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PCB's in Building Materials and the Implications for the Construction Industry

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Introduction

Polychlorinated bi-phenyls (PCBs) are present is a variety of building materials and may present a significant impact to construction projects. The presence of PCBs in caulking, sealants, paints, adhesives and other building materials dates from the 1930's to the banning of PCBs in domestically manufactured products in 1979. In that time period however, PCBs were added to hundreds of building products due to their characteristics of chemical stability, non-flammability, insulating properties, and high flash point.

Accounting for the presence of potentially hazardous and/or highly regulated materials on construction projects is by no means new to the construction industry. The use of proper inspection processes, project planning, and the anticipated use of specially trained, qualified hazardous materials contractors is also not new to the construction process. However, the presence of PCBs in building materials, such as window and joint caulking, industrial paints, waterproofing mastics, and other similar materials is not uniformly addressed by the construction industry. In recent years, this issue has gained significant attention on projects, although federal TSCA (Toxic Substances Control Act of 1976) regulations banning the use of PCBs are not new to the construction industry. These TSCA regulations give the EPA authority to enforce cleanup and disposal requirements of building products that contain and "unlawful use" of PCBs.

Concerns for the presence of PCBs in caulking and other building materials also represents public health concerns in public buildings, such as schools and municipal buildings. As such, EPA has published several guidance documents addressing general information, regulatory guidance, guidance for school officials, and guidance to the construction industry.

Construction projects are most impacted because the renovation and demolition processes results in disturbing and eventually disposing of these building materials that may contain PCBs. As such, the TSCA regulations place specific requirements on the proper handling, removal, transport and disposal of building materials that contain PCBs above regulated levels. These requirements significantly affect the cost and schedule of impacted construction projects, especially if not anticipated.

PCBs and Building Materials

According to the EPA website on PCBs, PCBs may be present in the following building materials:

- Transformers and capacitors
- Other electrical equipment including voltage regulators, switches, reclosers, bushings, and electromagnets
- Oil used in motors and hydraulic systems
- Old electrical devices or appliances containing PCB capacitors
- Fluorescent light ballasts
- Cable insulation
- Thermal insulation material including fiberglass, felt, foam, and cork
- Adhesives and tapes
- Oil-based paint
- Caulking
- Plastics
- Carbonless copy paper
- Floor finish

(Source: http://www.epa.gov/epawaste/hazard/tsd/pcbs/index.htm.)

The stability of the manufactured PCB mixtures caused them to be added to the above building products. The elastomeric properties exhibited by caulking with PCBs, for example, made it a desirable product for use in buildings as a weather sealant along building joints and windows and doors. Other properties that enhanced the products PCBs were added to include low flammability, plasticizer qualities, fire resistance, and high insulating properties. For this reason, PCBs were added to dielectric fluids and were commonly found in electrical products, transformers, light bulbs and ballasts.

Although production of PCBs in the U.S. ceased by the late seventies, PCBs continue to pose a risk to the environment due to their persistent nature and their ability to bioaccumulate. PCBs do not break down quickly in the environment, and prior to banning PCBs, their release was discovered early in the manufacturing processes and in the disposal of PCB-containing fluids and waste. The potential human health risk from environmental contamination is based in the concern that PCBs can bioaccumulate in plants and food products, and animals and fish, and could be ingested by humans. The health risks concerns range from the carcinogenic potential of PCBs in animals to non-cancer health effects on the body's internal systems.

PCBs are a manmade organic chemical termed chlorinated hydrocarbons and were manufactured for use in numerous applications from 1929 until the late 1970's when they were banned by the EPA. One of the most common trade names of a PCB mixture was the Aroclors. Other familiar terms for PCBs include over 30 trade names, including the more common:

• chlorodiphenyl,

- 1,1'-biphenyl chloro;
- 42% Cl (Aroclor 1242); and
- 54% Cl (Aroclor 1254)

Traditional Construction Approaches

As part of the construction planning process, an inspection for the presence of hazardous materials is typically done. This inspection addresses how these materials may be impacted by the planned work, and if the use of specialty contractors may be needed to remove these materials prior to the work of standard construction trades. Specifically, building materials are inspected to determine their asbestos content. The presence of lead-containing paint is identified to address the potential for exposure to lead-containing dusts during construction. An inventory of potential chemical hazards is done to find if certain facility maintenance products are present that may require special handling or disposal, such as paints, thinners, lubricants, etc. Other hazardous materials (OHMs) are also inventoried for proper handling and disposal and include, for example, light bulbs and ballasts (PCBs, sulfur, nickel), lighted exit signs (tritium), thermostats (mercury), and fire suppression systems (glycol).

In terms of general knowledge of PCBs in building materials by construction trades, the use of PCBs in light ballasts and electrical transformers is more widely known than PCBs being present in caulking, paints, adhesives, and building material products. The inspection process for PCBs in caulking materials is far more ambiguous than that for asbestos materials. Current asbestos inspection procedures are highly regulated, with the amount of samples of a homogeneous building material being specifically identified in regulations. This allows an inspector to reasonably estimate the cost of performing such an inspection, and it is very common in the asbestos inspection industry to be able to very accurately estimate the number of samples needed based upon the building layout (square footage of space, quantity of building system components such as piping, etc.). As presented below, this is not necessarily the case for PCBs in building materials.

Federal Regulatory Requirements

While an inspection and inventory process is necessary to identify the impact of PCBs in building materials may have on a construction project, there are some stark differences in the procedures and outcome of such an inspection.

For example, if an asbestos inspection identifies building materials positive for asbestos content, the material may not need to be removed if in good condition and if not impacted by the planned renovation work. Federal regulations allow for management in place. However, if an inspection for PCBs in building materials is performed and identifies the window caulking, for example, as having equal or greater than 50 parts per million (ppm) PCBs, this is considered an unauthorized use of PCBs according to the EPA TSCA regulations (40 CFR 761) and requires the removal of that material. According to the EPA, “Caulk that contains PCBs at greater than 50 ppm is not authorized for continued use and must be removed.”

This requirement alone places a significant burden on a building owner who otherwise may not realize their federal regulatory obligations to comply with TSCA. Recent news articles quoted school officials as stating that they were not going to test for PCBs in caulking because they would then be forced to remove all of that material--an effort they do not have adequate funding to perform. Regardless, many construction projects have been significantly impacted by unplanned removal of PCB-containing caulking material, affecting the project schedule and budget significantly.

PCBs in building materials at levels $\geq$ 50 ppm are termed "PCB Bulk Product Waste" and are required to be removed. It should be noted that as of this writing, the EPA had issued an Advanced Notice of Proposed Rulemaking (ANPRM) entitled "Polychlorinated Biphenyls (PCBs); Reassessment of Use Authorizations; Extension of Comment Period and Additional Public Meetings", dated June 16, 2010. This document specifically mentions the review for applicability of the 50 ppm threshold level, which triggers many requirements of the regulation.

Additionally required in the federal standard is addressing the building materials adjacent/attached to the PCB Bulk Product Waste material being removed. When a caulking that contained PCBs above 50 ppm was originally applied in liquid form, it is not uncommon that constituents of the caulking were absorbed into the surface onto which it was being applied. Caulk applied to a wood window frame to brick transition would have potentially absorbed into the wood and brick. A metal window frame, once the caulking is removed, may still exhibit significant and detectable PCB levels on the metal surface, and while not 'absorbed' into the metal, will remain if not properly washed. A caulked expansion joint between concrete masonry units (CMU) and poured concrete similarly may absorb into each building material as part of the adhesion process. As a result, significant levels of PCBs can absorb and be present <u>several inches</u> into the CMU or concrete.

In these cases, where PCBs have leached into the adjacent building materials or are present on them as a result of a PCB Bulk Product Waste, these materials are termed "PCB Remediation Waste" and must be cleaned or properly disposed.

PCB Bulk Product Waste; 40 CFR § 761.3

"Waste derived from manufactured products containing PCBs in a non-liquid state, at any concentration where the concentration at the time of designation for disposal was $\geq$ 50 ppm PCBs" [for example caulk, paints, sealants, adhesives, etc.]

PCB Remediation Waste; 40 CFR § 761.61

Waste that is contaminated by the PCB bulk product

– Porous materials: clean to <1ppm

--Non-porous: clean to <10ug/100cm2

[for example concrete, masonry, brick, window frames, exterior soils]

<u>Field Sampling Summarized</u>

Sampling of the caulking should include visual observations for different ages of applications, homogeneity of materials throughout the sampling area, applicability and use of the product on site and other field observations. The sampling process required for these <u>adjacent</u> building materials (brick, concrete) is more labor intensive than sampling the PCB containing product alone. As mentioned above, PCBs could be at levels above the 1 ppm threshold for porous materials several inches into the porous surface. Identifying this depth is done through core sampling and cannot be assumed. Core sampling involves drilling into the substrate material and collecting the cored substrate (dust). Proper decontamination of the drill bits and proper field decontamination processes are also required. The frequency of sampling is determined by statistical analysis of the sampling area(s) involved and in some cases, the results you are obtaining. Since much of this sampling is done to determine the direction of the waste stream, any assumptions made during testing prior to construction may result in verification testing done during construction to verify the waste streams selected are correct and in compliance with TSCA.

Another aspect of the field sampling process is that if PCBs are found above the above threshold levels, coordination with the EPA Regional Office's PCB coordinator is required. This includes the submittal of the means and methods for proper removal and disposal. Other notification requirements, proper recordkeeping and coordination with the building owner, local health officials and EPA Regional Coordinator are identified in the regulations.

Construction Procedures and Remediation

Generally, the handling, removal and control and disposal procedures for PCB bulk product and remediation wastes are similar in complexity to that of asbestos abatement or lead abatement. The actual protection factors employed by the remediation contractor may also include addressing dermal contact, but overall dust control, isolation of work areas and trades, and proper cleaning methods are all based on similar traditional industrial hygiene principles.

- Follow standard abatement procedures
- Dust Control
- Separation of Trades
- Isolation of work areas
- Wet methods, manual hand tools recommended
- HEPA equipped tools; PPE
- Monitoring may be required

Regarding waste disposal, according to the EPA, there are three options for management of *PCB remediation waste*:

- "*Self-implementing cleanup and disposal. The self-implementing option links cleanup levels with the expected occupancy rates of the area or building where the contaminated materials are present. Cleanup and disposal under this option requires you to notify your EPA Regional PCB Coordinator.*

- *Performance-based disposal. The performance-based option allows for disposal of the contaminated materials in either a TSCA chemical waste landfill or TSCA incinerator, through a TSCA-approved alternate disposal method, under the TSCA-regulated decontamination procedures, or in a facility with a coordinated approval issued under TSCA. Disposal under this option generally does not require you to obtain approval from EPA.*

- *Risk-based cleanup and disposal.* *The risk-based option allows for a site-specific evaluation of whether PCB remediation waste may be cleaned up or disposed of in a manner other than the alternatives provided under the self-implementing or the performance-based disposal options. Disposal of PCB remediation waste under this option requires you to obtain an approval from EPA based on a finding that the disposal will not present an unreasonable risk of injury to health or the environment."*

[Source http://www.epa.gov/epawaste/hazard/tsd/pcbs/pubs/caulk/caulkcontractors.htm.]

While these do present options on a construction project, the investigation-phase field procedures and the documentation and notifications involved can be time consuming and complex given different site situations and building use. As with many things, the details of getting to the above classifications through field testing and otherwise can be costly and, if not anticipated and cause significant project delays.

Worker Safety and Construction Risk

During the removal of PCB-containing building materials, enhanced dust control can be accomplished using various on site methods, including:

Use of reinforced polyethylene sheeting to limit dust and debris travel and minimize cleanup;
- Prohibit using mechanical devices;
- Use of high efficiency particulate air **(HEP**A)-filtered vacuums for clean-up;
- Use of wet methods and water mist to minimize dust encroachment on adjacent areas
- For exterior work, use of wind barriers, scrim, or other methods to minimize dust movement;
- Restricting access to the work areas, to minimize the potential for tracking
- Use of polyethylene sheeting at entrances/exits of work area
- Control air flow in and out of work areas

Worker-specific procedures during PCB removal activities mirror many asbestos and lead abatement procedures, such as:

- Minimal PPE use of coveralls, gloves and half -face HEPA-filtered respirators
- Washing of tools and equipment prior to exiting the work area
- Daily cleaning of dust and debris in work areas
- Separate wash areas and changing facilities

The OSHA permissible exposure limit (P E L) for PCB Aroclor 1254500 ug/m^3. PCB personal sampling is be performed in accordance with NIOSH 5503 using florisil glass tubes and low-volume personal sampling pumps

Implications on Construction Projects

Similar to undiscovered project conditions, if the presence of PCBs in building materials is discovered after project planning and budgeting is completed, there can be a significant increase to the project budget and schedule. As with most construction projects, increases in the project schedule and unplanned delays result in increased funding needed. If PCBs are discovered in the construction phases of a project, and investigations, remediation work plans, and waste disposal changes ensue, significant change orders to the original scope of work follow. These costs can be so significant as to completely alter the direction of a project.

Advantages to performing testing for PCBs during the planning stages of a project can of course remove unknowns, and also result in the ability to obtain competitive pricing for the work involved. Additionally, all of the stakeholders in the project will have been informed of the issue, eliminating surprise and public relations concerns of the PCB issue. If planned for, PCB-related work plans and procedures can match the Project Specifications, site health and safety planning, and be included in the general information provided on the project.

Regarding the timeframe of the various steps involved in properly addressing the PCB issue:

- Pre-characterization phase. This can take weeks if not months; laboratory analysis of samples can be 1-2 weeks alone;

- Remediation Plan Approval. This can take weeks also; documentation between project stakeholders and public and municipal officials requires time and coordination

- *Actual* remediation. This can take more weeks and most likely must be done prior to the work of other trades

If these processes have to be performed as part of construction-phase discovery, there are significant construction project delays as a result. Public relations on the project also suffer. Communication needs to the project stakeholders, subcontractor community, building occupants and abutters can also add complexity to an already delayed project. As always, time delays and change orders greatly affect the project budget and many of those involved will wonder why this issue was not addressed previously during the planning stages.

The presence of PCBs in building materials is also an issue known to many contractors and trades and if the design team is not addressing this issue prior to construction, contractors or subcontractors may bring the issue to light after the project has commenced.

Case studies to be presented include:

Example #1: No testing prior to the contract and start of work

- Work halts mid-project
- Time consuming testing, work plan preparation and regulatory submittals
- Approval of remediation processes
- Significant changes in order of work
- Subcontractor community also has concerns
- Additional sampling and testing of air and dust

- Months of pre-characterization and work plan development and coordination with public officials

Example #2: Discovery in design phase, Full Building Demolition

- Very high levels in caulk (100,000+ ppm PCBs)
- Significant absorption into concrete, CMU, brick
- Some concrete was structural
- Concrete impacted by 'form oil'; > 1ppm PCB; exempted material
- Order of demolition changed
- Significant segregation of wastes
- PCB Remediation = $1M+, months of project delays

Example #3 Exterior Renovation

- Exterior Concrete Pavers
- Multiple layers of caulking
- No history of prior removal
- Impacted by absorption into concrete pavers (horizontally)
- Impacted by absorption to foam layers beneath concrete (vertically) and potentially the soil

Other Considerations and Metrics

While this issue is not a new issue relative to the regulations that address it, PCBs in many building materials has not been consistently addressed uniformly in the construction industry. Also the issue has more exposure in certain parts of the country than others. Projects date back 5-10 years in the Northeast and West Coast, but are not as abundant in other parts of the country. With the current applicability of the regulations under review, the landscape of this issue will most likely change or become more precisely defined in the future. The EPA's website on this issue is also very helpful in identifying procedures and resources.

Other items to consider regarding the presence of PCBs in building materials are identified below.

- Other hazardous constituents present: Does the caulking, adhesive or paint also contain asbestos? If a paint or coating, it may require testing for other hazardous materials such as lead.

- PCB Bulk Product Waste ($\geq$50 ppm caulk, adhesives, paints, etc.) must be disposed, manifested separately from PCB Remediation Waste (adjacent building materials).

- ≥50ppm: TSCA (RCRA Title C) landfill as PCB waste; $300-350/ton

- >1ppm to <50ppm: PCB Remediation Waste: RCRA Title D Construction Waste Landfill; $125-$150/ton

- Innovative Construction Processes:

  - Encapsulants being applied to PCB remediation waste to minimize dust generation

  - Colorings being added to encapsulants to assist in identifying waste streams on site. Pre-labeling with colored paints can help identify extent of or location of regulated waste in adjacent building materials.

  - Management in place - Is not acceptable for *bulk product waste* – "unauthorized use" per TSCA regulations. Management in place may be acceptable for surrounding materials. Such methods may include authorized enclosure and encapsulation.

Closing

The presence of PCBs in building materials is an issue that has impacted many construction projects, but it is one that with proper planning and investigation, costs and schedule impact can be controlled. Like many construction issues that overlap into hazardous material handling, some of the information is best gathered from the field, as trends or discoveries sometimes help define the best pathways to resolution. This construction issue is certainly an emerging issue; it is highly regulated but not uniformly addressed throughout the country. The trails of others on projects that have been impacted can serve to avoid surprises and delays on current projects. The available resources for this emerging issue should be closely monitored for guidance and potential regulatory changes.