

Lead Concentrations and Labeling of New Paint in Cameroon

P. Gottesfeld,¹ G. Kuepouo,² S. Tetsopgang,² and K. Durand¹

¹Occupational Knowledge International, San Francisco, California

²Research and Education Centre for Development (CREPD), Yaounde, Cameroon

In spite of the availability of substitutes for lead compounds used in paints, manufacturers continue to produce these paints for decorative and industrial applications. We report here on the concentration of lead in new paint sold in Cameroon and provide a summary of labeling practices on paints available in the country, based on a market survey. Investigators visited 76 retail and wholesale paint suppliers in Cameroon to collect information from paint product labels and to collect samples of paints to analyze for lead content. Only 8.5% of paints had labels identifying any of the ingredients, and none of the lead paints included any warning language. Based on a convenience sample (weighted to include multiple colors from the most common brands), 61 mostly enamel paints were purchased from retail outlets and analyzed for lead content (median: 2150 ppm; range: <21–500,000 ppm). Sixty-six percent of the new paint samples had concentrations exceeding the U.S. standard of 90 ppm total lead. All but one of the samples with lead concentrations greater than 90 ppm were also greater than 600 ppm. The largest manufacturer in the country—Seigneurie, a subsidiary of the U.S.-based company PPG—had significant lead concentrations in 9 out of 22 (41%) paints tested. There is an immediate need to adopt mandatory standards to limit the lead content of paint manufactured, imported, and sold in the country. To promote safer paint products we recommend the development of a third-party certification program for paints without added lead. These recommendations are consistent with the objectives of the Global Alliance to Eliminate Lead Paint established under the auspices of the United Nations to address this problem on a global scale.

Keywords Africa, Cameroon, labeling practices, lead paint, lead poisoning

Address correspondence to: Perry Gottesfeld, Occupational Knowledge International, 4444 Geary Boulevard, Suite 300, San Francisco, CA 94118; e-mail: pgottesfeld@okinternational.org.

INTRODUCTION

Lead paint is a significant source of exposure to workers in a range of occupations and is one of the most important contributors to childhood lead poisoning.^(1,2) Due to the greater

proportion of children in developing countries, as well as a greater propensity of malnourished individuals to absorb lead, reducing exposure sources in these countries should be a priority for public health authorities.

Painters are exposed to lead when removing paint from surfaces coated with lead paint and during the application of lead paints. Air concentrations of lead during paint removal in homes and commercial buildings have been measured extensively. One study⁽³⁾ found time-weighted average (TWA) results as high as 550 $\mu\text{g}/\text{m}^3$, or 11 times the U.S. Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) TWA of 50 $\mu\text{g}/\text{m}^3$. Another study⁽⁴⁾ during a building renovation measured average exposures of 432.5 $\mu\text{g}/\text{m}^3$ during sanding and 64.75 $\mu\text{g}/\text{m}^3$ during scraping lead paint. When lead paint is removed using uncontrolled power sanding or open flame burning in housing, exposures can be higher than 5000 $\mu\text{g}/\text{m}^3$.⁽⁵⁾ Exposures during paint removal and repair activities on steel structures can be greater than 20,000 $\mu\text{g}/\text{m}^3$.⁽⁶⁾

Blood lead levels are also used to quantify exposure in workers involved in disturbing lead paint. Airborne exposure monitoring of workers sanding lead paint off a U.S. ship averaged 60.6 $\mu\text{g}/\text{m}^3$; the average blood lead levels of these workers was 7.6 $\mu\text{g}/\text{dL}$.⁽⁷⁾ Another study of U.S. bridge painters reported a geometric mean blood lead level of 18.2 $\mu\text{g}/\text{dL}$ at the end of a 2-week job of sanding lead paint. The geometric mean airborne lead exposure in this study was 58.8 $\mu\text{g}/\text{m}^3$.⁽⁸⁾ In India, a study of 30 workers who had been full-time, residential painters for 5–10 years reported a mean blood lead level of 21.56 $\mu\text{g}/\text{dL}$.⁽⁹⁾

Disturbing lead paint during renovations and repairs in homes and other child-occupied facilities also jeopardizes the health of children who are susceptible to lead poisoning from the resulting contamination of dust and soil in these environments. Young children get most of their lead exposure from contact with contaminated dust and soil in and around homes with lead paint.^(10,11)

In 1978 the U.S. Consumer Product Safety Commission (CPSC) banned lead paint for residential use, while allowing the use of these coatings for industrial and other applications.

Current U.S. regulations⁽¹²⁾ define lead-containing paint as “paint and similar surface-coating materials that contain lead or lead compounds, and in which the lead content (calculated as lead metal) is in excess of 0.009% of the weight of the total nonvolatile content of the paint or the weight of the dried paint film.” The CPSC has also banned the use of lead in toys, including paints and other surface coatings.

In the European Union (EU), cautionary labeling is required on paint products that have total lead concentrations exceeding 150 ppm by weight.⁽¹³⁾ The EU’s Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation bans the use of lead carbonates and lead sulfates (white lead), which have historically been used as pigments in paint. However, member states may allow the use of these lead compounds in paints for limited applications, including art preservation and for historic buildings. Other lead compounds that may be present in paints are not currently banned, but their concentrations and use are restricted or require regulatory approval.⁽¹⁴⁾ The EU also specifically restricts the concentration of soluble lead in toys, although these limits are currently under review.^(15,16)

While most developed countries have restricted the use of lead paint, there are still high concentrations of lead in paints sold in at least 20 developing countries, where data is available.^(17,18) Recent studies from Asia, Africa, and South America have shown that paints available on the retail market commonly contain lead at levels well in excess of the U.S. CPSC standard.^(19–23)

As a result of the growing evidence that lead paint is still being commonly used in residential and other applications, the Intergovernmental Forum on Chemical Safety adopted the Dakar Resolution for Eliminating Lead in Paints at its sixth session, held in Dakar, Senegal, in September 2008.⁽²⁴⁾ Subsequently, at the second meeting of the UN-sponsored International Conference on Chemical Management in May 2009, it was agreed that lead paint merited concerted action, and the conference endorsed the formation of a global partnership to eliminate the use of lead paint under the auspices of the United Nations Environment Program and the World Health Organization.⁽²⁵⁾ The Global Alliance to Eliminate Lead Paint has set out a broad agenda with the stated objective of phasing out the manufacture and use of paints containing lead.⁽²⁶⁾ In 2008 the American Public Health Association called for a ban on lead paint for residential and other uses.⁽²⁷⁾

Readily available substitutes for all lead pigments in paint have been available for over 100 years, including titanium dioxide, bismuth vanadate, and organic pigments.^(28–30) However, the use of lead pigments such as lead oxide, lead carbonate (also known as white lead), and lead chromate is still common practice in developing countries. Lead compounds are also used as drying agents in paints, although there are commercially available substitutes that often contain other metals, such as cobalt, magnesium, zinc, and zirconium.⁽³⁰⁾

Initial steps toward the goal of elimination of lead in paint must include a global assessment of the extent of production and sale of lead paint, particularly in countries where there are

no regulations restricting these applications. Data generated from such efforts can be an effective tool for both educating the public regarding the hazards of lead in paint, and encouraging government agencies to develop regulations restricting lead in paint. This data can also help persuade paint companies to reformulate their products. In most countries there is a lack of awareness among consumers and workers regarding the lead content of paints and the hazards posed by these products. This information is essential to begin to evaluate the risk to workers who are exposed on the job and to children who may be exposed to lead from the paint in their homes and schools.

Generally, paints are classified as decorative/architectural or industrial depending on application. In Cameroon, decorative paints are commonly used on homes, schools, and other child-occupied facilities, and there are currently no regulations restricting the use of lead paint. The purpose of our study was to gather information about the lead content of paint sold in Cameroon, and labeling practices for these paints. The main objectives were to (1) inform future regulatory efforts; (2) stimulate public education and awareness campaigns; and (3) initiate dialogue with paint manufacturers about voluntarily reformulating their products with safer alternatives.

METHODS

To gather information about the paint products available in Cameroon, we visited 76 paint retailers and wholesalers. We collected information from more than 1300 paint containers from 52 manufacturers, including 20 domestic and 32 imported brands. We recorded label information, including country of origin, and listed the ingredients and presence of any hazard warnings on a standard data form that was later entered into an electronic database.

Sixty-one paints were purchased from retail shops in the cities of Yaoundé, Douala, Bafoussam, Bamenda, Kumba, Ngaoundéré, Garoua, and Maroua between January and September 2011. The paints came from 15 different manufacturers (seven domestic and eight foreign). Samples were selected based on convenience and were weighted to ensure that multiple colors from among the major brands were included. All but one of the paint products purchased were oil-based enamel paints, as water-based paints are less likely to contain lead.⁽¹⁷⁾ Paints were purchased generally in small containers (less than 1 kg) and were selected to include a range of colors.

The paint containers were brought to the offices of the Research and Education Center for Development in Cameroon’s capital, Yaoundé, for processing. In countries with relevant legal frameworks, the regulatory definitions of lead paint generally apply to dry paint films that are present on toys or applied to homes or other child-occupied facilities. The volatile portion of paint can exceed 50% by weight, and testing the lead content before drying would have the effect of significantly diluting the lead content. Therefore, our testing protocol included drying paints and testing the concentration of lead in dry paint films.

A sample of each paint product purchased was painted onto transparent glass with a surface area of approximately 90 cm²

and placed in a wood rack to dry for 5 to 9 days. After drying, the paint was scraped off the glass with a razor blade onto a countertop covered with clean white paper. Each sample was weighed and placed in a plastic bag for shipment. Technicians used new plastic gloves, new paint applicators, and new razor blades for collecting and processing each sample to minimize cross-contamination.

All paint samples were sent by a commercial delivery service to the offices of Occupational Knowledge International in San Francisco. The samples were forwarded to an AIHA-accredited laboratory for analysis. Samples were analyzed by inductively coupled plasma emission spectroscopy for total lead content, after digesting the samples with modified OSHA and EPA methods (OSHA 125G/ EPA SW846 6010C).

RESULTS

Paint Product Information

Paints available for purchase at retail outlets in Cameroon included paints imported from all continents, but the majority of paint products were manufactured domestically. Examination of container labels revealed a lack of information regarding chemical composition and hazard warnings. Only 117 (8.5%) of 1376 containers had labels that included any ingredients, and none provided specific concentrations. There were two metal primers from different manufacturers that indicated "lead minimum" was present in the product, but they did not list any ingredients, the lead concentration, or any hazard warning. In fact, none of the 1376 container labels examined had any warning about lead hazards.

Lead Content of New Paint

Results of analysis for lead in new paints are listed in Table I, sorted by manufacturer. The median lead concentration for the 61 samples was 2150 ppm (range: <21–500,000 ppm). A total of 40 (66%) of the paints analyzed had lead concentrations greater than 90 ppm. The samples with lead exceeding this level are sorted by concentration in Table II. Lead concentrations of 39 (98%) of the 40 samples that exceeded 90 ppm were well in excess of 600 ppm. The highest lead concentration reported (500,000 ppm, or 50% lead by weight) was found in a metal primer. This value is 5556 times higher than the U.S. standard of 90 ppm. As expected, lead was not detectable (<23 ppm) in the one sample of latex paint collected.

Results indicated that there was a significant amount of variability in lead concentrations in the paint samples tested, even among those manufactured by the same company. Thirty-five of the 61 paint samples were produced by the two largest domestic paint companies in Cameroon: 22 by Seigneurie/PPG and 13 by Smalto. Nine of the 22 paint samples (41%) manufactured by Seigneurie/PPG were lead paint, whereas all 13 samples (100%) from Smalto were lead paint.

TABLE I. Lead Concentration in Paint Samples by Manufacturer

Sample ID	Manufacturer	Country of Origin	Lead (ppm)
05811-71	CIAC	Cameroon	1600
05811-63	Citizen chemical industry	Nigeria	<25
05811-70	Ever paint industry	UAE	2700
20511-57	IMSA	Cameroon	<24
27711-60	INDUS-CHIMIE	Ivory Coast	2800
05811-64	Industra	Ivory Coast	5500
20511-32	International Trust	UAE	2700
05811-66	National Paint	UAE	66000
20511-55	National Paint	UAE	61000
20511-45	National Paint	UAE	54000
06811-72	National Paint	UAE	6300
05811-74	National Paint	UAE	71
20511-46	National Paint	UAE	36
27711-59	National Paint	UAE	<22
20511-30	ONIP	France	<25
05811-69	SCPM	Cameroon	960
20511-39	Seigneurie	Cameroon	500000
20511-34	Seigneurie	Cameroon	69000
05811-67	Seigneurie	Cameroon	62000
11811-05	Seigneurie	Cameroon	59000
20511-54	Seigneurie	Cameroon	34000
20511-53	Seigneurie	Cameroon	29000
11811-04	Seigneurie	Cameroon	23000
20511-44	Seigneurie	Cameroon	1800
05811-68	Seigneurie	Cameroon	310
06811-73	Seigneurie	Cameroon	<47
11811-01	Seigneurie	Cameroon	<25
11811-02	Seigneurie	Cameroon	<25
05811-62	Seigneurie	Cameroon	<23
11811-03	Seigneurie	Cameroon	<21
11811-08	Seigneurie	Cameroon	<22
20511-33	Seigneurie	Cameroon	<23
20511-36	Seigneurie	Cameroon	<23
11811-06	Seigneurie	Cameroon	<24
11811-07	Seigneurie	Cameroon	<24
20511-49	Seigneurie	Cameroon	<24
20511-37	Seigneurie	Cameroon	<25
20511-42	Seigneurie	Cameroon	<47
20511-38	Simpex	Greece	16000
20511-56	Simpex	Greece	3100
20511-50	Simpex	Greece	2800
20511-47	Simpex	Greece	2500
20511-35	Simpex	Greece	1600
11811-16	Simplex	Greece	20000
20511-31	Smalto	Cameroon	240000
20511-48	Smalto	Cameroon	43000

(Continued on next page)

TABLE I. Lead Concentration in Paint Samples by Manufacturer (Continued)

Sample ID	Manufacturer	Country of Origin	Lead (ppm)
11811-10	Smalto	Cameroon	33000
11811-11	Smalto	Cameroon	3700
20511-40	Smalto	Cameroon	2900
20511-51	Smalto	Cameroon	2900
27711-61	Smalto	Cameroon	2500
11811-12	Smalto	Cameroon	2300
20511-52	Smalto	Cameroon	2200
05811-65	Smalto	Cameroon	2100
11811-09	Smalto	Cameroon	1500
20511-41	Smalto	Cameroon	1500
05811-75	Smalto	Cameroon	1500
11811-17	Socipec	Cameroon	49
11811-18	Socipec	Cameroon	<23 ^A
20511-43	Soquicam	Cameroon	710
27711-58	Vinacolor	Cameroon	2500
	Median		2150
	Range		<21–500,000

^ALatex paint sample.

DISCUSSION

The production, import, and sale of lead paint in Cameroon is creating both a short- and long-term hazard in the country that will create harm and leave behind a legacy of childhood lead poisoning that will take decades to correct. It will also indirectly increase the cost of housing to cover abatement and management costs. Disturbing lead paints during repainting, renovations, and repairs is associated with the highest potential exposures due to dust and soil contamination. Even the deterioration of paint that comes with age, or from friction and impact on windows and doors, can release significant lead dust into a home or school environment. The costs to safely abate lead paint hazards in and around homes, schools, and other child-occupied facilities are substantial and impose significant long-term costs on property owners and society.

It has been extensively demonstrated that the most vulnerable populations to lead exposure are children under the age of 6 and pregnant women. Recently, the U.S. Centers for Disease Control and Prevention adopted new childhood lead poisoning prevention guidelines reiterating that there is no known acceptable level of exposure for children. The agency has eliminated the term “level of concern” and instead will use a reference value approach to facilitate comparing an individual child’s blood lead level with that of U.S. children, based on the most recent surveillance data.⁽³¹⁾ Special emphasis is now being placed on primary prevention, “a strategy that emphasizes the prevention of lead exposure, rather than a response to exposure after it has taken place.”^(p.ix,31;32) Eliminating the production of lead paint is an example of primary prevention.

TABLE II. Paint Samples with Lead Concentrations >90 ppm

Sample ID	Manufacturer	Country of Origin	Lead (ppm)
05811-68	Seigneurie	Cameroon	310
20511-43	Soquicam	Cameroon	710
05811-69	SCPM	Cameroon	960
11811-09	Smalto	Cameroon	1500
20511-41	Smalto	Cameroon	1500
06811-75	Smalto	Cameroon	1500
20511-35	Simpex	Greece	1600
05811-71	CIAC	Cameroon	1600
20511-44	Seigneurie	Cameroon	1800
05811-65	Smalto	Cameroon	2100
20511-52	Smalto	Cameroon	2200
11811-12	Smalto	Cameroon	2300
20511-47	Simpex	Greece	2500
27711-58	Vinacolor	Cameroon	2500
27711-61	Smalto	Cameroon	2500
20511-32	International Trust	UAE	2700
05811-70	Ever Paint Industry	UAE	2700
20511-50	Simpex	Greece	2800
27711-60	INDUS-CHIMIE	Ivory Coast	2800
20511-40	Smalto	Cameroon	2900
20511-51	Smalto	Cameroon	2900
20511-56	Simpex	Greece	3100
11811-11	Smalto	Cameroon	3700
05811-64	Industra	Ivory Coast	5500
06811-72	National Paint	UAE	6300
20511-38	Simpex	Greece	16000
11811-16	Simpex	Greece	20000
11811-04	Seigneurie	Cameroon	23000
20511-53	Seigneurie	Cameroon	29000
11811-10	Smalto	Cameroon	33000
20511-54	Seigneurie	Cameroon	34000
20511-48	Smalto	Cameroon	43000
20511-45	National Paint	UAE	54000
11811-05	Seigneurie	Cameroon	59000
20511-55	National Paint	UAE	61000
05811-67	Seigneurie	Cameroon	62000
05811-66	National Paint	UAE	66000
20511-34	Seigneurie	Cameroon	69000
20511-31	Smalto	Cameroon	240000
20511-39	Seigneurie	Cameroon	500000
	Median		2900
	Range		310–500,000

Oil-based paints are the most likely market segment to contain lead pigments and driers. Although the market share of oil-based paint is shrinking compared with latex paints, the overall increase in demand for all architectural paints is projected to increase the production of oil-based paints globally.⁽³³⁾ Given

the expected growth of paint markets in emerging countries, lead paint may become the most significant source of lead exposure for children.

If immediate actions are not undertaken to phase out the use of lead in paint, the cost of this legacy to developing economies can be very high. In a 2007 study,⁽³⁴⁾ the authors estimated that lead exposure accounts for 7–25% of the disease burden among Nigerian children, costing the health and education sectors \$0.38–1.15 billion per year for every 1 $\mu\text{g}/\text{dL}$ increase in blood lead level. In comparison, the authors estimated that investments to reduce lead exposures can be cost-effective after factoring in medical costs and lost wages.

On a national basis, the widespread use of lead in paints contributes significantly to childhood lead exposures, with implications for future economic development. Even low-level exposure is associated with reduced school performance, anti-social behaviors, and higher rates of violence and crime. Lead paint can contribute to exposures in homes and other child-occupied facilities for decades after its initial application. Unless measures are taken to restrict the use of these paints, developing countries will inherit a costly legacy that will harm social and economic development.

Lead concentrations found in new decorative paints marketed in Cameroon indicate that lead is intentionally added as an ingredient in the manufacturing process, rather than being present as an incidental contaminant. Background levels of lead in paint in the United States following the restriction of lead levels to 600 ppm were generally less than 50 ppm.⁽³⁵⁾ The use of lead-containing ingredients in Cameroon was confirmed in interviews with at least two major paint manufacturers included in this survey. This practice is contrary to the UN's global initiative aimed at eliminating the intentional use of lead in paint worldwide.

After bringing these sample results to the attention of the two largest domestic companies, we were told there was no legal provision prohibiting the sale of lead paint in Cameroon. However, Seigneurie/PPG agreed to voluntarily stop the production of lead paint for decorative applications in Cameroon at the beginning of 2012 (personal communication; Diane Kappas, PPG, Pittsburgh, Pa., May 21, 2012). Smalto agreed to stop the production of lead paints in 2013 (personal communication; A. Tchouatchap Mougoue, Smalto, Douala, Cameroon, May 23, 2012). Neither company agreed to a universal policy to take back all lead-containing paints in the market, but Seigneurie/PPG made some effort to inform distributors of this change in March 2012 with an offer to exchange the product. Both companies indicated they would continue to make and distribute lead paint for other applications.

Lead paint sold in Cameroon is intended for consumer applications and commercial use. Our survey demonstrated that the products tested in this study are available from a large number of small retail outlets throughout the country. Most of these paints with significant lead concentrations are sold in small containers including those intended for use on metal. There are no distinctions made on labels or in store displays between household paints and industrial paints. As a result,

these lead-containing paints are widely applied in housing, schools, and other child-occupied facilities.

Both small domestic companies and large multinational companies are marketing lead paint in Cameroon. Seigneurie, the largest paint manufacturer in Cameroon, is a subsidiary of PPG—the second largest paint manufacturer in the world.⁽³⁶⁾ Large multinational companies that continue making lead paint in countries where this is legal, while having removed lead from paint sold in their home countries, are contributing to inequities in public health and imposing significant costs to society in the developing world.

There are still many countries in which paint testing has not been conducted, and neither government nor consumers are aware of the hazard. If more resources were available for such testing in these countries, the resulting data could be used to encourage regulatory action and raise awareness of the hazard.

Other lead exposure sources exist in Cameroon, including the recycling of used lead batteries and electronic devices; soldering, welding, and finishing of metallic components; and toys coated with lead paint. In addition, the consumption of large quantities of calabash clay by pregnant and non-pregnant women to combat morning sickness and for other reported benefits is also a common practice in Cameroon.^(37,38)

CONCLUSION

The lead concentration in consumer paint sold in Cameroon varies greatly, but the majority of oil-based paints contain lead in excess of the U.S. regulatory level. The results of our limited sample reveal that much of the paint being applied to schools, daycare facilities, and residential structures in Cameroon contain significant concentrations of lead, ranging up to 500,000 ppm. This situation is of serious concern to children's health and to workers involved in paint manufacturing, applying paints, and disturbing painted surfaces.

Our investigation of labels on paint containers available for sale in Cameroon demonstrated that current labeling practices are insufficient to inform consumers and workers of lead hazards. There is significant variation in lead concentrations even among oil-based paints made by the same manufacturer and available side-by-side with paint without added lead. However, consumers have no way to differentiate products with or without lead additives in the market. As a result of our testing, the largest paint manufacturer in Cameroon began placing stick-on labels on large-sized paint cans and on plastic bags distributed to retail outlets containing multiple small-sized (100 g) cans, indicating the lead concentration as less than 90 ppm. Although this is a significant development, it falls short of having warning labels pre-printed on the labels of all sizes of paint containers.

RECOMMENDATIONS

The test results presented in this study on paints marketed in Cameroon call for urgent action on the part of the Cameroon government to develop a regulatory standard to

stop the manufacture, import, and sale of lead paint. In the absence of government action, paint manufacturers should voluntarily stop the use of lead in paint for both decorative and industrial applications, and recall lead paint that remains in stores. Multinational companies based in countries with specific regulations restricting the use of lead in paints should operate with the most restrictive standards in all jurisdictions, and immediately remove hazardous lead paint from retail distribution. In addition, architects, engineers, and major paint purchasers (e.g., construction companies) can accelerate these changes by specifying the use of paint products that do not contain lead above 90 ppm.

We also see an immediate need for a standardized system of paint labeling with a special emphasis on providing specific information on the lead content, along with a public education campaign. Warning labels on paint containers should include language on the hazards of disturbing painted surfaces that may contain lead.

In response to the findings of this study, Cameroon's Standards and Quality Agency launched a technical committee to develop a mandatory standard for lead in paint. In addition, PPG has agreed to remove lead paint from their architectural paints in Cameroon (personal communication; Diane Kappas, PPG, Pittsburg, Pa., May 21, 2012). However, they have not committed to stop the manufacture of industrial and auto paints with lead and have not withdrawn older lead paint from stores.

Other major paint companies have recently announced measures to voluntarily limit the production of lead paint. In 2012, DuPont pledged to remove lead pigments from all vehicle coating products.⁽³⁹⁾ International Paint, the marine coatings subsidiary of AkzoNobel, announced in August 2012 that it has become the first producer to completely phase out the use of lead chromates for marine applications.⁽⁴⁰⁾

To encourage more paint companies to reformulate products and to provide customers with reliable information about these formulations, independent third-party certification of the lead content of paint is needed. Such a program should provide a recognizable logo on paints that meet specific standards for lead content and follow uniform labeling requirements. Given the limited resources available to most regulators in developing countries, third-party paint certification can serve as an interim measure while regulations are developed and facilitate enforcement in countries where regulations are already in place.

Voluntary measures on the part of individual companies and third-party certification efforts are unlikely to be sufficient on their own to eliminate the use of lead paint. Given the large number of paint companies operating around the world, and the slow pace of change, waiting for voluntary initiatives on the part of large multinational paint companies will not be enough. Complementary action is needed to level the playing field between large and small paint companies with mandatory standards. We recommend that all countries develop mandatory standards to limit the lead content of paint that is manufactured, imported, exported, and sold even in the absence of data on

lead levels in paints. In addition, such regulations should require manufacturers to label products with a list of key chemical ingredients and appropriate warnings regarding lead hazards.

ACKNOWLEDGMENTS

The authors greatly appreciate the financial support from the United Nations Environment Program under the Quick Start Program that made this work possible. We remain grateful to Galson Laboratories (East Syracuse, N.Y.) for donating the laboratory sample analyses, and to the Cameroonian ministries in charge of environment, health, industry, trade, and labor for their institutional support.

REFERENCES

1. **World Health Organization (WHO):** *Childhood Lead Poisoning*. Geneva: WHO Press, 2010.
2. **Jacobs, D.E.:** Lead-based paint as a major source of childhood lead poisoning: A review of the evidence. In *Lead in Paint, Soil and Dust: Health Risks, Exposure Studies, Control Measures and Quality Assurance*, Michael E. Beard and S.D. Allen Iske (eds.). Philadelphia, Pa.: American Society for Testing and Materials, 1995. pp. 175–187.
3. **Scholz, P.F., B.L. Materna, D. Harrington, and C. Uratsu:** Residential and commercial painters' exposure to lead during surface preparation. *AIHAJ* 63:22–28 (2002).
4. **Zhu, J., E. Franko, N. Pavelchak, and R. DePersis:** Worker lead poisoning during renovation of a historic hotel reveals limitations of the OSHA Lead in Construction Standard, *JOEH* 9:D167–D171 (2012).
5. **Jacobs, D.E.:** Occupational exposures to lead-based paint in structural steel demolition and residential renovation. *Int. J. Environ. Pollut.* 9(1):126–139 (1998).
6. **National Institute for Occupational Safety and Health (NIOSH):** "Request for Assistance in Preventing Lead Exposure Among Construction Workers." Available at <http://www.cdc.gov/niosh/docs/91-116/> (accessed February 6, 2013).
7. **Booher, L.:** Lead exposure in a ship overhaul facility during paint removal. *AIHAJ* 49(3):121–127 (1998).
8. **Rodrigues, E.G., M.A. Virji, M.D. McClean, J. Weinberg, S. Woskie, and L.D. Pepper:** Personal exposure, behavior, and work site conditions as determinants of blood lead among bridge painters. *JOEH* 7(2):80–87 (2009).
9. **Khan, M.I., I. Ahmad, A. Mahdi, et al.:** Elevated blood lead levels and cytogenetic markers in buccal epithelial cells of painters in India. *Environ. Sci. Pollut. Res.* 17:1347–1354 (2010).
10. **Bellinger, D.C.:** Lead. *Pediatrics* 113(Suppl. 3):1016–1022 (2004).
11. "Lead; Renovation, Repair, and Painting Program," *Code of Federal Regulations Title 40, Part 745*. 2008. pp. 21691–21769.
12. "Ban of Lead-Containing Paint and Certain Consumer Products Bearing Lead-Containing Paint," *Code of Federal Regulations Title 16, Part 1303*. 2008. pp. 376–380.
13. "Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on Classification, Labeling and Packaging of Substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC and Amending Regulation (EC) No 1907/2006," *Official Journal of the European Union, EN 31.12.2008*.
14. "Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)," *Official Journal of the European Union, EN 29.5.2007*.

15. Directive 2009/48/EC of the European Parliament and of the Council of 18 June 2009 on the safety of toys. *Official Journal of the European Union*, EN 30.6.2009.
16. "Consultation on the Revision of the Limit Values for Lead in Toys." Available at http://ec.europa.eu/enterprise/sectors/toys/public-consultation-lead/index_en.htm (accessed November 1, 2012).
17. **Kumar, A.:** "Lead in New Decorative Paints." Available at http://www.ipen.org/ipenweb/documents/work%20documents/global_paintstudy.pdf (accessed November 1, 2012).
18. **Clark C.S., K.G. Rampla, V. Thuppil, et al.:** Lead levels in new enamel household paints from Asia, Africa and South America. *Environ. Res.* 109:930–936 (2009).
19. **Clark C.S., K.G. Rampal, V. Thuppil, C.K. Chen, R. Clark, and S. Roda:** The lead content of currently available new residential paint in several Asian countries. *Environ. Res.* 102:9–12 (2006).
20. **Lin G.Z., R.F. Peng, Q. Chen, Z.G. Wu, and L. Du:** Lead in housing paints: An exposure still not taken seriously for children lead poisoning in China. *Environ. Res.* 109:1–5 (2009).
21. **Kumar, A., and P. Gottesfeld:** Lead content in household paints in India. *Sci. Total Environ.* 407:333–337 (2008).
22. **Adebamowo, E.O., C.S. Clark, S. Roda, O.A. Agbede, M.K.C. Sridhar, and C.A. Adebamowo:** Lead content of dried films of domestic paints currently sold in Nigeria. *Sci. Total Environ.* 388:116–120 (2007).
23. **Mathee A., H. Rollin, J. Levin, and I. Naik:** Lead in paint: Three decades later and still a hazard for African children? *Environ. Health Perspect.* 115:321–322 (2007).
24. **Intergovernmental Forum on Chemical Safety:** *Final Report: Dakar Resolution for Eliminating Lead in Paints.* Forum VI, Sixth Session of the Intergovernmental Forum on Chemical Safety. Dakar, Senegal, September 15–19, 2008.
25. **United Nations Environment Programme:** *Report of the International Conference on Chemicals Management on the Work of Its Second Session.* May 2009.
26. "Global Alliance to Eliminate Lead Paint: Objectives." Available at <http://www.unep.org/hazardoussubstances/LeadCadmium/PrioritiesforAction/GAELP/GAELPObjectives/tabid/6331/Default.aspx> (accessed November 2012).
27. **American Public Health Association:** "Calling for a Global Ban on Lead Use in Residential Indoor and Outdoor Paints, Children's Products, and All Nonessential Uses in Consumer Products." Available at <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1370> (accessed December 11, 2012).
28. **Tanquerel des Planches, L., and S.L. Dana:** *Lead Diseases: A Treatise from the French of L. Tanquerel des Planches; with Notes and Additions on the Use of Lead Pipe and Its Substitutes.* Lowell, Mass.: D. Bixby and Company, 1848.
29. **Rabin, R.:** Warnings unheeded: A history of child lead poisoning. *Am. J. Public Health* 79(12):1668–1674 (1989).
30. **Goodman, P.:** Review of Directive 2002/95/EC (RoHS) Categories 8 and 9—Final Report. Leatherhead, Surrey, U.K.: ERA Technology Ltd., 2006.
31. "Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention." Available at <http://www.cdc.gov/nceh/lead/ACCLPP/Final.Document.030712.pdf>. (accessed August 2012).
32. "CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendations," in *Low Level Lead Exposure Harms Children: A Renewed Call of Primary Prevention.* Available at: <http://www.cdc.gov/nceh/lead/ACCLPP/CDC.Response.Lead.Exposure.Recs.pdf> (accessed August 2012).
33. **The Freedonia Group, Inc.:** "Focus on World Architectural Paints." February 2008.
34. **Ogunseitan, O., and T. Smith:** The cost of environmental lead (Pb) poisoning in Nigeria. *Afr. J. Environ. Sci. Tech.* 1(2):27–36 (2007).
35. **U.S. Consumer Product Safety Commission:** *Briefing Package OS #5190: Regulatory Investigation Concerning Limits for Lead in Paint.* June 3, 1993.
36. **World Paint & Coatings Industry Association:** "World's Top Ten Paint Companies 2011 Annual Report." Available at <http://www.wpcia.org/News/2011report.html> (accessed November 5, 2012).
37. **U.S. Food and Drug Administration:** "Safety Alert: Nzu, Traditional Remedy for Morning Sickness." Available at: <http://www.fda.gov/Safety/MedWatch/SafetyInformation/SafetyAlertsforHumanMedicalProducts/ucm196045.htm> (accessed August 2012).
38. **Ekong, M.B., A. Akpantah, O.S. Ibok, M.A. Eluwa, and T.B. Ekanem:** "Differential Effects of Calabash Chalk on the Histology of the Liver of Adult Wister Rats." *The Internet Journal of Health* 8(2) (2009).
39. **E. I. DuPont de Nemours, Inc.:** "DuPont Refinish to Discontinue Leaded Pigments." Available at <http://www.dupontrefinish.eu/portal/en?page=GU-1.3.1.Current.Press.Release&category=PressReleaseCategoryOne&catid=48&catid2=5256> (accessed November 2012).
40. **International Paint Company:** "Beyond Compliance." Available at <http://www.international-pc.com/resource-centre/news/phasing-out-lead-chromates.aspx> (accessed November 2012).