



ENGINEERING



ENVIRONMENTAL



FIRE

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**2024 Chesapeake
AIHA/ASSP Educational
Seminar**

**Mercury in Rubber Gym
Floors: Overview and
Lessons Learned**

March 2024

- Background information on mercury
- Health effects and uses of mercury
- Background on rubber gym floors
- Next steps if you suspect a floor has mercury
- Four gym floor removal projects
- Significant Issues during floor removal
- Lessons learned and management strategies
- Wrap up and questions





- Mercury (Hg) is a naturally occurring element
- It is a mineral that is a liquid at room temperature
 - nick name is “quicksilver”
 - symbol Hg stands for hydrargyrum - Greek for “water” and “silver”
- Vapor is heavier than air, invisible, and odorless
- Liquid vaporizes quickly at room temperature
- Can form organic and inorganic compounds with varying degrees of toxicity



- The CNS and kidneys are the most impacted by exposure
 - Considered probable carcinogen by IARC and EPA
- Symptoms are non-specific and can be confused with other problems:
 - Anxiety
 - Shyness
 - Irritability
 - Loss of appetite
 - Sleep problems
- Mad as a hatter” expression/Mad hatter disease (Erethism) caused by effects of mercuric nitrate used as a smoothing agent in the felting process in the 18th to 20th centuries

- Historic uses:
 - alkaline batteries
 - electronic switches and lighting applications
 - fungicides/pesticides
 - paints and pigments
 - thermometers, thermostats, gas regulators, boiler heat generators (early 1900s)
 - scientific and medical devices, dental fillings
 - industrial processes
 - pharmaceuticals and cosmetics
 - rubber gym floors and outdoor athletic tracks
- There is a push to remove mercury-containing building materials and equipment from schools and hospitals (see EPA and ATSDR).

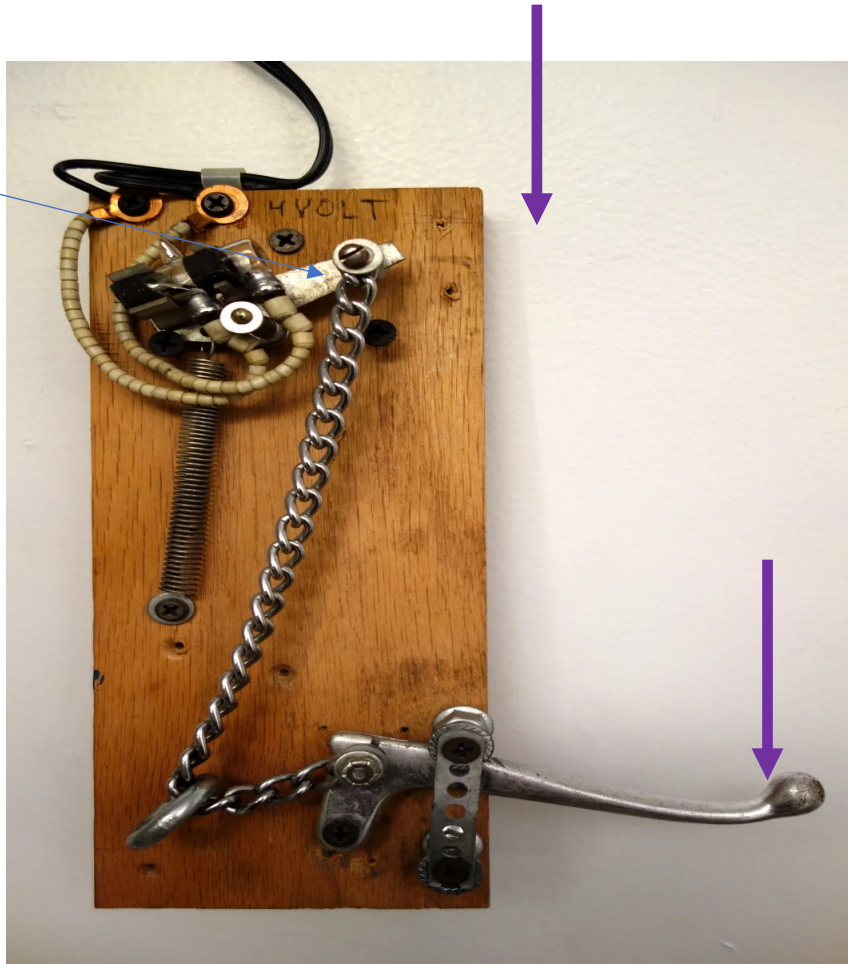


Mercury cup with ~2 tsps. of liquid mercury



This orientation means no mercury

Liquid mercury vials move as switch is activated







Liquid mercury inside a clear glass vial breaks when heat makes liquid expand





- A catalyst (phenyl mercuric acetate) was added to the polymer mixture of the flooring material in small amounts (0.1-0.2%)
- Installed (poured) in gymnasiums across the United States starting from 1960's to 2000s (not rubber tiles seen in fitness rooms)
 - Service life 20-40 years
- PMA catalyst causes floors to emit mercury vapor
 - Concentrations depend on the amount of mercury in the material, the temperature, and ventilation conditions
 - Age and condition of floor may also play a part

- [Video 1 - News Report: Washington Township School District Replaces Gym Floors That Contained Mercury In Time For New School – YouTube](#)







- Collect Bulk Samples of Flooring Material
- Cut out 2"x2" samples (2 or 3 samples total)
 - Drill through wooden flooring or remove door transitions for sampling purposes
- Analysis by an accredited laboratory using EPA Method 7471A or equivalent
 - < 1 ppm – mercury catalyst most likely not present
 - > 1 ppm – proceed to next steps to make decisions about removal

- Air sampling using mercury vapor analyzer
 - Real time monitoring (no lab needed)
 - Must have low level of detection (nanogram level)
 - Best tool for routine monitoring and for monitoring during removal
 - Can find hot spots
- Standard industrial hygiene air sampling (pump and tube) by NIOSH 6009
 - Takes about 8 hours to get a low detection limit
 - Requires lab analysis
 - Cannot find peaks or hot spots
 - Better for clearance sampling after floor removal





- Manage floor in place before removal and limit mercury exposure
- At a minimum:
 - cooler temperatures
 - good ventilation (check cooling and ventilation schedules)
 - Initial and seasonal air sampling (maximum temperature and minimum ventilation)
- Also recommended: floor maintenance, good housekeeping, restricting floor access (don't use as swing storage space), record-keeping, hazard communication and training (custodial and maintenance staff, gym faculty), ventilation system documentation, staff training, and indoor air quality (IAQ) management, in general
- Writing a mercury gym floor management plan would be prudent

- One study of flooring emissions: the mercury emission rate doubles for approximately every 9° F increase in floor temperature
- Monitoring twice a year in heating and cooling seasons, makes sense
- Discuss economy settings and schedules for ventilation and cooling with HVAC engineers and operators
 - adjust operation as necessary for controlling mercury vapor
- Choose a goal for controlling vapor concentrations
 - below 750 ng/m³ widely accepted for school populations

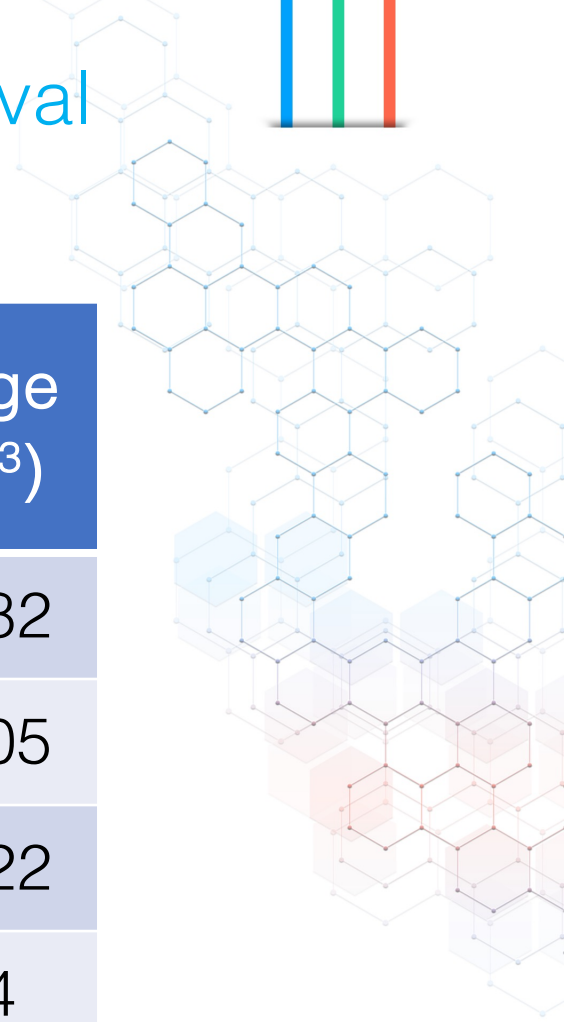
- Removal of flooring similar to an asbestos abatement project
- Negative air enclosures with HEPA-filtered negative air machines
- Workers
 - usually asbestos trained/know how to work in a negative air enclosure
 - additional training is given for mercury vapor awareness
- PPE
 - whole body covering
 - half-mask respirators with mercury vapor cartridges
- Vacuums specific to mercury clean up should be available on each project

- Note other materials that might be disturbed during floor removal
- Perform appropriate bulk material sampling and analysis, if not already known
 - Caulks and mastics at floor level
 - Floor tiles and mastic at transitions to adjoining rooms or hallways
 - Skim coat or other flooring layers
 - Lead-based paint, if it is in poor condition

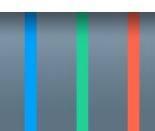
- Develop a remediation plan for floor removal
 - Do research, use available guidance and make decisions for your organization
- Request for bids should be specific and similar to asbestos abatement project
 - Include “mercury vapor removal” in language not just floor removal
- Location and configuration of gym can present challenges
 - Containment installation and operation
 - Exhaust placement, equipment and waste movement
 - Contractors should visit the school during the bidding process, if possible

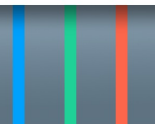
- Separate wastes during removal into large roll-off containers kept outside and covered
- Test waste separately by TCLP for mercury before disposal
 - Floors with TCLP leachate that exceeds the EPA maximum concentration of 0.2 ppm (mg/L) mercury must be disposed of as hazardous waste.
- Identify waste contractor during bid process
- Exception: Floor and door transition hardware can be salvaged and cleaned for reuse

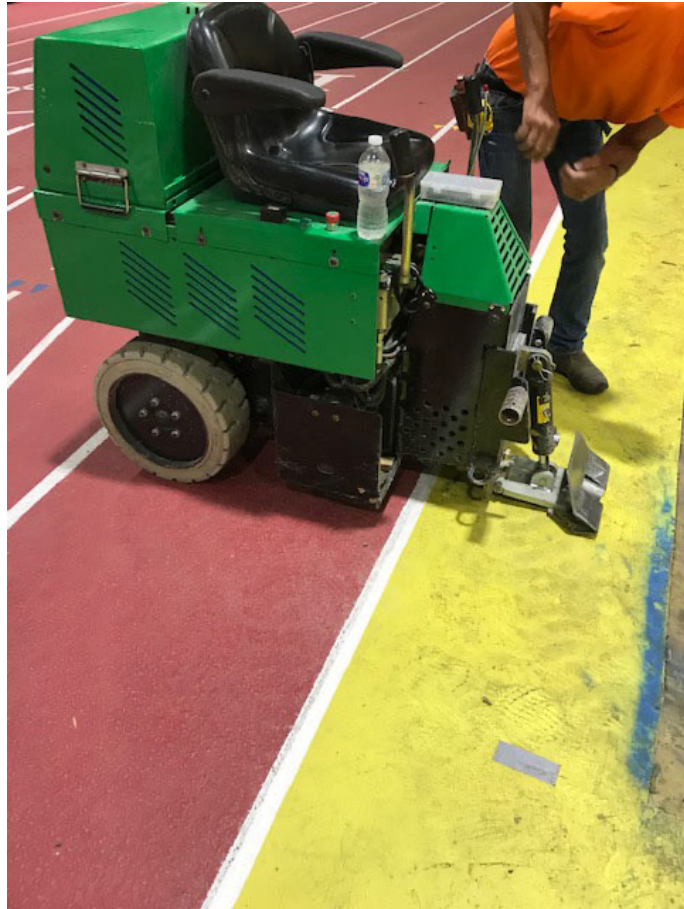
- Four schools (1960-1980s) with confirmed mercury gym floors
 - Three schools had typical wooden gym floors over the rubber flooring
- Short time frame: new floor planned to be installed as soon as possible after rubber floor removal and before school started in late August
 - Two contractors were chosen for two schools each starting in mid-June of 2021
 - Contractors chosen to install new flooring were on stand-by
- IH consultant hired to help develop remediation plans, to perform air monitoring, and to help with project management overall

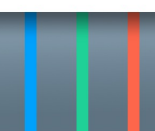


School	Summer 2020 (ng/m ³)	Fall 2020 (ng/m ³)	Winter 2021 (ng/m ³)	Spring 2021 (ng/m ³)	Average (ng/m ³)
School 1	149 - 206	0.5 - 307	118 - 150	45 - 65	78 - 182
School 2	85 - 116	64 - 77	53 - 73	44 - 154	62 - 105
School 3	-	-	84 - 491	26 - 153	55 - 322
School 4	-	-	3 - 54	0.5 - 33	2 - 44









- Mercury finds the lowest point in which to hide
 - Cracks, receptacles, and holes may be more contaminated
- Issue: High initial concentrations were found in the volleyball post sockets
- Strategy: Sockets were removed for inspection
 - Debris, pits and general deterioration inside
- Sockets cleaned out in all three schools that had them
- Monitoring focused on these areas until clean and clear

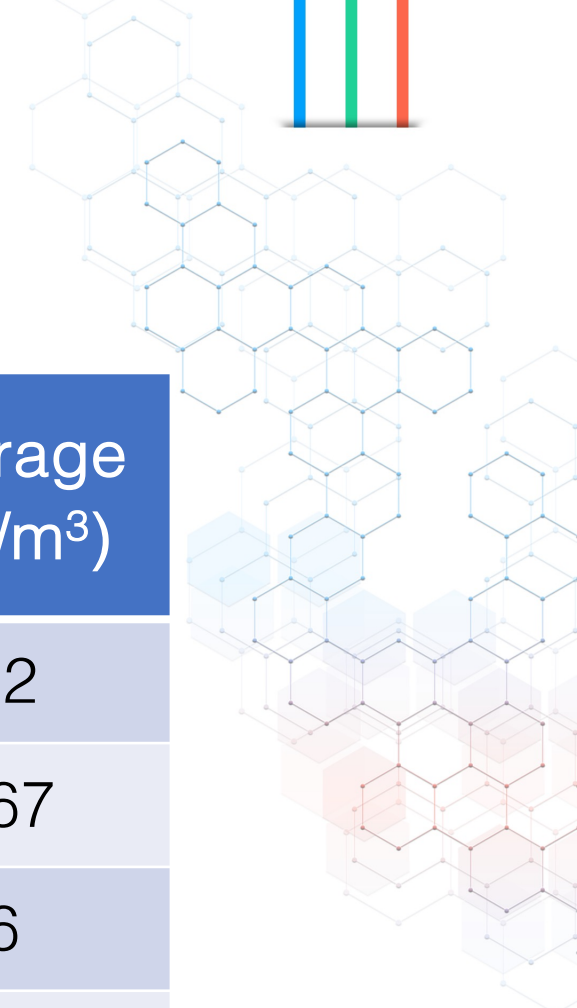


- Issue: Initial mercury vapor concentrations were above the target concentration (750 ng/m³) after the rubber gym floor was removed
- Strategy: Thorough visual inspection
 - A thin layer of rubber was observed around door transitions and where damage to concrete had formed potholes (Rubber was almost the same color as the concrete)
- Strategy Follow up: Hand grinders and other tools used to remove as much of the rubber as possible
- Note: Project enclosure was continuously ventilated, and temperatures were above 75° F

- Issue: Mercury vapor concentrations were above the target concentration (750 ng/m³) **after** more of the rubber gym floor was removed
- Strategy 1: Industrial heaters were added to the negative air enclosures being constantly ventilated throughout the removal (Temps – mid 90s° F)
- Strategy 2: The gym floor was abraded by shot blasting more times than planned
- Finally, mercury vapor concentrations fell and stayed below 750 ng/m³







School	Summer 2022 (ng/m ³)	Fall 2022 (ng/m ³)	Winter 2022 (ng/m ³)	Spring 2022 (ng/m ³)	Average (ng/m ³)
School 1	35	15	25	171	62
School 2	292	19	150	208	167
School 3	ND (2)	3	6	11	6
School 4	9	4	6	43	16



- [Video 2 - Contractor rubber floor removal without containment:
https://www.youtube.com/watch?v=eU-MnGcH6d4](https://www.youtube.com/watch?v=eU-MnGcH6d4)





- Contractor removing wooden floor over rubber gym floor with containment:
https://youtu.be/Zze23ilbyfE?si=g1-fz9aRQcr7_eEz

- MN – Strategies and Information Specific to Mercury in Gym Floors
<https://www.health.state.mn.us/communities/environment/hazardous/docs/hgflooring.pdf>
- NJ – Strategies and Information Specific to Mercury in Gym Floors
https://www.nj.gov/health/ceohs/documents/njdoh_mercury%20guidance_2020.pdf
- EPA - Overall Mercury Information <https://www.epa.gov/mercury>
- ATSDR – Overall Mercury Information <https://www.atsdr.cdc.gov/mercury/>
(Great resource overall including TOXFAQs, Don't Mess with Mercury videos for teachers, students and parents, fact sheets, etc.)

Questions?

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