LEAD IN PLAYGROUND EQUIPMENT IN THAILAND

October 2019

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ACKNOWLEDGMENTS

We take this opportunity to thank all those who were instrumental in compiling and shaping this study. Special thanks to Akarapon Teebthaisong who led the field investigation and to colleagues from the EcoWaste Coalition-Philippines and Shenzhen Zero Waste Network-China for their presence and assistance.

This report presents new data on the total lead content of painted playground equipment found in facilities managed and maintained by government agencies. The report also recommends action steps by different stakeholders to protect children from exposure to lead.

This report was undertaken as part of IPEN's Global Lead Paint Elimination Campaign. It was conducted in Bangkok City by the Ecological Alert and Recovery – Thailand (EARTH) in partnership with IPEN and funded by the Swedish Government. Responsibility for the content lies entirely with IPEN and EARTH, and the Swedish Government do not necessarily share the expressed views and interpretations.

Established in 1998, IPEN is an international NGO network of over 500 health and environmental organizations from 121 countries, mostly developing and transition countries of which EARTH participates to establish and implement safe chemicals policies and practices that protect human health and the environment. IPEN's mission is a toxics-free future for all. IPEN helps build the capacity of its member organizations to implement on-the-ground activities, learn from each other's work, and work at the international level to set priorities and achieve new policies. Additional information materials about IPEN's Global Lead Paint Elimination Campaign can be accessed at **https://ipen.org/projects/eliminating-lead-paint**.

EARTH is an independent non-profit organization striving for social and environmental sustainability and justice in Thai society. EARTH serves as a watchdog group monitoring the Thai government's industrialization policy, industrial pollution and unsustainable consumption patterns. EARTH promotes climate justice, good governance and accountability of governmental and international agencies. EARTH focuses on the impacts of hazardous substances on ecosystems, local communities and workers' health.

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1. BACKGROUND

1.1 BRIEF OVERVIEW OF HEALTH AND ECONOMIC IMPACTS OF LEAD EXPOSURE

Children are exposed to lead from paint when surfaces painted with lead-containing paint begins to chip or deteriorate, since this causes lead to be released to dust and soil.[1] This is then ingested through normal hand-to-mouth behavior by children.[2] They might also pick up paint chips and put them directly into their mouths, which can be especially harmful since the lead content is typically much higher than what is found in dust and soils. When toys, play equipment, or other articles are painted with lead paint, children may directly ingest the lead-contaminated, dried paint when chewing on them.[3] Playground equipment can also be a direct source of exposure since children will get lead paint on their hands when playing.

Lead exposure is especially harmful to children, especially aged six and under. Once lead enters a child's body through ingestion, inhalation, or across the placenta, it has the potential to damage several biological systems and pathways. The primary target is the central nervous system and the brain, but lead can also affect the blood system, the kidneys, and the skeleton.[4] Lead is also categorized as an endocrine-disrupting chemical (EDC).[5]

According to the World Health Organization (WHO): "There is no level of exposure to lead that is known to be without harmful effects."[6]

When a young child is exposed to lead, the harm to her or his nervous system makes it more likely that the child will have difficulties in school and engage in impulsive and violent behavior.[7] Lead exposure in young children is also linked to increased rates of hyperactivity, inattentiveness, failure to graduate from high school, conduct disorder, juvenile delinquency, drug use, and incarceration.[2] Lead exposure impacts on children continue throughout life and have a long-term impact on a child's work performance, and—on average—are related to decreased economic success.

A recent study investigating the economic impact of childhood lead exposure on national economies in all low- and middle-income countries estimated a total cumulative cost burden of $977 billion international dol-

lars* per year.[8] The study considered the neurodevelopmental effects on lead-exposed children, as measured by reduced IQ points, and it correlated lead exposure-related reductions in children's IQ scores to reductions in lifetime economic productivity, as expressed in lifelong earning power.

1.2 THE USE OF LEAD IN PAINT

Paints contain high levels of lead when the paint manufacturer intentionally adds one or more leaded compounds to the paint for some purpose. A paint product may also contain some amount of lead when paint ingredients contaminated with lead are used, or when there is cross-contamination from other product lines in the same factory. Leaded paint ingredients are most commonly used in solvent-based paint due to their chemical properties, and solvent-based paints sold for home use have been found to contain high levels of lead in many countries.[9-11]

Reports from around the world highlight lead paint as a hazard in places frequented by children such as public parks, recreational areas, and playground facilities, as well as in children's articles such as toys and play equipment. Scientific studies conducted in Australia, Brazil, England, India, Israel, Japan and South Africa all detected high lead levels in playground equipment, and where analyzed, high levels of lead in the surrounding soil, dust and sand.[12-18] Equipment with high lead levels were commonly coated with yellow or red paint, indicating the use of lead pigments for both decorative and anti-corrosive purposes. Studies of dust collected from playground equipment in Australia, France and China attributed the lead content to lead paint on the structure.[12, 19-20] The geographical spread of these results suggests that use of lead paint on playground equipment is of global concern.

Paints without added lead have been widely available for decades and are used by manufacturers producing the highest quality paints. When a paint manufacturer does not intentionally add lead compounds in the formulation of its paints and takes care to avoid the use of paint ingredients that are contaminated with lead, the lead content of the paint will be very low—less than 90 parts per million (ppm) lead by dry weight, and frequently down to 10 ppm or less.

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* An International dollar is a currency unit used by economists and international organizations to compare the values of different currencies. It adjusts the value of the U.S. dollar to reflect currency exchange rates, purchasing power parity (PPP), and average commodity prices within each country. According to the World Bank, *"An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States."* The international dollar values in this report were calculated from a World Bank table that lists GDP per capita by country based on purchasing power parity and expressed in international dollars.

Most highly industrial countries adopted laws or regulations to control the lead content of decorative paints beginning in the 1970s and 1980s. Many also imposed controls on the lead content of paints used on toys and for other applications such as in playground equipment which highly likely contributes to lead exposure in children. These regulatory actions were taken based on scientific and medical findings that lead paint is a major source of lead exposure in children, and that lead exposure in children causes serious harm, especially to children aged six years and under.

The current limit for decorative paints in e.g., the U.S., the Philippines, and India is a total maximum lead content of 90 ppm, and adherence to this ensures that a manufacturer can sell its paint anywhere in the world. This limit is also recommended for all paints, including paints for industrial applications, in the *Model Law and Guidance for Regulating Lead Paint*,[21] which was developed by the Global Alliance to Eliminate Lead Paint (GAELP) and published by the UN Environment Programme.

In the USA, outdoor playground products designed or intended primarily for use by children 12 years or under are required to comply with the total lead limit of 90 ppm for paint or any similar surface coatings as per the Consumer Product Safety Improvement Act.[22]

In the Philippines, a related memorandum circular on the scope of prohibition on the use of lead paint in toys and playground equipment was issued in 2016, setting the maximum limit on lead in paint at 90 ppm. "Children's products," according to the said circular, include, among other things, "indoor/outdoor playground equipment such as slides, swings, seesaws, play pens, and playhouses."[23]

1.3 REGULATORY FRAMEWORK IN THAILAND

The Thai government issued in January 2016 a Royal Decree requiring alkyd coatings to comply with industrial product standard B.E. 2559 (2016), which subsequently took effect in January 2017.

According to this decree, all enamel paints used for construction and decorative purposes which are manufactured or sold in Thailand must meet the following requirements (standard reference no: TIS 2625-2557):

- No more than 0.01% (100 ppm) lead, mercury and cadmium (dry weight); and
- No more than 0.1% (1,000 ppm) hexavalent chromium (dry weight).

In addition, all alkyd enamel paints manufactured or sold in Thailand are required to show a warning label about potential dangers from the product, for example, "contains toxic substance" or "keep away from children."

2. RESULTS

On 30 September 2019, EARTH visited Benjakitti Park and Lumphini Park located in Bangkok City, Thailand, and screened the playground equipment for lead content. In each playground, painted play equipment (e.g., climbing bars and frames, posts, railings, ramps, rockers, see-saws, slides, swings, etc.) were examined and physical details, e.g., color of painted surface, substrate type (metallic, wooden, plastic, fiberglass, etc.), and the condition of painted surface (new, old, visible chipping off or flaking) were documented.

In situ lead content analysis was performed on painted surfaces using a portable Olympus Innov-X Delta X-Ray Fluorescence (XRF) spectrometer. For a complete description of the materials and methods, please see Appendix A.

This study shows that:

- 20 out of 24 analyzed pieces of playground equipment contained total lead concentrations above 90 parts per million (ppm), dry weight. In addition, 14 analyzed pieces of playground equipment contained dangerously high lead levels above 10,000 ppm.
- 15 out of 16 bright-colored painted surfaces contained lead concentrations above 90 ppm, dry weight.
- The highest lead concentration detected was 72,300 ppm in a red monkey bar at a public playground in Benjakitti Park, Bangkok City, Thailand.

3. CONCLUSIONS AND RECOMMENDATIONS

The high lead levels found in painted playground facilities constitute a risk of lead exposure for children who spend time playing in these environments. The study results highlight the importance of urgent actions to prohibit the production, sale and use of lead paint for all purposes.

To address the problem of lead in paint, the EARTH and IPEN propose the following recommendations:

For the Department of Health and local authorities in charge of managing playgrounds and childcare facilities to promote the procurement and use of lead-safe paints for painting and maintenance of playground equipment, facilities, structures, and toys offered to children. They must also ensure that proper lead paint abatement procedures are observed when repainting lead painted playground equipment to avoid the dispersal of lead dust.

For the Thai Industrial Standards Institute (TISI) to enforce the industrial product standard for the safety of alkyd coatings (TIS 2625-2557) and establish periodic maintenance inspection of parks and playground environments and restrict the use of lead paint in playground equipment, facilities, and other painted structures.

For paint companies that still produce lead paints to expeditiously stop the use of leaded paint ingredients in paint formulations. Paint companies that have shifted to non-lead paint production should get their products certified through independent, third party verification procedures to increase the customer's ability to choose paints with no added lead.

For parents and teachers to raise children and students' awareness on the dangers of children sucking on or biting painted surfaces and on the importance of handwashing after playing in parks and playground environments.

For public health groups, consumer organizations and other concerned entities to support the elimination of lead paint, and conduct activities to inform the public and protect children from lead exposure through lead paint, lead in dust and soil, and other sources of lead.

For all stakeholders to come together and unite in promoting a strong policy that will eliminate lead paint in Thailand.

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APPENDIX

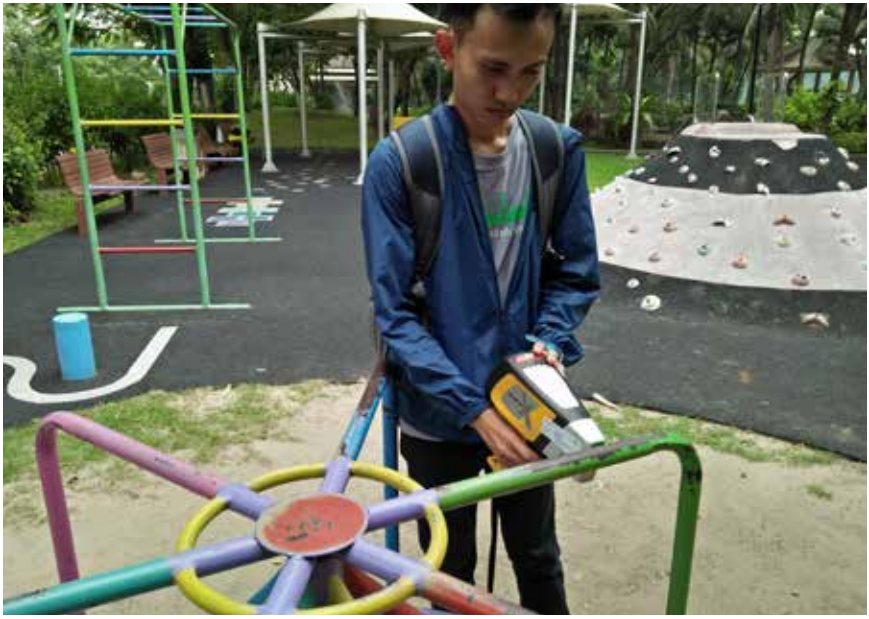
MATERIALS AND METHODS

Two playgrounds in Bangkok City were visited on 30 September 2019. In each playground, painted play equipment (e.g., climbing bars and frames, posts, railings, ramps, rockers, see-saws, slides, swings, etc.) were examined and physical details, e.g., color of painted surface, substrate type (metallic, wooden, plastic, fiberglass, etc.), and the condition of painted surface (new, old, visible chipping off or flaking) were documented.

In situ lead content analysis was performed on painted surfaces using a portable Olympus Innov-X Delta X-Ray Fluorescence (XRF) spectrometer.

A smooth area of a painted surface at a height accessible to children was selected. The XRF nose was firmly positioned against the surface for a period of 10 seconds by pressing the trigger mechanism. For each play-

Figure 1. Photo of staff of EARTH measuring lead content in playground facilities using portable XRF analyzer.



ground facility, XRF screening was conducted in three different parts taking into account the difference in colors and substrate materials. The measurements were recorded, and the screening process was photo-documented as shown in Figure 1.

The limit of detection for lead using this method is 7 ppm. To ensure accurate analyses, calibrations were performed when the XRF analyzer is started or restarted and is repeated when the instrument has been used more than four hours without interruption as indicated in the operating manual.*

The playground area was secured throughout the XRF screening process to ensure that no children were present as the XRF analyzer emits harmful radiations especially if pointed towards a body part or person.

* Da Rocha Silva, J. P., et al. (2018). High blood lead levels are associated with lead concentrations in households and day care centers attended by Brazilian preschool children. ENVIRONMENTAL POLLUTION, 239, 681–688. https://doi.org/10.1016/j.envpol.2018.04.080.

TABLE 1. LEAD CONCENTRATIONS (PPM) MEASURED IN PLAYGROUND ENVIRONMENTS IN THAILAND.

Playground Name and Location	Playground Facilities	Part (includes type of material)	Color	Lead Content (ppm)	Other Remarks
Playground A Lumphini Park (Bangkok City)	Multi-purpose play equipment	Metallic	Yellow	30,000	Chipping
			Blue	ND*	
			Yellow	ND	
	Climber	Metallic	Red	384	Chipping
			Blue	1,120	
			Yellow	68,900	
	Multi-purpose play equipment	Metallic	Blue	67,000	Chipping
			Red	400	
			Yellow	27,800	
	Tire monkey bar	Metallic	Yellow	23,000	New
			Blue	ND	
	Tire for crawling	Metallic	Yellow	24,900	New
	Tire swing	Metallic	Yellow	26,200	New
	Basketball pole	Metallic	White	94	Rusty, chipping
Playground B Benjakitti Park (Bangkok City)	Slide	Metallic	Orange	29,300	Worn out, rusty, chipping
			Brown	ND	
			Blue	1,660	
	Climber	Metallic	Brown	367	Worn out, rusty, chipping
	Merry-go-round	Metallic	Yellow	38,700	Chipping
			Red	17,400	
			Green	37,600	
	Monkey bar	Metallic	Yellow	67,300	Chipping
			Red	72,300	
			Green	47,700	

** ND: not detected*

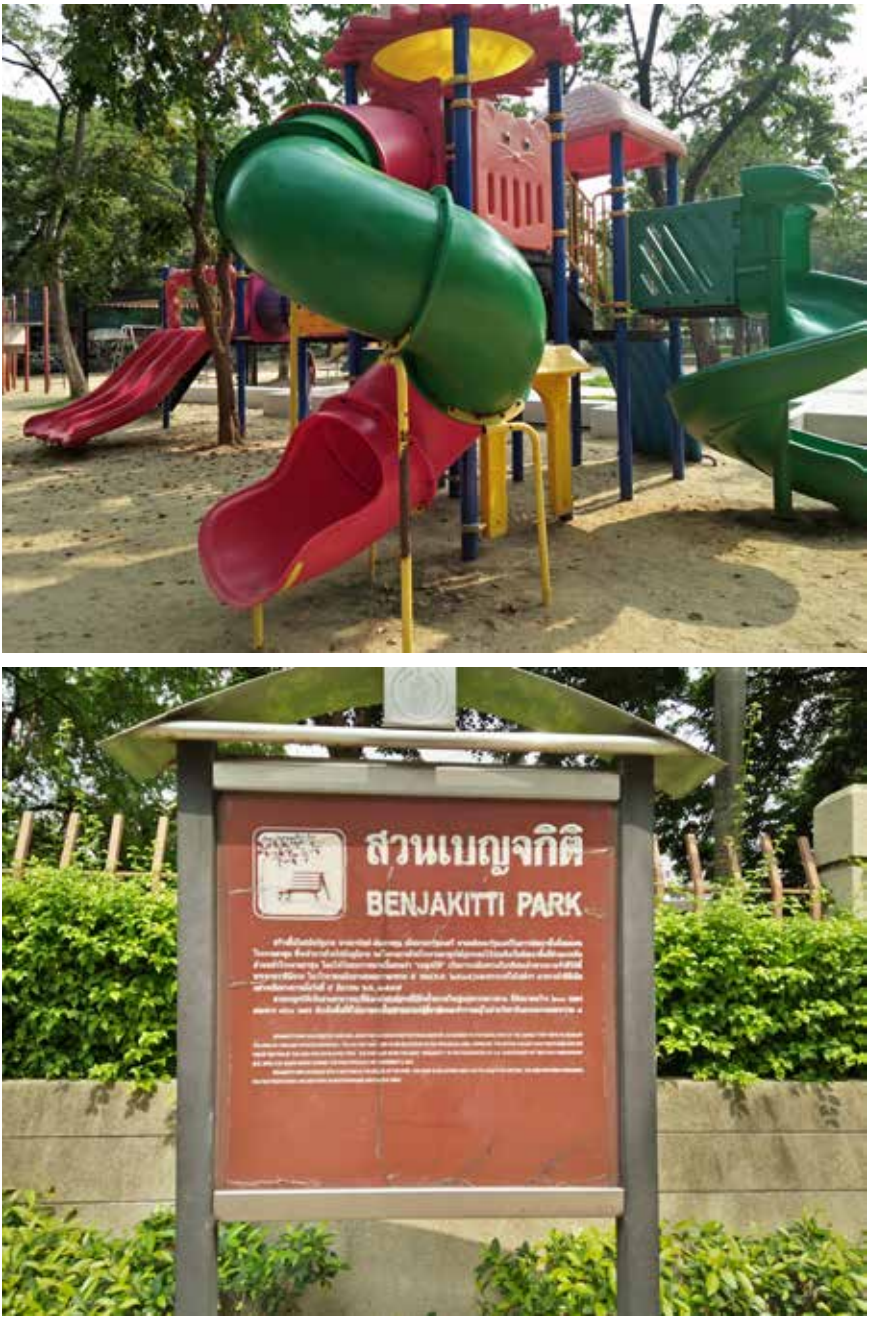


Figure 2. Photos of Analyzed Playground Facilities.

TABLE 2. DISTRIBUTION OF LEAD CONCENTRATION BY COLOR OF PAINTED SURFACES.

Color	No. of Painted Surfaces Sampled	No. of Samples Above 90 ppm	No. of Samples Above 10,000 ppm	Minimum Lead Content (ppm)	Maximum Lead Content (ppm)
Yellow	9	8	8	ND*	68,900
Blue	5	3	1	ND	67,000
Red	4	4	2	384	72,300
Green	2	2	2	37,600	47,700
Brown	2	1	0	ND	367
Orange	1	1	1	29,300	29,300
White	1	1	0	94	94

** ND: not detected*

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