Research & Development Highlights

Testing of Canadian Sources for Lead Analysis

93-200 Technical Series

Introduction

Recent findings have highlighted the hazards of leaded paint, especially to pregnant women and children. Renovation of houses containing leaded paint can expose these groups to dangerous lead levels. In light of these findings, householders have expressed a need for information on how to have their paint tested for lead content. In response to these needs, this study examined various testing methods for the concentration of lead in paint.

Research Program

The research looked at lead testing with X-ray fluorescence (XRF) machines, chemical test kits, and laboratory analysis. The different procedures were evaluated in terms of accuracy, suitability and cost.

Field measurements using the XRF instruments and chemical test kits were performed on typical painted surfaces found in commercial buildings in the downtown Toronto area. The results of this testing were compared with results of paint samples submitted for laboratory analysis.

Twenty-two painted surfaces were selected for field evaluation from five empty buildings which possessed a variety of painted substrates, including metal, concrete, wood and brick. Analysis indicated that paint lead levels on these surfaces ranged between 150 to 16000 parts per million (PPM).

XRF instruments

Three XRF instruments were tested. The first spectrum instrument was capable of measuring lead via both L- and K-line X-ray emissions. The second spectrum XRF was configured to detect and measure only L-line X-ray fluorescence. The third XRF machine uses a gamma ray rather than an X-ray to excite the lead electrons in paint. The penetrating power of gamma radiation is significantly greater and can be influenced by lead in the substrate as well as in the painted surface. The direct read XRF in this study measured the K-line X-ray fluorescence only.

Chemical Test Kits

Evaluation of the test kits was conducted in the same test areas that were measured with the XRF instruments. Three of the test kits were tested on the painted surface, on a groove cut into the paint, and on paint chips leached overnight in white vinegar. The 4th test kit was tested solely on leached chips while the 5th was tested on the painted surface and on the paint groove only. No quantitative evaluation was done for the test kit results (see table 1).

Laboratory Analysis

Paint chip samples were obtained from painted surfaces adjacent to and surrounding ten of the taped-off test areas within the buildings. All samples were treated to generate a homogeneous sample.

Each of the eleven labs was sent subsamples of the ten homogeneous paint samples as well as one duplicate paint sample, one certified standard reference paint sample, one water sample spiked with a known concentration of lead, and one blank water sample.

Each lab was asked to supply a brief description of their analytical methodology.

Findings

XRF instruments

The three XRF instruments gave generally consistent results when either L- or K-line readings were compared. However, in some instances, Lead readings were substantially lower than corresponding K-line readings, which indicated that the lead-containing paint was present under one or more non-lead paint films.

The third XRF instrument was the most susceptible to substrate interference and required a background correction. However, results indicated that (with one exception) substrate interference was not a significant factor in influencing lead measurements in this study.

Repetitive testing of the same substrates (such as paint over plaster, wood or metal) gave fairly consistent results. Repetitive readings taken for green paint on a number of different substrates at one location showed significant variability. This is thought to be due to variations in paint film composition instead of substrate interference problems, a phenomenon that was observed at other test sites as well.

The accuracy and repeatability of the direct-read XRF was questionable at levels in the range of 0.5 - 1.5 mg/cm^2, as was noted by the equipment supplier.

Capital cost for the XRF instruments ranged from $12,000.00 to $69,000.00. The price for an estimated five hour building survey, based on instrument rental and operator price, ranged from $350.00 to $1,000.00.

Chemical Test Kits

The results from the various test kits showed a great deal of variability. Repetitive testing of both the same surface and the same paint on different substrates frequently gave both positive and negative results.

Groove-cut test results were often positive even while the corresponding surface test results were negative, indicating that the test kits were capable of testing only the surface layer. This lead to inaccuracies, since leaded paint was often found under non-leaded paint layers.

The rhodizonate kits were found to be easier to read and gave more consistent results than the lead sulphide-based kits. Rhodizonate kits give a pink positive result, which is easily distinguishable on most surfaces, while lead sulphide turns brown. This can be difficult to distinguish on dark surfaces, leading to trouble in interpreting the results.

Test kit prices ranged from $12.00 to $41.00 and the number of tests per kit ranged from 5 to 100.

Laboratory Results

With the exception of one laboratory, all results were generally in agreement. All labs demonstrated acceptable precision and reproducibility by generating consistent lead concentrations in the blind duplicate sample. As well, all labs were capable of good accuracy for low lead level measurement as given in the spiked water sample. The certified high lead reference material caused problems for a number of labs with 4 of the 11 labs giving results under 60% of the expected value. This is probably due to the digestion processes used in these labs which leach the lead out of the paint sample. The reference sample level is based on true lead content rather than leachable content, which may explain the lower results.

Cost per sample ranged from $8.00 to $50.00; and turnaround time ranged from one to 5 1/2 weeks, (see table 2).

Implications for the Housing Industry

Laboratory results are more accurate than XRF readings and chemical test kits, but can be quite expensive for a full paint condition survey. XRF equipment gave acceptable results, but the equipment is unavailable in Canada, except in Toronto and Saint John, N.B. The chemical test kits are suitable mainly as a screening device for householders.

- Chemical testing can be used as a first step in lead testing. The rhodizonate kit results are easier to read than the sodium sulphide results; but because neither will penetrate the paint surface to any degree, they should be applied to a groove cut into the paint, which exposes all layers.

Table 1. **Chemical Test Kit Comparison**

CATEGORY	TEST KIT 1	TEST KIT 2	TEST KIT 3	TEST KIT 4	TEST KIT 5
Type	Rhodizonate	Rhodizonate	Sulphide	Sulphide	Sulphide
Basis of Measurement	Pink Colour	Pink Colour	Black/Brown Colour	Black/Brown Colour	Black/Brown Colour
Qualitative Measurement	Yes	Yes	Yes	Yes	Yes
Quantitative Measurement	No	No	Yes*	Yes*	Yes*
Test Method	Surface or Groove	Surface, Groove or Chip	Chip only	Surface, Groove or Chip	Surface, Groove or Chip
Test Per Kit	5	100	50	100	100
Cost	$12.00	$41.00	$25.00	$30.00	$38.00

*The sulphide test kits claim to be semi-quantitative. However, this method of quantification would be very subjective.

Table 2. Comparison of Analysis Cost and Turnaround Time per Laboratory

LABORATORY	**TURNAROUND TIME (weeks)**	**ANALYSIS COST (per sample)**
#1	3.5	$25.00
#2	3.5	$32.00
#3	5.5	$38.00
#4	1.5	$14.00
#5	3	$11.00
#6	1	$32.00
#7	2.5	$15.00
#8	2	$16.00
#9	2	$50.00
#10	3	$37.00
#11	3	$8.00

Average Turnaround Time – 2.5 weeks Average Cost – $25.00

Project ***Manager:*** *Don Fugler*
Research Report: Testing of Canadian Sources for Lead Analysis (1993)
Research Consultant: Proctor & Redfern Ltd.

A full report on this research project is available from the Canadian Housing Information Centre at the address below.

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