NIEHS, National Toxicology Program
NIOSH, Industrywide Studies Branch
Interagency Agreement

Update on Current Research

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for Elizabeth Whelan
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NTP and NIOSH: Common Goals

• To provide scientific data and knowledge necessary for making appropriate decisions that protect and improve public health.

• Establish and maintain partnerships with other federal agencies to leverage resources and reduce undue overlap
Goals of the NTP/NIOSH Collaboration

• Conduct exposure and health assessments of priority agents of mutual interest to NTP and NIOSH

• Capitalize on NIOSH access to human populations and work sites to provide real-world context for toxicology studies

• Guide decision-making for NIOSH epidemiologic studies

• Toxicology and epidemiology studies provide evidence-base for guidance documents
  • Report on Carcinogens, OHAT reviews, NIOSH Criteria Documents

[Image]
Impact of the Collaboration

- Findings inform testing priorities (e.g., DTBBA, 2M4N)

- Guides selection of relevant laboratory test exposures and doses (e.g., metal working fluids)

- Has led to development of methods for generation of laboratory test exposures (e.g., welding fume, mold, asphalt fume)
Update of Current Studies

- Manganese Fractions In Welding Fume
- Carbon Nanotubes and Carbon Nanofibers
- Bisphenol A
- Coal Tar Pitch Volatiles Containing PAHs in Coal Tar Sealant Applications
- Flame Retardants
Occupational Exposure Assessment Of Manganese Fractions In Welding Fume

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Objective: to characterize welders’ exposures in multiple industries to 4 manganese fractions based on selective chemical solubility due to different Mn valence states

NIOSH evaluated novel method for soluble Mn; Mn (0, 2+); Mn (3+, 4+); insoluble Mn; (& Mn-sum)
  - Successful transfer of sequential extraction method to contract lab

Conducted 10 monitoring surveys
  - Construction at oil refineries, heavy equipment manufacturing, appliance manufacturing, shipyard, steel fabricators

Over 300 full-shift worker-day breathing zone TWA measurements
  - Required > 650 personal samples; (x 5 = ~3250 data pts.)
Occupational Exposure Assessment Of Manganese Fractions In Welding Fume

- 15 site reports sent to companies, unions
- Manuscript tentatively accepted, *J Occupational & Environmental Hygiene*
  - Refinery construction, stick welding
  - Welders’ exposures > 10x new ACGIH TLV, respirable
  - Mn 0, 2+ slightly more prevalent than Mn 3+, 4+ which were much greater than soluble & insoluble Mn

- Additional manuscript internal review; target journal – *Annals of Occupational Hygiene*
  - Heavy equipment manufacturing – MIG welding
  - Mn 0, 2+ and Mn 3+, 4+ most abundant [~85% of Mn(sum)] in similar levels with each other and much greater than soluble & insoluble Mn

- Finalizing new method for sequential extraction, draft NIOSH Manual of Analytical Methods 7305 and draft manuscript
Industrywide Exposure Assessment Study of Workers Exposed to Carbon Nanotubes and Carbon Nanofibers

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Carbon Nanotube Feasibility Study
NTP Funding FY08-09

• **Objective:**
  - Enumerate workplaces, workers, and materials involved in engineered carbonaceous nanomaterial (ENM) production and use.
  - Determine industrywide use of administrative and engineering controls to minimize exposure

• **Major findings:**
  - 70 ECN manufacturers, users, distributors above R&D scale (or within 5 years)
  - Most frequently used ECN (~80%) were carbon nanotubes (CNT) and nanofibers (CNF)
  - Total workforce size (as of 2009) was <1000, growing at 15% annually (22% for CNT)
  - Companies reported high use of controls, which was verified in subsequent visits; use of good housekeeping methods to minimize dust was less prevalent.
Carbon Nanotubes (CNT) Exposure Assessment, NTP Funding FY12 – FY14

- **Objective:** conduct exposure assessments for carbon nanotubes and carbon nanofibers (CNT/CNF) in a representative sample of US workplaces.

- **Conducted 19 Site Visits**
  - CNT/CNF Primary Manufacturers
  - CNT/CNF Secondary Manufacturers (Electronics and Composites Facilities)
    - 128 Workers Sampled (2 days each)
      - 480 Full Shift, Personal Respirable and Inhalable Elemental Carbon Samples
      - 256 Full Shift, Personal Samples analyzed by TEM
      - ~ 105 Dermal Samples (currently being analyzed by SEM)
      - ~ 90 Sputum Samples (currently being analyzed by hyperspectral imaging)

- **Overall Personal Exposures**
  - Respirable- 0.34 µg/m³
  - NIOSH Recommended Exposure Limit (REL) = 1 µg/m³
  - Inhalable- 1.21 µg/m³
CNT Exposure Assessment Project
NTP Funding FY12 – FY14

- 4% of respirable samples > REL.
- 30% of inhalable samples for EC (no REL) > 1 ug/m³.
- Manually sized the material as single fibers or agglomerates up to 10 um. We found very few single fibers and about 75% of the agglomerated materials were ~4um to 10um (the thoracic region). Unsure if there will be any adverse health outcomes from these larger materials.
- Exposure was highest to multiwall compared to single wall CNT
- When separated into the industry, composites industry had the highest exposures compared to producers or companies using the materials in electronics.
Carbon Nanotube Feasibility Study
NTP Funding FY08-09

- **Impact**
  - IARC meeting of CNT carcinogenicity
  - Nordic Expert Group for Criteria Documentation of Health Risks to develop OELs

- **Publications:**


- **Manuscript Submitted to Journal**
Occupational Exposure to Bisphenol A in the United States

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Occupational Exposure to BPA in the U.S.
NTP Funding FY12-15

- **Companies**
  - Initial walk-around visit, n=9
    - Recruitment, n=6
    - Sampling, n=6

- **Industries**
  - BPA mfg.; polycarbonate, phenolic and epoxy resins, investment casting wax, and investment casting foundry

- **Workers**
  - 78 workers (154 worker-days)
Occupational Exposure to BPA in the U.S.

- **Samples Per Person**
  - 7 urine samples over two days (n=532)
  - 2 air samples over two days (n=153)
  - 2 hand wipe samples, day 2 only, pre- and end-shift (n=151)

- **Analysis**
  - Urine: Total & Free BPA completed for sites 1-4
  - Air and Hand Wipe: BPA completed for sites 1-5

- **Next Steps**
  - Complete sample analyses and database compilation
  - Data analysis, manuscript preparation, required reviews
  - Notify workers, companies, and unions of results
Assessment of exposure to coal tar pitch volatiles containing PAHs in coal tar sealant applications

NTP Funding FY15-17, Donald Fleming CIH,

- USGS researchers have recently identified elevated levels of PAHs in coal tar sealants.
- A series of worksite surveys will be conducted during coal tar pavement sealant application jobs (e.g. parking lots) during FY15-17.
- Occupational exposures will be assessed by analysis of metabolites in biological samples, and of chemicals in dermal wipe samples and in personal air samples.
- Air samples will be analyzed for the following PAHs:
  - Coal tar pitch volatiles
  - Acenaphthene
  - Acenaphthalene
  - Anthracene
  - Benz(a)anthracene
  - Benzo(b)fluoranthene
  - Benzo(k)fluoranthene
  - Benzo(g,h,i)perylene
  - Benzo(a)pyrene
  - Chrysene
  - Dibenz(a,h)anthracene
  - Fluoranthene
  - Fluorene
  - Indeno(1,2,3-c,d)pyrene
  - Naphthalene
  - Phenanthrene
  - Pyrene
Assessment of Occupational Exposure to Flame Retardants, NTP Funding FY15-17, Cheryl Estill

- Widely added to US products and are changing rapidly due to polybrominated diphenyl ethers (PBDEs) phase-out
- Characterize routes of exposure and exposures in various industries
  - manufacture of products that use flexible polyurethane foams, plastics, or resins,
  - fabrication and manufacture of rigid polystyrene foam,
  - cutting, installing or spraying insulation at construction sites,
  - gymnasiums,
  - manufacture of wire harnesses or printed circuit boards, and
  - fire service
- Samples to collect from workers: urine, serum, air, hand wipe

Flame Retardants

- tetrabromobisphone A (TBBPA)
- 2,3,4,5 – tetrabromobenzoate (TBB)
- 2,3,4,5 – tetrabromophthalate (TBPH)
- decabromodiphenyl ethane (DBDPE)
- hexabromocyclododecane (HBCD)
- tris (1,3-dichloro-2-propyl) phosphate (TDCPP)
- tris (1-chloro-2-propyl) phosphate, (TCPP)
- tricresyl phosphate (TCP)
- triphenyl phosphate (TPP)
- PBDEs (BDE-28, -47, -66, -85, -99, -100, -153, -154, -183, Σpenta, -209)
Thank You