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PCBs in Building Materials & the Implications for the Construction Industry

Polychlorinated biphenyls (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 1930s 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 chemical stability, nonflammability, insulating properties and high flash point.

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.

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 are 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 Toxic Substances Control Act of 1976 (TSCA) regulations banning the use of PCBs are not new to the construction industry. These TSCA regulations give EPA authority to enforce cleanup and disposal requirements of building products that contain and "unlawful use" of PCBs.

The presence of PCBs in caulking and other building materials is a public health concern 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 renovation and demolition processes result in disturbing and eventually disposing of these building materials that may contain PCBs. As such, 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 & Building Materials

According to EPA, 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.

The stability of PCB mixtures manufactured caused them to be added to these building products. 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 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 1970s, PCBs continue to pose a risk to the environment due to their persistent nature and to 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 disposal of PCB-containing fluids and waste. The potential human health risk from environmental contamination is based on the concern that PCBs can bioaccumulate in plants, food products, animals and fish and could be ingested by humans. Health risk concerns range from the carcinogenic potential of PCBs in animals to noncancer 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 to the late 1970s until they were banned by EPA. One of the most common trade names of a PCB mixture was Aroclors. Other familiar terms for PCBs include more than 30 trade names, including the more common:

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

Traditional Construction Approaches

An inspection for the presence of hazardous materials is typically done as part of the construction planning process. 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 potential for exposure to lead-containing dusts during construction. An inventory of potential chemical hazards is done to identify 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 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 specifically identified in regulations. This allows an inspector to reasonably estimate the cost of performing such an inspection, and it is common in the asbestos inspection industry to be able to accurately estimate the amount of samples needed based on the building layout (square footage of space, quantity of building system components such as piping, etc). As presented here, this is not necessarily the case for PCBs in building materials.

Congress banned the manufacture of PCBs in the U.S. in 1977 because of their toxic effects. In 1979, EPA banned the processing or use of PCBs, except in totally enclosed equipment. However, a large number of fluorescent light ballasts that were installed prior to these bans may contain PCBs and may still be in use in U.S. schools.

Federal Regulatory Requirements

While an inspection and inventory process is necessary to identify the impact 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, is equal or greater than 50 parts per million (ppm) PCBs, this is considered an unauthorized use of PCBs according to EPA TSCA regulations (40 CFR 761) and requires the removal of that material. According to 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 that otherwise may not realize their federal regulatory obligations to comply with TSCA. Recent news articles quoted school officials stating that they would not 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 ≥50 ppm are termed "PCB bulk product waste" and are required to be removed. It should be noted that as of this writing, EPA had issued an advanced notice of proposed rulemaking titled "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 applied. Caulk applied to a wood window frame to brick transition would have absorbed into the wood and brick potentially. 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 had absorbed into each building material as part of the adhesion process. As a result, significant levels of PCBs can absorb and be present several inches 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 nonliquid state, at any concentration where the concentration at the time of designation for disposal was ≥ 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

•Nonporous: clean to <10µg/100cm^2

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

Field Sampling Summarized

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 adjacent building materials (brick, concrete) is more labor-intensive than sampling the PCB-containing product alone. As mentioned, 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 obtained. 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 these 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 & Remediation

Generally, the handling, removal, 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;

•high-efficiency particulate air (HEPA)-equipped tools; PPE;

•monitoring may be required.

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

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.

While these present options on a construction proj-

Safety 2011 Recap

Safety 2011 included record attendance and special events to celebrate ASSE's 100th anniversary. The Construction Practice Specialty (CPS) held its annual face-to-face meeting along with the Utilities Branch. CPS also sponsored Four sessions and led a roundtable discussion. CPS leadership attended the biannual Council on Practices and Standards meeting where growth and technological engagement were discussed and the Health & Wellness Branch was approved. CPS volunteers also helped answer questions at the Practice Specialties booth where free practice specialties were raffled off, complimentary newsletters were available for all 28 groups and mouse pads were given out. **Click here** for our blog recap of what happened in Chicago at our biggest and best conference yet! **Click here** to order CD or MP3 audio recordings from Safety 2011 conference sessions. If you were unable to make it to Safety 2011, please mark your calendar now for Safety 2012 in Denver, CO, June 3-6, 2012.

ect, 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 these classifications through field testing and otherwise can be costly and if not anticipated, can cause significant project delays.

Worker Safety & 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;

•prohibiting use of mechanical devices;

•use of HEPA-filtered vacuums for cleanup;

•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 (PEL) for PCB Aroclor is 1,254,500 ug/m3. PCB personal sampling is to 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 are completed, there can be a significant increase to the project budget and schedule. As with most construction projects, an increased project schedule and unplanned delays result in increased funding. If PCBs are discovered in the construction phases of a project, and the 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 they can completely alter the direction of a project.

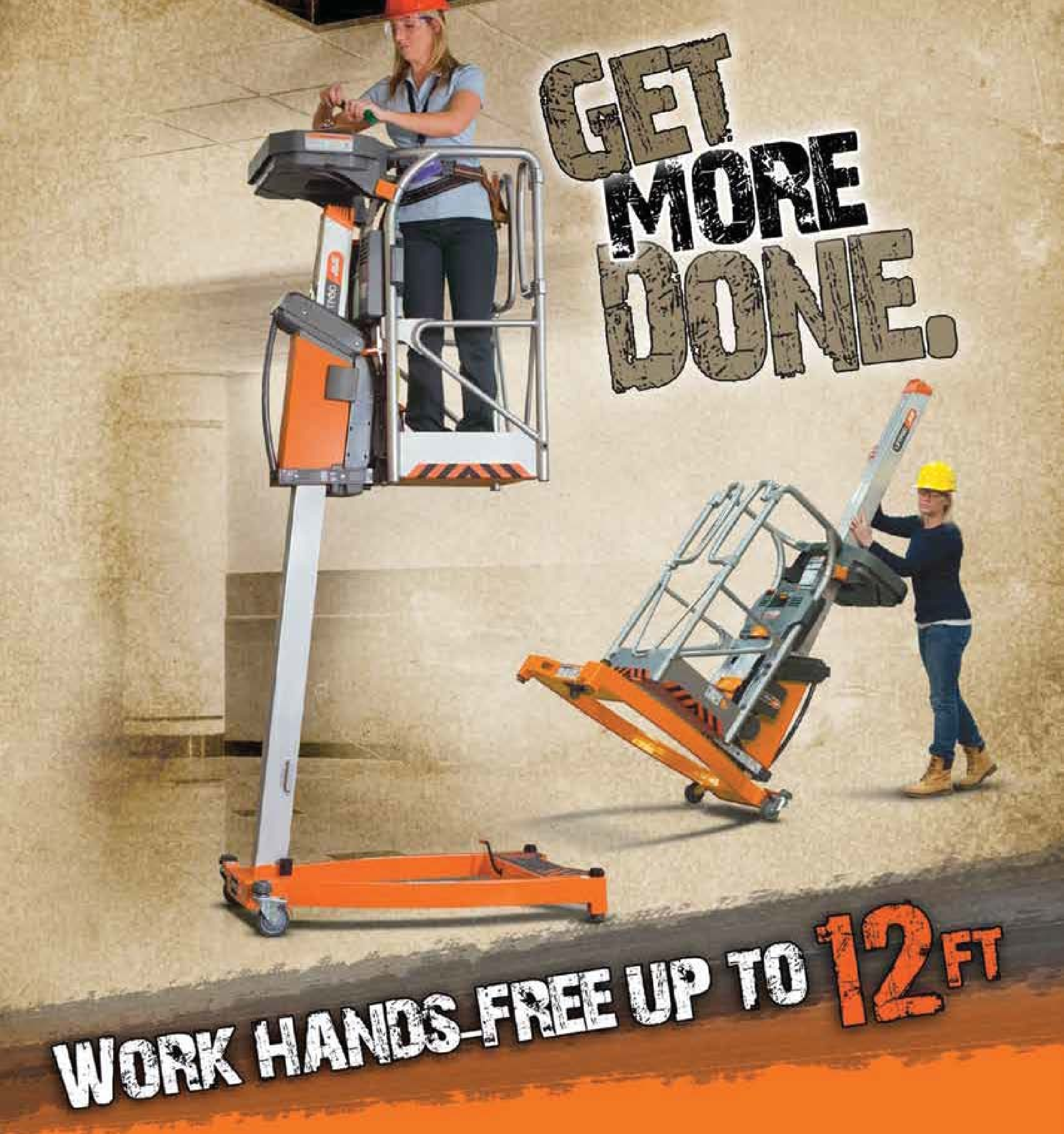
Advantages to performing testing for PCBs during the planning stages of a project can of course remove unknowns, and also result in the ability to obtain competitive pricing for the work involved. Additionally, all of the stakeholders in the project will have been

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 can be included in the general information provided on the project.

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

•**Precharacterization phase.** This can take weeks if not months; laboratory analysis of samples can be 1 to 2 weeks alone;

•**Remediation plan approval.** This can take weeks also; documentation between project stakeholders and public and municipal officials requires time and coordination;



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

If these processes must be performed as part of construction-phase discovery, significant construction project delays can result. Public relations on the project also suffer. Communication 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 does not address 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 precharacterization 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 & Metrics

While this issue is not a new issue relative to the regulations that address it, PCBs in many building materials have 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 to 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 will become more precisely defined in the future. EPA's website is also helpful in identifying procedures and resources.

Other items to consider regarding the presence of PCBs in building materials include:

•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);

•$\geq$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 include:

•encapsulants applied to PCB remediation waste to minimize dust generation;

•colorings added to encapsulants to assist in identifying waste streams on site. Prelabeling 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.

Conclusion

The presence of PCBs in building materials is an issue that has impacted many construction projects, but 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 emerging and 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. Available resources for this emerging issue should be closely monitored for guidance and potential regulatory changes.

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