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

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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Occupational Exposure Assessment Of Manganese Fractions In Welding Fume, NTP funding FY09-11

- 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.

CDC NIOSH

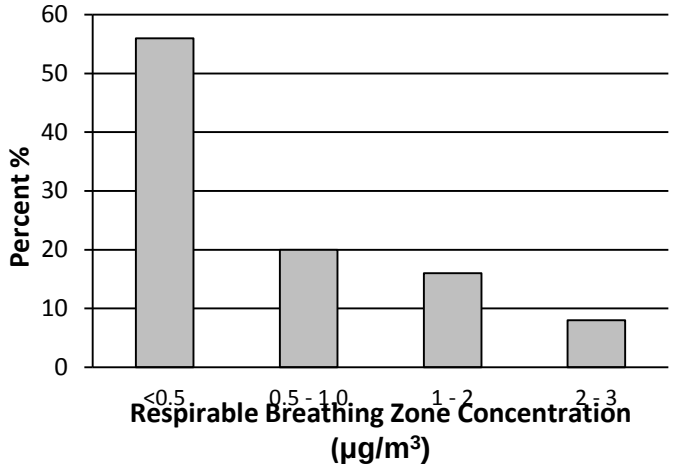
Carbon Nanotubes (CNT) Exposure Assessment, NTP Funding FY12 – FY14

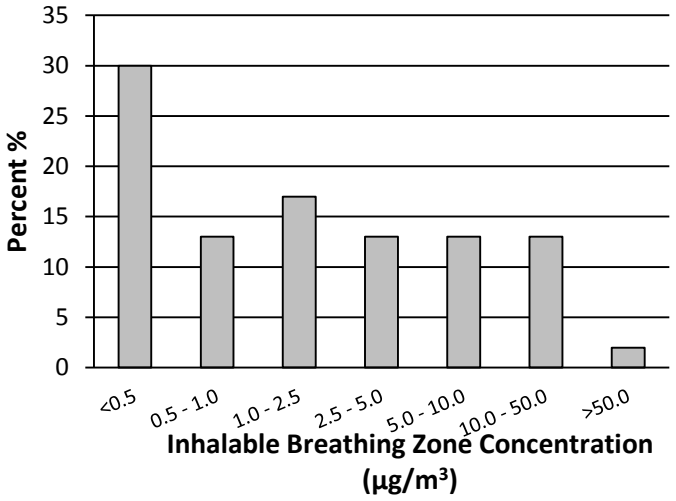
- **Objective:** conduct exposure assessments for carbon nanotubes and carbon nanofibers (CNT/CNF) in a representative sample of US workplaces.
- **Conducted 19 Site Visits**
  - CNT/CNF Primary Manufacturers
  - CNT/CNF Secondary Manufacturers (Electronics and Composites Facilities)
    - 128 Workers 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 $\mu g/m^3$ -
  - NIOSH Recommended Exposure Limit (REL) = 1 $\mu g/m^3$
  - Inhalable- 1.21 $\mu g/m^3$

CNT Exposure Assessment Project

NTP Funding FY12 – FY14

- 4% of respirable samples > REL.
- 30% of inhalable samples for EC (no REL) > 1 ug/m^3.
- 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:**
  - Schubauer-Berigan et al. Engineered carbonaceous nanomaterials manufacturers in the United States: workforce size, characteristics and feasibility of epidemiologic studies. *J Occup Environ Med*; 53(6 Suppl):S62-S67, 2011.

  - Dahm et al. Exposure control strategies in the carbonaceous nanomaterial industry. *J Occup Environ Med* 53(6 Suppl):S68–S73, 2011.

  - Schubauer-Berigan et al. Characterizing adoption of precautionary risk management guidance for nanomaterials, an emerging occupational hazard. *J Occup Environ Hyg* 2014, DOI: 10.1080/15459624.2014.946515

- **Manuscript Submitted to Journal**
  - Dahm MM, et al. Carbon Nanotube and Nanofiber Exposure Assessments: An Analysis of 14 Site Visits. Submitted to *Annals of Occupational Hygiene*

CDC NIOSH

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
- Indenol(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 diphyenyl 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