CASE STUDY: LEAD POISONING PREVENTION
ECOBOND® LBP provides effective lead poisoning prevention solution;
Reduces potential for relative lead bioavailability by up to 74%

OVERVIEW

New data reveals that 1 in 38 children, ages 1-5, in America are currently affected by lead poisoning. Lead is especially dangerous to children under the age of 6; at this age, children's brains and nervous systems are more sensitive to the damaging effects of lead. Lead exposure in children can cause:

- Nervous system and kidney damage
- Learning disabilities, attention deficit disorder, and decreased intelligence
- Speech, language, and behavior problems; Hearing damage
- Poor muscle coordination; Decreased muscle and bone growth

PROBLEM

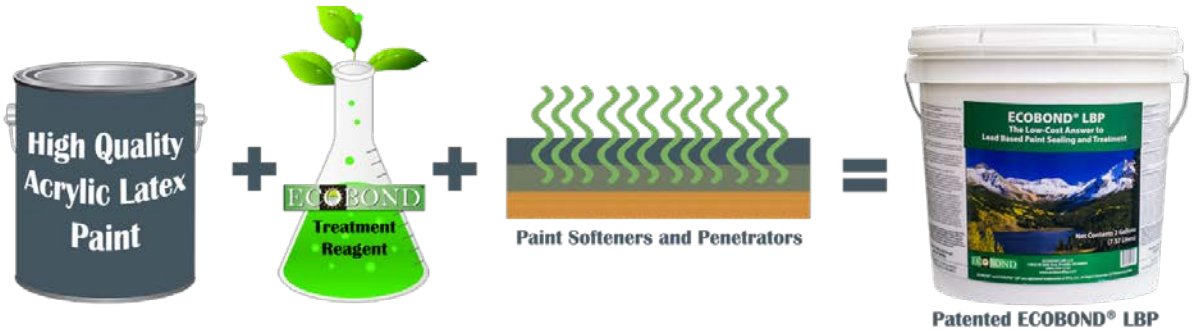
According to the US EPA, the leading cause of childhood lead poisoning is lead paint exposure. Although there is national focus (US EPA, HUD) on reducing lead paint hazards, especially for children; with up to 80% of all structures in the United States containing lead based paint, it is not a problem that can be solved quickly. Historical lead hazard reduction methods, e.g. encapsulation and removal, can be costly and may use caustic chemicals; alternative methods for lead poisoning prevention and limiting the impact of lead on young children are needed. To be most effective, these methods must be readily available, economical and easy to use.

SOLUTION

ECOBOND LBP, LLC has invested significant resources in order to develop an effective and easy to use lead poisoning prevention product to seal and treat lead paint hazards, and reduce relative lead bioavailability (the ability of the body to absorb lead). This product, ECOBOND® LBP, is based on the same ECOBOND® technology that has been used successfully for over a decade to treat lead and other metals in over 1,000,000 tons of solid waste. Independent testing performed to US EPA-approved procedures for relative bioavailability of lead confirmed in multiple testing that a standard coating application of ECOBOND® LBP successfully reduced the bioavailability of lead-paint containing materials.

WHAT IS ECOBOND® LBP?

ECOBOND® LBP is a patented specialty paint product that combines a high quality acrylic latex paint formula with natural lead treatment reagents and safe proprietary softeners and penetrators (to enhance adhesion and permeation) to form an easy to use, safe, and environmentally protective product that seals and treats lead paint hazards.



Patented ECOBOND® LBP

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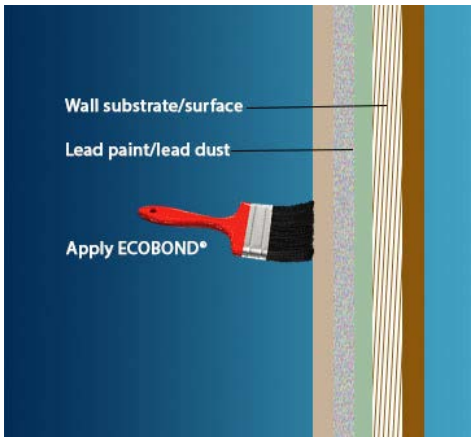
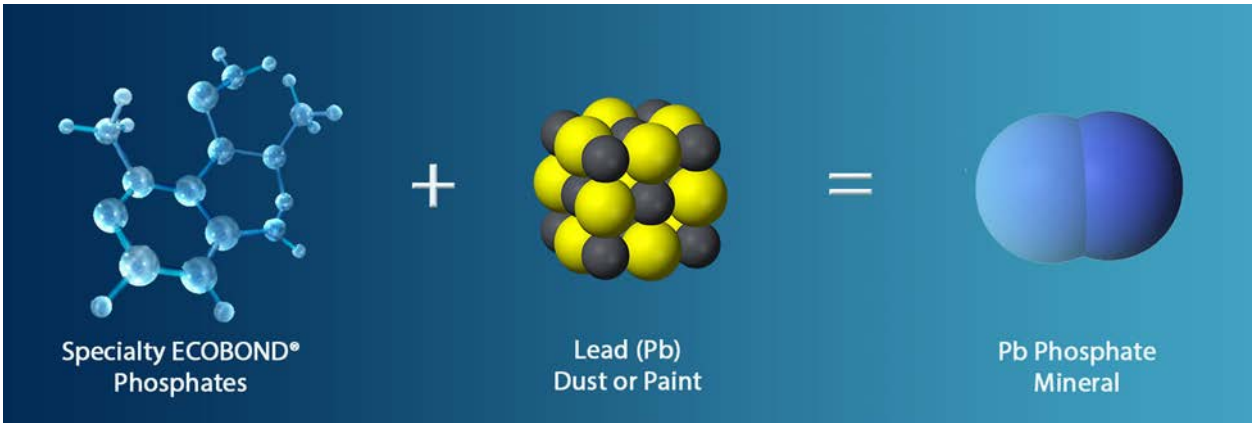
USES OF ECOBOND® LBP

ECOBOND® LBP is a multi-purpose product applicable for a wide range of lead based paint projects such as:

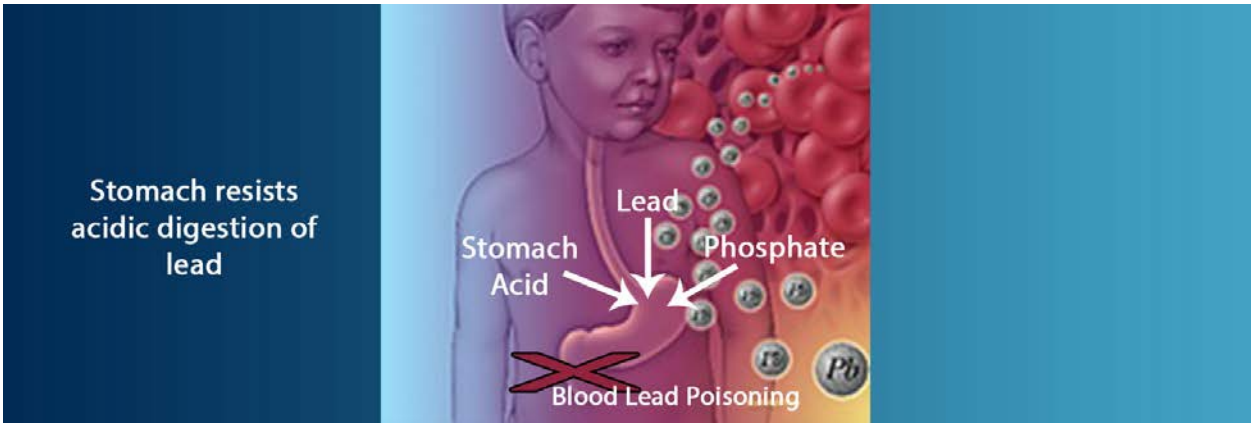
- Interior primer and tintable topcoat (walls, doors, cabinets, and trim)
- Exterior primer (siding, trim, and exterior structures)
- Prevent the spread of lead dust, treat lead dust
- Treat lead in lead paint for non-hazardous disposal
- Seal and treat lead dust and lead paint prior to component removal
- Allowed for use in all 50 states as Lead Paint Interim Control (42 USC 63A 4851b(13))



HOW DOES ECOBOND® LBP REDUCE RELATIVE LEAD BIOAVAILABILITY?



Specialty ECOBOND® phosphates combine with lead dust/paint to create a lead-phosphate mineral that reduces the ability to absorb lead into the blood stream, thereby reducing relative lead bioavailability.



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METHOD:

To verify effectiveness of ECOBOND® LBP to prevent lead poisoning and reduce relative lead bioavailability, ECOBOND® LBP was applied to typical lead paint surfaces such as exterior siding and interior trim that was coated with multiple layers of lead paint. ECOBOND® LBP was applied at 8-12 mils wet thickness. Samples were collected following EPA sampling procedures and sent to an independent, certified laboratory for testing. ACZ Laboratories, Inc. (Steamboat Springs, CO) completed testing following US EPA test procedures EPA 9200.2-86 (Appendix A), which independently confirmed that ECOBOND® LBP successfully reduces relative lead bioavailability.

RESULTS:

Table 1 provides a summary of representative study samples and treatment results. Each sample material contained two layers of lead paint over the substrate material; in addition samples 1, 3 and 4 also contained a layer of standard latex paint over the lead paint layers. Pre-treatment lead levels ranged from ~60,000 mg/kg (ppm) to greater than 100,000 kg/mg (ppm) with, In Vitro Bioaccessibility (IVBA) Pb levels ranging from 11% - 73%. Following ECOBOND® LBP application, IVBA Pb levels ranged from 2.9% - 23.9%; demonstrating successful reduction in relative lead bioavailability by 50% - ~75%.

Table 1 ACZ Laboratories Treatment Results - ECOBOND® LBP In Vitro Bioaccessibility (IVBA) Reduction

	Untreated		Treated with ECOBOND® LBP		Total Reduction (EPA 9200.1-86)
	IVBA Pb mg/l	IVBA %	IVBA Pb mg/l	IVBA %	% Reduction
Sample #1* LBP1-22-6 Exterior slot siding 2 layers lead paint; 1 layer latex paint >100,000 mg/kg	1040	73.20%	320	23.9%	68%
Sample #2* LBP1-22-9 Interior wood siding 2 layers lead paint ~ 60,000 mg/kg	338	25.6%	133	9.1%	64%
Sample #3* L98390-3 Interior wood trim 2 layers lead paint; 1 layer latex paint >80,000 mg/kg	113	11.1%	23.1	2.9%	74%
Sample #4 L98390-2 Interior wood trim 2 layers lead paint; 1 layer latex paint >80,000 mg/kg	113	11%	31.5	3.7%	67%

* One coat of ECOBOND® LBP, 8-12 mil wet; pH of 2.2

CONCLUSIONS:

Lead Poisoning Prevention: Application of ECOBOND® LBP specialty paint over existing lead paint containing surfaces greatly reduces the spread/exposure of lead dust and possible lead ingestion is greatly minimized.

Reduction of Relative Lead Bioavailability: As indicated in Table 1 above, for this study, IVBA Pb pre-treatment results ranged from 113 mg/l to as high as 1,040 mg/l. Following the application of ECOBOND® LBP, IVBA Pb results ranged from 320 mg/l to as low as 23 mg/l. On average, ECOBOND® LBP provided a 68% reduction of relative lead bioavailability and as high as 74%; thus decreasing the ability of lead to be absorbed.

Sealing and Treating Lead Paint Hazards: The effectiveness of ECOBOND® LBP has been proven in over three thousand independent applications nationwide over the past 5 years as well as laboratory tested on over 1,000 samples with each study has returning similar results (See Case Study: Effectiveness of ECOBOND® LBP to Seal and Treat Lead Paint Hazards). These results demonstrated ECOBOND® LBP's ability to seal and treat lead paint hazards under the wide variety of lead paint remediation activities. Lead paint hazards included lead dust, peeling and chipping lead paint, and multiple layers of lead paint for both interior and exterior applications. The lead paint materials selected for testing were specifically selected for their multiple layers of lead paint and unusually high lead concentrations; proving ECOBOND® LBPs robust capabilities.

ECOBOND® LBP is also tested to:

1. Reduce lead paint hazards up to 95% (EPA Method 1311)
2. Reduce airborne lead dust up to 99% (ASTM E1613-12)
3. Reduce relative lead bioavailability up to 75% (EPA 9200.1-86)
4. Mold and mildew resistant (ASTM D5590-00 modified)
5. Fire resistant (ASTM E84) Flame spread 0, Smoke developed 0 NFPA/IBC Class A Coating

Appendix A: Overview of US EPA Test Method EPA 9200.2.86 April 2012

Method Summary: Reliable analysis of the potential hazard to children from ingestion of lead in the environment depends on accurate information on a number of key parameters, including (1) lead concentration in environmental media (soil, dust, water, food, air, paint, etc.), (2) childhood intake rates of each medium, and (3) the rate and extent of lead absorption from each medium ("bioavailability"). Knowledge of lead bioavailability is important because the amount of lead that actually enters the blood and body tissues from an ingested medium depends on the physical-chemical properties of the lead and of the medium. For example, lead in soil may exist, at least in part, as poorly water-soluble minerals, and may also exist inside particles of inert matrix such as rock or slag of variable size, shape, and association. These chemical and physical properties may tend to influence (usually decrease) the absorption (bioavailability) of lead when ingested. Thus, equal ingested doses of different forms of lead in different media may not be of equal health concern.

Definitions: The term *bioavailability* (BA) has many different meanings across various disciplines of toxicology and pharmacology. For the purposes of this SOP, the term bioavailability means:

> *The fraction of an ingested dose that crosses the gastrointestinal epithelium and becomes available for distribution to internal target tissues and organs.*

Bioavailability expressed as a fraction (or percentage) of a dose is commonly referred to as *absolute bioavailability*. The term *relative bioavailability* (RBA) refers to a comparison of absolute bioavailabilities. Relative bioavailability generally is important in risk assessment because we are often most interested in knowing the extent to which the absolute bioavailability of a metal increases or decreases in context with the exposure matrix (*e.g.*, food vs. water vs. soil), or with the physical or chemical form(s) of the metal to which humans are exposed. Often, it is more feasible to assess relative bioavailability than absolute bioavailability (an example of this for lead is demonstrated in U.S. EPA, 2007b). Thus, for the purposes of this guidance document, relative bioavailability means:

> *The ratio of the bioavailability of a metal in one exposure context (i.e., physical chemical matrix or physical chemical form of the metal) to that in another exposure context*.

A related term, pertaining to bioavailability assessment, is *bioaccessibility*. For the purposes of this SOP, this refers to an *in vitro* measure of the *physiological solubility* of the metal that may be available for absorption into the body. Since solublization is usually required for absorption across membranes, poorly soluble forms of metals, with low bioaccessibility, may also have low bioavailability. In certain circumstances, if solubility is the major determinant of absorption at the portal of entry, bioaccessibility may be a predictor of bioavailability. Lead is an example of this, as is discussed in U.S. EPA (2007a).

$$\textit{In vitro bioaccessibility} = \frac{Pb_{ext} * V_{ext} * 100}{Pb_{soil} * Soil_{mass}}$$

where:

Pb_{ext} = *in vitro* extractable Pb in the in vitro extract (mg/L)
V_{ext} = extraction solution volume (L)
Pb_{soil} = Pb concentration in the soil sample being assayed (mg/kg)
$Soil_{mass}$ = mass of soil sample being assayed (kg)

The extraction solution volume in this SOP is 0.1 L. For additional definitions for bioavailability-related terms (e.g., Relative Bioavailability) refer to U.S. EPA (2007a). The *in vitro* bioaccessibility assay described in this SOP provides a rapid and relatively inexpensive alternative to *in vivo* assays for predicting RBA of lead in soils and soil-like materials. The method is based on the concept that lead solubilization in gastrointestinal fluid is likely to be an important determinant of lead bioavailability *in vivo*. The method measures the extent of lead solubilization in an extraction solvent that resembles gastric fluid. The fraction of lead which solubilizes in an *in vitro* system is referred to as *in vitro* bioaccessibility (IVBA), which may then be used as an indicator of *in vivo* RBA. Measurements of IVBA using this assay have been shown to be a reliable predictor of *in vivo* RBA of lead in a wide range of soil types and lead phases from a variety of different sites (U.S. EPA, 2007b).