PFC Risk Assessment

Health Risk Assessment Unit
Minnesota Department of Health
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PFC Risk Assessment

- Goal:
  - Determine the concentrations of PFCs in water and fish that are protective of public health
- Steps:
  - Develop a protective dose (reference dose) based on toxicity studies and consideration of uncertainty
  - Determine exposure values (e.g., water consumption appropriate for the public)
  - Calculate water and fish tissue concentrations that should have no known long-term or short-term health effects

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Available Data

- Minnesota toxicologists connected to national research and risk assessment work
  - Staff contacted researchers at the EPA, other states, and industry to acquire all available information on PFC toxicity
  - Staff share results of Minnesota's risk assessment
- Minnesota provides input on the
  - Design and completion of studies conducted at EPA and 3M
  - Federal interpretation of novel studies and data needs

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PFC Toxicity

- PFCs are toxic
  - Toxic to rats, mice, and non-human primates
  - Scant evidence of human toxicity
- Sufficient data on PFOA and PFOS
  - Includes data on the longer retention of the chemical in humans compared to laboratory animals
  - Includes short-term and long-term studies
  - Still many unknowns and ongoing studies

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PFC Toxicity

- Insufficient data on PFBA
  - Only one 4 week study has been completed
- Insufficient data on other PFCs
  - PFCs larger than C8 may be more toxic
  - However, cannot predict a pattern of toxicity or accumulation based only on the chain length

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PFOA Toxicity

- Studies
  - Monkey study (six month study)
    - Increased liver weight
    - Each dose caused an effect, some severe
  - Rat studies (up to 2 years) —changes in development, blood, liver, and immune system
- Difference between monkeys and humans
  - 3.8 year half-life in humans compared to 20 day half-life in monkeys
  - Over time, the dose in humans will be higher than the dose given to the monkeys

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PFOA Toxicity, continued

- Dose of concern 3,000 ug/kg-d
- Divide by 70-fold to calculate the equivalent human dose
- Divide by 300-fold uncertainty factor
  - Animal to human uncertainty (3x)
  - Intraspecies variability (10x)
  - Lack of a no effect level in the study (10x)
- Result: Reference dose of 0.14 ug/kg-d

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PFOS Toxicity

- Study
  - Monkey study
    - Six month study
    - Decreased “good” cholesterol and thyroid hormones
    - Each dose caused an effect, although minimal at the lowest dose tested
  - Difference between monkeys and humans
    - 5.4 year half-life in humans compared to 0.3 year half-life in monkeys
    - Over time, the dose in humans will be higher than the dose given to the monkeys

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PFOS Toxicity, continued

- Dose of concern 150 ug/kg-d
- Divide by 20-fold to calculate the equivalent human dose
- Divide by 100-fold uncertainty factor
  - Animal to human uncertainty (3x)
  - Intraspecies variability (10x)
  - Use of a minimal low effect level in the study (3x)
- Result: Reference dose of 0.075 ug/kg-d

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PFBA Toxicity

- Completed Studies
  - 28-day study (3M) – draft report
    - Liver weight increase and decreased cholesterol
  - Toxicity studies conducted in 1980-90s
    - 5 to 14-day exposures
    - Compared PFOA, PFBA, and PFAA effects on liver
- Summary
  - Suggest the liver is a primary target
  - Suggest less toxic than than PFOA
  - Shorter half-life in various test animals

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PFBA Toxicity, continued

- Ongoing studies
  - Developmental study (EPA) – ongoing
    - developmental delays and weight effects found; final results not available
  - 90-day study (3M)
    - results will not be available until March 2008
  - Study of the possible mechanism of toxicity in mice (EPA, UM)

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PFC Human Health Effects

- Worker Studies of PFOA and PFOS
  - Hormone levels, liver enzymes monitored
  - Half-life calculated
  - PFOA and PFOS blood levels rise with increasing exposure

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PFC Human Health Effects, cont.

- There are no specific levels of PFCs in human blood that are associated with adverse health effects
- Some inconsistent associations found
- Other PFCs not studied as extensively
  - Short chain chemicals (C4) generally do not accumulate in the body
  - C6 sulfonate and PFCs larger than C8 accumulate in the human body

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PFC Exposure

- Worker studies
  - 3M
  - DuPont
- Community exposure measurements
  - Red Cross blood bank
  - Oakdale
  - National Health and Nutrition Examination Survey
- Large-scale epidemiologic study
  - In Ohio/West Virginia
  - PFOA exposures

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PFC Exposure

- We all have PFCs in our blood and it likely comes from many sources
- In risk assessment, we should take into account:
  - Exposures from multiple sources of PFCs
  - Long half lives in humans
  - Consider all portions of the population (infants to elderly, those who drink a large amount of water, eat a lot of fish)

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PFC Exposure

- Multiple sources of exposure are taken into account
  - Relative source contribution factor of 0.2
- Long half lives in humans means that water intake are calculated over a corresponding long time period
  - PFOA 19 years intake; 0.053 L/kg-d
  - PFOS 27 years intake; 0.048 L/kg-d
- Calculations on water intake are based on 95% of the population

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PFC Risk Assessment

- Health Based Values (HBV) for Water
  - Inputs
    - Monkey-to-human adjusted Reference Doses
    - Long-term water intakes (in L/kg-d)
    - Standard relative source contribution factor of 0.2
  - Level in water that is protective
    - HBV of 0.3 ppb for PFOS
    - HBV of 0.5 ppb for PFOA
    - Guidance of 1 ppb for PFBA

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PFC Risk Assessment

- PFOS Health Based Calculation for Fish
  - Inputs
    - Monkey-to-human adjusted Reference Doses
    - Meal ratio of 227 g fish/ 70 kg human body weight
  - Limit meals based on concentration in fish
    - greater than 38 ppb fish=1 meal per week
    - greater than 160 ppb fish=1 meal per month

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