are blended with pigments, binders, solvents and sold as a "paint."
- Finish is sprayed on to substrate with 60 to 70% yield
  - In >80% of use overspray is contained by water spray systems (most to water, some to air)
  - In remaining use overspray is captured on dry filter media (most to land, some to air)
- Finish is cured at >350C
  - Same issues as with dispersion customers processing

Washington Works Personal Monitoring-APFO

Year	Sample Type	Samples	Minimum Concentration (mpb)	Maximum Concentration (mpb)	Mean (mpb)	Standard Deviation
[illegible]	Partial Shift	100	<0.01	0.58	0.061	0.151
1998		83	.001	0.78	0.103	0.145
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1996	[illegible]	73	N/D	0.29	0.055	0.069

- AEL for APFO is 0.01 mg/m3 = 0.56 ppb
- Logan Analysis shows that most jobs are in compliance AEL
- Where jobs are out of compliance, specific tasks or locations have been identified where significant exposure occur. Engineering controls and/or respiratory protection taken in these cases

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Comparison of 1989 to 2000 by Job Classification (ppm)

JOB	DESCRIPTION	2000 Average (n)	1995 AVERAGE (n)	1989 AVERAGE (n)
08/18AI	Office Admin	0.48 (8)		
08AA	FP/D FLS	1.98 (3)		
08PC	Monomer Operator	[illegible] (4)		
08PC	autoclave	**4.1 (4)**	[illegible].5 (6)	4.7 (7)
08PF	polykettle	**6.5 (5)**	2.9 (7)	4.0 (4)
08PH	dispersion	1.1 (2)	[illegible]	3.2 (3)
08PI	FP finishing	**3.8 (3)**	[illegible]	[illegible] (6)
08PJ	FP packout		0.6 (5)	
08PM	C-8 dryer recovery	[illegible]	1.7 (2)	
18PA	FEP polykettle	1.6 (4)	2.3 (4)	
18PB	FEP extruder/oven	1.1 (5)	1.6 (5)	3.5 (3)
18PC	FEP wet finishing		[illegible]	
18PD	FEP packout		0.1 [illegible]	
18PF	Tefzel/PFA/FP	0.4 (3)		
18PJ	PFA/FEP bead	1.5 (2)	0.7 (2)	
18PK	FEP safety/disp		0.1 (1)	
RESULTS SUMMARY - MECHANICS				
58MC	FP/disp/gran/TA	1.3 (4)	1.4 (1)	
58MD	general shift		1.1 (9)	
58MG	process E&I		0.6 (7)	
68MA	general shift	0.1 (1)	1.1 (5)	
68MB	FEP E&I		0.9 (7)	

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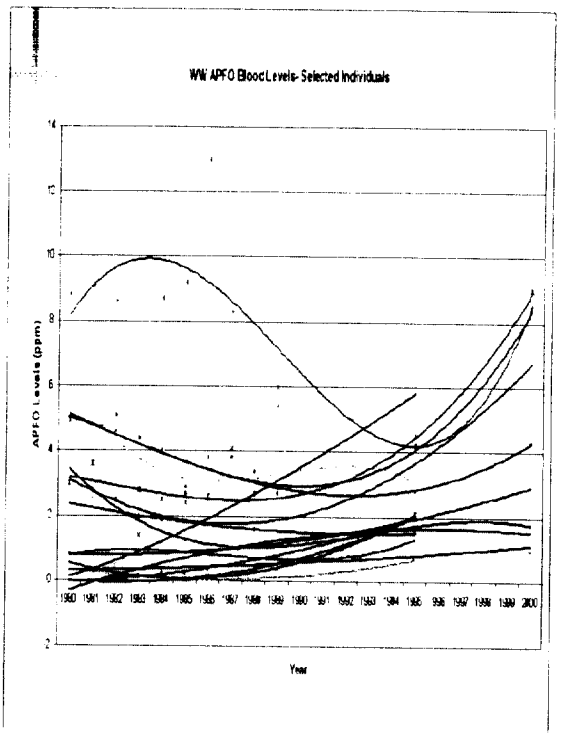
WV APFO Blood Levels- Selected Individuals
APFO Levels (ppm)
Year

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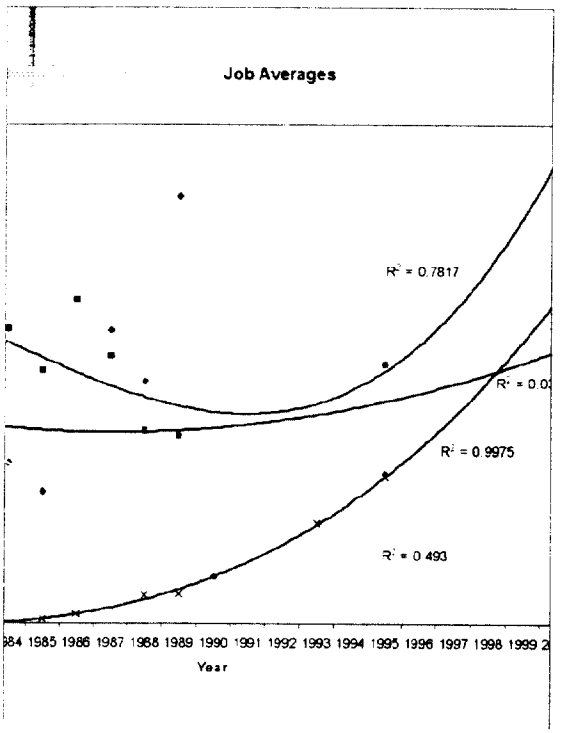
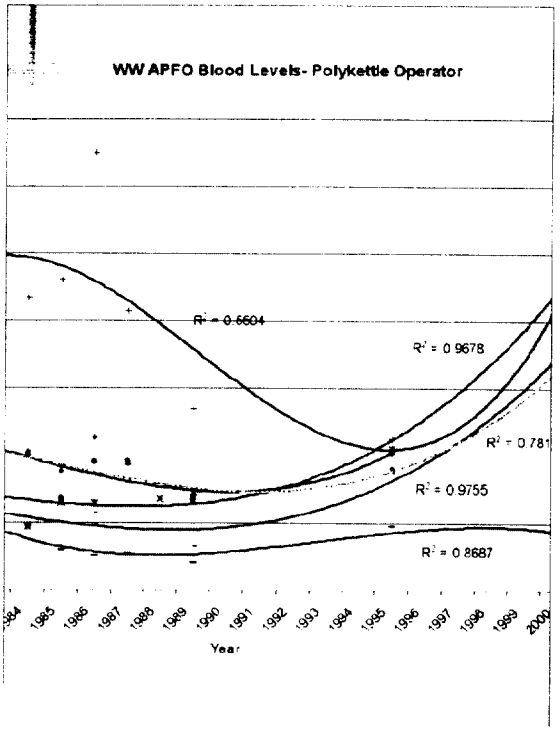
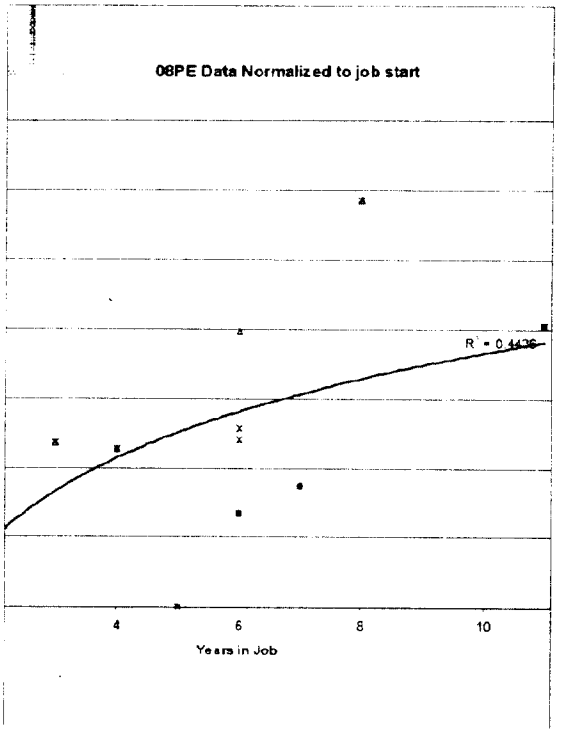

Job Averages
R² = 0.7817
R² = 0.0
R² = 0.9975
R² = 0.493
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2
Year


WW APFO Blood Levels- Polykettle Operator
R² = 0.6604
R² = 0.9678
R² = 0.781
R² = 0.9755
R² = 0.8687
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Year


08PE Data Normalized to job start
R² = 0.1436
4
6
8
10
Years in Job

Disclaimer on Observations

"It is very important to recognize the serious limitations on the usefulness of this(sic) data. These include the small size of most of the data sets, the frequent transfer of site employees from one job to another, and the slow rate at which C-8 blood levels decrease after exposure stops."

In the analysis completed, statistical rigor was not used in all cases due to the small size of the data set.

Observations

- *"Different employees with long tenure in the same job sometimes show marked differences in their blood level... This can be due to either different work habits or differences in individual metabolism." Not so sure that this is the case based on 2000 data.*
- **"Comparison of average job blood levels from the 1995 and 1989 studies is badly confused by the fact that much of the data is not from the same people.** Levels in 1995 seem somewhat lower on the average than in 1989, and this is probably due to reduced skin contact following the use of C-8 liquid solutions instead of the dry powder."
- The individual data points tend to be trending down from 1980-1990. From 1990-1995, no conclusions can be drawn from the data to determine if the concentrations are going up or staying flat. **In 2000, the general average has dropped (1.16ppm from 1.57ppm) but three job classifications have shown a significant increase.**
- For most individuals and jobs, blood concentrations seem to be stabilizing at 2-4 ppm
- **Job 08PE, autoclave operator data allows an analysis to be completed normalized for low levels when they started in the job. Though confounded by the different time frames (spanning the time when dry and solution APFO were used), the data seem to point to suggest a steady increase in concentrations up to about 4 ppm**

Note: items in quotes are taken from AJ Playtis summary, May 7, 1996

Bold items are observations that are from the 2000 sampling round.

Italics item is an observation from 1995 that may not be valid based on 2000 data

Next Steps for DuPont Fluoroproducts

- Work with biggest dispersion customer to understand
  - Exposure potential
  - Emissions vs. Destruction
- Understand Finishes customer exposure potential by monitoring internal labs
- Institute Emissions Control Policy
- Develop more robust bio-monitoring program
- Continue leadership position with FMG: implement 5 point program:
  - Reproduction study
  - Environmental Fate and Effects
  - Mass Balance across industry
  - Pharmacokinetics work
  - Commitment to containment