



# Mercury Cleanup Activities





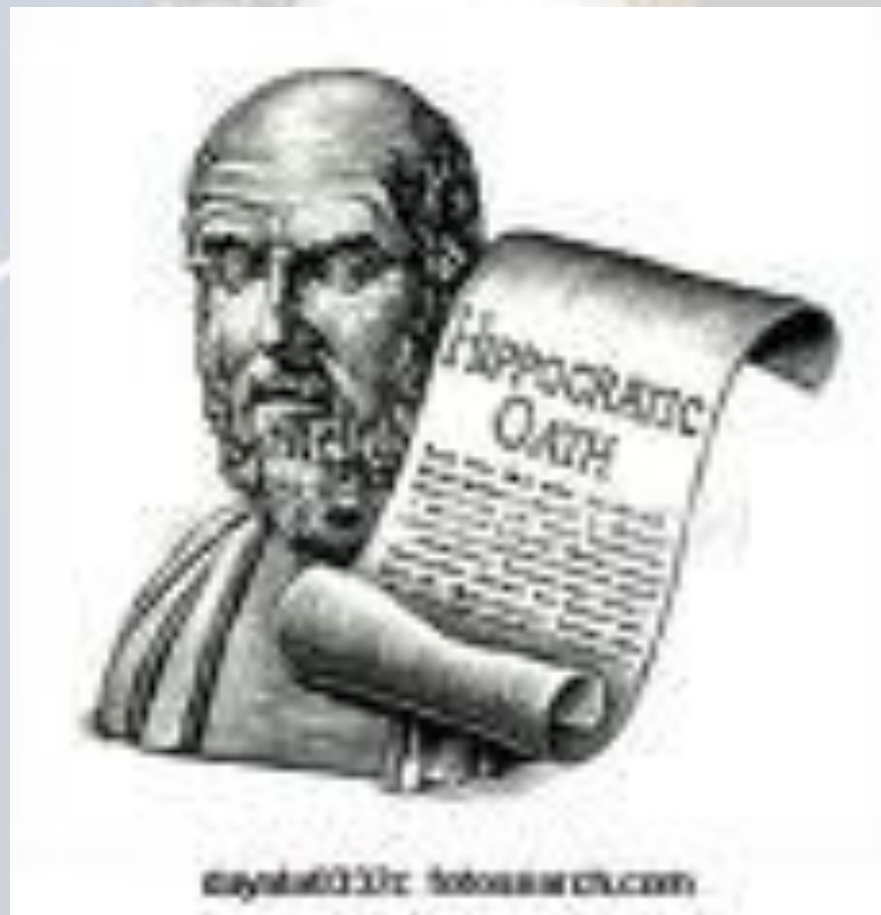
# Looking Ahead

- Reducing Contamination Spread
- Cleanup of contaminated media:
  - Indoor Air
  - Indoor Surfaces and Structures
  - Soil
  - Water
  - Contaminated Personal Belongings
  - Contaminated Containers



# Don't Make It Worse

- Hippocratic Oath, “do no harm...”.
- Hazmat Oath, “you !\*\*!# fool, don't make a small mess a big mess!”.
- Delineating and controlling hot zones and cold zones are key, especially if we are responding to a recent spill.





# Site Delineation and Control

- Visual observation and real-time air monitoring equipment during our initial assessment in order to identify source areas (liquid mercury or beads).
- Liquid mercury on surfaces is readily spread by traffic.
- Areas with liquid mercury are our hot zone.
- Areas mercury vapor has diffused into may not contain liquid mercury.



# In Practice...

- If the spill is recent, contamination is probably confined to a few areas or rooms.
- If non-contaminated portions of a structure or facility can be cleared for use, disruption to the public will be greatly reduced.
- The decontamination corridor separates the hot zone from the cold zone.



# Decontamination Line

- Mercury droplets like to adhere to bottom of shoes or boot covers.
- Attempting to wash off mercury is unproductive and creates difficult-to-manage liquid waste.
- Decontamination by disposal of gloves, boot covers, and overalls is the most effective decon.
- Nobody should ever leave the hot zone without removing boot covers!



# Now We're Ready For Work!

- Once we've figured out where there are mercury sources;
- And we've assured ourselves that we are not going to spread it;
- It's time to cleanup!
- We will consider some different media.



# Contaminated Media: Air

- Mercury vapors in the air pose much less of a contamination risk than liquid mercury.
- Mercury vapors however, make response more difficult by:
  - Confounding location of sources
  - Necessitating use of PPE
  - Preventing clearance of areas otherwise free of liquid mercury
- We will control ventilation to reduce mercury vapor concentrations near the spill.





# Controlling Ventilation

- Close/Shut off intakes near indoor spills.
- Create plastic curtains to keep mercury vapors out of cleared areas.
- Vent vapors outdoors/away from site.
- Shut and seal doors of contaminated rooms.
- Do not confuse this step with heating/venting which we will use later to remove residual contamination.
- We control ventilation early in the response in order to make our response more effective.



# Next Step: Grab the Gobs!

- Pools and droplets of liquid mercury can quickly bounce around and contaminate previously clean areas.
- The first step in cleanup is to capture these mobile droplets.
- Eyedropper, duct tape, mercury vacuum are good tools.
- Needless to say, never use an ordinary vacuum for this purpose!





# Vacuuming: A Beginning, Not an Ending

- The mercury vacuum, although very useful, will rarely be sufficient to remove all liquid mercury sources:
  - Microscopic droplets elude detection.
  - Tiny droplets cling to surfaces tightly.
  - Crevices shield droplets.



View of U.S. EPA ERRS contractor using a mercury vacuum to collect liquid mercury from the floor of a bedroom.



# Surface Cleanup

- If you can see liquid mercury droplets on a porous surface, you will likely have to remove the surface.
- Sometimes a hard porous surface (like concrete) can be coated with an impermeable resin to reduce vapor emission.
- Yanking and disposal is almost always a better solution than attempting to decon porous surfaces.



View of mercury-contaminated carpet removal.



# Yank!

- Impacted carpet must be yanked.
- Carpet backing behind yanked carpet should be pulled too.
- When in doubt, yank carpet out!







# Yank?

- Wood—more difficult decision—porosity, degree of contamination, cost of replacement, and likelihood of success by alternate means must all be evaluated.



View of U.S. EPA ERRS contractor mopping floors with HgX solution.



# Yank?

- Concrete/Masonry/Tile—Another difficult choice. Sealants and sorbents may or may not be feasible depending upon level of contamination and nature of surface.
- Remember, wherever there has been liquid mercury spilled, we will have to be aggressive in order to achieve desired residential cleanup goals.





# Metals and Non-Porous Surfaces

- Metals and other non-porous surfaces should be amenable to cleanup by mercury removal and use of a sorbent or heating/ventilation to remove residual material.
- The complexity of the surface, the degree of contamination, and the cost of the item must all be considered when cleanup is attempted of such surfaces.
- Mercury quickly finds its way into the cracks and crevices of an otherwise non-porous item, making cleanup difficult or impractical.



# Plumbing

- Elemental mercury often is introduced into drains:
  - Spills into floor drains
  - Attempts to dispose down drains
  - Uninformed cleaning attempts
- This mercury can be recovered by removing drain traps.





# Some Rules of Thumb for Cleanup of Structures

- Visible mercury always requires cleanup.
- Near surface vapor measurements  $>6 \mu\text{g}/\text{m}^3$  – mercury beads probably still present.
- Near surface measurements  $<1 \mu\text{g}/\text{m}^3$  – surface probably uncontaminated.
- Measurements between  $1 - 6 \mu\text{g}/\text{m}^3$  – status unclear. There may not be mercury beads, but residual mercury might require additional treatment.



View of Jacome mercury vapor air sampling and mercury-contaminated carpet removal.



# Soils and Sediments

- Soils pose different challenges than indoor spills.
- Health risk primarily from contact and tracking to indoors.
- Location of hotspots requires careful sampling strategy.
- Soils are not the focus of today's training.



View of U.S. EPA ERRS contractor excavating mercury-contaminated soil in a residential area.



# Water

- Elemental mercury is very insoluble in water.
- Elemental mercury in the presence of water can slowly be oxidized to toxic salts.
- During response we do our best to keep water out of the mercury and mercury out of the water.





# How Can I Tell What's Practical To Clean?

- Clothing and small items are bagged and allowed to sit for one hour. A measurement is then taken of the atmosphere in the bag:
  - $<6 \mu\text{g}/\text{m}^3$  May safely return to service or user
  - $6\text{-}25 \mu\text{g}/\text{m}^3$  May attempt to salvage and decontaminate.
  - $>25 \mu\text{g}/\text{m}^3$  Usually do not attempt salvage.



Documentation of a mercury-contaminated mattress.







# In The Heat Shed

- The heat shed is a temporary outdoor structure where portable items with low levels of mercury contamination are alternately heated and ventilated.
- Items in the heat shed are periodically bagged and screened (described earlier) to determine if they can be released.



Documentation of contaminated clothing.





# Furniture

- Furniture in “hot” areas must be evaluated:
  - Is it contaminated? (near surface readings elevated relative to background)
  - If uncontaminated, can we work around it, or do we need to move it somewhere else?
  - If contaminated, will ventilation and heating outside help?
  - Should it be disposed of?
- Near-surface readings and our understanding of the nature of mercury spread at the site will help us make these decisions.



View of U.S. EPA ERRS contractor loading mercury-contaminated clothing and household items into rolloff boxes for disposal.





# Container Cleanup

- Dumpsters and garbage cans are poor places to put mercury.
- Indoor containers that have held mercury should be discarded.
- A little bit of mercury and a lot of trash can create a big mess!





# CLEANUP TECHNIQUES





# What's Ahead

- Mercury Indicator Powders
- Mercury Spill Kits
- Mercury Vacuums
- Mercury Sorbents
- Heating/Venting.





# Cleanup Techniques

- Most of our cleanup activity consists of identifying and recovering liquid mercury.
- Frequently after we have done that high levels remain in air.
- Additional treatment is usually required.
- We will discuss these cleanup techniques in a little more detail.



# Powders

- A variety of mercury sorbent powders are available.
- Generally act to oxidize mercury into less volatile mercury salt.
- Mercury becomes immobilized.
- Some powders change color.





# Amalgams

- Amalgamating powders immobilize mercury and make it easier to clean up.
- Most use zinc metal's ability to form amalgams with mercury.
- Powdered sulfur also works.





# Liquid Decon Agents

- Liquid decontaminants are the chemical with which we have had the most experience.
- Liquid decon agents act quickly enough to be practical during emergency response.
- Our experience has been mixed.
- Most useful if an area has already been thoroughly cleaned and levels remain slightly above cleanup goal.
- Don't expect miracles.



# More

- The best use of mercury decon agents is to reduce levels of residual mercury on non-porous surfaces after all visible mercury has been removed.
- Decon agents can help us reach the residential standards, but only if we are already close to reaching that goal.
- Sorbents probably work best when we are at  $<5 \mu\text{g}/\text{m}^3$  near surfaces.



# Mercury Vacuum

- Unlike normal vacuum, exhaust is filtered through sophisticated (expensive) filter before leaving vacuum.
- Costly filter change after each use.





# Final Step

- We've collected visible mercury, removed porous contaminated items and surfaces, treated hard surfaces, and still above cleanup goal – what next?
- Heating and ventilating can be an effective way to reduce residual vapor concentrations if very near cleanup goal.
- Temperature is important!



# Heating/Ventilation

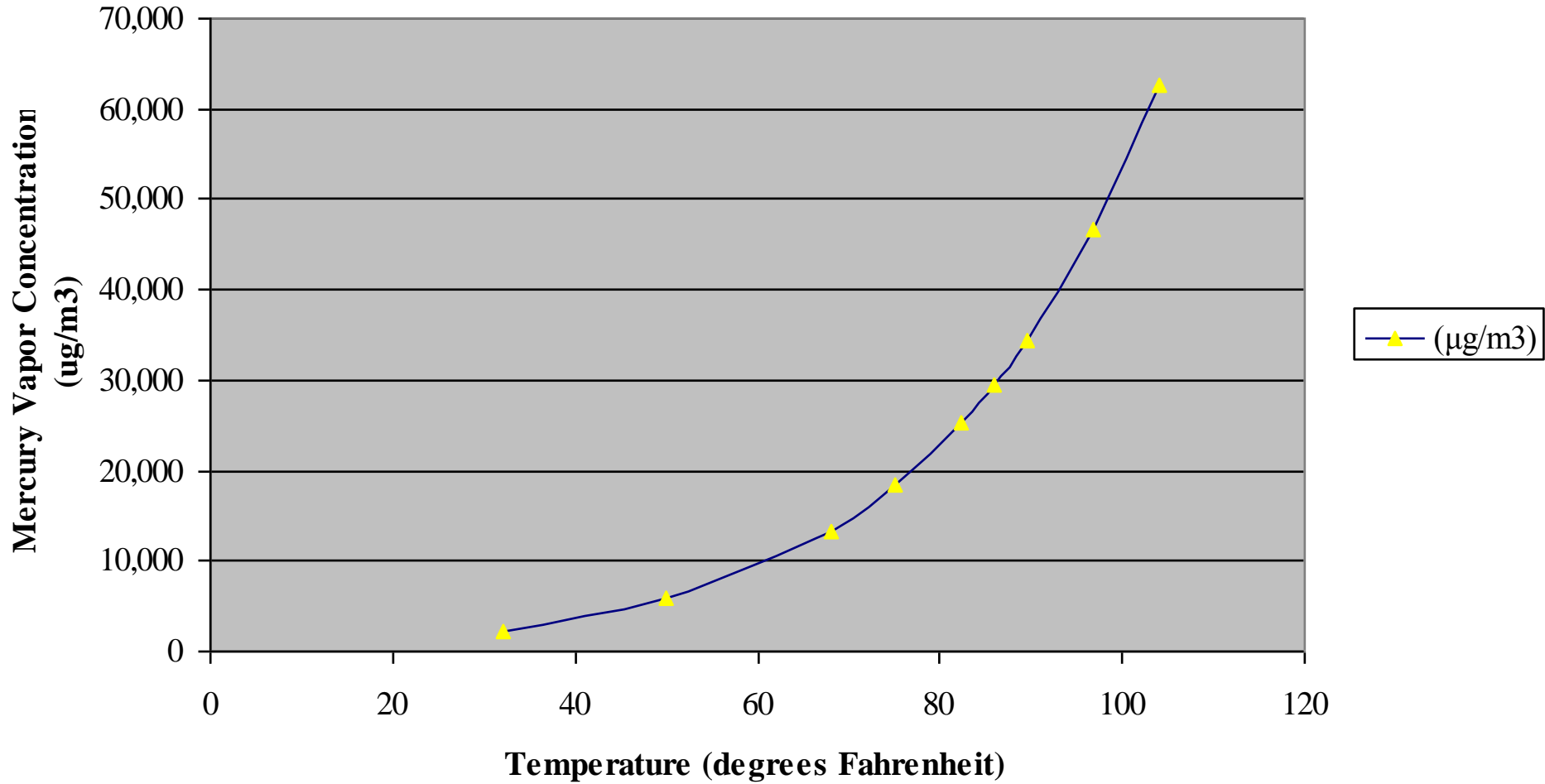
- Let area get as warm as practical (ideally  $>90^{\circ}\text{F}$ ).
- Ventilate vigorously.
- If the environment allows, heat and vent simultaneously.
- At this stage further decon should no longer be required.



View of industrial fans blowing air into the house to allow venting of volatilized mercury.



# Mercury Vapor vs. Temperature





# Conclusion

At different stages of the response, we are performing the following activities in a stepwise process:

- Prevent spread – isolate hot zone and control air flow.
- Cleanup liquid mercury and and droplets.
- Remove contaminated porous media – disposal or heat shed.
- Treat non-porous surfaces – Hg decon agent.
- Final step – heating/venting.



# POST-CLEANUP CONFIRMATION





# Post Cleanup

- The Dilemma:
  - Reaching residential cleanup standards can be challenging.
  - Sometimes residual mercury or microscopic mercury beads can remain after best cleanup efforts.
  - Mercury vapor concentrations vary greatly depending on temperature.
  - We need a way of establishing that we have met cleanup goals and it is safe for re-occupancy.
  - Systematic air monitoring or air sampling is how we prove we have been successful in achieving residential standards.



# Cleanup Confirmation Air Monitoring or Sampling

- A necessary step.
- Air monitoring is usually reliable if performed systematically with a sensitive instrument (e.g., Lumex) and at the high range of indoor living temperature.
- If not air monitoring, then air sampling provides even more reliable data.



# Cleanup Confirmation Monitoring

- Place salvaged furniture and personal items back in area.
- Make sure temperature is high range for indoor temp (recommend around 80 degrees F).
- Shut off ventilation.
- Let area “settle” for at least one hour.
- Monitor breathing zone through each room.
- Lower monitoring height for younger populations.





# Air Sampling: Pros and Cons

- Pro: Provides most realistic assessment of vapor concentrations in the room because of long collection period.
- Con: What do you do while you're waiting for lab results?
- Con: What if the results show you haven't been successful?







# Questions?

