

## **Studies on the Toxicological and Environmental Properties of PFBA as of July 2008**

### **I. Perfluorobutyrate or Perfluorobutanoic Acid (PFBA) and its ammonium or potassium salts**

#### ***A. Human Data***

1. Olsen, et al., Estimation of the Half-life of Serum Elimination of Perfluorobutyrate (PFBA) in Four 3M Male Employees, 3M Final Report, July 18, 2007
2. Olsen, et al., Descriptive Analysis of Perfluorobutyrate (PFBA) in Sera Collected in 2005 from Former and Current 3M Cottage Grove Employees Who Resided in Selected Communities of Washington and Dakota Counties, 3M Final Report, July 20, 2007
3. Olsen, et al., Descriptive analysis of perfluorobutyrate (PFBA) and perfluorobutanesulfonate (PFBS) in sera collected in 2006 from 3M Cordova Electronic Materials factory employees, July 30, 2007
4. Cover letter to EPA and 3M Environmental Laboratory Analytical Report, Initial Quantitative Screening of Commercial Lots of Human Serum Obtained in 2004 for Endogenous Fluorochemicals Using Protein Precipitation and Liquid Chromatography Tandem Mass Spectrometry, Lab Request Number E05-0120, revised August 12, 2005, U.S. EPA docket AR-226-3547
5. 3M's August 1, 2007 presentation to MDH regarding PFBA human biomonitoring and human half life study.
6. Blood sampling data conducted by plaintiffs' counsel in Washington County:
  - a. Spreadsheet summarizing plaintiffs' PFBA blood data. Plaintiffs analyzed blood from 76 Washington County residents for PFBA. Of those 76 residents' samples, only 4 had levels above the detection limit for PFBA (5 percent of the samples tested). The four individuals were in the range of 1.6 to 2.8 ppb (ng/mL) in serum.
  - b. Letter from Robert Bilott to U.S. EPA, dated May 12, 2005, with attached laboratory sheets;
  - c. Letter from Robert Bilott to U.S. EPA, dated October 20, 2005, with attached laboratory sheets;
  - d. Letter from Robert Bilott to U.S. EPA, dated January 13, 2006, with attached laboratory sheets;

- e. 3M Letter to U.S. EPA, dated August 4, 2006, enclosing July 18 letter from Robert Bilott and attached laboratory sheets;
- f. Letter from Robert Bilott to U.S. EPA, dated February 2, 2007, with attached laboratory sheets; and
- g. 3M Letter to U.S. EPA, dated May 8, 2007.

#### ***B. Risk Assessment***

- 7. Clewell, Harvey and Tan, Cecilia, Preliminary Risk Assessment for Perfluorobutanoic Acid (PFBA), submitted to MDH February, 2008.

#### ***C. Toxicology Studies***

- 8. 3M presentation to MDH September 2006
- 9. 3M presentation to MDH November 2006
- 10. 3M presentation to MDH March 2007
- 11. 3M presentation to MDH August 2007
- 12. 3M presentation to the House of Representatives Health and Human Services Working Group: PFC Oversight December 2007

#### Repeat-Dose Studies

- 13. Van Otterdijk, F.M., Repeated Dose 90-Day Oral toxicity study with MTDID 8391 [PFBA] by Daily Gavage in the Rat Followed by a 3-week Recovery Period. NOTOX BV Laboratory, December 21, 2007
- 14. Van Otterdijk, F.M., Repeated Dose 28-Day Oral Toxicity Study with MTDID-8391 [PFBA] by Daily Gavage in the Rat, Followed by a 21-Day Recovery Period, Final Report, NOTOX B.V. Laboratory, December 2006
- 15. Lieder, et al., Twenty-Eight Day Oral Toxicity Study of Perfluorobutyrate in Rats, abstract and poster presented at 2007 annual meeting of the Society of Toxicology ("SOT") (SOT abstracts are published as a supplement to the journal *Toxicological Sciences* titled the *Toxicologist* and are available at [www.toxicology.org](http://www.toxicology.org)).
- 16. Lieder, et al., Twenty-Eight Day Oral Toxicity Study of Perfluorobutyrate in Rats, abstract and poster, presented at SOT CCT February 2007
- 17. Gaylor, David W., Benchmark Dose Calculations for Ammonium Perfluorobutyrate (PFBA), December 2007, submitted to MDH
- 18. Charles River Laboratories, A 5-Day Repeat Dose Oral Toxicity Screening Study in Rats with a 7-Day Recovery Period with MTDID-

25. Buskens, C.A.F., NOTOX B.V., Evaluation of the Ability of MTDID 8391 [PFBA] to Induce Chromosome Aberrations in Cultured Peripheral Human Lymphocytes (with Repeat Experiment), October 24, 2006

#### Developmental Studies

26. Das, et al., Effects of Perfluorobutyrate Exposure during Pregnancy in the Mouse, *Toxicological Sciences* (2008) [electronic publication ahead of print]

#### Thyroid Studies

27. Chang, et. al., Effects of Perfluorobutyrate on Thyroid Hormone Status in Rats, poster presentation, EPA PFAA Days Workshop (June 2008)

#### Other Literature

28. Ikeda, T. et al., "The Induction of Peroxisome Proliferation in Rat Liver by Perfluorinated Fatty Acids, Metabolically Inert Derivatives of Fatty Acids," *J. Biochem.* 98(2): 475-82 (1985)
29. Just, W. et al., "Biochemical Effects and Zonal Heterogeneity of Peroxisome Proliferation Induced by Perfluorocarboxylic Acids in Rat Liver," *Hepatology* 9(4): 570-81 (1989)
30. Intrasuksri, U. & Feller, D., "Comparison of the effects of selected monocarboxylic, dicarboxylic and perfluorinated fatty acids on peroxisome proliferation in primary cultured rat hepatocytes," *Biochem. Pharmacol.* 42(1): 184-88 (1991)
31. Kozuka, H. et al., "Characteristics of induction of peroxisomal fatty acid oxidation-related enzymes in rat liver by drugs: relationships between structure and inducing activity," *Biochem. Pharmacol.* 41(4): 617-23 (1991)
32. Kozuka et. al., Characteristics of peroxisome proliferation: co-induction of peroxisomal fatty acid oxidation-related enzymes with microsomal laurate hydroxylase. *Chem Pharm Bull* (Tokyo). 39(5):1267-71 (1991)
33. Takagi, A. et al., "Short-term exposure to the peroxisome proliferators, perfluorooctanoic acid and perfluorodecanoic acid, causes significant increase of 8-hydroxydeoxyguanosine in liver DNA of rats," *Cancer Lett.* 57(1): 55-60 (1991)
34. Vanden Heuvel, J., et al., "Inhibition of Long-Chain Acyl-CoA Synthetase by the Peroxisome Proliferator Perfluorodecanoic Acid in Rat Hepatocytes," *Biochemical Pharmacology*, 42:295-302 (1991)
35. Permadi, H., et al., "Effects of perfluoro fatty acids on xenobiotic-metabolizing enzymes, enzymes which detoxify reactive forms of oxygen

and lipid peroxidation in mouse liver,” *Biochem. Pharmacol.* 44(6): 1183-91 (1992)

36. Permadi, H. et al., “Effects of perfluoro fatty acids on peroxisome proliferation and mitochondrial size in mouse liver: dose and time factors and effect of chain length,” *Xenobiotica* 23(7): 761-70 (1993)
37. Feller, D.R. and U. Intrasukri, “Mechanism of peroxisome proliferation by perfluorinated fatty acids in primary cultures of rat hepatocytes,” (abstract) *Toxicologist* 13:395, item 1547 (1993)

#### Acute Studies

Note: Study reports from 1949 and 1950 are not available, and reliability of data or data recording on index cards has not been verified.

38. Index card of data, dermal absorption in rabbits, Hazleton, Jan. 10, 1950
39. Index card of data, LD50 values by oral, intraperitoneal and intravenous exposure in mice, Hazleton, Jan. 10, 1950
40. Index cards of data, acute intraperitoneal injection in mice, intravenous injection in rabbits, 1949

### ***D. Environmental Studies***

#### Treatability Studies

41. Mader, B. T., Evaluation of point-of-use water treatment devices for the removal of fluorochemicals from water, E07-0079, August 2007
42. 3M Environmental Laboratory, Assessment of Fluorochemical Removal from Groundwater by Granulated Activated Carbon using Laboratory-Scale Accelerated Carbon Column Test, Round 2, E-05-0427, November 21, 2006
43. Mader, B.T., Evaluation of the Removal of Fluorochemicals from Water using Ion Exchange Resins, E06-0507, February 2007
44. Vecitis, et al., Sonochemical Destruction of Persistent Organic Pollutants Presentation to American Chemical Society 2007 Annual Meeting
45. 3M Environmental Laboratory, Testing of the 3M Cottage Grove Center Wastewater Treatment Plant Activated Carbon System (without attachments), E04-0642, February 2004
  - a. 3M Environmental Laboratory, Testing of the 3M Cottage Grove Center Wastewater Treatment Plant Activated Carbon System (with attachments), E04-0642, February 2004

#### Ecotoxicity Studies

46. Data sheet, 96-Hour acute static toxicity in fathead minnow, LR-7364, Dec. 18, 1981

47. Printout, 96-Hour sludge toxicity results (FC-23), LR-7364, Jan. 7, 1982
48. Letter report from AScI Corporation, dated April 1, 1998, summarizing preliminary toxicity assessments of normal perfluorobutyric acid for *Daphnia magna*, fathead minnows and *Selenastrum capricornatum*
49. Minderhout, et al., PFBA: A non-GLP 96-Hour Static Rangefinding Test with the Chironomid (*Chironomous tentans*), Wildlife International, Ltd., August 9, 2007
50. Minderhout, Tui and Krueger, Henry O., PFBA: A non-GLP 96-Hour Static Rangefinding Test with the Green Frog (*Rana clamitans*), Wildlife International, Ltd., August 9, 2007
51. Minderhout, et al., PFBA: A non-GLP 96-Hour Static Rangefinding Test with the Cladoceran (*Ceriodaphnia dubia*), Wildlife International, Ltd., August 9, 2007
52. Minderhout, et al., PFBA: A non-GLP 96-Hour Static Rangefinding Test with the Oligochaete (*Lumbriculus variegatus*), Wildlife International, Ltd., August 9, 2007
53. Minderhout, et al., PFBA: A non-GLP 96-Hour Static Rangefinding Test with the Freshwater Mussel (*Elliptio complanata*), Wildlife International, Ltd., August 9, 2007
54. Minderhout, et al., PFBA: A non-GLP 96-Hour Static Rangefinding Test with the Rainbow Trout (*Oncorhynchus mykiss*), Wildlife International, Ltd., August 9, 2007
55. Thomas, et al., PFBA: A 48-Hour Static Acute Toxicity Test with the Cladoceran (*Daphnia Magna*), Wildlife International, Ltd., April 28, 2008
56. Thomas, et al., PFBA: A 96-Hour Static Acute Toxicity Test with the Bluegill (*Lepomis macrochirus*), Wildlife International, Ltd., April 22, 2008
57. Thomas, et al., PFBA: A 96-Hour Static Acute Toxicity Test with the Fathead Minnow (*Pimephales promelas*), Wildlife International, Ltd., April 28, 2008
58. Thomas, et al., PFBA: A 96-Hour Static Acute Toxicity Test with the *Hyaella azteca*, Wildlife International, Ltd., May 13, 2008

#### ***E. Isoperfluorobutyric acid***

##### Environmental Studies

59. Amato, et al., Iso Perfluorobutyric Acid: Green Alga Growth Inhibition Test, OECD 201, AScI Corporation ID# 5030-047-04, Sept. 24, 1999

60. Amato, et al., Iso Perfluorobutyric Acid: Activated Sludge, Respiration Inhibition Test, OECD 209, AScI Corporation ID# 5030-047-05, July 15, 1999
61. Amato, et al., Iso Perfluorobutyric Acid: Fish, Acute Toxicity Test, OECD 203, AScI Corporation ID# 5030-047-03, Apr. 12, 1999
62. Amato, et al., Iso Perfluorobutyric Acid: Daphnia Acute Immobilization Test, OECD 202, AScI Corporation ID# 5030-047-02, Apr. 12, 1999
63. Christensen, Validation of an Analytical Method for Use in Determination of Test Item Concentrations in Various Matrices, AScI Corporation ID# 5030-047-01, Dec. 1, 1998

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