A new method to identify sources of lead and other heavy metal contaminants in house and work place dust in New Zealand and mitigating measures to reduce their health effects.

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A new method of identifying the source of lead and arsenic in house dust has been trialled in Hawke's Bay.

Lead and arsenic are both linked to serious human health effects. In the US and EU, the level of priority pollutants, like lead, is routinely analysed in the blood of children. This is not the case in New Zealand. As a result the health implication of generally high levels of lead in house dust goes unnoticed.

Identifying the source of these chemicals present in the dust is the first step towards abatement. Lead and arsenic can originate from contaminated soils for example from orchards which is not limited to new subdivisions, from building and construction activities, from painting and other renovation activities, from in-door sources and even from certain hobbies and cosmetics. The new method presented in this paper is simple, faster and significantly less expensive compared to conventional methods. It allows simple abatement steps to be put in place for less cost than classical whole house analysis.

Over 80 % of the houses tested in Hawke's Bay had lead levels over the US EPA recommended 'action level', with more than half 4 – 10 times this concentration. Arsenic in house dust exceeded the NZ residential soil guideline in one third of the houses tested with a maximum of 5 times this threshold concentration. Unlike the soil around the house, young children have access to this house dust most of the time leading to longer exposure times. Lead once ingested is built into the bones and internally recycled leading to life-long poisoning.

The present "low income vicious circle": "low income – no house maintenance – use of old equipment – leading to reduction of IQ of next generation – plus often chronic sickness – high percentage drop-out from schools – entry into low income jobs", can be broken when the source of very common household dust pollutants is identified and mitigated. This will result in a major improvement of New Zealand public health and therefore GDP in the lifetime of one generation.

Therefore this new method of identifying pollutants in house dust would benefit a significant segment of the New Zealand population, especially those in the lower income groups.

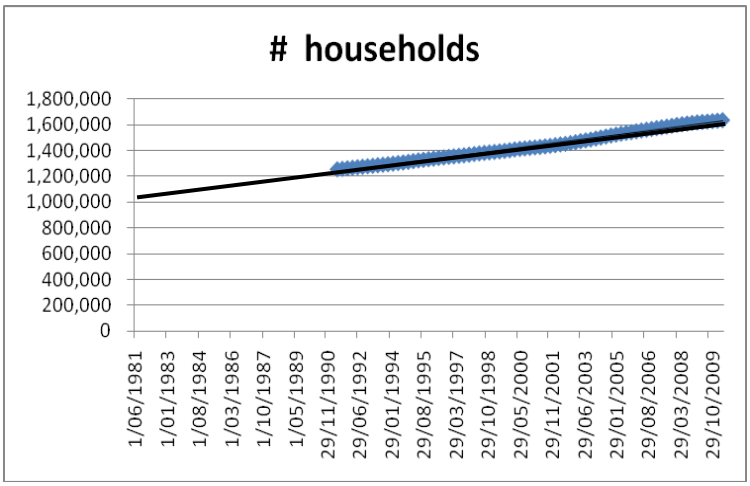
Introduction

Lead in house dust presents a very serious health threat to people and young children in particular. The exposure to house dust is longer than to the soil around the house, so while National Environmental Standards are introduced to protect human health from contaminants in soil, this important expose route seems to be overlooked. In the past the house dust exposure was determined using swipe analysis to calculate lead per square meter of house surfaces. This method is time consuming and costly. Using on-site XRF analysis of house dust obtained from the vacuum cleaner bag from grain size fractions not only provides a house-wide average but also indicates if the lead in the dust originates from inside or outside the house.

Lead-based paint history

Lead carbonate was the main pigment in white paint (see picture on the right[1]) second to lead sulphate and lead chromate was the main pigment in yellow paints. Pre-1945 paint could contain over 50 % of lead by weight. Phasing out of lead in paint started in the late 60-ies, however it was still used well into the early 80-ies.

In 1980 there were about 1 million households in NZ (see extrapolation of the graph below, based on NZ Statistics data). In 1984, the Building Research Authority of New Zealand (BRANZ) estimated that 251,000 properties in New Zealand had lead-based paint on them, and that each year up to 5,000 properties undergo work to remove paint containing lead pigments[2].



Removal of lead based paint creates a serious hazard if not done properly and with the right precautions. In the US from January 1, 2011, firms working in pre-1978 homes and child-occupied facilities must be RRP certified and use lead-safe work practices during renovations. The penalty for noncompliance is $37,000 per day, per violation and possible jail time[3].

Size of problem: Compare with o/s data: How big is the problem in Detroit?

The United States Public Health Services estimated that 1 child in 6 suffers from lead poisoning with a total of 3-4 million children affected nationwide. According to Detroit Health Department and the Census, 73.9% of the City's housing was built before 1955 and, therefore, contains paint with a high proportion of lead[4]. All children in the City of Detroit are considered at-risk by the State.

It is very likely the problem in New Zealand is of similar magnitude or larger, as we have far more wooden houses with fully painted walls compared to Detroit where older houses are made of bricks with only doors and windows painted.

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[1] http://upload.wikimedia.org/wikipedia/commons/6/69/LeadPaint1.JPG

[2] Section 2.2 in Guidelines for the Management of Lead-Based Paint (12-11-2008) https://www.healthed.govt.nz/resource/guidelines-management-lead-based-paint#chap2.2

[3] http://epaleadtraining.com/rrp-in-a-nutshell/

[4] http://detroitleaddata.cus.wayne.edu/problem-about.asp

Threshold or guideline levels

In Holland the threshold value for lead in residential soil including schools and parks is 540 mg/kg. When more than 25 m^3 of soil has levels over this value remediation is compulsory within 4 years.

In the US, California, the screening value is 225 mg/kg for soil at schools[5]. Interestingly they recommend the use of XRF portable analyser for field validation: [quote p 15] : "On-site field analyses for lead in soil may be conducted using portable x-ray fluorescence (XRF) in accordance with U.S. EPA Method 6200" [end quote].

Two basic measures of lead exposure exist: lead loading and lead concentration. The latter is the concentration as found in house dust; the first is a sum of all surface areas containing lead. Results from Davies et al. (1990)[6] suggest that the average lead loading measurements in a child's environment illustrated more realistically the exposure of the child to lead than did lead concentration measurements. The authors state the following in their report:

> *"...the correlation of blood lead concentrations with lead loading in house dust (r=0.46) was much higher than for the [dust] lead concentrations (r=0.21)...Hence, the lead loading, taken over all the exposed floor surface in the rooms concerned, probably represented a better measure of exposure than the concentration."*

In the final report "SAMPLING HOUSE DUST FOR LEAD" by the US EPA[7] the particle size of the dust is taken into account. Clearly for school age children lead in the particle range up to 200 micron is the most important as this particle size may adhere to hands and be ingested or be part of inhaled dust. However for younger children also larger particles may be injected by hand to mouth contact.

In their discussion they find discrepancies between lead in the different particle sizes which they in part explain in the last paragraph on page 4-4: [quote] Another study that examined donated vacuum cleaner bags of dust from 'new' and 'old' homes found that dust from the newer homes (post-1982) agreed with most of the previous studies. In this case, dust particles below 106 µm had higher lead concentrations than did larger particles. However, for dust collected from the older homes (pre-1963), lead concentrations were similar among the smaller particle size classes (<53, 53 to 106, 106 to 150, 150 to 212, and 212 to 250 µm), but the largest dust particle size class, 250 to 2,000 µm, had the highest lead concentrations (U.S. EPA, in press). The observed differences between dust from the new and old homes may be due in part to the different sources of lead dust in the environment. For example, house dust contaminated primarily by deteriorated lead-based paint may have very different characteristics than house dust contaminated mostly by soil and urban

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[5] Interim Guidance Evaluation Of School Sites With Potential Soil Contamination As A Result Of Lead From Lead-Based Paint, Organochlorine Pesticides From Termiticides, And Polychlorinated Biphenyls From Electrical Transformers by Dept of Toxic Substances Control, California, http://www.dtsc.ca.gov/Schools/upload/Guidance_Lead_Contamination_060912.pdf

[6] Davies, D.J.A., Thornton, I., Watt, J.M., Culbard, E.B., Harvey, P.G., Delves, H.T., Sherlock, J.C., Smart, G.A., Thomas, J.F.A., and Quinn, M.J. (1990). Lead intake and blood lead in two-year-old U.K. urban children. *The Science of the Total Environment*, 90, 13-29

[7] EPA 747-R-95-007, Final Report, Sampling House Dust for Lead, Basic concepts and Literature Review, September 1995, http://www.epa.gov/lead/pubs/r95-007.pdf

dust. However, it is not yet known how different sources of lead affect the relationship between dust particle size and lead concentration. [end quote]

Our own hypothesis is that paint derived lead from inside the house is likely present in the medium to larger particles, while lead carried into the house as dust on clothing and footwear is more likely associated with smaller grain size particles. If this proves correct the analysis of the vacuum cleaner dust bag can give an indication of the source of the lead which allows ranking / grouping follow-up surveys.

Despite the apparent consensus to focus on swipe tests of surface areas in the building, we would argue that a guideline for lead in vacuum cleaner dust bags would be more practical as:

1 Analysis of dust from dust bags, even related to particle size is a lot easier, faster and therefore cheaper than performing swipe tests throughout the building and analysing all there swipes.

2 Using a XRF analyser, sieving and analysing the 5 fractions each 3 times (15 analysis) and reporting the results in spreadsheet with small correlation graph (see below) takes about 45 minutes / bag and would be quite inexpensive compared to swipe tests and laboratory analysis – still not giving a division between coarse or fine dust.

3 Given the 'ostrich politics' of most New Zealanders it would be a lot easier to have vacuum cleaner dust bags delivered to central pick-up points (like Environment Centres), where the individual may remain anonymous and can collect the result and recommendation without having to identify themselves or disclose where they live. "Free surveys for lead paint in Houses" offered during A & P shows and Field Days in Hawkes Bay – even with a stand in the marquee of the Regional Council, only resulted in 14 people, over 5 events requesting this service. The results would remain 'anonymous' was also important to them. From the 14 only 5 consented that their date be used in this report.

Human health effects

Even low levels of lead have a significant effect on the IQ of children. The results of a study in New England[8] are: [quote] the blood lead concentration was inversely and significantly associated with IQ. In the linear model, each increase of 10 µg per deciliter in the lifetime average blood lead concentration was associated with a 4.6-point decrease in IQ (P=0.004), whereas for the subsample of 101 children whose maximal lead concentrations remained below 10 µg per deciliter, the change in IQ associated with a given change in lead concentration was greater. When estimated in a nonlinear model with the full sample, IQ declined by 7.4 points as lifetime average blood lead concentrations increased from 1 to 10 µg per deciliter. [end quote] This is illustrated in the figure below.

[8] Intellectual Impairment in Children with Blood Lead Concentrations below 10 µg per Deciliter, by Richard L. Canfield, Ph.D., Charles R. Henderson, Jr., M.A., Deborah A. Cory-Slechta, Ph.D., Christopher Cox, Ph.D., Todd A. Jusko, B.S., and Bruce P. Lanphear, M.D., M.P.H. N Engl J Med 2003; 348:1517-1526 **April 17, 2003** http://www.nejm.org/doi/full/10.1056/NEJMoa022848

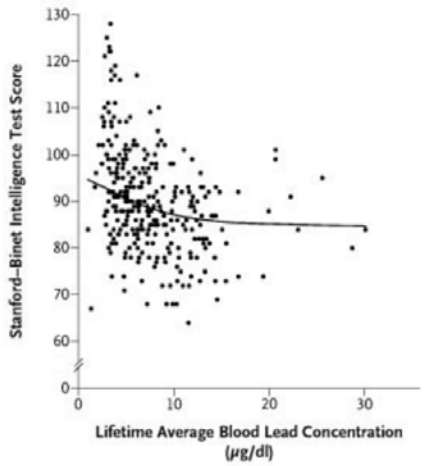

Figure 2. IQ as a Function of Lifetime Average Blood Lead Concentration.

IQ was assessed with use of the Stanford–Binet Intelligence Scale, fourth edition. The line represents the relation between IQ and lifetime average blood lead concentration estimated by the covariate-adjusted penalized-spline mixed model. Individual points are the unadjusted lifetime average blood lead and IQ values. To convert values for lead to micromoles per liter, multiply by 0.0483.

In an invited commentary: 'Lead, Bones, Women, and Pregnancy—The Poison Within?' Howard Hu and Mauricio Hernandez-Avila[9] explain that early childhood lead poisoning results in a lifelong exposure as the lead is mineralised from the bone into the blood and re-absorbed. This way lead is even transferred from mother to baby, pre and post natal as is also found in a study by Adrienne Ettinger et al.[10] Howard Hu and colleagues urge for research into this secondary poisoning effect, which seems to be reduced a bit by high dietary calcium intake.

However the real need is to focus on the primary cause as observed by Bruce Lanphear[11] who is very critical of the voluntary and non-regulatory approach and he concludes: [quote] Primary prevention of childhood lead poisoning from residential lead hazards is long overdue. Despite conclusive evidence that regulatory efforts were responsible for the dramatic decline in lead poisoning—and the early warnings by Gibson and Turner—educational efforts such as passing out brochures and mop buckets inexplicably continue to be emphasized, rather than the need for promulgation of regulations to protect children from residential lead hazards. Moreover, effective prevention interventions are typically withheld until after a child's blood lead concentration exceeds 15 µg/ dL. The key to primary prevention is to require screening of high-risk, older housing units to identify lead hazards before a child is poisoned—before occupancy and after renovation or abatement. Voluntary recommendations will inevitably fail. Screening and follow-up testing of high-risk children will remain an important part of lead poisoning prevention programs, but they should serve as a safety net, not the focus. Unfortunately, public health and housing agencies lack the resources they need to protect children from lead poisoning, and even when they do act, the study by Kemper and colleagues is a cogent reminder that it is too little, too late.

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[9] American Journal of Epidemiology, Vol. 156, No. 12, DOI: 10.1093/aje/kwf164, http://aje.oxfordjournals.org/content/156/12/1088.full.pdf

[10] Levels of Lead in Breast Milk and Their Relation to Maternal Blood and Bone Lead Levels at One Month Postpartum, Adrienne S. Ettinger, Martha María Téllez-Rojo, Chitra Amarasiriwardena, Teresa González-Cossío, Karen E. Peterson, Antonio Aro, Howard Hu, and Mauricio Hernández-Avila, vol. 112 | no. 8 | June 2004 • Environmental Health Perspectives *http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1242024/pdf/ehp0112-000926.pdf*

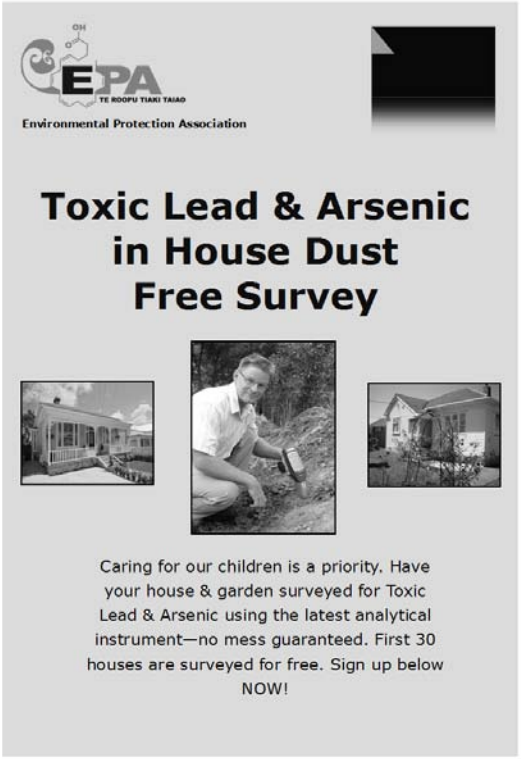
[11] Childhood Lead Poisoning Prevention – Too Little, Too Late, B.P. Lanphear, (2005), Journal of the American Medical Association 293 (18) 2274 - 2276, http://jama.ama-assn.org/content/293/18/2274.full.pdf

The presence of lead in bones leads to lead in breast milk as is found in a study by Adrienne Ettinger et al.[12]

The effect on the brains of children goes *beyond* 'just lowering' the IQ level. The conclusions of the article "Lead Exposure, IQ, and Behaviour in Urban 5- to 7-Year-Olds: Does Lead Affect Behaviour Only by Lowering IQ? Read: [quote] "We have found, in children with relatively high lead exposure that concurrent blood lead concentration was associated with externalizing and school problems at 7 years old, and the effect was not entirely mediated through the lead effect on IQ. On the other hand, higher blood lead concentration at 2 years of age was not associated with behaviour at 7 years of age. Finding both direct and indirect effects of concurrent blood lead concentration on behaviour among school-aged children lends further urgency to the necessity of preventing lead exposure in children, preferably continuing into school age."[end quote][13] and any mitigating actions which may reduce the exposure to the contaminant.

Hawke's Bay Lead in House Dust Survey

"Free surveys for lead paint in House dust" has been offered during 5 events (A & P shows and Field Days) in Hawkes Bay in a stand placed in the marquee of the Regional Council, during 2007 – 2009. The main poster, in colour and on A2 in the stand is given to the right.



This has resulted in only 14 people requesting this service. Oddly all were known to the investigator and all part of the organic community.

As the data collected was promised to remain confidential, permission was sought for use in this paper. 9 of the 15 people could be contacted of which 5 have given permission to use the data.

Of the other 10 houses surveyed 2 had even higher lead levels while the other 8 were in the same range as the 5 presented here in this paper.

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[12] Levels of Lead in Breast Milk and Their Relation to Maternal Blood and Bone Lead Levels at One Month Postpartum, Adrienne S. Ettinger, Martha María Téllez-Rojo, Chitra Amarasiriwardena, Teresa González-Cossío, Karen E. Peterson, Antonio Aro, Howard Hu, and Mauricio Hernández-Avila, vol. 112 | no. 8 | June 2004 • Environmental Health Perspectives *http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1242024/pdf/ehp0112-000926.pdf*

[13] Aimin Chen, Bo Cai, Kim N. Dietrich, Jerilynn Radcliffe and Walter J. Rogan, Pediatrics 2007;119;650-658, DOI: 10.1542/peds.2006-1973 http://www.pediatrics.org/cgi/content/full/119/3/E650

Analytical procedure.

Upon arrival the analysis procedure is explained to the home occupier. The vacuum cleaner dust bag is obtained and first sieved in a coarse (5 mm) garden sieve. The smaller than 5 mm dust is than placed in a laboratory set consisting of: 'pan' collecting < 75 µm dust and sieves 75 µm, 150 µm, 300 µm, 1200 µm, and a lid. The dust is shaken vigorously for a minute and the dust placed in heaps.

The XRF analyser needs a sample thinkness of about 5 mm (detail photo's in Appendix D).
In all vacuum cleaner bags enough fine dust was present for a dust pile of at least this thickness.
Multiple analysis shows great variability in metal concentration in the coarse dust (> 1200 µm) which contains also the wool / hairs and lots of debris. The finer the dust the more homegeneous is the metal concentration in the sample.

The result of the analysis is discussed with the occupier (see below in results section). Next most painted surfaces inside and outside are analysed by holding the analyser on the surface for 20 seconds. For convenience, the lead concentration found is indicated with a sticker:

red = high concentration; action required and no dry sanding allowed.
yellow = medium concentration: consider action and avoid sanding
green = low concentration found; no action required

Results

Five house surveys will be discussed. The first house is a town house built in the early 80-ies. The vacuum cleaner bag sieve test results are shown below.

Dust	Average Pb
micron	(mg/kg lead)
0-75	<LOD
75-150	29
150-300	190
300-1200	<LOD
1200-5000	<LOD

In house 1 (74TM) the higher lead concentration is found in the fraction 150 – 300 µm, with < LOD (limit of detection) which is 10 - 20 mg/kg for the very fine and coarse dust.

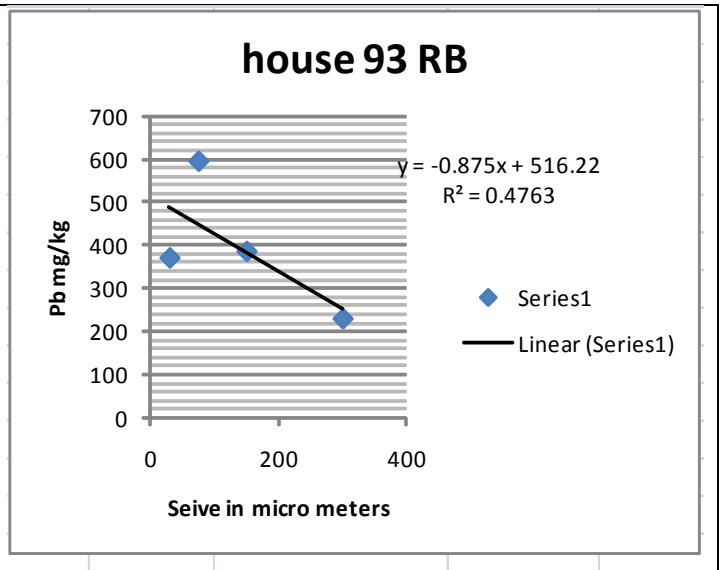
Overall the concentration is low and indeed analysing the painted surfaces in and outside the house very few areas with lead paint were found (See appendix A).

House 2 (93RB) is built around 1900 and is set in an orchard. It has maximum lead concentration in the vacuum cleaner bag dust in grain size 75 – 150 µm. No analysis was carried out on the dust over 1.2 mm.

The higher concentrations are found in the finer fractions. More lead painted surfaces were present outside indicating the finer fractions of dust are more likely derived from outside.

Presented as well is the arsenic concentration in the finer fractions of house dust (high concentrations[14]), which was found to originate from the dirt floor of the bicycle shed next to the house. This appeared to have been a spray shed. The floor was subsequently concreted.

Dust	Average Pb (mg/kg	Average As (mg/kg
micron	lead)	lead)
0-75	370	96
75-150	594	133
150-300	460	53
300-1200	230	<LOD
1200-5000	N/A	N/A



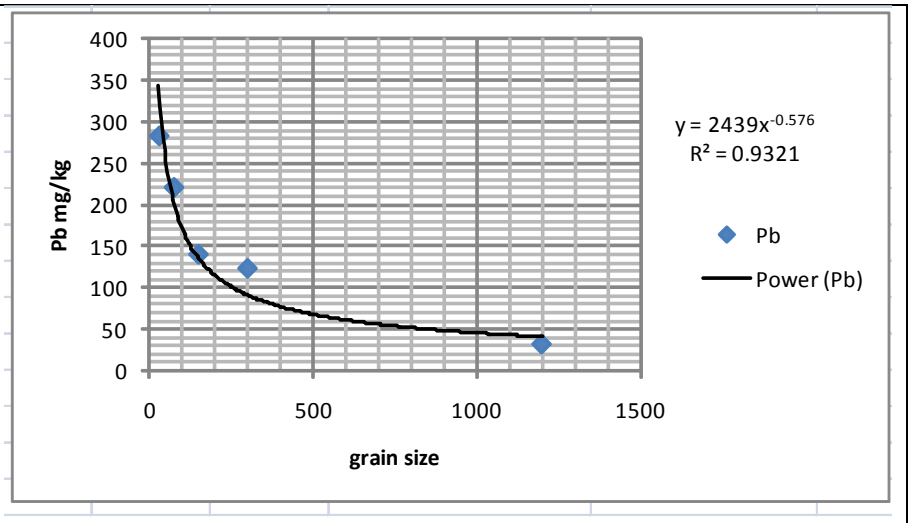
Lead concentration in relation to particle seize

[14] The proposed National Environmental Standard for soil on rural residential blocks with 10 % produce grown on site is 20 mg/kg

House 3 (73 SR) is an old Bach in a coastal location. The original part dates from before 1900, however over the years parts of the building have been added. A fair number of internal walls were recently re-painted, however significant lead was found in outside painted surfaces as well as in the soil around the building (lead 300 – 400 mg/kg w.w.).

This is reflected in the higher lead concentration in the fine dust.

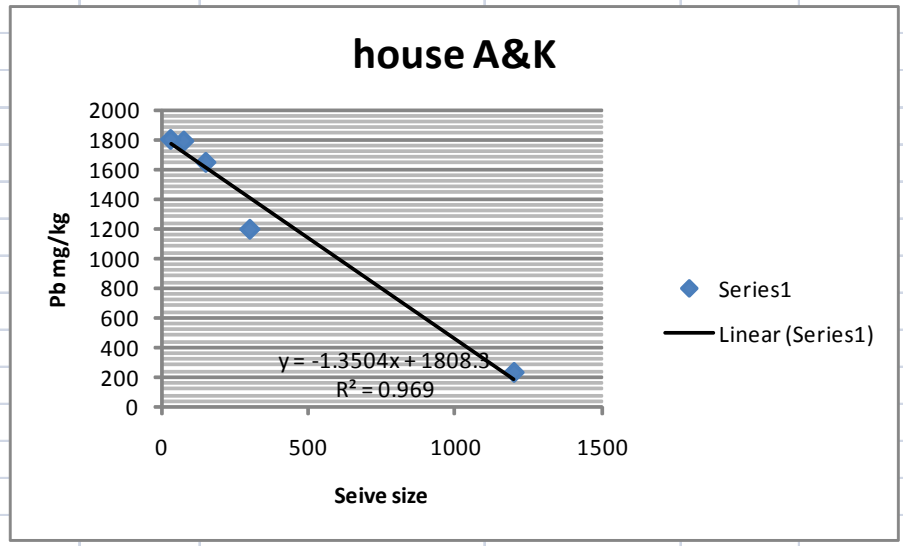
Dust micron	Average Pb (mg/kg lead)
0-75	282
75-150	221
150-300	140
300-1200	123
1200-5000	33



Lead concentration in relation to particle seize

House 4 (A&K) is an 1880 villa, fully renovated and painted using eco-paints. However just weeks prior to the survey, one outside wall was sanded and re-painted.

Dust micron	Average Pb (mg/kg lead)
0-75	1805
75-150	1793
150-300	1649
300-1200	1196
1200-5000	388



Lead concentration in relation to particle seize

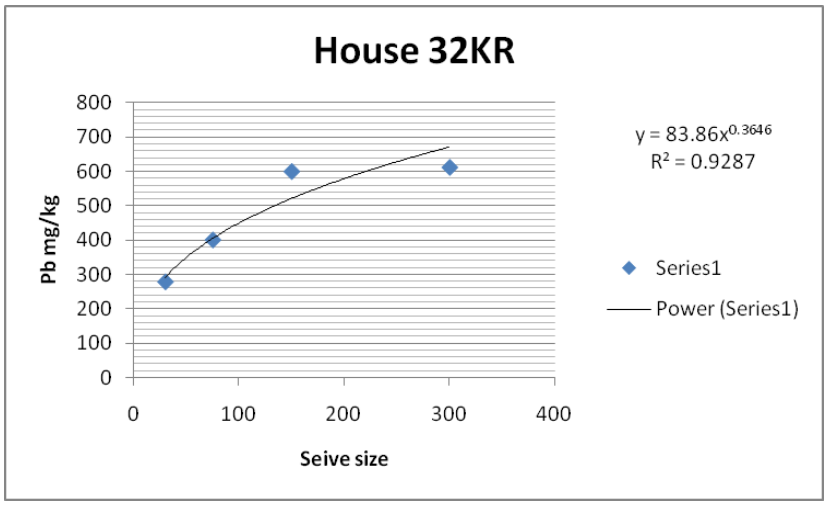
The lead concentration was tracked over a 3 month period, re-analysing a vacuum cleaner bag every 6 weeks. A strong decline in lead concentration was found, however the lead concentration in the fine particle fraction remained well above the US EPA house dust action level of 300 mg/kg.

Dust bag of 3 March 2011		Dust bag of 10 April 2011		Dust bag of 4 June 2011	
Dust micron	Average Pb (mg/kg lead)	Dust micron	Average Pb (mg/kg lead)	Dust micron	Average Pb (mg/kg lead)
0-75	1805	0-75	1240	0-75	573
75-150	1793	75-150	1181	75-150	606
150-300	1649	150-300	1133	150-300	529
300-1200	1196	300-1200	777	300-1200	462
1200-5000	388	1200-5000	167	1200-5000	183

House 5 (32KR) is a 1910 villa, partly re-painted on the inside, however original paint on the outside.

The higher lead concentrations are found in the courser particle seizes which would point to generation from inside the house, however this house also has an extensive roofed over deck area with painted walls, pillars and picket fence. All paint on these surfaces has lead concentrations between 70,000 and 117,000 mg/kg. As the front deck is in frequent use any dust generated there would be walked into the house as if the front deck was an extension of the indoor living area.

Dust micron	Average Pb (mg/kg lead)
0-75	279
75-150	401
150-300	599
300-1200	611
1200-5000	n/a



Lead concentration in relation to particle seize

Note: In the graph of house 5 the value of the analysis of the dust of over 1.2 mm has been left out as it consisted mainly out off wool / hair being far from 'compact', and the XRF would therefore read too low a concentration.

Relationship lead containing particle size and origin of dust

Two of the 5 houses (3 and 4) show the highest lead concentration in the finest grain size of the house dust, two houses (1 and 2) show the highest concentration at a fine but not the finest grain size and one house (5) shows an inverse relationship with the coarser particles containing more lead.

Both houses with highest lead concentration in finest particle size (3 and 4) have the possibility of lead containing dust being walked into the house from outside (lead in soil and recent sanded lead paint dust).

House 1 and 5 have high lead paint in the porch / veranda area and the coarser lead paint flakes could have originated from 'on the doorstep' – being 'almost inside'.

House 2 is a hybrid, with both high lead in soil outside as well as on some inside walls.

The full survey results are provided in Appendix A. Note the titanium concentration is often indicative for the presence of paint, while high iron indicates presence of soil, even though clearly brown or dark red tinted paint can have iron oxides and green pigments often contain chromium.

Conclusion

Analysis of lead in the various grain size fractions of vacuum cleaner dust bags provides rapid screening of the house dust and may point towards potential sources of the lead. Using a XRF analyser makes this screening fast and economical and supplies additional information of other elements indicative of the type of dust, its possible origin and co-contaminants which may also affect the health of the inhabitants.

Recommendations

Lead surveys of house dust are recommended for all households in pre-1980 housing, especially for families with small children.

Lead analysis of blood of pregnant woman should be considered to prevent a live long exposure to lead starting even before the new individual is born. Lead testing in baby blood should be a standard test[15], as like in the US. A large percentage of children in New Zealand will be at sufficient risk that they should have their blood tested at least once.

The presented method provides a faster and more economic analysis option, however a study to correlate its results with the MoH recommended swipe tests should be undertaken.

A study to correlate lead in house dust with lead in blood should be undertaken and possibly extended to lead in bone tissue and psychological and behavioural testing.

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[15] Lead analysis of blood from babies is standard in the US http://aappolicy.aappublications.org/cgi/content/full/pediatrics;101/6/1072 and the 2009 follow-up: http://aappolicy.aappublications.org/cgi/content/abstract/pediatrics;116/4/1036

Appendix A Heavy metals in house dust by grain size fraction

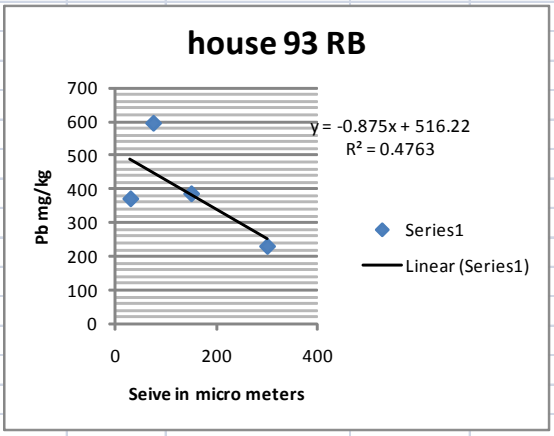
House 1	b75TM								
Reading	Ti	Fe	Cu	Zn	As	Pb	Sample No.	Job No.	Time
1									8:27:52
2	<LOD	4765	<LOD	124	<LOD	<LOD	b 74 TM Rd HN	vac dust < 75	8:29:29
3	<LOD	6232	<LOD	372	<LOD	29	b 74 TM Rd HN	vac dust > 75	8:30:56
4	<LOD	11111	57	373	<LOD	190	b 74 TM Rd HN	vac dust >150	8:32:30
5	<LOD	4377	<LOD	51	<LOD	<LOD	b 74 TM Rd HN	vac dust >300	8:33:44
6	<LOD	3417	<LOD	49	<LOD	<LOD	b 74 TM Rd HN	vac dust >1200	8:34:18
7	<LOD	5133	<LOD	128	<LOD	26	b 74 TM Rd HN	walls inside	8:36:54
8	<LOD	9402	75	2980	<LOD	432	b 74 TM Rd HN	walls inside	8:41:48
9	<LOD	13544	<LOD	126	<LOD	32	b 74 TM Rd HN	walls inside	8:42:32
10	<LOD	1688	<LOD	80	<LOD	44	b 74 TM Rd HN	walls inside	8:43:09
11	<LOD	2856	<LOD	116	<LOD	85	b 74 TM Rd HN	walls inside	8:43:42
12	<LOD	5064	<LOD	133	<LOD	32	b 74 TM Rd HN	walls inside	8:44:32
13	<LOD	11379	<LOD	267	<LOD	82	b 74 TM Rd HN	walls inside	8:45:19
14	<LOD	11808	54	283	<LOD	75	b 74 TM Rd HN	walls inside	8:46:00
15	<LOD	3932	<LOD	357	<LOD	14	b 74 TM Rd HN	walls inside	8:46:37
16	<LOD	2756	<LOD	77	<LOD	<LOD	b 74 TM Rd HN	walls inside	8:47:46
17	<LOD	2636	<LOD	36	<LOD	<LOD	b 74 TM Rd HN	walls inside	8:48:33
18	<LOD	7761	<LOD	283	<LOD	26	b 74 TM Rd HN	walls inside	8:49:35
19	<LOD	17299	307	673	81	1037	b 74 TM Rd HN	porch - front door	8:59:54
20	<LOD	13443	88	318	123	2867	b 74 TM Rd HN	porch - front door	9:01:58
21	<LOD	12432	<LOD	180	<LOD	291	b 74 TM Rd HN	porch - front door	9:02:46
22	<LOD	14900	<LOD	448	<LOD	3931	b 74 TM Rd HN	porch - front door	9:03:25
23	<LOD	13162	<LOD	72	<LOD	180	b 74 TM Rd HN	porch - front door	9:04:17
24									9:07:49
25									9:09:31
26	3382	13356	<LOD	46	<LOD	<LOD	b 74 TM Rd HN	Walls bedrooms	9:10:45
27	<LOD	13602	<LOD	124	<LOD	47	b 74 TM Rd HN	Walls bedrooms	9:11:52
28	2657	14911	<LOD	69	<LOD	77	b 74 TM Rd HN	Walls bedrooms	9:12:39
29	<LOD	13019	<LOD	37	<LOD	75	b 74 TM Rd HN	Walls bedrooms	9:13:16
30	<LOD	14386	<LOD	140	<LOD	214	b 74 TM Rd HN	Walls bedrooms	9:19:43
31	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	b 74 TM Rd HN	Walls bedrooms	9:20:38
32	<LOD	14287	<LOD	33	<LOD	<LOD	b 74 TM Rd HN	Walls bedrooms	9:21:16
33	1978	15872	<LOD	129	<LOD	50	b 74 TM Rd HN	Walls bedrooms	9:22:35
34	<LOD	9944	<LOD	170	<LOD	33	b 74 TM Rd HN	Walls bedrooms	9:23:24
35	2089	15491	<LOD	110	17	<LOD	b 74 TM Rd HN	Walls bedrooms	9:24:39
36	<LOD	9793	<LOD	2059	<LOD	143	b 74 TM Rd HN	Walls bedrooms	9:25:41
37	<LOD	14150	<LOD	3021	<LOD	108	b 74 TM Rd HN	Walls bedrooms	9:27:07
38	<LOD	19383	84	1919	<LOD	383	b 74 TM Rd HN	Walls bedrooms	9:27:59
39	2156	14991	47	430	30	83	b 74 TM Rd HN	Walls bedrooms	9:29:21
40	<LOD	18525	<LOD	754	<LOD	161	b 74 TM Rd HN	Walls bedrooms	9:30:01
41	<LOD	7369	<LOD	255	<LOD	86	b 74 TM Rd HN	Walls bedrooms	9:30:50
42	3026	14352	<LOD	233	30	85	b 74 TM Rd HN	Walls bedrooms	9:31:24
43	<LOD	3465	<LOD	75	<LOD	13	b 74 TM Rd HN	Walls bedrooms	9:31:59
44	2364	13083	<LOD	194	<LOD	561	b 74 TM Rd HN	Walls bedrooms	9:33:16
45	<LOD	13089	<LOD	42	<LOD	<LOD	b 74 TM Rd HN	Walls bedrooms	9:33:55
46	<LOD	19414	<LOD	6039	<LOD	122	b 74 TM Rd HN	Walls bedrooms	9:34:41
47	2175	14445	<LOD	3327	<LOD	<LOD	b 74 TM Rd HN	Walls bedrooms	9:35:13
48	<LOD	5100	<LOD	3517	<LOD	17	b 74 TM Rd HN	Walls bedrooms	9:35:52

49	2086	13265	<LOD	11880	36	145	b 74 TM Rd HN	Garden back	9:36:31
50	<LOD	16143	<LOD	117	<LOD	22	b 74 TM Rd HN	Garden back	9:37:27
51	2049	16557	<LOD	116	<LOD	26	b 74 TM Rd HN	Garden back	9:38:04
52	1965	11619	<LOD	42	<LOD	25	b 74 TM Rd HN	Garden back	9:39:07
53	2519	17165	<LOD	78	<LOD	143	b 74 TM Rd HN	Garden back	9:39:40
54	<LOD	16005	<LOD	113	<LOD	<LOD	b 74 TM Rd HN	Garden back	9:40:10
55	3025	18316	67	195	31	49	b 74 TM Rd HN	Garden back	9:40:46
56	<LOD	9331	<LOD	470	<LOD	53	b 74 TM Rd HN	Garden back	9:42:43
57	<LOD	13686	<LOD	71	<LOD	21	b 74 TM Rd HN	Garden back	9:43:27
58	<LOD	15792	<LOD	67	<LOD	<LOD	b 74 TM Rd HN	Garden back	9:43:56
59	<LOD	14577	<LOD	132	<LOD	61	b 74 TM Rd HN	Garden back	9:44:51
60	2056	12590	81	409	46	138	b 74 TM Rd HN	Garden back	9:45:36
61	3521	18497	<LOD	533	<LOD	117	b 74 TM Rd HN	Garden back	9:46:16
62	<LOD	11869	<LOD	439	<LOD	205	b 74 TM Rd HN	Garden back	9:46:51
63	<LOD	3600	<LOD	101	<LOD	<LOD	b 74 TM Rd HN	Garden back	9:47:38
64	<LOD	6402	<LOD	211	<LOD	24	b 74 TM Rd HN	Garden back	9:49:04
65	<LOD	7591	<LOD	186	<LOD	16	b 74 TM Rd HN	Garden back	9:49:56
66	3527	98389	80	1465	<LOD	45	b 74 TM Rd HN	Garden back	9:50:40
67	<LOD	8968	<LOD	1097	<LOD	70	b 74 TM Rd HN	Walls bedrooms	9:51:19
68	<LOD	13482	<LOD	1236	32	36	b 74 TM Rd HN	Walls bedrooms	9:53:39
69	<LOD	6743	<LOD	293	<LOD	25	b 74 TM Rd HN	Walls bedrooms	9:54:40
70	<LOD	14343	<LOD	284	32	35	b 74 TM Rd HN	Walls bedrooms	9:55:14
71	2226	14167	126	184	<LOD	159	b 74 TM Rd HN	Walls bedrooms	9:55:54
72	<LOD	12258	<LOD	256	<LOD	56	b 74 TM Rd HN	Walls bedrooms	9:56:25
73	<LOD	14689	<LOD	3827	<LOD	105	b 74 TM Rd HN	Walls bedrooms	9:57:15
74	<LOD	6169	<LOD	368	<LOD	27	b 74 TM Rd HN	Walls bedrooms	9:59:08
75									12:31:16
76	<LOD	12350	<LOD	590	<LOD	37	b 74 TM Rd HN	Kitchen / garage	12:32:38
77	<LOD	3865	<LOD	145	<LOD	14	b 74 TM Rd HN	Kitchen / garage	12:33:19
78	<LOD	6234	<LOD	387	14	<LOD	b 74 TM Rd HN	Kitchen / garage	12:34:21
79	2671	14253	<LOD	2083	<LOD	57	b 74 TM Rd HN	Kitchen / garage	12:34:53
80	<LOD	10776	52	194	<LOD	194	b 74 TM Rd HN	Kitchen / garage	12:35:37
81	<LOD	8319	<LOD	459	<LOD	47	b 74 TM Rd HN	Kitchen / garage	12:36:08
82	1714	9314	<LOD	553	<LOD	83	b 74 TM Rd HN	Kitchen / garage	12:36:55
83	<LOD	7560	<LOD	147	<LOD	133	b 74 TM Rd HN	Kitchen / garage	12:37:34
84	<LOD	7734	<LOD	442	43	95	b 74 TM Rd HN	Kitchen / garage	12:38:13
85	<LOD	10712	<LOD	149	<LOD	628	b 74 TM Rd HN	Kitchen / garage	12:38:54
86	<LOD	7763	<LOD	302	<LOD	36	b 74 TM Rd HN	Kitchen / garage	12:39:28
87	<LOD	5492	<LOD	317	<LOD	39	b 74 TM Rd HN	Kitchen / garage	12:40:02
					<LOD	30			
					29	75			
					190	150	highest concentration at < 300 and > 150 micromete		
					<LOD	300			
					<LOD	1200			

House 2	93RB									
Reading	Ti	Cr	Fe	Cu	Zn	As	Pb	Sample No.	Job No.	Time
1										11:36:41
2	<LOD	<LOD	15406	2367	666	<LOD	282	dust >300	93 RB Rd Hav	12:06:49
3	3819	325	7277	87	540	<LOD	177	dust >300	93 Riverbenc	12:07:40
4	1951	<LOD	8180	208	861	51	481	dust >150	93 Riverbenc	12:09:15
5	<LOD	238	6141	112	714	47	290	dust >150	93 Riverbenc	12:09:55
6	1985	<LOD	8908	165	821	60	608	dust >150	93 Riverbenc	12:10:35
7	<LOD	<LOD	11728	242	1161	142	578	dust >75	93 Riverbenc	12:11:33
8	<LOD	<LOD	10831	309	1200	125	610	dust >75	93 Riverbenc	12:12:10
9	2509	<LOD	11948	300	1022	116	460	dust <75	93 Riverbenc	12:13:14
10	3640	<LOD	13918	239	1147	75	281	dust <75	93 Riverbenc	12:14:13
11	<LOD	<LOD	8745	<LOD	241	<LOD	244	soil front	93 Riverbenc	12:15:35
12	<LOD	<LOD	13139	<LOD	145	<LOD	56	soil front	93 Riverbenc	12:16:33
13	45520	<LOD	10926	2081	1034	1046	26877	soil shed	93 Riverbenc	12:18:09
14	2474	<LOD	13022	76	87	<LOD	116	soil shed	93 Riverbenc	12:18:53
15	2424	<LOD	12753	1398	307	76	522	soil shed	93 Riverbenc	12:20:35
16	<LOD	<LOD	9074	1200	561	<LOD	677	soil shed	93 Riverbenc	12:21:18
17	<LOD	<LOD	13499	2692	537	69	684	soil shed	93 Riverbenc	12:24:31
18	39028	<LOD	262	<LOD	2014	832	4867	paint outside	93 Riverbenc	12:27:07
19	139749	<LOD	552	<LOD	385	892	8832	paint outside	93 Riverbenc	12:27:49
20	25097	28655	456	<LOD	496	3560	20530	paint outside	93 Riverbenc	12:28:35
21	16548	<LOD	16168	<LOD	50	686	5367	paint outside	93 Riverbenc	12:29:17
22	68191	2041	1041	940	67	1647	22	paint outside	93 Riverbenc	12:30:12
23	534549	<LOD	2231	<LOD	17036	<LOD	52751	paint outside	93 Riverbenc	12:31:24
24	167859	<LOD	348	<LOD	328	375	7379	paint outside	93 Riverbenc	12:32:11
25	299786	<LOD	773	<LOD	3871	<LOD	14921	paint inside	93 Riverbenc	12:33:51
26	102703	<LOD	332	<LOD	<LOD	<LOD	<LOD	paint inside kitchen	93 Riverbenc	12:34:30
27	<LOD	1943	796	<LOD	21887	3310	24533	paint inside	93 Riverbenc	12:35:54
28	197996	<LOD	1358	<LOD	63	<LOD	<LOD	paint inside living	93 Riverbenc	12:37:33
29	121847	<LOD	397	<LOD	164	40	117	paint inside living	93 Riverbenc	12:38:02
30	138682	<LOD	112	<LOD	215	<LOD	27	paint inside living	93 Riverbenc	12:38:54
31	<LOD	<LOD	84	<LOD	15	29	218	paint inside living	93 Riverbenc	12:40:01
32	40548	<LOD	8981	<LOD	<LOD	<LOD	<LOD	paint inside living	93 Riverbenc	12:41:18
33	1019015	<LOD	1192	<LOD	111931	<LOD	96252	paint inside living	93 Riverbenc	12:42:01
34	1382365	<LOD	2809	<LOD	18269	<LOD	142650	paint inside living	93 Riverbenc	12:42:46
35	<LOD	<LOD	102	<LOD	18	109	326	paint inside living	93 Riverbenc	12:44:31
36	114124	<LOD	225	<LOD	134	35	227	paint inside living	93 Riverbenc	12:45:23
37	105513	<LOD	321	<LOD	94	<LOD	169	paint inside living	93 Riverbenc	12:45:58
38	140503	<LOD	154	<LOD	130	<LOD	83	paint inside living	93 Riverbenc	12:46:36
39	219682	<LOD	944	<LOD	11685	903	27372	paint inside living	93 Riverbenc	12:47:13
40	257509	<LOD	794	201	265	<LOD	133	paint inside living	93 Riverbenc	12:48:13

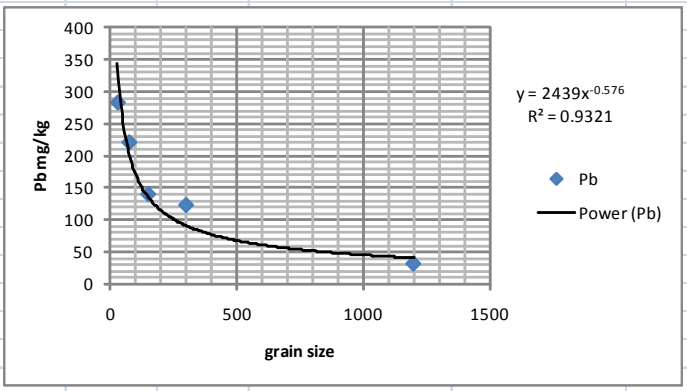
	Pb
dust >300	282
dust >300	177
dust >150	481
dust >150	290
dust >150	608
dust >75	578
dust >75	610
dust <75	460
dust <75	281

		µm	Average Pb
	dust >300	300	230
	dust >150	150	385
	dust >75	75	594
	dust <75	30	370



House 3 73SR										
Reading	Ti	Cr	Fe	Cu	Zn	As	Pb	Sample No.	Job No.	Time
1										16:56:34
2	<LOD	9892	759	2319	60	4502	<LOD	door post	23 SR	16:57:59
3	292707	<LOD	4198	<LOD	128	<LOD	<LOD	living	23 SR	16:59:41
4	83478	<LOD	787	943	195	2782	<LOD	living	23 SR	17:00:20
5	625633	<LOD	1204	<LOD	21399	<LOD	40086	living door	23 SR	17:01:09
6	113486	<LOD	248	<LOD	174	83	459	living	23 SR	17:02:19
7	194188	<LOD	757	<LOD	618	1126	15043	living	23 SR	17:02:55
8	109173	2773	1724	<LOD	852	4726	12477	living	23 SR	17:03:30
9	263087	<LOD	1698	<LOD	120	<LOD	38	living	23 SR	17:04:31
10	125701	<LOD	337	<LOD	1170	<LOD	1817	kitchen	23 SR	17:05:11
11	234003	<LOD	3128	<LOD	<LOD	<LOD	<LOD	kitchen	23 SR	17:06:33
12	281214	<LOD	593	<LOD	1105	71	402	kitchen	23 SR	17:07:11
13	205498	<LOD	752	<LOD	89	<LOD	505	kitchen	23 SR	17:08:04
14	257039	<LOD	3435	<LOD	1825	471	18423	bed 1	23 SR	17:09:13
15	60306	<LOD	18984	<LOD	2978	<LOD	6263	bed 1	23 SR	17:09:54
16	205962	559	507	<LOD	129	<LOD	51	bed 2	23 SR	17:11:00
17	285604	<LOD	476	<LOD	272	<LOD	18	bed 2	23 SR	17:11:39
18	104228	9966	11791	126	2736	<LOD	3123	porch	23 SR	17:12:40
19	84688	<LOD	7605	206	699	<LOD	225	porch	23 SR	17:14:00
20	3915	<LOD	9200	51	420	<LOD	305	soil	23 SR	17:15:17
21	<LOD	<LOD	16824	<LOD	986	<LOD	397	soil	23 SR	17:15:54
22	<LOD	<LOD	9876	57	630	<LOD	55	soil	23 SR	17:16:41
23	225800	<LOD	344	<LOD	536	<LOD	3081	outside house paint	23 SR	17:17:43
24	158702	<LOD	11784	<LOD	1251	<LOD	4955	outside house paint	23 SR	17:18:35
25	<LOD	<LOD	12512	<LOD	39	<LOD	<LOD	outside house paint	23 SR	17:19:30
26	<LOD	<LOD	4489	42271	20297	<LOD	33	seive over 1200	23 SR	17:26:34
27	<LOD	<LOD	6652	44	485	31	123	seive over 300	23 SR	17:27:16
28	1965	<LOD	10226	85	816	41	140	seive over 150	23 SR	17:28:14
29	3703	<LOD	12162	157	1071	93	221	seive over 75	23 SR	17:28:55
30	5554	<LOD	13247	309	1238	76	282	seive under 75	23 SR	17:29:39

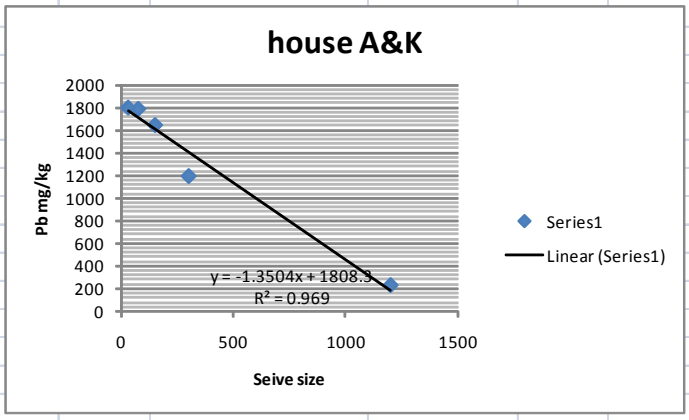
grain size	Pb
1200	33
300	123
150	140
75	221
30	282



House 4	A&K									
Reading	Ti	Cu	Zn	As	Pb	Sample No.	Job No.	Operator	Depth	Time
1										10:42:38
2	14	1502	18	2221	0	deck	A&K	Ben	G/L	10:44:42
3	6138	104	909	83	955	house dust	A&K	Ben	G/L	10:46:27
4	1220467	-121	10073	-17314	95085	outside paint	A&K	Ben	G/L	10:53:02
5	20917	407	1251	950	102	outside paint green	A&K	Ben	G/L	11:10:49
6	52	167	194	153	38	soil	A&K	Ben	G/L	11:16:57
7	672	632	113	591	38	soil in grass	A&K	Ben	G/L	11:17:26
8	1243	169	414	271	133	soil close to shed	A&K	Ben	G/L	11:23:50
9	511	1	206	-6	172	soil close to shed	A&K	Ben	G/L	11:25:24
10	1396	23	308	12	178	soil close to shed	A&K	Ben	G/L	11:26:04
11	2069	43	153	3	37	soil veg garden	A&K	Ben	G/L	11:29:41
12	2657	55	142	14	27	soil next to wood	A&K	Ben	G/L	11:31:58
13	909	41	137	14	55	soil lawn	A&K	Ben	G/L	11:36:11
14	2722	50	199	28	166	soil lawn	A&K	Ben	G/L	11:36:45
15	1006	51	191	85	215	soil lawn	A&K	Ben	G/L	11:37:15
16	1507	140	148	152	61	soil lawn	A&K	Ben	G/L	11:38:05
17	946	68	155	36	43	soil lawn	A&K	Ben	G/L	11:38:40
53	764	1491	1188	15	90	seive over 1125	A and K	Ben	0 - 75	11:33:20
54	3289	2356	1477	2	267	seive over 1125	A and K	Ben	0 - 75	11:33:45
55	1064	99	412	111	326	seive over 1125	A and K	Ben	0 - 75	11:34:11
54	1705.3693	1315.55	1025.625	42.45819	227.6853					
57	12093	180	1336	10	1565	seive over 300	A and K	Ben	0 - 75	11:35:39
58	6904	32	933	-47	740	seive over 300	A and K	Ben	0 - 75	11:36:05
59	9831	62	1119	-1	1283	seive over 300	A and K	Ben	0 - 75	11:36:30
58	9609.5283	91.14545	1129.282	-12.6463	1196.395					
60	9259	97	1155	-56	1510	seive over 150	A and K	Ben	0 - 75	11:37:13
61	6442	85	1058	-63	1605	seive over 150	A and K	Ben	0 - 75	11:37:42
62	7530	94	1136	-128	1833	seive over 150	A and K	Ben	0 - 75	11:38:06
61	7743.6999	92.14381	1116.242	-82.2454	1649.346					
63	6264	70	1067	-82	1857	seive over 75	A and K	Ben	0 - 75	11:38:43
64	6907	71	1077	-54	1821	seive over 75	A and K	Ben	0 - 75	11:39:25
65	6235	107	1103	-43	1702	seive over 75	A and K	Ben	0 - 75	11:39:53
64	6468.5023	82.9876	1082.247	-59.5165	1793.344					
66	5081	76	1044	-41	1830	seive under 75	A and K	Ben	0 - 75	11:40:45
67	5067	79	998	-48	1797	seive under 75	A and K	Ben	0 - 75	11:41:16
68	5446	102	1004	-41	1787	seive under 75	A and K	Ben	0 - 75	11:41:41
67	5198.2246	85.67084	1015.411	-43.1089	1804.546					

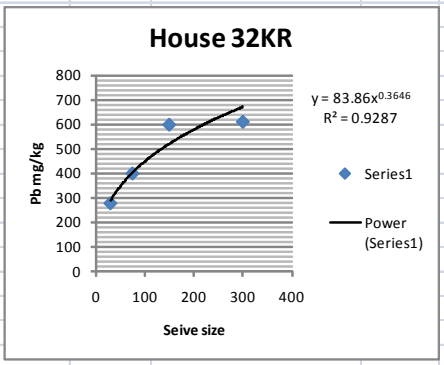
age seive Pb comc.

	Av Pb
1200	228
300	1196
150	1649
75	1793
30	1805



House 5	32KR							
Reading	Ti	Cu	Zn	As	Pb	Sample No.	Job No.	Time
1								9:46:59
2	175421	67	17705	-19	34	car	k 32 HN	9:49:27
3	68273	1375	829	2778	10	deck	k 32 HN	9:54:37
4	95330	905	610	1783	-5	deck	k 32 HN	9:55:19
5	901212	-37	28389	-14888	117257	front windows	k 32 HN	9:56:07
6	760576	-44	19704	-14629	89795	front windows	k 32 HN	9:56:35
7	835463	-125	21724	-14544	96613	front windows	k 32 HN	9:57:10
8	492932	-13	3219	-4221	26842	front windows grey	k 32 HN	9:57:51
9	282840	-8	1649	-1722	9196	front windows grey	k 32 HN	9:58:21
10	941587	-60	12143	-11691	77990	front wall yellow	k 32 HN	9:59:17
11	1005128	-46	10822	-12874	79194	front wall yellow	k 32 HN	9:59:41
12	173162	-12	9953	17	390	interior windows office	k 32 HN	10:00:50
13	208523	-11	12469	-3	290	interior windows office	k 32 HN	10:01:14
14	343624	-24	5733	-2532	18741	cupboard blue office	k 32 HN	10:02:22
15	356187	20	3823	-3171	15635	cupboard blue office	k 32 HN	10:02:47
16	376398	-21	12	-2	1	hallway walls	k 32 HN	10:03:41
17	361105	-13	28	1	-14	hallway walls	k 32 HN	10:04:10
18	195306	-14	1798	-113	1660	toilet windows	k 32 HN	10:05:08
19	203528	-6	614	-92	524	toilet windows	k 32 HN	10:05:35
20	144980	-5	262	1	110	toilet walls	k 32 HN	10:06:05
21	148878	-24	255	-6	114	toilet walls	k 32 HN	10:07:13
22	143555	-19	124	-22	189	kitchen walls	k 32 HN	10:09:17
23	136241	-29	147	-8	117	kitchen walls	k 32 HN	10:09:49
24	128768	-15	827	29	502	kitchen windows	k 32 HN	10:10:29
25	160212	-10	1252	-4	1025	kitchen windows	k 32 HN	10:10:58
26	150960	-16	3037	-8	247	sm bedroom windows	k 32 HN	10:12:10
27	258001	-2	2670	-530	3465	sm bedroom windows	k 32 HN	10:12:43
28	184791	12	35	-6	5	sm bedroom walls	k 32 HN	10:13:33
29	152259	17	86	-2	5	sm bedroom walls	k 32 HN	10:14:06
30	6753	124	-3	-8	4	sm bedroom walls	k 32 HN	10:14:43
31	133228	-22	60	-5	2	mid bedroom walls	k 32 HN	10:15:39
32	169236	13	55	-3	5	mid bedroom walls	k 32 HN	10:16:08
33	193366	-20	4653	29	270	mid bedroom window	k 32 HN	10:16:56
34	191698	10	3977	-40	591	mid bedroom window	k 32 HN	10:17:29
35	155068	-25	11254	-15	396	front bedroom window	k 32 HN	10:18:21
36	118124	-20	9282	6	312	front bedroom window	k 32 HN	10:18:48
37	129072	-21	6	2	2	front bedroom walls	k 32 HN	10:19:30
38	345948	-3	39	7	0	seive over 1200	k 32 HN	10:19:57
39	2837	259	930	34	137	seive over 1200	k 32 HN	11:20:46
40	-27	8934	5943	39	191	seive over 1200	k 32 HN	11:21:22
	348758	9190	6913	79	328			
41	2465	62	424	-26	718	seive over 300	k 32 HN	11:22:16
42	2150	76	481	-46	550	seive over 300	k 32 HN	11:22:42
43	1876	100	591	14	564	seive over 300	k 32 HN	11:23:11
	2164	79	499	-20	611			
44	2761	96	381	2	445	seive over 150	k 32 HN	11:24:10
45	1534	86	433	-35	603	seive over 150	k 32 HN	11:24:36
46	1567	87	376	-18	750	seive over 150	k 32 HN	11:25:08
	1954	90	397	-17	599			
47	2403	161	439	-5	391	seive over 75	k 32 HN	11:25:51
48	1639	133	440	2	412	seive over 75	k 32 HN	11:26:18
49	3054	118	386	-2	399	seive over 75	k 32 HN	11:26:44
	2366	137	422	-2	401			
50	2027	91	457	6	292	seive under 75	k 32 HN	11:28:52
51	1386	108	416	4	273	seive under 75	k 32 HN	11:29:21
52	1695	95	384	9	273	seive under 75	k 32 HN	11:29:53
	1703	98	419	6	279			

	Av Pb
300	611
150	599
75	401
30	279



Appendix B Statutory controls on lead in New Zealand

The statutory controls[16] which address the issue of lead contamination are summarised below.

3.1 Health and Safety in Employment Act 1992

Under the Health and Safety in Employment Act 1992, employers must take all practicable steps to protect their employees and other persons in the vicinity from hazards associated with their work. As exposure to lead in paint removal work is a recognised occupational hazard and can cause 'serious harm', an employer must take all practicable steps to eliminate, isolate or minimise the 'significant hazard'.

Employers are required to monitor staff health and exposure to significant hazards where a 'minimisation' method of hazard management is adopted. They must also notify the Department of Labour when occupationally-induced lead poisoning is identified in any of their employees.

The Act also requires a principal (who appoints a contractor) to take all practicable steps to ensure that the contractor is not harmed by hazards associated with the contracted work. As a competent contractor should be well aware of the hazard of lead-based paint, the duty of the principal is largely to ensure they select a contractor who is aware of the hazard, and capable of managing it effectively.

Where a property is managed on a commercial basis, the Act will also apply. It requires the person who controls a place of work (including plant in the place of work) to ensure occupants and others are not harmed by hazards arising from their management of the property. Although a domestic property may not normally be considered a place of work, it would be during those periods when contractors are active on site.

Although the Act does not apply to occupiers who do or engage contractors whose work falls under the definition of 'residential work', it does however apply to the contractors working in a domestic situation as they will be either an employer, principal, employee, a self-employed person or a person who controls a place of work. As such they have duties under the Act.

Lead poisoning is a 'serious harm' illness of occupation and is notifiable under section 25 of the Act. Occupational health professionals may notify the Department of Labour where occupationally induced lead poisoning is identified or suspected (under the Notifiable Occupational Disease System [NODS]).

3.2 Health Act 1956

The Health Act 1956 is the prime statute controlling health hazards to the public at large. It identifies lead poisoning by absorption equal to or in excess of 0.48 µmol/l from non-occupational sources as a notifiable disease (Section B of Schedule 2), which must be reported by a medical practitioner to the medical officer of health. The health protection

[16] Ref: http://www.osh.dol.govt.nz/publications/booklets/lead-based-paint-guide2008/lead-based-paint-guide2008_03.asp

officer or environmental health officer may inform occupants of the premises concerned of the precautions to be taken.

Under the Act, environmental health officers or medical officers of health may issue Cleansing Orders (section 41) or Closing Orders (sections 42 and 44) on a dwelling that is unsanitary or likely to cause injury to any occupier. These sections could be applied to lead-contaminated properties.

3.3 Building Act 2004

The Building Act specifies design and performance criteria for new buildings, and regulates building work through a consent system for all buildings. Although paint removal falls within the definition of building work, a building consent would not normally be required.

The Building Act is administered by local authorities.

3.4 Residential Tenancies Act 1986

The Residential Tenancies Act 1986 provides for tenant health protection by requiring a landlord to:

- provide and maintain the premises in a reasonable state of repair having regard to the age and character of the premises
- comply with all requirements in respect of buildings, health and safety under any enactments that apply to the premises.

Landlords are thus required to protect occupants and others from (among other things) lead contamination arising from paintwork in the tenant's property or its fixtures and fittings. However, this would not apply to the tenant's own painted furnishings.

3.5 Resource Management Act 1991

The Resource Management Act 1991 is the main controlling statute dealing with the sustainable management of natural and physical resources, and includes the management of environmental contaminants. The Act prohibits the discharge of any contaminant to land or water. Commercial activities may not discharge contaminants into the air. For example, a resource consent may be required for the removal of paint by abrasive blasting contractors given the significant emission of dust and particulates to the atmosphere and surrounding environment, or a regional plan may prohibit such activities in a residential area.

3.6 Hazardous Substances and New Organisms Act 1996

The Hazardous Substances and New Organisms Act (HSNO) and its associated regulations places controls on the import, manufacture or use (including disposal) of chemicals that have hazardous properties. This includes house paint or industrial paint containing lead. The Act requires lead-containing paint (manufactured or imported after 2006) to be labelled with warning and hazard information. The labelling required will depend on the chemical form in which the lead is present in the paint and the amount present.

Hazardous Substances and New Organisms Act 1996 - Group Standards for Surface and Coatings and Colourants

Under the Group Standards for Surface and Coatings and Colourants, any substance permitted that is intended for use as a paint must comply with the restrictions as set out in the Australian Uniform Paint Standard, as per Appendix 1 of the Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) No. 20. The SUSDP prohibits the manufacture, sale, supply or use of any paint with a lead content greater than 0.1 percent and 0.2 percent (percentage based on the non-volatile content of the paint) for lead and lead compounds and lead and lead compounds occurring as an impurity in zinc-based paint, respectively. The restrictions on application apply to: (1) a roof or for any surface to be used for the collection or storage of potable water; or (2) furniture; (3) any fence, wall, post, gate, building (interior or exterior), bridge, pylon, pipeline, storage tank or any similar structure; or (4) any premises, equipment or utensils used for the manufacture, processing, preparation, packing or serving of products intended for human or animal consumption. Also, under SUSDP it is prohibited to manufacture, sell, supply or use a paint for the application to toys unless the paint complies with the specification for coating materials contained in Part 3 of the Australian Standard 1647 for Children's Toys (Safety Requirements).

3.7 Real estate purchase agreements

The contractual agreement governing the sale and purchase of domestic property would normally require the vendor to inform the purchaser of any outstanding statutory notices served on the property. This would include Closing Orders and Cleansing Orders served under the Health Act 1956 to remedy a lead-based paint risk.

Appendix C How to identify and safely remove lead paint[17]

What's the problem?

If your house was built before 1980, assume it has some **lead-based paint**. This is a problem because when you start to remove the paint you risk absorbing the lead through contact with your skin, or from the atmosphere through sanding dust or flakes. It contaminates clothing and furnishings and can lead to lead poisoning. Symptoms of lead poisoning include stomach pains, loss of appetite, weakness and difficulty walking. It can eventually lead to death.

You can test paint for lead content by using **sodium sulphite solution (5%**). Some paint shops and pharmacies sell the solution. Generally the test is carried out by cutting into the paint exposing the back of the suspect layer and dropping some of the solution onto it. If it turns black it contains lead.

Even if your home has been painted more recently, the **paint on the lower layers** may contain lead, if they were painted over previously.

If you are employing a painter, they should be aware of the problem and know how to deal with it, but it is a good idea to raise the issue with them.

Note that lead-based paint is only a danger to health if it has deteriorated, for example, if it has started to flake. If it is in good condition, repainting it is a good option rather than trying to remove it. In fact, removing it is likely to increase the risk of exposure from dust and flake.

Removing lead-based paint

If you have to remove lead-based paint, there are **specific precautions** you must take to protect your health, as well as that of your family and pets.

The best method is by **wet sanding** - misting painted surfaces with a spray bottle and removing paint using sharp scrapers or **wet and dry sandpaper**. This keeps the dust to a minimum.

Abrasive blasting is not recommended because of the amount of dust generated. Chemicals can be used for small areas. Dry hand sanding or machine sanding can be done provided the dust is carefully contained. Water blasting for outside is fine provided the flakes are collected and disposed of without contaminating the soil or surrounding area.

Precautions you should take include:

- Taking down the curtains and furniture and covering the carpets with protective covering before removing the paint.
- Keeping other people and pets away while you're working.
- Using a toxic dust respirator.
- Wearing a hair covering and protective clothing, including gloves and suitable footwear.

[17] http://www.consumerbuild.org.nz/publish/DIY-safety-lead.php

- Keeping windows and doors closed if you are working outside, to stop paint dust and flake getting inside.
- Wiping sanded surfaces and then vacuuming. Collect as much of the dust and paint flakes as possible. Contact your local council for advice on where to dispose of it (don’t burn it as this releases it into the atmosphere).
- Thoroughly washing your hands and face before eating or drinking.
- Changing out of contaminated clothing before going anywhere else.

Get the latest guidelines for the management of lead-based paint from the Department of Labour, Office of Safety and Health.

Storing paint and chemicals

Follow these guidelines for safe storage:

- Keep paint and chemicals, such as turpentine, in a locked dry cupboard.
- Make sure all containers are correctly labelled, closed and sealed.
- Never store poisonous substances in old food containers.
- Do not store large quantities (more than five litres) of flammable liquids (such as petrol and turpentine) inside the house or a garage attached to the house. They should be stored somewhere well away from where people are living.

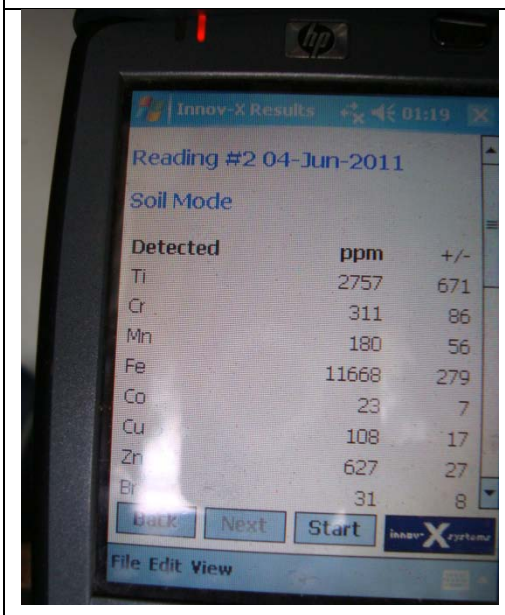
Appendix D Details of dust in grain seize fraction being analysed

Analysing the course fraction

< 75 micron fraction analysed 3 times

75 – 150 micron fraction

150 – 300 micron fraction



Analyser display

300 – 1200 micron fraction

> 1200 micron fraction

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