

HOT TOPICS IN AIR QUALITY



Hot!



AN UPDATE ON
SAMPLING STRATEGIES
AND TECHNOLOGIES





A COLLECTION OF SHORT SUBJECTS

- **Nanoparticles:** NIOSH Guidance
- **School Zone Initiatives:** New programs to monitor air contaminants around schools
- **Mercury:** A Metal that is making EPA Mad☹
- **Lead:** Still Trying to Get the Lead Out
- **Methamphetamine:** The Dark Side of Organic Chemistry
- **Diacetyl-IHs** Take on a Whole New Flavor
- **Breath Analysis**-New Medical Applications

JUST WHEN YOU THOUGHT YOU KNEW EVERYTHING ABOUT PARTICULATES...



WAIT THERE'S MORE.

A totally new type of particle
in a new state of
matter....**NANOPARTICLE.**

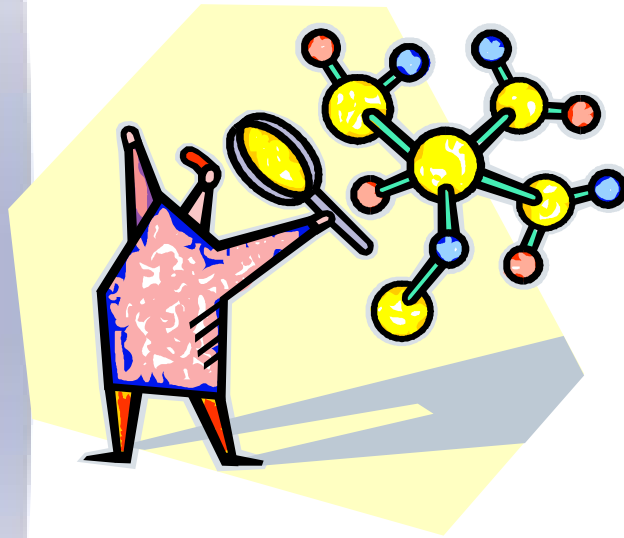


NANOPARTICLES: A NEW STATE OF MATTER

- Nano-sized particles cannot be regarded as a liquid or solid.
- Even though they are a particle, they behave like a vapor.
- They do not deposit like a dust particle or fiber into the respiratory system.
- They diffuse like a gas/vapor.

NANOPHASE
NANOPHASE

NANOPARTICLES DEFINED



- Nano-sized particles are **1 to 100 nanometers** (0.001-0.1 microns).
- Nano-scale materials are being used in electronics, magnetic and medical imaging, drug delivery, and consumer products.



NANOPARTICLES vs. ULTRAFINES

Nanoparticles

- Particles **intentionally** engineered for specific applications by high tech companies.

Ultrafines

- Nano-sized particles in air produced **unintentionally** by combustion engines, welding operations, etc.
- Have properties similar to the engineered nanoparticles



NOTES ON TOXICOLOGY OF NANOS

- Nanoparticles produce greater lung inflammation and other toxic effects than larger sized particles of the same material.
- This is because they have a higher surface area and react more with the tissue.
- Some studies have shown that they can pass through the protective mechanisms of the body and be distributed to various organs.



NOTES ON TOXICOLOGY OF NANOS

- NIOSH reported at AIHce 2009 that many samples for metal oxide nanos showed agglomeration.
- Agglomerated nanoparticles, however, still maintain the high surface area and surface chemistry when inhaled.
- Also, they tend to deagglomerate upon inhalation





NOTES ON TOXICOLOGY OF NANOS

- Nanoparticles can exhibit so-called *translocation*.
- Larger particles enter through the lung and damage the lung (like asbestos).
- But nanoparticles can be inhaled through the lung and then damage another organ.
- Once inhaled, they may also travel along the olfactory nerve and penetrate directly into the brain producing toxic effects.



EVALUATING EXPOSURES: EXPOSURE LIMITS

- Because of the unique toxicology of nanoparticles, NIOSH plans to develop *new* Recommended Exposure Limits (RELs) for specific compounds found in the workplace in the nano size range.
- At this time, there is one NIOSH REL for nanosized particles. NIOSH recommends an REL of 0.1 mg/m³ for “ultrafine” titanium dioxide as a TWA for up to 10 hr/day and 40 hr/ week. (TLV is 10 mg/m³)

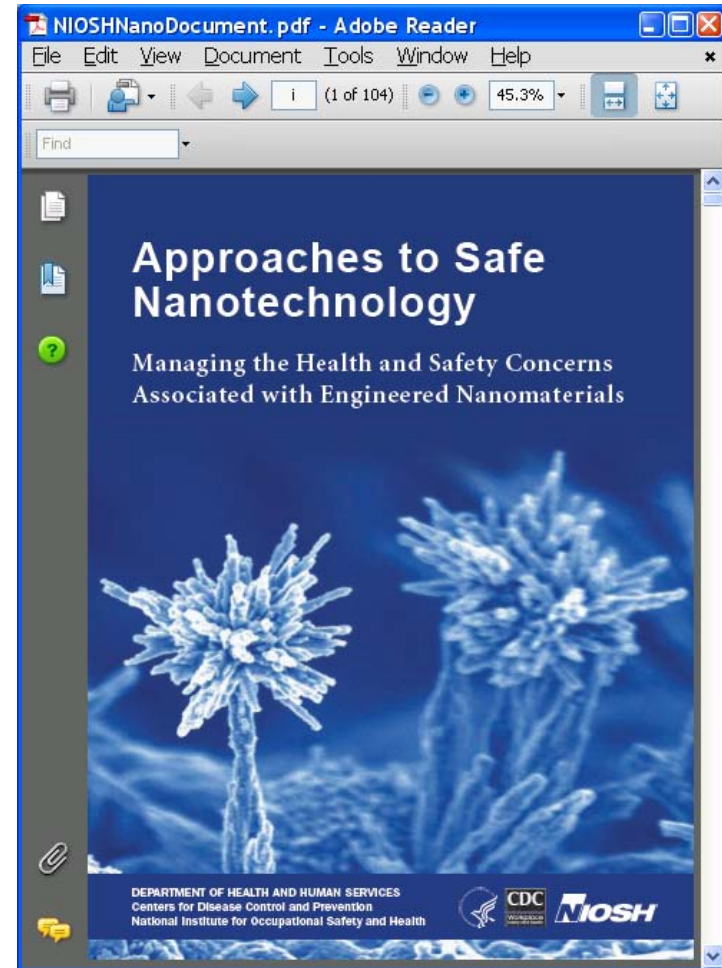
A vertical decorative bar on the left side of the slide, featuring a colorful, abstract pattern of green, blue, and purple. At the top of this bar is a large, semi-transparent triangle with a gradient from blue to purple.

WITH FEW EXPOSURE LIMITS WHY SAMPLE?

- To determine if there is THE POTENTIAL for exposure.
- To determine if the job produces levels of nanoparticles significantly (>25%) above background.
- To check for leaks.
- To evaluate job tasks.
- To evaluate engineering controls.

EVALUATING EXPOSURES: NIOSH GUIDANCE

- NIOSH has published a guidance document that is available online at www.cdc.gov/niosh/topics/nanotech/safenano/
- See the **Appendix** of this document for the NIOSH strategy for evaluating exposures to nanoparticles.





EVALUATING EXPOSURES: NIOSH EMISSION ASSESSMENT TECHNIQUE

The NEAT Approach:

1. Determine (a) if airborne releases are occurring and (b) if control measures are effective in reducing engineered nanoparticle exposures.
2. Compare particle NUMBER and relative particle SIZE at the emission source to background levels.
3. Use filter samples to further characterize the nanoparticles.



EVALUATING EXPOSURES: NIOSH EMISSION ASSESSMENT TECHNIQUE

NIOSH recommends the use of:

- a) Direct-reading particle counters
- b) Filter samples with lab analysis

To obtain key particle metrics including:

- Particle number
- Particle size
- Particle shape
- Degree of agglomeration
- Mass concentration of elemental constituents



EVALUATING EXPOSURES: NIOSH EMISSION ASSESSMENT TECHNIQUE

What do you do with this data?

- Compare to existing OELs
- Determine if controls are working
- Determine if there is a leak
- Compare area to personal samples to evaluate work tasks. Normally, the task generates the exposure.



EVALUATING EXPOSURES: THE SPECIFICS

1. Measure background levels at 3 to 5 locations with two different types of particle counters: a condensation particle counter (CPC) and optical particle counter (OPC).

Note: NIOSH field studies showed typical background levels of 1,246 to 19,500 particles/cm³.

Note any unusual conditions in test environment that could impact the background levels. Examples from NIOSH field studies:

- ShopVac with no filter: +80,000 particles
- Propane forklift: +45,000 particles



EVALUATING EXPOSURES: THE SPECIFICS

2. After establishing a reliable background level, use the same particle counters to measure emissions from the work process.
3. If *elevated* nanoparticles are detected, collect 2 filter samples at the emission source using 0.8 μm MCE filters.
4. Analyze one filter for particle morphology using TEM/SEM. Analyze the other for elemental mass using ICP or equivalent.



CPC VS OPC: WHY 2 PARTICLE COUNTERS?

CPC Technology

Particles are passed through an alcohol bath at an elevated temperature, cooled in a condenser block, and detected by a light-scattering device.

- The CPC technology allows for the measurement of particles down to **10 to 15 nm**.
- But, you only get **one particle count** with this instrument
- **1.0 μm** is the largest particle size detected.



CPC VS OPC: WHY 2 PARTICLE COUNTERS

OPC Technology

The principle of laser light scattering is used to simultaneously measure particles in various size ranges.

- The OPC technology allows for the measurement of total number of particles per liter of air within **3 to 6 defined size ranges**.
- It can only detect particle sizes down to **300 nm**, but can detect larger particles (agglomerates) up to **5 um**.

PARTICLE COUNTERS

FROM SKC: CPC



SKC 745-3800
\$7500.

- Detects particles as small as 15 nm and as large as 1 μm
- Concentration range up to 100,000 particles/cm³
- Datalogging
- Data management software

PARTICLE COUNTERS FROM SKC: OPC



SKC 745-3887

\$1,900

3-channel Model:

- Economical option
- Size ranges: 0.3, 0.5, and 5.0 μm
- User-selectable sampling time and frequency
- Internal datalogger
- Includes data management software

PARTICLE COUNTERS

FROM SKC: OPC



SKC 745-3886
\$2,980

5-channel Model:

- Flexible option
- Size ranges: 0.3, 0.5, 1.0, 3.0, and 5.0 μm
- Optional probe for RH/temp and air velocity
- Internal datalogger
- Includes data management software

FILTER SAMPLING: TECHNICAL NOTE

- Concern has been raised that nanoparticles will go through the pores of typical filters used for microscopic/chemical analysis.
- NIOSH reports that the activity of nanoparticles is so intense that the particles constantly collide and **DO NOT** go through the pores like a sieve.



FILTER SAMPLING: THE NIOSH APPROACH

- NIOSH has been using the SKC Leland Legacy[®] pump with 0.8 μm MCE filters for TEM/SEM by NIOSH 7402 and metal analysis by NIOSH 7300 or equivalent.
- Heat-treated quartz filters are used for carbon analysis by NIOSH 5040 for elemental carbon.



Leland Legacy Pump

SKC 100-3002

FILTER SAMPLING: THE NIOSH APPROACH

To enhance sensitivity of measurement, NIOSH uses high flow rates to collect samples with the Leland Legacy pump and filters at **7 L/min for task sampling of 15-30 min.**

NIOSH uses **37-mm MCE filters**, for both TEM/SEM and elemental analysis. Filters are used open-face for more even deposition.



NOTES ON CONTROLS FOR NANOPARTICLES

- NIOSH reports that HEPA filters **ARE** effective in trapping nanos down to 10 nm.
- **Note: Viruses (such as H₁N₁) are nano-sized particles.** Protective measures used for viral contaminants would be effective in controlling other nano-sized particles.
- Controls used in pharmaceutical industry may be useful for nanos.





NANOS AND FUME HOODS: NIOSH RECOMMENDATIONS

- There has been concern that fume hoods may not effectively contain nanos at 100 ft/min as nanos are too buoyant. (AIHA *Synergist* September 2009)
- NIOSH responded to me that they always recommend that lab fume hoods operate at optimal velocities specified by manufacturer.
- Less turbulent devices like a low-flow vented enclosure, however, may be more effective than fume hoods for nanos.

FOR MORE INFORMATION

The screenshot shows a Windows Internet Explorer browser window displaying the NIOSH Nanotechnology Topic Page. The address bar shows the URL <http://www.cdc.gov/niosh/topics/nanotech/>. The browser interface includes a search bar, navigation buttons, and a toolbar. The page content features the NIOSH logo and the text "National Institute for Occupational Safety and Health". The main heading is "NIOSH Safety and Health Topic: Nanotechnology". Below this, there is a section titled "Nanotechnology at NIOSH" which includes a paragraph of text, a list of bullet points, and a "Topic Index" with several links. A small image of a nanotechnology experiment is also visible.

NIOSH Topic: Nanotechnology | CDC/NIOSH - Windows Internet Explorer

http://www.cdc.gov/niosh/topics/nanotech/

File Edit View Favorites Tools Help

bing

myAOL - your home... Inbox - AT&T Yahoo... NIOSH Topic: Na...

Norton

Fraud monitoring is on

CDC Home CDC Search CDC Health Topics A-Z

NIOSH National Institute for Occupational Safety and Health

Search NIOSH | NIOSH Home | NIOSH Topics | Site Index | Databases and Information Resources | NIOSH Products | Contact Us

NIOSH Safety and Health Topic:
Nanotechnology

Nanotechnology at NIOSH

NIOSH is the leading federal agency conducting research and providing guidance on the occupational safety and health implications and applications of nanotechnology. This research focuses NIOSH's scientific expertise, and its efforts, on answering the questions that are essential to understanding these implications and applications:

- How might workers be exposed to nano-sized particles in the manufacturing or industrial use of nanomaterials?
- How do nanoparticles interact with the body's systems?
- What effects might nanoparticles have on the body's systems?

As part of this effort, NIOSH is conducting [strategic planning](#) and research, partnering with public and private-sector colleagues from the United States and abroad, and making the information and interim recommendations widely available. As observers generally agree, research to answer these questions is critical for maintaining U.S. competitiveness in the growing and dynamic nanotechnology market.

Nanotechnology on the NIOSH Science Blog
NIOSH recently co-sponsored a workshop focused on research needed for characterizing exposures to nanomaterials among workers, other populations, and environments by measuring and modeling exposure levels, and by monitoring indicators of biological responses through the product life of a nanomaterial.
[Read more and comment on the NIOSH Science Blog.](#)

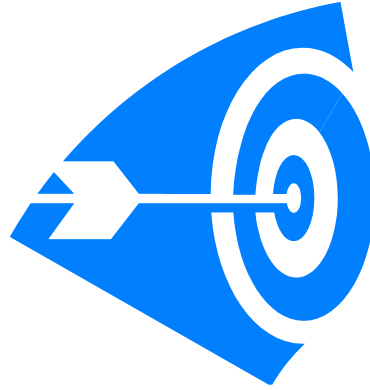
Nanotechnology

Topic Index:

- Nanotechnology Home
- [About Nanotechnology](#)
- [Critical Topics](#)
- [NIOSH Research](#)
- [For Public Comment](#)
- [News & Events](#)
- [Informational & Educational Materials](#)
- [Partnerships](#)

Internet 100%

See the NIOSH Nanotechnology Topic Page at www.cdc.gov/niosh/topics/nanotech



TARGETING AIR CONTAMINANTS IN SCHOOL ZONES

A Current Priority for U.S. EPA

AIR CONTAMINANTS IN SCHOOL ZONES



- Asthma is the #1 health reason that children miss school. In the U.S., children are absent 15 million school days every year due to this illness.
- Air contaminants from surrounding industries along with engine exhaust contribute to the overall problem.

U.S. EPA INITIATIVE: MONITORING SCHOOLS

**EPA aims
air-check
plan at 62
schools**

Big-city, small-town
targets in 22 states

SA - TUESDAY, MARCH 31, 2009 / 10A TODAY
**Schools glad
to have EPA
sample air**

Officials hope list of 62
sites will be expanded

On March 31, 2009, U.S. EPA released a list of priority schools for air quality monitoring as part of an initiative *to understand whether outdoor toxic air pollution poses concerns to school children.*

POLLUTANTS TO BE MONITORED NEAR SCHOOLS

Carbonyls - Acetaldehyde

Diisocyanates - 2,4-TDI, 1,6-HDI

Metals - Arsenic, Cobalt, Lead, Hexchrome,
Manganese, Nickel as PM10 or TSP

PAHs - Benzo(a)pyrene, Naphthalene

VOCs - Acrolein, Benzene, 1,3-Butadiene

Others - 4,4-Methylenedianiline



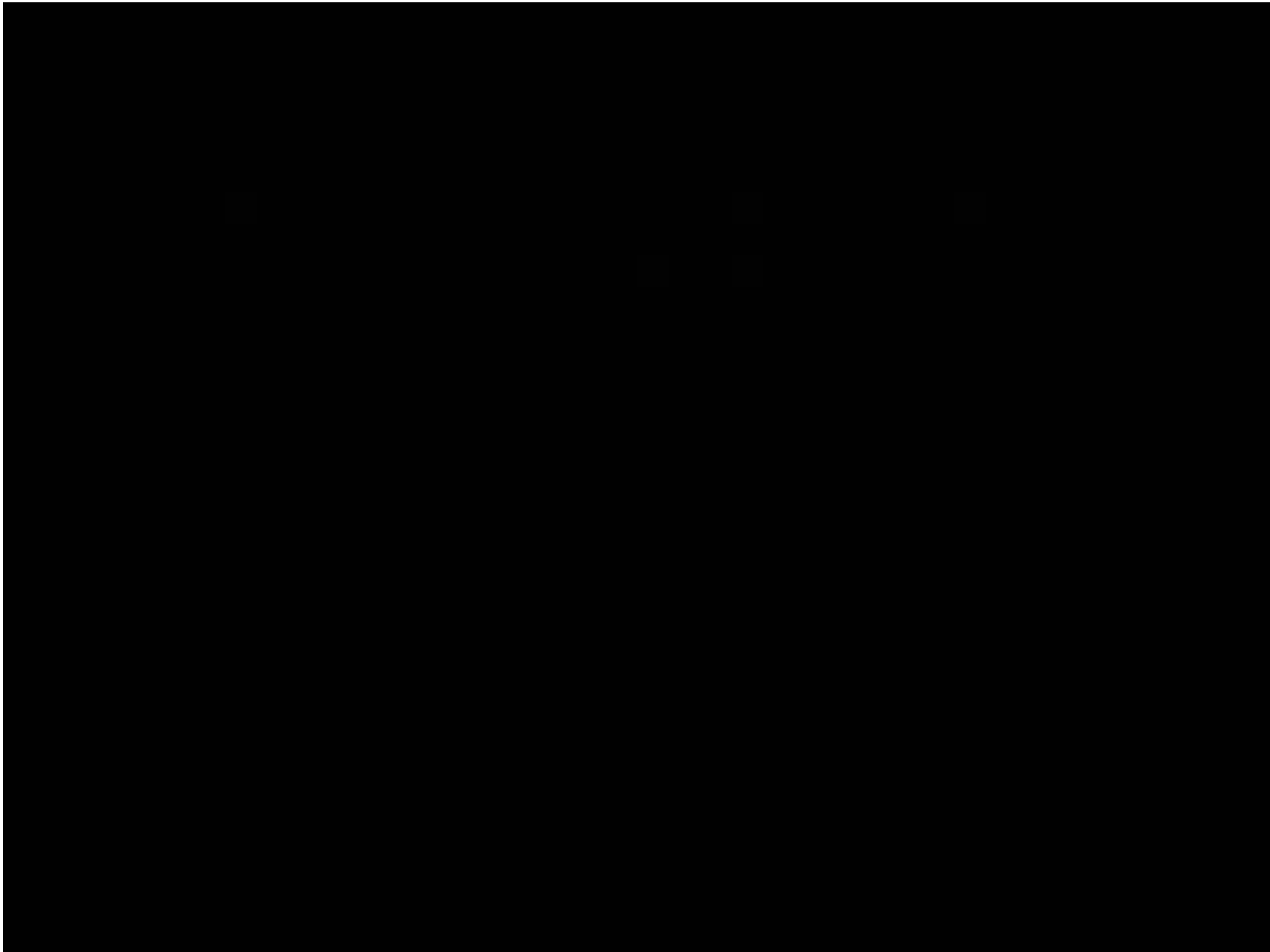
TEST RESULTS REPORTED IN OCTOBER 2009

- *USA TODAY* reported that **acrolein** was found at 15 schools at levels “at least 100 times higher than what the government considered safe for long-term exposure.”
- But in 2010 EPA reported that the acrolein results are uncertain due to issues with canister collection.
- For more information, see www.epa.gov/schoolair/



OTHER SCHOOL INITIATIVES: ASTHMA FREE SCHOOL ZONES (AFSZ)

- The AFSZ program in NYC focuses on school ventilation improvements, reduction in vehicle idling/traffic congestion around schools, air sampling for target compounds, and environmental health training for school and community members.
- See www.afsz.org for more information on this program along with a fun rap video done by kids on this subject.



SCHOOL ZONE INITIATIVES: SAMPLING DETAILS

- SKC AirChek® XR5000 pumps and PMI impactors are being used currently in the AFSZ project to sample PM2.5 in and around NYC schools.



XR5000 Pump
SKC 210-5001



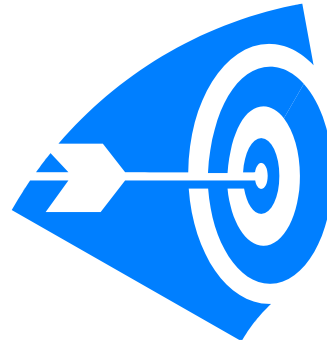
PMI SKC 225-352

MERCURY: A METAL THAT IS MAKING EPA MAD



Is the
MAD HATTER
still exposed?

EPA TARGETS MERCURY EMISSIONS



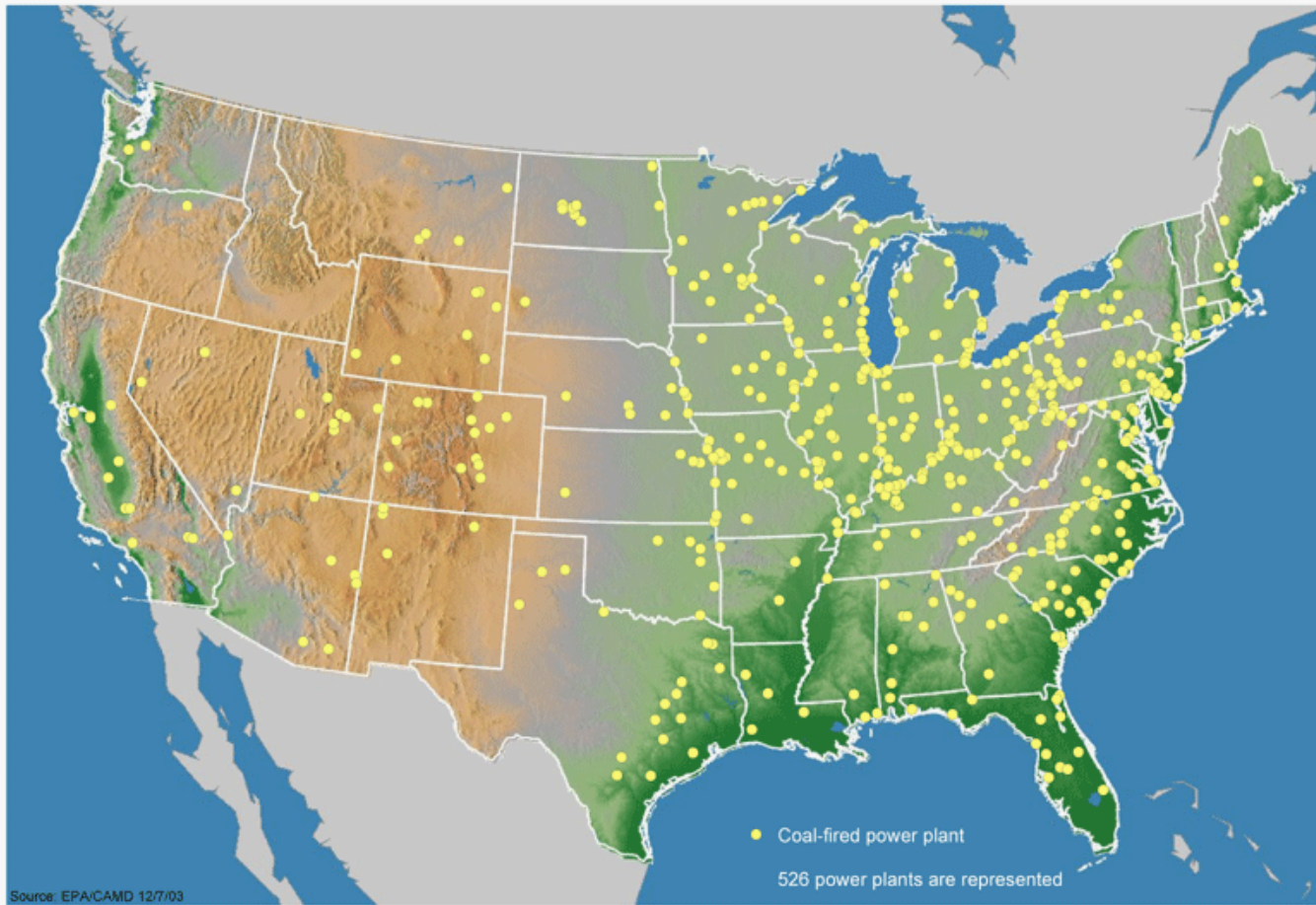
POWER PLANTS

BURNING COAL



CEMENT KILNS





U.S. Coal-Fired Power Plants





RAW MATERIALS & FUEL CONTAIN
MERCURY



OPTIONS FOR MERCURY EMISSION MONITORING

- Continuous Emission Monitoring Systems (CEMS)

- Sorbent Traps





SORBENT TRAP SAMPLING AND ANALYSIS

- Known volumes of flue (stack) gas are drawn through a trap containing potassium iodide (KI)-treated charcoal at 200 to 600 ml/min using a specialized stack sampling box.
- Samples are acid leached and analyzed by cold vapor atomic fluorescence or atomic absorption spectrometry.
- Sold by SKC as *MET Traps*. See www.skcinc.com and search using *MET*.



MET Sorbent
Trap on end of
probe



MONITORING WITH MET TRAPS

PER APPENDIX K OF 40 CFR, PART 75

- 3-section trap with each section containing the same amount of sorbent:
 - Section 1:** Sample collection
 - Section 2:** Breakthrough indicator
 - Section 3:** Vapor-spiked with mercury for recovery studies
- Paired sampling is performed using 2 traps for each sample
- Sample time is typically 3 to 7 days.

MONITORING WITH MET TRAPS

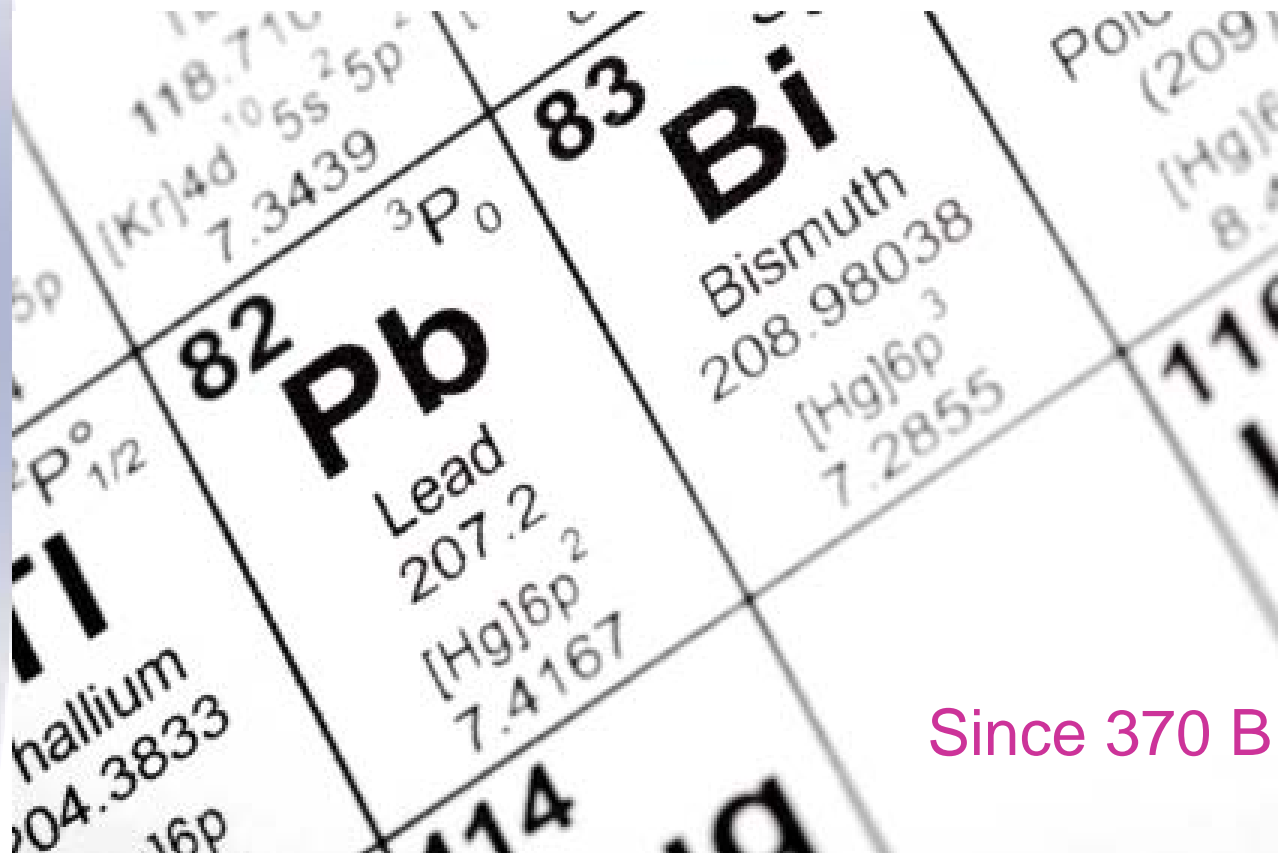
PER APPENDIX K OF 40 CFR, PART 75



SKC MET Traps are available with different spike amounts on the last section. UNspiked 2-section traps are available for initial screening.

STILL TRYING TO...

GET THE LEAD OUT



Since 370 B.C.

AIHA *SYNERGIST* REPORT

SEPTEMBER 2008

- Lead is one of the **most common overexposures found in industry** and is a leading cause of occupational illness.
- OSHA has a 5-year strategic plan to lower lead exposures 15% in targeted workplaces.
- Lead poisoning is the **leading environmentally induced illness in children.**



TO MAKE MATTERS WORSE: LEAD EXPOSURES FOR KIDS

- Unacceptable levels of lead in toys has been a public health issue in the news.
- Old playground equipment may have been painted with lead paint.
- Old AstroTurf on ball fields may also be a source of lead exposures.





A BOLD MOVE AGAINST LEAD CONTAMINATION

Lead in Electronics

- The European Union mandated the removal of various hazardous substances, including lead, from electrical/electronic equipment.
- This is known as the Removal of Hazardous Substances (RoHS) directive.



A BOLD MOVE AGAINST LEAD CONTAMINATION

Lead in Electronics

- All manufacturers of electronic equipment, including SKC, are attempting to identify components such as resistors, capacitors, and printed circuit boards that contain lead so they can find suitable alternatives.
- Non-compliant products could be banned from sale and/or confiscated.

SAMPLING METHODS - LEAD



LeadCheck Swabs
SKC 225-2404

LEADCHECK® SWABS

- For surface screening including electronic equipment and toys
- Self-contained swab changes color in presence of lead on surfaces
- Interferences limited to tin (stannous chloride) and silver



SAMPLING METHODS - LEAD

Painted Toys

- Make a small cut into the paint or rough up the vinyl surface with sandpaper.
- Activate the swab and rub the tip over the test area for 30 to 60 seconds.
- Look for red color.

Circuit Boards

- Wipe the test area with isopropyl alcohol and rub the swab directly onto the board OR rough up the surface with sandpaper and rub the surface with a Q-Tip.
- Squeeze one drop of reactive dye from the swab into a tray and dip the Q-Tip into the dye.



SAMPLING METHODS - LEAD

NIOSH Method 7700

- Lead in Air by Chemical Spot Test
- Specifies 0.8 μm MCE filters at 2 L/min for sample collection
- Followed by qualitative assessment for lead using LeadCheck swabs
- Laboratory analysis can be performed to quantitate levels with positive result



EPA Lead Renovation, Repair, and Painting Rule

“EPA recognizes that, when used by a certified renovator, the Professional LeadCheck[®] lead test kit can reliably determine that regulated lead-based paint is not present on all surfaces, except plaster and drywall”. These kits include necessary Test Confirmation Card (not included in kits purchased at retail stores).



SAMPLING METHODS - LEAD

FULL DISCLOSURE

- Scientific breakthrough - colorimetric wipe for lead on *skin* or surfaces
- Developed by U.S. NIOSH - NIOSH Method 9105
- Licensed to SKC
- Behavior modification tool - allows workers to determine if their hand washing has been thorough enough
- Limit of ID is 18 μg of lead

FULL DISCLOSURE LEAD WIPES

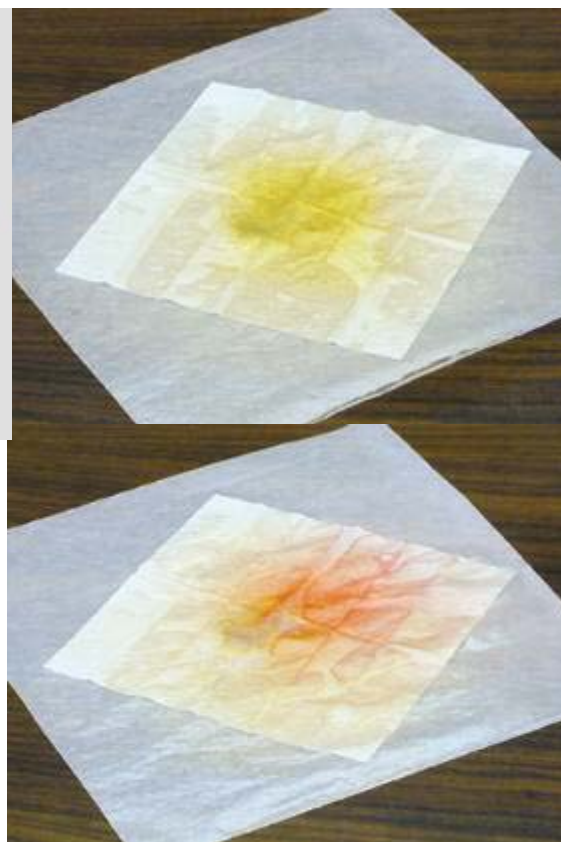
Step 1



Step 2



Step 3



SKC Full Disclosure Kit
550-001



NEW FROM NIOSH : DECONTAMINATING WASHCLOTHS FOR REMOVAL OF TOXIC METALS INCLUDING LEAD

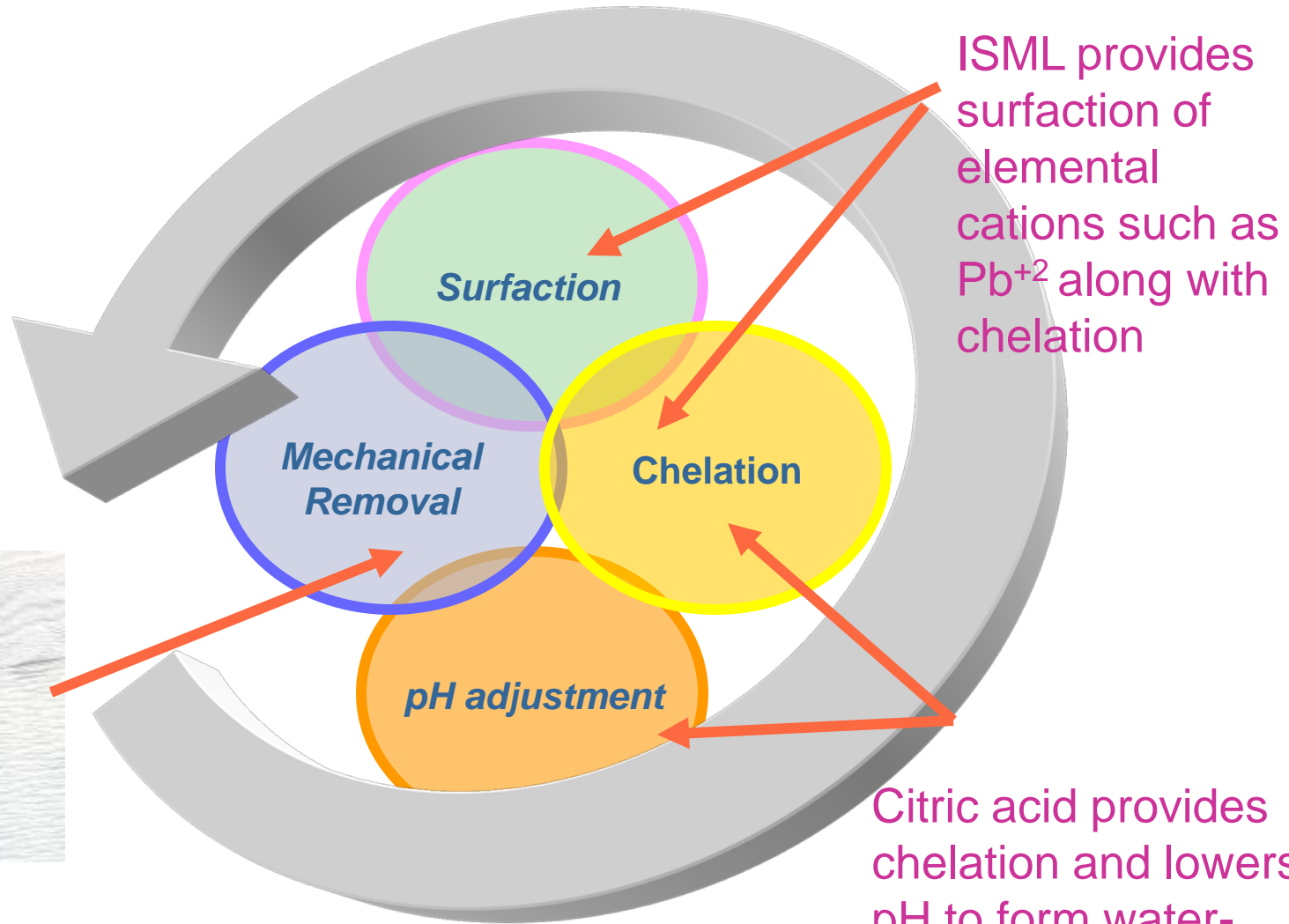
1. More effective than soap and water
2. No abrasives
3. Gentle on skin
4. Environmentally friendly
5. No EDTA or other persistent organic pollutants



AN EFFECTIVE AND GREEN CHOICE

- The active ingredient, ISML, is not a listed substance on U.S. TSCA.
- Not listed on EU Inventory of New and Existing Chemical Substances
- Swedish Society for Nature Conservation calls it a “Good Environmental Choice.”
- The pre-moistened towel is used to wipe the hands and to reach under the fingernails.
- After wiping, the towel is discarded into a trash receptacle reducing effluent discharged into waste water systems.
- Hands are then rinsed with water.

HOW IT WORKS



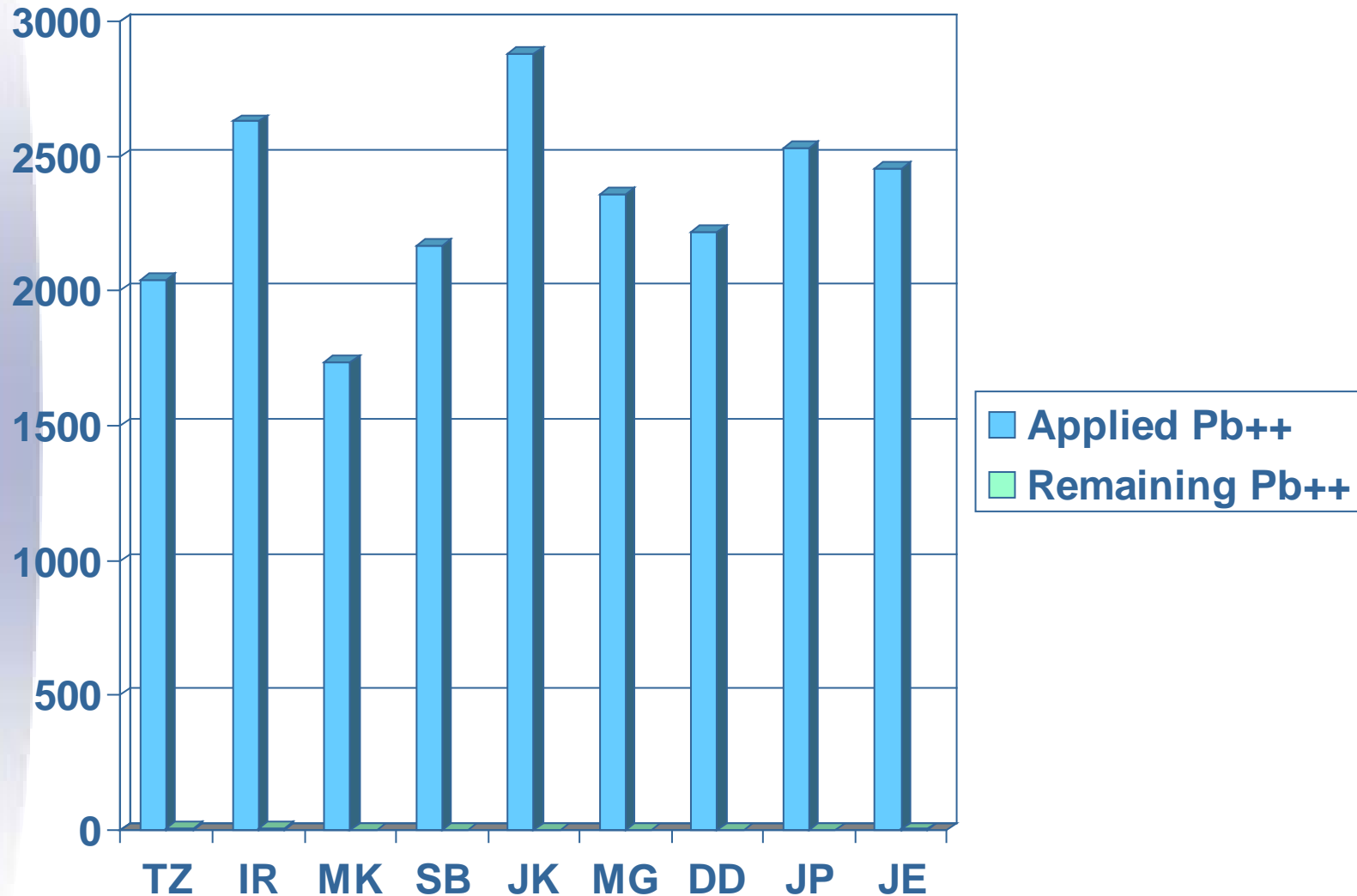
ISML provides surfaction of elemental cations such as Pb^{+2} along with chelation

Citric acid provides chelation and lowers pH to form water-soluble metal-citrate complexes

Engineered towel enhances mechanical removal



LEAD REMOVAL EFFICIENCY IS 99.8%.



n = 9

2,338 µg effective skin loading

PARTNER DECON TOWELS WITH **FULL DISCLOSURE**

For a complete lead safety system of:

1. **I**dentification
2. **D**econtamination
3. **C**onfirmation



Decon Towels
SKC 763-001/2

Full Disclosure and
Decon Towel Kit

SKC 550-100



Methamphetamine powder



Ice methamphetamine



METHAMPHETAMINE: THE DARK SIDE OF ORGANIC CHEMISTRY

METHAMPHETAMINE: DEFINING THE PROBLEM

- Meth is derived from commonly available decongestants and diet aids containing ephedrine or pseudoephedrine and cooked in clandestine (illegal) “labs.”
- Methamphetamine is highly addictive, cheap, and easy to produce.



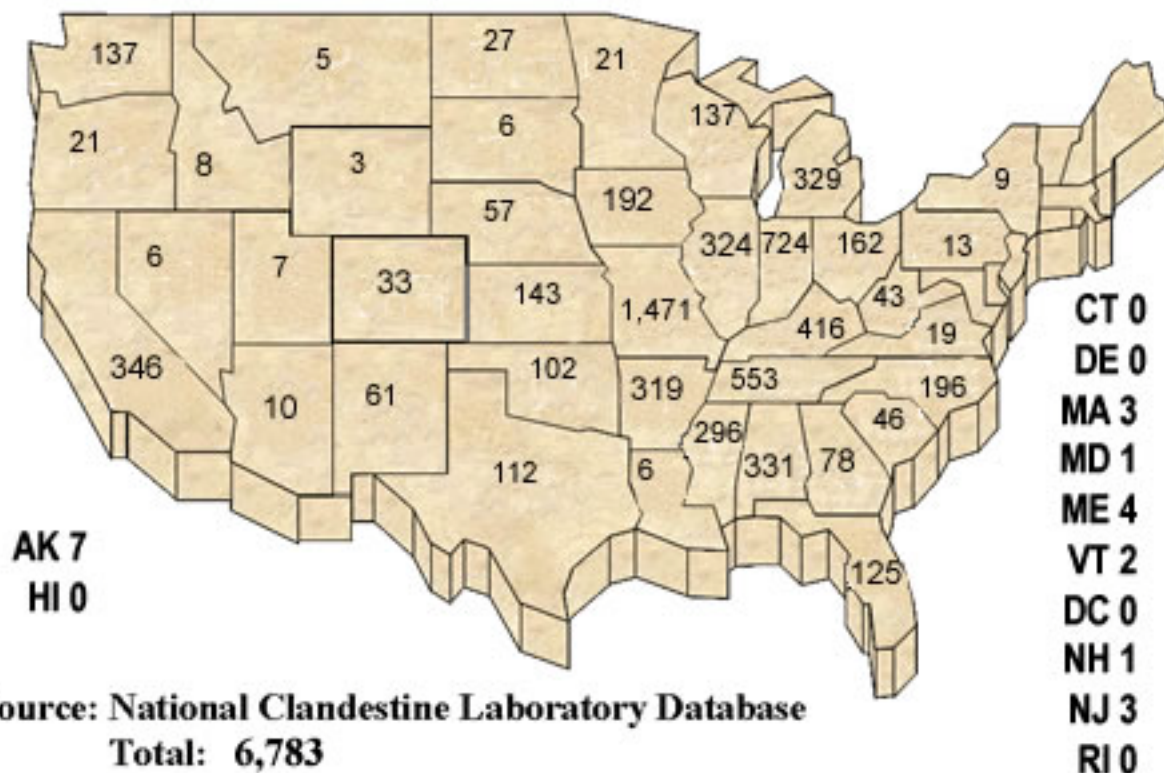
TYPICAL METH LABS



U.S.A. METH LAB INCIDENTS

YEAR 2008

**Total of All Meth Clandestine Laboratory Incidents
Including Labs, Dumpsites, Chem/Glass/Equipment
Calendar Year 2008**



Source: National Clandestine Laboratory Database

Total: 6,783

Dates: 01/01/2008 - 12/31/2008

Map last updated March 2009

RESPONDING TO METH

Health and safety professionals have a role to play in the response to and cleanup of clandestine meth laboratories.



IH ROLE IN METH LABS

TO PROTECT EXPOSED WORKERS

- Law enforcement
- Fire, Haz-Mat, or ambulance crews
- Social services
- Utilities services
- Landlords
- Custodial or housekeeping staff



IH ROLE IN METH LABS

TO PROTECT BUILDING OCCUPANTS

- To develop health and safety plans for decontamination of buildings/environment
- To confirm that appropriate “safe” levels have been met prior to reoccupancy



CHEMICAL HAZARDS IN METH PRODUCTION

RED

PHOSPHORUS

METHOD

- Iodine
- Phosphine
- Sodium hydroxide
- Sulfuric acid

NAZI

COLD LABS or BIRCH METHOD

- Ammonia
- Sulfuric Acid
- Hydrocarbons





SAMPLE COLLECTION

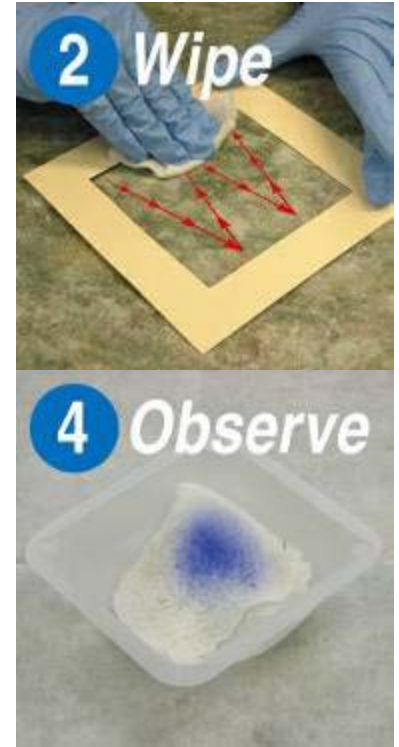
- NIOSH reports that **air** contaminants will only be present during active “cooking” of meth.
- The particulate aerosol formed during meth production, however, deposits onto available surfaces.
- A better method for sampling meth after a cook is using **surface wipe** sampling.

SKC METH RESIDUE KITS



- **Qualitative** test for meth contamination at levels $\geq 15 \mu\text{g}$
- Quickly identify meth residue using easy colorimetric wipe test
- For pre and post-cleanup assessments and quick checks during remediation

METHALERT OPERATION



SKC MethAlert Kit 560-001

SKC METH RESIDUE KITS

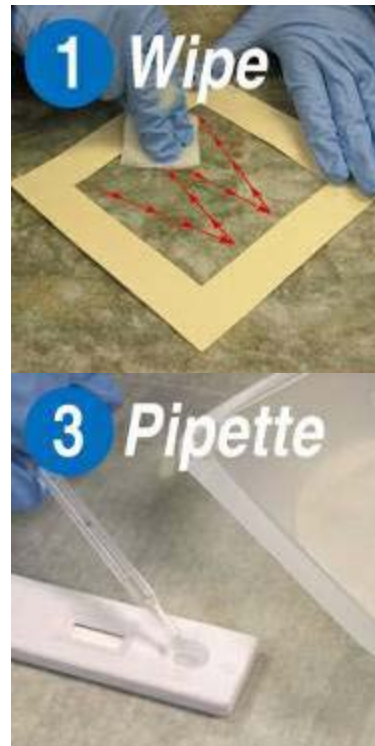


- **Semi-quantitative** test for meth at levels of identification of 50, 100, 500, or 1500 **nanograms/100 cm²**
- Designed to check meth residue before, during, or after meth remediation
- Most sensitive meth field test kit available

METHCHEK OPERATION



SKC MethChek[®] Kit
560-002 through 005B





BREATH ANALYSIS

NEW MEDICAL APPLICATIONS

- There are **BEIs[®]** for compounds in exhaled breath including CO, ethyl benzene, methyl chloroform, tetra- and tri- chloroethylene.
- Breath analysis is also being used as a diagnostic tool for medical applications.
- Correlations have been found between concentrations of VOCs in exhaled breath and numerous diseases.



SULFUR COMPOUNDS IN BREATH

A 2009 article in the *Journal of Chromatography* reports that sulfur containing compounds such as H₂S in breath are attributed to:

- Impaired liver function
- Organ rejection following transplant
- Lung cancer
- Cystic fibrosis
- Schizophrenia

A decorative vertical bar on the left side of the slide, featuring a colorful triangle (blue, purple, green) at the top and a blurred, multi-colored background (green, blue, purple) below. The title text is positioned to the right of this bar.

SAMPLE BAGS USED FOR BREATH ANALYSIS

- Standard sample bags used in occupational/environmental sampling can be used for breath analysis.
- The authors recommended **FlexFOIL** bags as the best choice for collection and storage of sulfur-containing compounds in breath with storage times up to 24-hrs.

AND FINALLY...WHAT HAPPENS WHEN U.S. POLITICIANS DO HYGIENE?

- Our profession takes on a whole new flavor- **BUTTER FLAVOR.**
- Chemically known as diacetyl
- U.S. OSHA was under Congressional mandate to finalize a sampling method for this chemical.



Bronchiolitis Obliterans

See OSHA 1012 and 1013 using SKC Sorbent Tube 226-183.

Let's end with—

AN ODE TO DIACETYL

There once were politicians in the District
Who thought they knew it all.
So they set their sights on safety
With plans for exposures to fall.
They read about toxic chemicals
Benzene, lead, and such.
But decided to regulate popcorn—
Butter-flavored and loved so much.
Good-bye golden kernels
Of sheer buttery fun.
Hello silica gel tubes
Washed and baked till they're done.





THANK YOU FOR YOUR
INTEREST IN HOT TOPICS!

Email me at SKCTech@skcinc.com

with any further questions

