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Total lead concentration in new decorative enamel paints in Lebanon, Paraguay and Russia

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ABSTRACT

Lead concentrations in new enamel decorative paints were determined in three countries in different areas of the world where data were not previously available. The average total lead concentration of the enamel decorative paints purchased in Lebanon, Paraguay and Russia was 24,500 ppm (ppm, dry weight), more than 270 times the current limit of 90 ppm in Canada and in the United States. Sixty-three percent of these paints contained concentrations greater than 90 ppm. Fifty-nine percent contained concentrations greater than 600 ppm, the current limit in some countries. The maximum concentrations found were 236,000 ppm in Lebanon, 169,000 ppm in Paraguay and 52,900 ppm in Russia. An average of 29% of the samples contained exceedingly high lead concentrations, $>=$10,000 ppm.

Five brands of paint were sampled in each of Lebanon and Paraguay and seven in Russia. Three colors from each brand were analyzed. For five of the six samples of the two brands in Lebanon with affiliations outside the country, the lead concentrations ranged from 1360 ppm to 135,000 ppm. In Lebanon the maximum concentration in the Egypt-affiliated brand (Sipes) was 135,000 ppm and the maximum for the USA-affiliated brand (Dutch Boy) was 32,400 ppm. Lead was not detected in any paints from the three of the four brands of paint purchased in Paraguay that had headquarters/affiliations in other countries (Brazil-Coralit), Germany (Suvinil) and USA (Novacor)). Two of the three paints from each of the other Paraguay brands contained high levels of lead with the maximum concentrations of 108,000 and 168,000 ppm; one of these brands was manufactured under a license from ICI in the Netherlands. All of the paints purchased in Russia were from Russian brands and were manufactured in Russia. All three paints from one brand contained below detection levels of lead. The maximum levels of lead in the other six brands in Russia ranged from 3230 to 52,900 ppm. The two brands with the highest lead concentration, TEKS and LAKRA, were produced by companies in the top three in market share.. Overall, lead concentrations were much higher in the colored paints such as red and yellow than in white paints. In each of the three countries a brand based in that country had a colored paint that either met a 90 ppm limit or was close to meeting the limit-demonstrating that practical technology was available in each of these countries to produce low lead bright colored enamel decorative paints. Even though technology for producing paint without added lead existed in each of these countries, twenty-nine (29) percent of the paints analyzed contained exceedingly high concentrations ($>=$10,000 ppm) of lead.

1. Introduction and background

Paints containing dangerously high lead concentrations are still available in many countries as has been documented by a number of investigators (Adebamowo et al. 2007, Berne et al. 2011, Clark et al., 2005, 2006, 2009, 2014a,b; Ewers et al., 2011, Gottesfeld et al., 2013, 2014, IPEN, 2013, Johnson et al., 2009, Kumar, 2007, Kumar and Gottesfeld, 2009, Lin et al., 2008, Mathee et al., 2007,

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Montgomery and Mathe, 2005, Nganga et al., 2012, Toxics Link/IPEN Global Study, 2009, UNEP, 2013a and Van Alphen, 1999). High lead concentrations have even been found in a country ,China, with a legal restriction on the lead content (Lin et al., 2008, Clark et al., 2009). However in many other countries information on lead concentration in new decorative enamel (oil-based) paints is not available. Exposure to lead causes many very serious health problems, particularly to very young children (NTP, 2012), and the effects can persist in later years (e.g. Dietrich et al., 2001, Cecil et al., 2008). Health authorities have concluded that there is no safe limit for the concentration of lead in the blood of children (CDC, 2012). There is therefore an urgent need to ensure that paints are produced using only non-lead materials. This need applies to all paints used in housing and other areas where children are present, whether the paints are manufactured within the country where they are purchased or imported. In response to the concern over the continued use of lead in paints intended for use in areas where children and others are exposed a Global Alliance to Eliminate Lead Paint was created by the World Health Organization (WHO) and the United Nations Environmental Program (UNEP, 2013b).

The exposure to lead of young children is often through contact with dust contaminated with chips of lead paint (Bornschein et al., 1985, Clark et al., 1991, Jacobs et al., 2002, Gaitens et al., 2009). Lead-contaminated dust is created as painted surfaces deteriorate and particularly when previously painted surfaces are prepared for repainting by removing loose-paint in an un-safe manner. Regulations to require that persons engaged in renovation, repainting and remodeling and lead abatement activities are trained in lead-safe work practices have been enacted in the United States (USEPA, 2008, 2010, 2012) and would also be useful in other countries. Hazards from previously applied leaded paints can exist for many years after lead has been eliminated from new paints. For example, in the United States lead-based paint hazards still exist in 24 million housing units many years after the use of lead in paints was prohibited in 1978 (Jacobs et al., 2002). Evidence of reduced intelligence caused by childhood exposure to lead has led the World Health Organization to list “lead caused mental retardation” as a recognized disease. WHO also lists it as one of the top 10 diseases whose health burden among children is due to modifiable environmental factors (WHO, 2010). This research was designed to help fill the gaps in knowledge of lead concentrations in new paint in countries, in different areas of the world, where such data are missing. Lead concentrations in new enamel decorative paints were therefore determined in Lebanon, Paraguay and Russia.

2. Materials and methods

This project was a cooperative effort between IPEN, IndyACT in Lebanon, ALTERVIDA in Paraguay, EcoAccord in Russia and the University of Cincinnati (UC) in 9 the United States, IndyACT, ALTERVIDA, and EcoAccord are each members of IPEN, an international network of non-governmental organizations (NGOs) of health and environmental organizations from all regions of the world. IPEN is a leading global organization working to establish and implement safe chemicals policies and practices to protect human health and the environment. Its 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.

Three colors, usually red, white and yellow, from each of five brands of paint were obtained in Lebanon and in Paraguay. In Russia, three colors from each of seven brands were sampled. These three colors were chosen because previous studies have indicated that yellow paints tend to have the highest lead concentration, white paints the lowest and red intermediate (Clark et al., 2009). The brands that were sought to be included from each country were the most popular brands and a brand from a smaller company. The brands selected in Russia included two of the three brands with the largest market share, TEKS and LAKRA (Tikkurila, 2015a). Samples were prepared in each country on wood according to a protocol described elsewhere (Clark et al., 2014a,b) using supplies shipped from UC. Detailed information was obtained for each paint sample such as: the country where the paint was manufactured, the country of the brand headquarters/, affiliations date paint manufactured (if provided) and information on the label regarding lead content (if provided). This information was recorded on the laboratory submittal form completed for each country. The dried paint samples were shipped from each country to UC where they were analyzed for total lead content by the Hematology and Environmental Laboratories. Paint was carefully removed from the painted wood by means of a clean sharp paint scraper using care to not remove any of the wood. The paint scrapings were extracted with nitric acid and hydrogen peroxide according to the method: Standard Operating Procedures for Lead in Paint by Hotplate or Microwave-based Acid Digestions and Atomic Absorption of Inductively Coupled Plasma Emission Spectroscopy, EPA, PB92-114172, September 1991 (US EPA, 1991). Extracts were analyzed by flame atomic absorption spectroscopy using a Perkin-Elmer 5100 spectrometer. The H and E Laboratory was accredited by the American Industrial Hygiene Association (AIHA) as an environmental lead laboratory under the National Lead Laboratory Accreditation Program. The laboratory participated in the Environmental Lead Proficiency Analytical Testing (ELPAT) proficiency program operated by the AIHA under a program established by the U.S. Environmental Protection Agency. Strict quality control procedures were maintained according to the accreditation guidelines. The accreditation program operated by AIHA meets all international program requirements which comply with ISO/IEC 17025 and subsequently ISO/IEC 17011. AIHA is a full member of the International Laboratory Accreditation Cooperation (ILAC). The AIHA accreditation program is recognized globally.

Total lead concentrations in parts per million (ppm) dry weight were compared by country where paints were purchased, brand headquarters country, color, and by lead concentration distributions, such as number of samples with lead concentrations $>=$90 ppm, 600 ppm, 10,000 ppm, $<=$90 ppm by brand and country. These concentrations were chosen because 90 ppm is the current limit in the United States (CPSIA, 2008), Canada (Health Canada, 2010 and Nepal, 2014), 600 ppm is the current limit in some other countries (e.g. Brazil (Brazilian Federal Law, 2008), the Philippines (Philippines DENR, 2013), Singapore (Singapore NEA, 2004), Sri Lanka (Sri Lanka CAA, 2011), and Uruguay (Uruguay NEO, 2011), and 10,000 ppm is considered an exceedingly high concentration.

3. Results

Data on individual samples are presented in Tables 1, 2 and 3 for Lebanon, Paraguay and Russia, respectively. There was a wide range of lead concentrations detected in the paints from each country (Table 4), with the percent of the samples containing levels of lead greater than or equal to 90 ppm ranging from 27% in Paraguay to 87% in Lebanon. The average concentration of lead was 48,300 ppm in the paints from Lebanon, 23,100 ppm in the paints from Paraguay and 8340 ppm in the paints from Russia. The maximum detected concentration was 236,000 ppm in paint from Lebanon. All paints were purchased in October 2011, but the dates on which the paints were manufactured were only provided on