

Case Study

[In each issue, IEQS presents a case study on an indoor air investigation in a particular building. The information in the cases comes from various sources, including published material, reports in the public record, and, in some cases, reports supplied by the consultants involved in the case. IEQS presents a variety of approaches to investigation and mitigation implemented by consultants with a broad range of experience, philosophies, and expertise. Inclusion of a particular case study in the newsletter does not imply IEQS's endorsement of the investigative procedures, analysis, or mitigation techniques employed in the case. IEQS invites readers to submit comments, suggestions, and questions concerning the case. At the discretion of the editors, correspondence may be presented in a future issue.]

Biological Contamination Forces School Evacuation: Part 2

This case study is the conclusion of Part 1, which we presented last month. As we reported in that issue, more than 400 students and 30 staff members had to be evacuated from a midwestern US elementary school for nearly five months as a result of health complaints from old mildew and chemical exposure. The students and staff were evacuated from the school to an alternate site for a significant portion of the 1996-1997 school year while cleaning and other corrective actions were completed. The size and duration of the evacuation marked this as one of the most significant IAQ incidents in the country in recent years.

The elementary school, which serves students in kindergarten through fifth grade, had a troubled history; many of the school district staff referred to it as "the building that made them sleep." The malfunction of the boiler system in conjunction with a steam leak put an acute odor into the air, resulting in an IAQ investigation. Among the consultant's conclusions:

- Odors resulted from several compounds, rather than a single contaminant or chemical.
- Biological contamination was present in the school at the time of the initial site investigation and during the subsequent sampling.
- The heating system provided the primary pathway for contaminants reaching occupants of the building, although other odors may have entered the building through the boiler room, teachers' lounge, or the kitchen air intake fan. The use of the kitchen fan may also have dispersed the contaminants.
- High levels of ambient dust contributed to the overall impression that the building air was unsatisfactory.

- The operation of the heating and ventilation system in the school was compromised by poor design, improperly sized filters, and insufficient cleaning to the point where it contributed to the IAQ problem.
- The low levels of residual boiler chemicals found in the air indicated that boiler treatment chemicals were not a substantial part of the odor that potentially caused ill health effects.
- Low humidity levels in the building during winter months may have contributed to the IAQ problems experienced by occupants.
- Past sensitization to chemical and biological contaminants could have contributed to the number and intensity of symptoms experienced by occupants exposed to the building conditions.

Along with the conclusions, the consultants recommended an extensive list of corrective actions. Some of these activities involved further investigation, testing techniques, and specified cleanup or construction activities.

The thrust of the recommendations was to control water infiltration into the building, clean up biological contamination in all areas from the service tunnels to the roof deck, seal penetrations from the service tunnels into the classrooms, clean and repair the unit ventilators, remove any confounding asbestos insulation (and repair remaining materials), reinsulate steam lines, and subject the facility to an intense cleaning and disinfection to remove any residual fungal spores. Post-remediation testing to verify air quality prior to the readmission of occupants would follow these repairs and cleaning.

Preliminary cost estimates put the price tag for all recommended repairs at \$150,000-\$250,000, depending on how much work was conducted by inhouse personnel versus contractual labor.

It was estimated that the cleanup and repairs could take up to three months. As such, school officials made arrangements to temporarily rent a different building so that school could begin again while they developed and implemented a final plan.

Varied Public Reaction

After the presentation of the preliminary report at an open school board meeting, officials scheduled an additional public information meeting to answer questions, discuss the situation, and review options for implementation of corrective actions. This meeting turned into a fairly contentious affair with a definite schism between individuals who had suffered symptoms or who had children who suffered symptoms and those whose children had not been affected. Because the primary contaminant was biological, rather than chemical, a wider range in physiological responses was to be expected and had to be explained, as many individuals were disturbed by the level of estimated costs.

Many people expressed disappointment that there wasn't a more definitive accounting of how many individuals had experienced symptoms on the day that the school was evacuated, while others were not convinced that fungal spore contamination could actually cause the serious symptoms described by many of the occupants. Representatives from both state and county public health agencies were instrumental in explaining many of the technical concepts and providing credibility to the investigation conclusions and corrective recommendations.

Healthy School Environment

Initially, school district personnel thought they could implement the cleanup of the occupied areas of the building while contractors with specialized training in asbestos and other contaminants corrected problems in the basement and tunnel areas. However, the ongoing review of the building, including a borescope examination of wall and ceiling cavities, revealed more extensive contamination than anticipated. The magnitude of the cleaning process, and the fact that many items used by teachers and staff had to be disposed of if they could not be easily decontaminated, made it difficult for school personnel to complete the remediation in an acceptable time period. Therefore, the contractual remediation efforts expanded to include

the occupied areas of the building as well as the service tunnels. Because of the extended period of time that the students would be housed in alternate facilities and the necessity for the cleaning crew to understand the intrinsic value of the teachers' materials, school officials set up a process to allow the teaching staff limited input into the cleaning and disposal process so that critical items could be retrieved, decontaminated, and utilized at the alternate school building.

Because of concerns about past sensitization and the amount of dust that was dislodged during the sorting and cleaning process, teaching and administrative staff were unable to enter the building. Workers instituted engineering controls, including the use of negative air machines with HEPA filters, in each classroom to minimize the possibility of recontamination once an area was cleaned. Although the workers tried to keep the process of sorting and cleaning as reasonable as possible, it was painful for the teachers both physically and emotionally.

Sorting took place one classroom at a time following basic guidelines, but it was almost Christmas by the time the process began in earnest. As such, many of the teachers had to endure below-freezing temperatures as they observed the sorting process from out-of-doors and communicated through the windows with the workers inside.

Officials used wind breaks and portable heaters to reduce the physical discomfort, but the emotional pain of seeing contaminated teaching materials disposed of was substantial. Indeed, the school district provided counselors to assist the staff in dealing with the sense of loss and displacement that developed during the remediation. This sense of loss was compounded by the fact that with the volume of materials moved, sorted, cleaned, and discarded, some mistakes occurred. Some items that were designated for decontamination were disposed of. Other items did not survive the decontamination process (laundering, HEPA vacuuming, washing with bleach solutions, etc.) and had to be thrown out. Still other items that were properly decontaminated were displaced or mishandled by other contractors doing general construction work or by the staff transporting the items between buildings.

Specific Remediation Activities

In addition to the cleaning, sorting, laundering, and decontamination of classroom items, the remediation effort addressed the 41 initial recommendations made as part of the preliminary report and the additional 8 that were added as the remediation process moved forward. Some of the major activities conducted with the help of the industrial hygiene consulting firm, architects, a general contractor, and appropriate subcontractors are summarized below.

- Excavate the exterior of the foundation walls and apply waterproofing materials.
- Regrade asphalt and soil to slope away from the building.
- Remove molded/water-stained fiberglass and asbestos insulation and clean cinder block walls in the dirt tunnels under the 1953 portion of the building.
- Repair steam leaks.
- Use a truck-mounted HEPA vacuum to remove asbestos debris in the sand and the top 2 inches of sand, and to clean debris from cement-floored tunnels.
- Regrade sand to minimize contours.
- Apply biocide per manufacturer's instructions to floor (including sand), walls, and deck of tunnels.
- Reinsulate steam and return pipelines.
- Cap the soil floor of the crawl spaces with concrete.
- Inspect/repair all tunnel vents and mesh screen over louvers where missing.
- Remove water-stained/molded ceiling tile and replace with new tile in various locations throughout the building.
- Conduct a borescope inspection of the interstitial space above the glue-on ceiling tile or plaster where conditions restricted a visual inspection.
- Remove and replace water-damaged and rotted sink bases using appropriate engineering controls.
- Remove water-damaged sink counter tops.
- Seal all pipe penetrations from the tunnels to the classrooms.
- Reseal all wall penetrations where piping repairs created access to the wall cavities/tunnels.
- Clean, disinfect, and repaint food storage cabinets.
- Reclean all unit ventilators, radiators, and heaters, including a complete cleaning of the fin tubes and adjacent motor boxes.
- Check and recalibrate the room thermostats and unit ventilator steam control valves.
- Install appropriate sized, pleated air filters in each unit ventilator.
- Install a powered exhaust fan in the bathroom in the teachers' lounge.
- Perform a thorough cleaning of each area where radiators/unit ventilators were cleaned, using soap and water.
- HEPA-vacuum hallway carpets following room cleanings and utilize more effective vacuums for all future vacuuming.
- Steam clean carpets with clean water heated to a temperature greater than 130°F.
- Utilize negative air machines as air filtration devices in the school for 48-72 hours prior to occupancy.
- Drain, clean, and disinfect sump pump pit. Lower pump to allow crock to hold as little water as possible.
- Fabricate and install a tight-fitting cover for the sump pump pit.
- Remove containers of unused boiler chemicals.
- Carefully review all custodial products and substitute less hazardous alternatives where appropriate.
- Provide additional training on the proper usage of custodial chemicals, i.e., no mixing of separate cleaning compounds, neutralization of acidic cleaners after use, etc.

Verification

Because of the level of contamination and complexity of the corrective actions, a number of people were initially involved in the management of different aspects of the project. However, it soon became clear, due to impending staff changes in the school district's administrative ranks, that one organization or individual should take the lead role in determining whether all corrective actions were accomplished appropriately. Officials decided that the industrial hygiene consulting firm would inspect and document all work performed.

After thorough visual inspections of the work efforts, consultants completed extensive testing that duplicated the majority of the initial investigatory test, so that objective comparison data could be provided before people were asked to reoccupy the facility. The analytical results were dramatic, with spore concentrations significantly decreasing, carbon monoxide levels decreasing to zero, and major improvements recorded in the carbon dioxide level/ventilation rate. The industrial hygiene consultants made sure that none of the cosmetic improvements made at the same time that the remediation efforts were being conducted (painting of lockers, floor stripping and refinishing, etc.) contributed to additional environmental concerns by creating objectionable odors or debris.

Prior to the return of students and staff, consultants and staff conducted a visual review to ensure that no details were missed. A public meeting/open house allowed members of the community to observe firsthand the work that was done. Diagrams and photo murals explained each major step of the renovation process. Representatives from the various organizations involved in the remediation efforts were present to answer questions and explain details to interested attendees.

Taking advantage of the school calendar, officials allowed the students to bring personal items from the temporary school building to the newly renovated building on the last

afternoon before spring break. Over spring break the teachers' materials, supplies, textbooks, etc., were brought back to the newly cleaned school. A final set of samples for biological contaminants the weekend prior to reoccupancy ensured that contamination had not been reintroduced into the building with the student and staff materials. The building and its occupants were observed carefully after the return of students and staff to ensure that their presence in the building did not adversely impact the air quality. Everyone was delighted and relieved that the remediation efforts had worked to a point that all of the impacted individuals, with one exception, were able to reoccupy the building without any additional health problems. The success of the remediation project can be summed up through the words of one of the teachers who exclaimed a few weeks after the staff moved back, "Hey the building doesn't make me sleepy anymore!"

For More Information

This case was investigated and reported by Michael Pinto of Wonder Makers, Inc. (WMI). Pinto is a nationally recognized expert in the area of indoor air quality. He was one of the participants who testified in Washington, DC, regarding OSHA's proposed indoor air quality standard. Readers may contact Pinto at WMI, P.O. Box 50209, Kalamazoo, MI 49005-0209. Tel: (616) 382-4154; Fax: (616) 382-4161; E-mail: info@wondermakers.com; Web site: www.wondermakers.com.

News and Analysis

Courts Side with Tenants in Apartment Building IEQ Suits

Two important court rulings — one in New York and one in Massachusetts — have given tenants redress against building owners in suits brought over indoor air pollution caused by businesses also located in the buildings. The New York City case involved a building in which perchloroethylene (perc) from a dry cleaning establishment was detected in apartments above the facility. The Massachusetts case involved environmental tobacco smoke (ETS) that was entering a second-floor apartment from a nightclub on the first floor.

In both cases, the judges ruled that the situations interfered with the tenants' "quiet enjoyment" of their property and violated an implied

warranty of habitability. The New York judge also ruled that the case involved partial constructive eviction — because the tenants at times had to leave the apartment and stay elsewhere. The judge in that case awarded the tenants a total of more than \$53,000. In the Massachusetts case, the judge awarded the tenant a three-month rent abatement and ordered the landlord to correct the situation.

The New York case came to trial in the Housing Court because two tenants in the Upper Manhattan building had each withheld rent of slightly more than \$17,000. Both apartments were located on the second floor of the