OSC | 11
Ohio Safety Congress & Expo

#336 Understanding mercury spills and clean-up levels

Joel Hogue

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3:45 to 4:45 p.m.

Ohio | Bureau of Workers' Compensation

UNDERSTANDING MERCURY SPILLS AND CLEANUP LEVELS

Joel Hogue
Elemental Services & Consulting, Inc.
www.escoinfo.com
740.815.9660

UNDERSTANDING UNITS OF MEASURE

- mg = milligram
- µg = microgram
- ng = nanogram
- To change between one unit of measure to another, move decimal point three (3) places
  - 1.0 mg = 1000 µg
  - 1.0 µg = 1000 ng
  - 1.0 ng = 0.001 µg
  - 1.0 µg = 0.001 mg
- **BE SURE YOU SPEAK THE SAME LANGUAGE**

GENERAL BEHAVIOR

When striking surfaces, mercury fractures into very small, even microscopic beads, each one emitting vapor

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FRACTURED MERCURY

Expect to find it everywhere

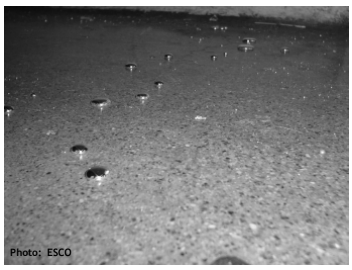

Photo: ESCO

SURFACE TENSION

- Mercury has the highest surface tension of any liquid. It has such a high surface tension that it actually does not flow, rather it fractures into small "*beads*" that roll great distances
- Gravity affects mercury beads: the smaller the bead, the less "*flattening*" of the bead, larger beads are "*flattened*" more due to specific gravity and gravity influencing a larger volume of mercury
- From left to right, the following diagram illustrates the beading effect caused by surface tension for equal sized drops of mercury, water and alcohol (the left circle represents a round marble)

Drawing: ESCO

MERCURY LIQUID VS. VAPOR

- Important distinction during cleanup, waste management, decontamination and health & safety

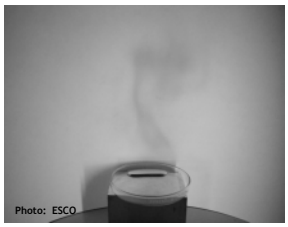

Photo: ESCO

SATURATED MERCURY VAPOR VS. TEMPERATURE

- At 50˚F:
  - Vapor pressure is 0.00049 mmHg
  - Saturated vapor concentration is 5.56 mg/m^3
- At 68˚F:
  - Vapor pressure is 0.0012 mmHg
  - Saturated vapor concentration is 13.2 mg/m^3
- At 77˚F:
  - Vapor pressure is 0.00185 mmHg
  - Saturated vapor concentration is 19.90 mg/m^3
- At 86˚F:
  - Vapor pressure is 0.00278 mmHg
  - Saturated vapor concentration is 29.40 mg/m^3
- At 95˚F:
  - Vapor pressure is 0.00415 mmHg
  - Saturated vapor concentration is 43.30 mg/m^3
- At 104˚F:
  - Vapor concentration is 0.00608 mmHg
  - Saturated vapor concentration is 62.40 mg/m^3

Source: "Lange's Book of Chemistry", Page 10-22, Reference 2

WHY THIS IS IMPORTANT

- Vapor concentrations are a function of temperature
- Demonstrates the need for ventilation
- If all mercury is not removed, later impact is likely
- Where will the vapor go? (walls, ceilings)
- Ambient vs. surface temperature

VAPOR & DUST

- Mercury vapor attaches to dust
- Transport & deposition (tracking) (dust & particulates)
  - 2 dimensional vs. 3 dimensional

COMPLEX ELEMENT & COMPOUND

- What happens when chemicals are introduced into the project?
  - Pre-existing or decontaminants
- What happens during vacuuming?
  - Vacuum/Scatter Effect
- What is the difference between liquid and vapor?
- What is impacted?

INTIAL ACTIONS

- Evacuate immediate area and do not allow pregnant women, small children or pets to enter area
  - Individuals within the spill zone should remove shoes prior to exiting the area
- Do not attempt to vacuum spilled mercury without an approved mercury specific vacuum
- If mercury came in contact with clothing, including shoes, remove and place in plastic bag and seal
  - Place shoes in separate bag from other items to avoid possible cross contamination. Label bags with owners name and contact information. Place plastic bag containing contaminated clothing out of doors and downwind

INTIAL ACTIONS (CONT'D)

- If mercury came in contact with exposed skin, immediately wash exposed areas with warm water and mild detergent
- Open doors and/or windows to outdoor atmosphere if mercury was spilled in areas with outside doors and/or windows – Do not walk through spill area to open windows
- If possible, turn off HVAC and/or other ventilation to and from impacted areas
- If possible, place towels or other impervious materials on floor to stop vapors from exiting under doorways. Or, you may place duct tape along door edges to contain vapor

INTIAL ACTIONS (CONT'D)

- Do NOT attempt to cleanup the spilled mercury
- Notify regulatory agencies such as EPA, local health department, local fire department
- Notify qualified response contractor
- Notify others, as appropriate
- DO NOT RE-ENTER AREA OR ALLOW OTHERS TO RE-ENTER THE AREA

INTIAL ACTIONS (CONT'D)

- If school or other public location, identify one person to coordinate and manage incident with regulatory agencies, parents, media, response contractor and others who may be impacted by the incident
- Identify potentially exposed individuals
- Identify possible satellite spill locations (school buses, other rooms, homes, automobiles, etc.). Isolate as needed

SEARCH CAREFULLY

Photo: ESCO

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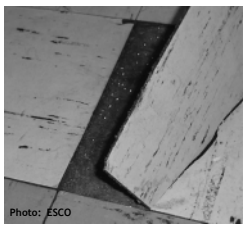

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WHAT IS IT?

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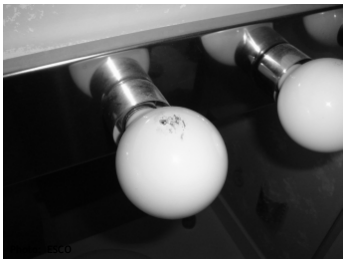
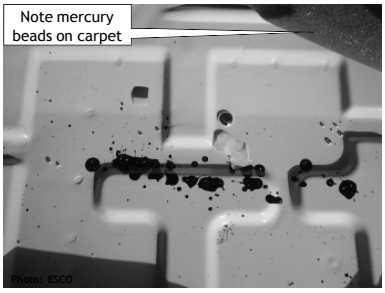
FOLLOW THE TRAIL

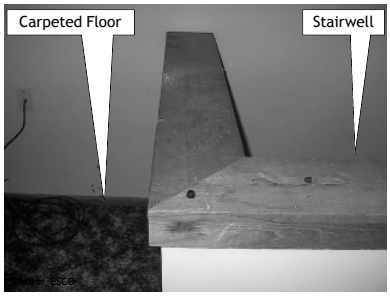


SEARCH CAREFULLY

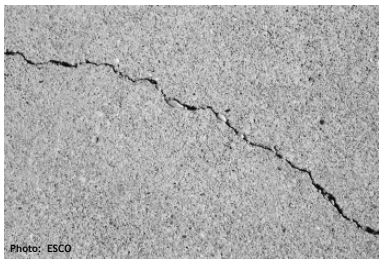
IN AUTOMOBILES



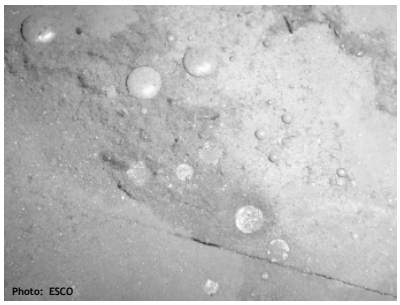
BE CAREFUL



WHERE WILL IT GO?



OXIDATION & SPOTTING



FLOURED & SICKENED MERCURY

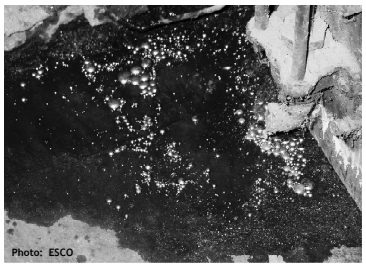
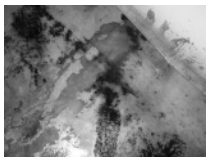


Photo: ESCO

WHERE'S THE MERCURY?

Photo: ESCO

WHAT'S THE SOURCE?



Photos: ESCO

MERCURY REMOVAL

- Physical removal **AND** decontamination are required for **all** mercury releases
- Vacuuming is not as simple as "*sweeping it up*"
- Decontamination may include any or all of the following:
  - Ventilation
  - Heat (with ventilation)
  - Chemical decontamination
  - Physical removal (disposal)
  - Combination of some or all

SCIENCE & CHEMISTRY OF MERCURY

- **MERCURY IS AN ELEMENT**
  - It cannot be destroyed thermally or chemically
  - Chemical decontamination does not "*neutralize*" or "*dissolve*" mercury
  - Chemical decontaminants change mercury's form or type to another to facilitate removal
  - Liquid vs. vapor vs. compound

SCIENCE & CHEMISTRY OF DECONTAMINANTS

- The science must work
- Vapor suppressants vs. decontaminants
- "*Home brews*"
- "*Mercury*" vs. "*mercury contamination*" removal
- Vapor emitting, non-soluble form is converted to a non-vapor emitting, water soluble form to facilitate removal
- Zinc, et al simply don't work

KNOWLEDGE & EXPERIENCE MATTER

- Adverse health effects are real
- Although not *rocket science*, there is much more to mercury than most people realize
- Many releases can be managed very quickly, with minimal disruption
- Yet, many releases become *MONSTERS* and can be very, very costly

WHY EXPERIENCE MATTERS

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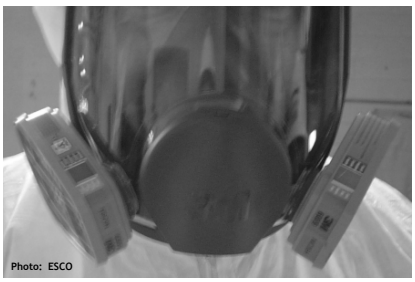

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- A single fever thermometer in a house, on carpet (3 ft^2) cost $14,000
- 2 CFL's broken on vinyl tile floor cost $5,000
- A school with a broken scientific thermometer cost >$250,000
- A leaking sphygmomanometer in doctor office cost >$35,000
- Disposal can exceed cost of cleanup, if not performed appropriately

WHY EXPERIENCE MATTERS

- Some contractors and consultants use MRL concentration to justify additional work
  - Nearly **ALL** clearance/cleanup levels are **RECOMMENDED**; only OSHA has a regulatory level
- Many contractors and consultants don't understand MVA's and how they are used to determine vapor concentrations
- Very few contractors and consultants have any training for mercury spills or MVA's

TARTAN® SURFACES

- Not all "*rubber*" flooring contain mercury
- Not all "*mercury-containing*" flooring requires immediate removal
- Many contractors and consultants treat as "*spill*"
- Flooring that contains mercury may not required immediate removal
  - What's its use, vapor concentrations, engineering controls, condition, etc.
- Issue is vapor (and waste)
- "*Impacted*" items rarely require disposal

MERCURY AIR MONITORING & FINAL CLEARANCE SAMPLING ISSUES

- Mercury clearance sampling is predicated upon **NO** mercury being present
- NIOSH 6009 vs. Lumex® vs. others
- Final clearance must be performed simulating actual use conditions (worse case)

CLEARANCE SAMPLING WITH LUMEX® MVA

- Lumex® vs. other MVA's vs. NIOSH 6009
- Where to screen
  - Breathing zone
  - Floor
  - Other
- How to screen
  - Headspace screening
  - Other (vacuums, etc.)
- Documentation

MERCURY SPILLS IN GENERAL

- Always think about mercury behavior (Hg & Hg vapor)
  - Generally, the higher the mercury falls, the smaller the beads
  - Transport & deposition (dust & particulates)
    - 2 dimensional vs. 3 dimensional
  - Tracking by humans, pets, vehicles, other
  - HVAC systems & filters, others
  - Temperature, others
- Historic spills are more difficult than recent spills to clean & decontaminate

DISPOSAL ISSUES

- Mercury
  - Characteristic, Listed and Universal Waste
    - But is it hazardous waste?
    - Which disposal method is appropriate?
  - What about waste generated in homes?

THINGS TO KEEP IN MIND

- Who sets clearance levels? Why?
- Who should have project involvement? Why?
- Look beyond the spill zone
  - Tracking by humans / pets / vehicles
  - Custodial closets
    - Vacuums, mops, brooms, etc.
- Don't assume regulators know more than you
- Don't assume contractors or consultants know what they're doing
- Mercury spills rarely cause immediate adverse health effects
  - Educate yourself, take your time and verify

AND FINALLY…HOW CLEAN IS CLEAN?

- Remember…nearly **ALL** clearance/cleanup levels are **RECOMMENDED**; only OSHA has a regulatory level

- OSHA (Occupational)
  - PEL (as ceiling) – 100.0 µg/m³
- NIOSH (Occupational)
  - REL (10 hrs X 40 hrs) – 50.0 µg/m³
- ACGIH (Occupational)
  - TLV (8 hrs X 40 hrs) – 25 µg/m³
- ATSDR (Residential / Occupational)
  - MRL (Minimal Risk Level) – 0.2 µg/m³
  - Action Level (Indoor) – 1.0 µg/m³ (remediation trigger)
  - Residential Isolation – 10.0 µg/m³
  - Residential Possessions – 10.0 µg/m³ (**CAUTION**)
  - Occupational / Commercial – 3.0 µg/m³

THANK YOU / QUESTIONS

Joel Hogue
Elemental Services & Consulting, Inc.
740.815.9660
joelhogue@escoinfo.com

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