



**California State Board of Equalization**  
450 N Street, Sacramento, California

**Vinyl Composite Tile Removal  
Report**

*Project No. 2372.02-572*



**Prepared for:**  
California Department of General Services  
707 Third Street, 3-305  
Sacramento, California 95605

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**Report Date:**  
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## **1.0 Introduction**

In 2011, the Department of General Services (DGS) Building Property Management (BPM) provided building access, and together with Hygiene Technologies Inc. (HTI) and LaCroix Davis LLC (LCD), conducted an extensive vinyl composite tile (VCT) investigation throughout the Board of Equalization (BOE) building located at 450 N Street, Sacramento, California to determine the cause of strong odors once again present on the 21<sup>st</sup> floor.

The investigation concluded that interactions of tile adhesive and concrete slab with high pH values ( $\text{pH} \geq 10.95$ ) beneath the VCT most likely led to the failure and breakdown of the VCT adhesive. The value of  $\geq 10.95$  represents a pH value of 11.0 or greater. The degraded adhesive was suspected as a possible source for the strong odors in some building areas. The VCT Investigation Report of January 18, 2012 states that “A report published in Polymer Degradation and Stability (Vol. 93, Issue 2, 2007), “Degradation of Floor Adhesives as a Function of pH”, by Anderberg and Wadso, concludes that high pH readings in the range of 11-13 can degrade vinyl flooring adhesives and create odors.”

As a result, a number of rooms with high concrete slab pH values and/or delaminated VCT were selected for VCT replacement. This report summarizes and documents the activities performed during the VCT removal and replacement.

Under the project management of Mr. Chris Corpuz, Senior Manager, the LCD field project team for the VCT replacement was staffed by personnel from various LCD offices:

- Stephen Davis, Principal;
- Benjamin Heckman, Senior Manager;
- Theodore Ice, Senior Associate;
- Gary Bayne, Senior Associate;
- James Koniuto, Senior Associate.

## **2.0 VCT Removal Activities**

The results of the VCT investigation odor surveys, concrete slab pH tests (following ASTM F710 requirements, see VCT Repair and Replacement Protocol in Appendix A), and floor tapping were used to determine which areas and rooms required VCT replacement. Additional criteria for a replacement included visual indicators such as delamination, staining, or the separation of tiles.

A total of thirty-five (35) rooms were selected for VCT removal activities. The selected rooms were separated into low pH ( $< 10.95$ ) and high pH ( $\geq 10.95$ ) groups. Table 1 lists the selected rooms, provides findings from the initial investigation used as criteria in the selection, and summarizes testing activities during the replacement. The testing activities during the replacement included a combination of bulk, tapelift, and air clearance samples.

The replacement work was performed by JLS Environmental Services (JLS) from October 21, 2011 through January 14, 2012, under the supervision of HTI and LCD personnel. All activities followed the VCT Repair and Replacement Protocol developed during the VCT Investigation. A copy of the protocol is attached in Appendix A.

Because of the potential odors that could be generated during the VCT removal process, JLS designed and implemented an exhaust system that utilized HEPA filter-equipped air handlers and the restroom exhaust fan system. The restroom exhaust fan systems operate 24-hours a day and were used to remove any odors that were generated during the VCT removal process. Before the disturbance of VCT was allowed, the room was sealed and placed under negative pressure using a HEPA filter-equipped air handler. The exhaust end of the air handler was connected, via a corrugated flex hose, to the closest restroom on the floor.

The VCT removal activities for each room included construction of a containment, removal of cove base, inspection of walls behind the cove base, removal of VCT, scraping or grinding of adhesive (low pH group), grinding of the concrete slab surface (high pH group), pH testing of concrete slab with initial pH values at or below the threshold of 10.95, application of sealant to slabs with pH values  $\geq 10.95$ , and the installation of new sealer, adhesive, and floor tiles. All activities are summarized in daily logs attached in Appendix B.

If suspect mold was found behind the cove base or other locations made visible in the replacement process, it was considered to be mold and was remediated. Since all work was performed under containment, this approach was acceptable and allowed for a fast completion of all replacement activities in each room. Volatile organic compound (VOC) air samples collected during VCT and adhesive removal activities, and mold air samples collected upon completion of the VCT removal activities, served as clearance samples to ensure that no contaminants were released into the ambient air outside of the room. To address the presence of benzene in some locations, at least one benzene personal monitoring sample per job classification was collected.

### **3.0 Onsite Project Monitoring**

As with earlier remediation activities, the LCD team of industrial hygienists provided on-site monitoring of the VCT removal activities in the form of:

- Identifying and testing areas for subsequent mold mitigation or remediation;
- Inspecting JLS-constructed containment structures prior to any removal activities or disturbance of mold-contaminated materials by JLS;
- Providing area air monitoring (including both spore trap and VOC summa canister sample collection) to confirm the protective efficacy of JLS containment system and work practices;
- Inspection of the mitigated/remediated areas, prior to collecting final clearance air samples to confirm that the contaminated areas/materials within the containment had been adequately cleaned.

#### **4.0 VOC Sampling**

On each floor where VCT replacement activities took place, the LCD team collected one VOC air sample from a representative room and one VOC air sample in the general hallway. In addition, each time VCT was removed from any room in the building, one VOC air sample was collected outside the building as a background sample. The air samples were collected in summa canisters (6 liters) for approximately eight hours and analyzed using the EPA Method TO-15 for potential VOC and tentatively identified compounds. LCD employed the services of Air Toxics Ltd. in Folsom, California. Air Toxics Ltd. is accredited by the National Environmental Laboratory Accreditation Program (NELAP). The Air Toxics Ltd. laboratory reports are attached in Appendix C.

Only a limited number of compounds were identified in the samples, including: bromomethane, Freon 11, ethanol, acetone, 2-propanol, hexane, cyclohexane, 2-butanone (MEK), benzene, and 1,2,4-trimethylbenzene (pseudocumene). Samples from Floor 2 showed a slightly larger compound spectrum, also including: 1,3 butadiene, 2,2,4-trimethylpentane, toluene, and styrene. The majority of VOC were detected at low concentrations and, in general, in locations where the summa canister was located in the room that was undergoing VCT removal (i.e., vinyl tile was being disturbed and adhesive exposed).

As required by California regulations, personal monitoring was conducted for benzene. A total of five (5) personal and one (1) area monitoring samples were collected and analyzed for benzene by Galson Laboratories. The benzene laboratory report is attached in Appendix D.

Benzene was detected in some test locations (all samples were <0.06 PPM); at concentrations below the permissible exposure limit (PEL) of one part benzene per million parts of air (1 ppm) and the short term exposure limit (STEL) of five (5) ppm as averaged over a sampling period of fifteen (15) minutes. JLS personnel engaged in tile removal at locations where benzene was possibly present were trained in accordance with Title 8, California Code of Regulations, Section 5218 Benzene. JLS personnel also wore protective clothing and their respiratory protective equipment was fitted with organic vapor cartridges.

#### **5.0 Mold Sampling**

With the exception of Rooms 22B and 2222, one spore trap sample was collected from each of the rooms after VCT removal activities were completed. The samples served as clearance samples to ensure that any mold potentially encountered during the VCT replacement was remediated. Each sample was collected at a sampling rate of 15 liters per minute for 5 minutes. The samples were submitted to EMLab P&K of West Sacramento under chain-of-custody to be analyzed for the presence of mold growth. The laboratory reports are attached in Appendix E.

The spore trap samples were compared to background samples collected from ambient air in unaffected hallway areas on the same floor, and to exterior samples. The sample results from the remediated rooms with VCT replacement confirmed that no mold species were present at spore counts higher than the background samples.

## 6.0 Report Documents

The VCT Removal Report was compiled from site monitoring and testing data prepared and accumulated during the VCT removal activities. The following documents are included in the report appendices. They are organized by date where applicable:

- **VCT Repair and Replacement Protocol** – Developed during the VCT Investigation and excerpted from its report;
- **Daily Logs** – Summarize the daily VCT Removal activities;
- **VOC Laboratory Reports** – Present the analytical results for VOC samples collected in the subject room/area;
- **Benzene Laboratory Reports** – Present the analytical results for benzene samples collected in the subject room/area;
- **Mold Laboratory Reports** – Present the analytical results for mold-related samples collected in the subject room/area.

## 7.0 Limitations and Qualifications

The assessment performed by LCD does not include or cover the following matters: Matters that are subsequently discovered that could not have been reasonably foreseen or detected, using industry standards, during the performance of the assessment; matters that could not have been discovered by LCD because of barriers, lack of access or other matters affecting accessibility; matters that were not disclosed to LCD prior to, during, or after the performance of the assessment; any new deficiency that arose after the completion of the assessment by LCD.

To the extent that additional information becomes available to LCD, LCD reserves the right (without any obligation to do so) to modify its evaluation and/or this report at any time, based upon further review and analysis of any such additional information or data.

Certain items mentioned in the report were performed by others not involving the supervision of, or management by, LCD, but were relied upon by LCD in making its evaluation and assessment.

The assessment performed by LCD is not meant or intended to supplement, modify, or extinguish any warranty or representation made or given by third parties performing any of the recommended corrective work.

When consultation involves microbiological growth, or any assessment thereof, such microbiological growth may reoccur if the source of the growth is not remedied. All remediation of fungi in indoor environments can be inherently limited in the sense that conclusions are drawn and recommendations developed from information obtained from limited research and site evaluation. Except as may be noted in the assessment performed by LCD, subsurface areas, latent defects, or non-accessible areas and conditions were not field investigated and may differ from the conditions implied by the surface observations. Additionally, the passage of time may result in a change in the environmental characteristics at

the subject property and the surrounding properties. No investigation or assessment can absolutely rule out the existence of any microbiological growth at any given site. LCD does not remediate or remedy sources of microbiological growth.

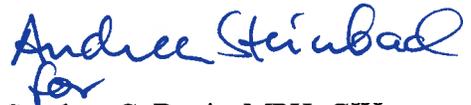
This Report and the assessment/survey conducted by LCD is prepared, and was performed, solely for the use and benefit of the client identified at the beginning of this report. No other party may rely on this report for any other purpose.

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**Table 1: Vinyl Composite Tile Removal  
Summary of Activities, October 2011 - January 2012**

Floor	Room	VCT Investigation Findings									Sampling Dates	
		Inspection Date (2011)	Percent Accessible	Odor Description	Delamination	Wide Seams	Dark Edges	Cracks	Other	pH Value	VOC	Mold
24	Storage 24C	6/17	25%	mod.	✓	✓	✓	—	—	9.58	10/22/11	10/23/11
23	23B Storage	6/17	50%	mild-mod.	—	✓	✓	✓	—	<b>11.00</b>	10/21/11	10/23/11
23	23C Storage	6/17	50%	mod.	✓	✓	—	✓	✓	<b>11.33</b>	10/21/11	10/23/11
22	22B Mail Center	6/17	90%	mild	✓	✓	✓	✓	✓	10+	06/17/11	—
22	22D Storage	6/17	60%	mod.	✓	—	—	—	—	<b>11.18</b>	10/28/11	10/30/11
22	2222 Copy Room	6/17	100%	variable	✓	—	—	✓	✓	—	—	—
22	Storage South	6/17	65%	mod.-high	✓	—	—	—	—	<b>10.97</b>	10/28/11	10/30/11
20	20B Mail Center	6/17	75%	mod.-high	✓	—	—	—	—	<b>11.09</b>	—	10/30/11
20	2006 Storage	6/17	100%	mod.-high	✓	—	—	—	—	10.61	—	10/30/11
19	19A Storage	6/17	80%	high	✓	—	—	—	—	<b>10.98</b>	11/04/11	11/06/11
19	19B Storage	6/17	80%	mild	✓	—	—	—	—	10.64	11/04/11	11/06/11
19	19C Storage	6/17	80%	mod.-high	✓	—	—	—	—	10.69	11/04/11	11/06/11
19	1911 Storage	6/17	50%	mild	✓	—	—	—	—	10.53	11/04/11	11/06/11
17	17A Storage	6/17	100%	mod.	✓	—	—	—	—	10.65	11/11/11	11/13/11
17	17B Storage	6/17	95%	mod.	—	—	—	✓	✓	<b>11.05</b>	11/11/11	11/13/11
17	1708 Supply Room	6/17	80%	mild	✓	—	✓	✓	✓	<b>11.44</b>	11/11/11	11/13/11
17	1712 Storage	6/17	60%	mild	✓	—	—	✓	—	<b>11.18</b>	11/11/11	11/13/11
14	Mail 14B	6/20	45%	mild, VCT-adhesive	✓	✓	✓	✓	—	10.72	11/18/11	11/20/11
14	Copy 1405	6/20	60%	mild, VCT-adhesive	✓	✓	✓	✓	—	10.88	11/18/11	11/20/11
11	Mail/Pay Phones	6/20	60%	mild+, VCT-adhesive	—	—	—	—	—	10.84	11/26/11	11/27/11
8	Storage 8A	6/20	50%	mild, VCT-adhesive, contents	✓	—	—	—	—	<b>11.40</b>	11/18/11	11/20/11
8	Storage 804	6/20	60%	mild, cardboard, VCT-adhesive	✓	—	—	—	—	10.93	11/18/11	11/20/11
7	Storage 7A	6/20	40%	mild, VCT-adhesive	✓	—	—	—	—	<b>10.96</b>	11/25/11	11/27/11
7	Mail 7B	6/20	90%	mild, VCT-adhesive	✓	—	—	—	—	<b>10.98</b>	11/25/11	11/27/11
7	Storage 7D	6/20	100%	mod., VCT-adhesive	✓	—	✓	—	—	<b>11.06</b>	11/25/11	11/27/11

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		Inspection Date (2011)	Percent Accessible	Odor Description	Delamination	Wide Seams	Dark Edges	Cracks	Other	pH Value	VOC	Mold
7	Storage 706	6/20	80%	mild+, VCT-adhesive	✓	—	—	✓	—	<b>11.07</b>	11/25/11	11/27/11
6	Mail Storage 6B	6/20	65%	mild, VCT-adhesive, cardboard	✓	✓	—	—	✓	10.85	12/02/11	12/14/11
6	Storage 6C	6/20	5%	VCT-adhesive, stored items	—	—	—	—	—	<b>11.04</b>	12/02/11	12/14/11
5	Storage 522	6/21	50%	mild, VCT-adhesive	✓	✓	—	—	—	<b>11.13</b>	12/02/11	12/14/11
4	Storage 4B Mail Center	6/21	50%	mod., contents, VCT-adhesive	✓	✓	—	✓	—	10.70	12/02/11	12/14/11
3	Storage 3D	6/21	60%	mod., VCT-adhesive	✓	—	—	—	—	10.65	01/08/12	01/08/12
3	Storage 312	6/21	60%	mild, VCT-adhesive, contents	✓	✓	—	✓	✓	10.59	01/08/12	01/08/12
2	Mail Center Storage 2B	6/21	80%	mild+, VCT-adhesive	✓	—	✓	✓	—	10.23	01/13/12	01/14/12
2	Storage 2D	6/21	60%	mod., VCT-adhesive	✓	—	—	—	—	<b>11.01</b>	01/13/12	01/14/12
2	Storage Room 205	6/21	50%	mild, VCT-adhesive	✓	—	—	—	✓	10.63	01/13/12	01/14/12

**11.01** pH Data are in **bold** where sealant is required after the removal.

**Appendix A**  
**VCT Repair and Replacement Protocol**

## **VINYL COMPOSITE TILE REPAIR AND REPLACEMENT PROTOCOL**

Based on the results of the research, testing, discussions, and field meetings for the vinyl composite tile (VCT) investigation, LCD and the project team developed the following protocol to address future testing of the concrete slab and removal/replacement of the VCT:

### **Initial Testing of Floor – pH Testing Protocol per ASTM F710-08**

1. Select area to be tested using visual indicators (e.g., delamination, staining, separation of tiles) or floor tap indicator
2. Remove the VCT from the selected floor test location
3. Remove excess adhesive and lightly sand a test area (approximately 3-inch diameter circle)
4. Apply distilled water to the area (approximately 1-inch diameter circle) at the center of the 3-inch diameter circle prepared in Step 3 above
5. Allow water to sit for at least 60 seconds
6. Perform a qualitative pH test using wide range pH paper; document result; *or* Perform a quantitative pH test using a calibrated digital pH meter; document results
7. One to three locations may be prepared and tested depending on the size of the room
8. When testing is completed, the test location is dried, and a new tile is installed

### **Determination of Tile Removal Method**

When pH testing indicates a floor at <pH 10.8; the new VCT shall be re-installed using Armstrong Adhesive for High pH Applications.

When pH testing indicates a floor at a pH 10.8 or greater; the new VCT shall NOT be installed without first grinding and properly sealing the floor surface with Koester VAP I 2000<sup>®</sup>, or DGS-approved equivalent.

### **Define Work Area**

- Identify room/area in which VCT is to be replaced.
- Depending on room/area, this step may require (with assistance from BPM) deactivation and/or isolation of various building systems (e.g., HVAC, fire alarm) in the defined work area.
- All ceiling vents/openings and other wall penetrations shall be sealed using critical barriers.

### **Personnel Training and Qualifications**

- Only trained and qualified remediation and IH personnel shall be allowed to enter established negative-pressure containments, if visible mold growth may be present.
- Only trained and qualified personnel shall be allowed to enter established negative-pressure containments and must be accompanied by remediation personnel, if visible mold growth is present.

- All personnel involved in the physical removal or handling of VCT during the removal process shall have received benzene awareness level training.

### **Personal Protective Equipment (PPE)**

- All remediation personnel performing VCT removal shall wear a full-face air-purifying respirator with combination volatile organic vapor/HEPA cartridges; or a half-face air-purifying respirator with combination volatile organic vapor/HEPA cartridges and tight-fitting goggles; disposable protective clothing that covers head and feet; gloves.
- Visiting personnel and consultant observers shall provide their own PPE and wear, at a minimum, a half-face air-purifying respirator with combination volatile organic vapor/HEPA cartridges; disposable protective clothing that covers head and feet; gloves.

*NOTE: During the collection of clearance air samples, no respiratory protection is required; disposable protective clothing and gloves are still required.*

### **Work Area Preparation and/or Containment**

- Rooms with VCT designated for removal shall be physically isolated with critical barriers/containments with integral decon unit; and equipped with ventilation equipment to provide a minimum negative air pressure of .02 inches water gauge with exhaust directed to one of the restrooms on the floor.
- Each restroom that is selected to act as the exhaust area shall be sealed, in order to create a negative pressure condition that will draw any VCT odors out of the removal negative pressure enclosure and out the restroom exhaust system.
- The work area ventilation equipment shall be connected to the exhausted restroom by means of flexible ventilation ducting. Flexible ducting shall not be allowed to create trip hazards or other foot traffic obstacles in the hallways.

*NOTE: Contractor shall determine whether the number and size of rooms to be remediated will exceed the capacity of the restroom exhaust systems.*

- Once negative-pressure has been established, the room's entire cove base shall be removed and the exposed wall area behind the removed cove base visually inspected for any evidence of suspect mold growth.

### **Suspect Stains at Wall Bottom**

Any suspect stains (i.e., physical evidence of water-related problems or suspect mold) on the gypsum board wall bottoms can be removed by simply removing a larger section of the wall bottom; the project industrial hygienist has the discretion to direct the removal of these small areas of wall without requiring a test for mold.

### **Suspect Stains Greater Than 100 Square Feet**

Any suspect stains (i.e., physical evidence of water-related problems or suspect mold) greater than 100 square feet) on the gypsum board wall will be sampled to confirm the presence or absence of VMG; surface samples are to be collected using Bio-Tape™ or similar method(s) at the discretion of the industrial hygienist.

*NOTE: All areas that are remediated or test negative for VMG shall be marked using a tinted encapsulant in order to provide future O&M personnel with an indication that the area has been properly tested or remediated.*

### **Edge Trim Wall Bottom**

The bottom ½ to 1-inch of the room's gypsum board wall (around the entire room perimeter) shall be removed using an edge trim saw. If at all possible, the edge trim shall not penetrate deeper than the first layer of gypsum board. However, if multiple layers are in contact with the floor surface, they shall also be trimmed, but shall not penetrate deeper than the wall bottom plate.

If two or more layers of gypsum board are penetrated without encountering a bottom plate or other fire stop material, the penetration/void shall be sealed with a metal plate and fire stop material before replacing/repairing the trimmed layers of gypsum wall.

### **VCT Removal**

Once all suspect and confirmed VMG have been properly addressed, the contractor may proceed with VCT removal. All intact VCT and debris shall be manually removed along with any adhesive. As a potential source of odor, all visible adhesive shall be removed. Do not allow any residual adhesive to remain.

- If manual removal methods are not effective in removing residual adhesive, mechanical grinding equipment may be used.
- If mechanical grinding equipment is used to remove adhesive, the adhesive free floor shall again be pH tested using the pH test methods previously described.

### **Air Monitoring**

Whenever an entire room/area of VCT is to be removed, a minimum of three twelve-hour Summa® Canister Air Samples shall be collected during the performance of the VCT removal work: one sample inside the room in which the VCT is being removed; one sample in the hallway outside the room where VCT is being removed (one canister sample per floor per day); and one sample shall be collected outdoors as a background sample. These samples shall be submitted to an air laboratory and analyzed by EPA Method TO-15 under standard turn-around time.

At the discretion of the industrial hygienists, random air sampling (various analytes) may be periodically performed to demonstrate the efficacy of control measures and work practices.

### **Areas with Visible Mold Growth**

After the VCT and adhesive removal process has been completed, all work area negative pressure enclosures shall be cleared for mold, and should be dry and visually clear of contamination and debris as determined by the industrial hygienist.

- Each VCT removal area that is cleaned shall require a minimum of 12-hours of air scrubbing and be free of odors.
- Two (2) outside air samples (one outside the containment, but on the same floor; one at ground level) **prior** to collection of inside containment samples.
- The number of inside air samples shall be determined by the size of the containment and at the discretion and consensus of the project industrial hygienists; as few as one (1) and no more than five (5).
- Two (2) outside air samples **after** collection of inside samples (one outside the containment, but on the same floor; one at ground level on opposite side of the building where initial outside sample was collected).
- Criteria for successful air sample clearance:
  - Quantitative spore counts collected inside containment are less than those observed in outside samples.
  - Similar in rank order and distribution.
  - Air sample does not contain specific spores of concern that were identified during initial identification of VMG.

### **Housekeeping**

In general, work areas should be left dry and visually clear of contamination and debris, on completion of work. Some contamination and debris may remain during intermediate stopping points in the removal and cleaning process.

### **VCT Replacement**

Install new VCT in accordance with manufacturer's instructions.