

10080 - Distributions and Quality of Acidic Pesticide Measurements in Bag Dust from Four Areas of USA

Camann DE, Yau AY, Southwest Research Institute, Colt JS, National Cancer Institute. Vacuum bag dust samples were collected from case and control adults as part of a National Cancer Institute study of non-Hodgkin's lymphoma. Samples were obtained from homes of study subjects in four areas of the United States: the Detroit, Michigan area, the state of Iowa, Los Angeles County, California, and the Seattle, Washington, area. Bags were collected when the subject owned half or more of the carpets at least five years and had used the vacuum cleaner within one year. Up to 2.0 g of fine (<150 um) sieved dust was extracted with acidified acetonitrile/phosphate buffer, esters hydrolyzed to acidic form, cleaned through a C18 cartridge, derivatized by silylation, and analyzed by GC/MS selected ion monitoring for four acidic herbicides (2,4-D, dicamba, MCPA, and 2,4,5-T) and pentachlorophenol (PCP). All detections and co-eluting interferences from dust were identified, coded, and treated consistently. The quality of the bag dust measurements is excellent. Lab spikes of 15 home dusts showed that all analytes were efficiently extracted: mean (\pm std dev) spike recoveries ranged from 74% (\pm 17%) for PCP to 109% (\pm 25%) for 2,4-D. Analysis of lab splits of 15 dust samples showed close agreement between the regular sample and the lab split: 96% of the 24 detection pairs agreed within 20%. Confirmation analyses performed by full-scan GC/MS on 20 samples generally verified the large regular analysis results. Results from the first 622 homes, sampled between December 1998 and March 2000, indicated that concentrations above 0.1 ug/g in the fine dust were common for PCP (85% of homes) and 2,4-D (73%), less common for dicamba (15%), but unusual for MCPA and 2,4,5-T. The concentration distributions of PCP and 2,4-D were very broad, ranging 2 to 3 orders of magnitude from the 25th percentile to the maximum value. Levels of PCP, 2,4-D, and dicamba each were largest in Iowa, and smallest in Los Angeles. Concentration percentiles were about 10-fold higher for 2,4-D, and 2- to 3-fold higher for PCP, in Iowa than in Los Angeles. MCPA detections were more prevalent in Detroit dust than elsewhere. Most 2,4,5-T detections were in Seattle dust.

Pesticide (all sites)	N	Concentration (ug/g) Percentiles							
		10%	25%	50%	75%	90%	95%	99%	Max
PCP	614	< 0.08	0.16	0.37	0.78	1.64	3.18	10.4	57.5
2,4-D	615	< 0.08	0.09	0.30	1.10	2.94	7.01	24.0	148.
Dicamba	602	< 0.08	< 0.08	< 0.08	< 0.08	0.16	0.32	1.48	2.17
MCPA	606	< 0.18	< 0.18	< 0.18	< 0.18	< 0.18	0.20	1.08	3.90
2,4,5-T	573	< 0.18	< 0.18	< 0.18	< 0.18	< 0.18	< 0.18	0.18	1.46
Pesticide by site									
PCP in Detroit	106	< 0.08	0.11	0.27	0.67	1.28	2.33	16.7	24.2
PCP in Iowa	201	0.12	0.27	0.55	1.06	2.47	3.94	10.0	12.0
PCP in Seattle	163	0.09	0.22	0.42	0.83	1.64	3.09	16.2	57.5
PCP in LA	144	< 0.08	0.09	0.21	0.41	0.77	1.71	5.1	9.4
2,4-D in Detroit	108	< 0.08	0.16	0.37	1.24	2.31	4.14	8.0	24.9
2,4-D in Iowa	203	0.12	0.30	0.80	2.44	7.78	10.4	51.4	148.
2,4-D in Seattle	162	< 0.08	0.10	0.22	0.78	1.91	2.70	8.9	18.5
2,4-D in LA	142	< 0.08	< 0.08	< 0.08	0.13	0.42	1.21	4.1	24.3

10168 - CHANGES IN SURFACE DUST, DEEP DUST, LEAD, AND THE 3-SPOT TEST IN CARPETS DURING VACUUMING

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Infants, children, and adults can ingest and breathe dust from carpets which may contain lead (Pb), allergen, pesticides, benzo-a-pyrene, other carcinogens, and phthalates. This study examines the changes in surface dust, deep dust, Pb, and the 3-spot test during vacuuming by sampling ten carpets over eight years of age in the Seattle area by, 1. Laying out an area of one to three square meters on a carpet in the living room with masking tape, 2. Completing a 3-spot test to measure the time in seconds to get green lights on three spots with an upright Hoover Wind Tunnel Vacuum (Model U 6445-900) with a dirt detector (HVDD), 3. Measuring the surface dust in g/m^2 with the High Volume Small Simplified Surface Sampler (HVS4) using ASTM Method 5438-00, 4. Vacuuming with the HVDD and weighing the vacuum bag before and after each test to measure the deep dust in g/m^2 , and 5. Repeating the above cycle of a 3-spot test, HVS4 surface sample, and HVDD deep dust sample until the 3-spot test measures less than 11 seconds with the dirt detector on high sensitivity or the surface dust loading was $0.4 \text{ g}/\text{m}^2$ or less. Dust less than 150 microns from the HVS4 and HVDD samples were analyzed for Pb. The surface dust, deep dust, and dust collection rate (g/min) tended to drop rapidly at first and then much more slowly during vacuuming. The starting surface dust loading was 0.7 to $21.1 \text{ g}/\text{m}^2$ which decreased 85 to 99% when the deep dust was removed. The deep dust ranged from 8.3 to $465 \text{ g}/\text{m}^2$ with a median of $63.2 \text{ g}/\text{m}^2$. It took from 2.3 to $95 \text{ min}/\text{m}^2$ to remove the deep dust. The starting dust collection rate was 4 to $37 \text{ g}/\text{min}$ and the ending rate was 0.5 to $4.3 \text{ g}/\text{min}$. The starting 3-spot test ranged from 13 to 110 seconds. The Pb in the total surface dust correlated with Pb in the total deep dust sample ($r=0.98$). The surface Pb measured 190 , $59,800$, and 11 ppm in three samples from one carpet in a remodeled house. Removing all the deep dust in a small area was required before cleaning other areas to reduce the risk of leaving high Pb concentrations in surface dust. This study also confirms the utility of the 3-spot test which provides trained families and carpet cleaners with a quick and low-cost estimate of deep dust and the time required to clean carpets. This test when used with a short questionnaire can be used to estimate the potential Pb exposure and relative safety of a carpet for a crawling child in an old home. The 3-spot test correlated with deep dust ($r=0.73$, $P=0.0028$, $n=14$).

10409 - Analytical Method for Determining Dinitroaniline, Phenolic, and Chloroacetamide Herbicides in House Dust

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An analytical method was needed for measurement in dust of five herbicides commonly used in the Midwestern United States to control weeds in soybeans and corn for a study to investigate if residential proximity to crop fields predicts herbicides detected in the carpet dust samples. The five herbicides were from various chemical classes: trifluralin and pendimethalin (dinitroaniline), bromoxynil (phenol), bentazone and dimethenamid (chloroacetamide). Two extraction procedures were evaluated to obtain the extraction efficiencies of the five herbicides from house dust. At least four dust samples were combined from each of three non-agricultural areas of Iowa for use in this method validation study. Six matrix spikes of each house dust pool were prepared by spiking 5-9 μg of each herbicide into 2.0g of sieved dust. Three matrix spikes of each dust pool were sonicated using diethyl ether:hexanes (1:1). Extract cleanup using florisil was applied to the extracts. GC/MS analysis in selected-ion-monitoring mode was performed to quantitate the analytes. The other three matrix spikes of each dust pool were sonicated in acidified phosphate buffer in acetonitrile, followed by base hydrolysis. These extracts underwent clean up using a C18 cartridge. The final extracts were derivatized using diazomethane prior to GC/MS analysis. The mean recoveries of trifluralin, pendimethalin and dimethenamid in the diethyl ether:hexanes (1:1) extracts with florisil cleanup were 84%, 110% and 97% respectively. Bromoxynil and bentazone were not recovered at all using the diethyl ether:hexanes (1:1) solvent system with florisil cleanup. The extraction efficiencies of bromoxynil and bentazone greatly improved with the acidified phosphate buffer extraction. The mean recoveries were 102% for bromoxynil and 96% for bentazone. Based on the above recoveries, we have demonstrated that these five herbicides can be extracted efficiently by using two different solvent systems and analysis by GC/MS.

10533 - Measurements of Transferable Residue From Ceramic Tile, Vinyl Tile, Hardwood Flooring, and Carpet Using a Press Sampler and C₁₈, PUF, and Cotton Sampling Disks.

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Unintentional and unavoidable human exposure is a consequence of pesticide use indoors. Pesticides on household surfaces are a source of exposure to children. Therefore, concern has been raised regarding the potential for contamination of foods in homes where pesticides have been used. The exposure pathways that contribute to total dietary intake of pesticides for infants and children are believed to be different than that of adults. This includes indirect dietary exposure through either direct contact between foods and contaminated surfaces (surface-to-food transfer) and/or through an intermediate, such as hands (surface-to-hands-to-food transfer). Accurate measurements of surface residue transfer are needed to determine the extent of pesticide transfer to foods handled and/or eaten by a child. Consequently, a method is needed to measure pesticide residues available on surfaces. Wiping surfaces with a solvent moistened cotton gauze has been an accepted method for measuring surface residues, but the use of solvents can mar the sampled surface, which would be an unacceptable outcome for field sampling. Alternatively, a surface press sampler that presses C₁₈ sampling disks (3MTM EmporeTM Extraction disks composed of 90% Octadecyl adsorbent particle and 10% inert PTFE) against a surface for a specified period of time with a constant applied force has been used to measure transferable surface residue. The C₁₈ disks, which adsorb and/or absorb the residue during contact with the surface, are removed, extracted in solvent and analyzed for the transferred surface residue concentration. The objective of this study was to determine if a surface press sampler in conjunction with either dry preconditioned C₁₈, polyurethane foam (PUF; 1/4" thickness) or cotton (100% natural cotton) disks could be used to obtain transferable residue information from household surfaces. The extent of surface residue transfer to the C₁₈, PUF and cotton disks were then compared to isopropanol surface wipes. The surfaces tested consisted of ceramic tile, vinyl tile, hardwood flooring, and carpet. Each surface was contaminated with an aqueous solution of pesticides commonly used and/or found in homes (diazinon, malathion, chlorpyrifos, fipronil, cypermethrin, deltamethrin, cyfluthrin and permethrin) at loading rates of 0.1 and 1µg/cm², which are similar to previously measured deposition levels reported from residential monitoring of broadcast and total release aerosol applications. Following spraying, each surface was allowed to dry then duplicate contaminated surfaces were press sampled for surface contact times of 2, 5, 10, and 60 min. The extent of residue transfer to C₁₈, PUF and cotton disks were compared and will be reported as percentages of pesticides transferred based on wipes. Future studies will include comparing the extent of residue transfer to the disks with that of pesticide transfer to food items.

10552 - Relationship Between HUD Wipe, Hand-press, and Carpet Fiber Pb Loadings

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Tests were conducted to investigate the relationships between the HUD wipe collection method and a) the total Pb loading contained in the carpet fibers of archived samples, and b) the Pb transferred during single press, hand contact events. Hand press, wipe, and carpet fiber samples were collected from 5 samples of archived, Pb-contaminated carpeting using procedures developed previously at RTI. The Pb loadings (mass/area) for each metric were determined analytically from washes and extracts using ICP-AES. A set of five successive presses conducted at the same location on one of the carpet samples showed that the fiber reservoir of Pb particles available for dermal transfer is sufficient to allow characterization after a single press, but was essentially depleted after a second hand press. This finding suggested that the collection of HUD wipe samples (over the entire 144 in² carpet area) following a single hand press could be made without a negative bias occurring due to particle depletion. The results from characterization of four additional carpet samples indicated a statistically significant linear association between the Pb loadings collected by the dermal press and the HUD wipe method, after correcting for the Pb mass removed from the multiple press sample. Comparison of the hand and wipe Pb loadings with the carpet fiber Pb loadings indicated that less than 0.2% of the Pb on the fibers was transferred to the hand after a single press, and less than 0.1% was transferred to the HUD wipe. From these limited experiments, the following conclusions were drawn.

- (1) HUD wipes collected from 144 in² areas on carpet surfaces provide a reasonable representation of the Pb available from carpet contact for a hand press, although underestimating the transfer on the average by a factor of 2.3.
- (2) Even with a very small sample set (n = 5), a strong association ($R^2 = 0.85$) was observed between the Pb collected by HUD wipes and the Pb transferred to the hand during a dry press.
- (3) While carpet fibers present an enormous potential reservoir for Pb particles, only a small portion is actually transferable to either the hand during a contact event (<0.2%) or to a HUD wipe following typical sampling procedures (<0.1%).
- (4) There was a statistically significant association between carpet fiber Pb loadings and the Pb loadings collected on either a hand or a HUD wipe.
- (5) The Pb available for dermal transfer from successive presses at the same location on medium pile carpeting is very finite, being depleted in these tests after only 2 presses.

The wealth of information provided in this focused effort demonstrates the value of the procedures and skills developed by RTI while conducting previous carpet research on Pb contamination for HUD.

10614 - Polycyclic Aromatic Hydrocarbon (PAH) levels in House Dust from Homes with Infants in Relation to Maternal Smoking Behavior

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House-dust is a major sink of pollutants in the home, and consequently may also be a major source of contaminants, especially for infants. Polycyclic Aromatic Hydrocarbons (PAHs) are toxic compounds known to arise from combustion sources such as environmental tobacco smoke (ETS) and automobile exhaust. In this study, we examined house dust samples for levels of PAHs in relation to smoking behavior. Subjects were mothers with infants 2 – 12 months who were recruited into three groups; Direct Exposure Group (DEG), where mothers smoked in the home, Indirect Exposure Group (IEG), where mothers smoked but not around the infant, and Non- Exposure Group (NEG), where mothers and other household members did not smoke. A total of 49 homes were visited 3 times over a period of a week. At each visit, vacuum sampling using the HVS3 surface sampler was performed in the living room as well as baby's sleeping room. The same 1.5 by 1.5 meter area was sampled each visit. Fine dust particles were isolated from the bulk sample with a stainless steel mesh sieve (collection size <150 microns). The samples were extracted by sonication into hexane, spiked with perdeuterated internal standards, and analyzed by GC/MS for 18 PAHs. Sample volumes permitted a total of 37/49 homes to be analyzed for PAHs in dust samples; 10 NEG, 15 IEG, and 12 DEG. The distribution and means of the indirect exposure (IEG) and non-exposure (NEG) groups were similar enough that they were pooled (geometric means 0.89 +/- 0.41 ppm and 1.04 +/- 0.16 ppm respectively for living areas). The influence of smoking on house-dust total PAH levels was found to be significantly higher for the direct exposure group (geometric mean 1.52 ppm +/- 0.49 ppm for living areas) when compared with the pooled indirect exposure and non-exposure groups (p=0.027). Levels of PAHs were found to be higher in the living areas than in the infant bedrooms (p<0.01) and levels were highly correlated (r =0.802, p < .0005). This correlation, however, was highly influenced by the direct exposure group (DEG only r=0.924, p < .0005). Two possible PAH markers of smoking were identified: phenanthrene and pyrene. These two compounds were found to be elevated in the DEG group relative to the IEG and NEG groups. This study is the first to show statistically significant elevation in PAH levels in house-dust in relation to smoking behavior

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Twenty five farm (F) households and 25 non-farm (NF) households in Iowa were enrolled in a study investigating agricultural pesticide contamination inside homes. Surface wipe samples were collected from inside the home and the primary family vehicle. In addition dust samples were collected from carpet inside the homes. Samples from 39 homes (20 F and 19 NF) were analyzed for atrazine, metolachlor, acetochlor, alachlor, and chlorpyrifos. Samples from 11 homes (5 F and 6 NF) were analyzed for glyphosate and 2,4-D. The results for glyphosate and 2,4-D are unavailable at this time. Inside the home, the wipe samples were collected from the kitchen counter, top of the washing machine, and from various rooms with hard surface floors. In the vehicle, a wipe sample was collected from the steering wheel and driver's seat. For the wipe samples, chlorpyrifos was detected most frequently in homes (F 60 %; NF 53 %), followed by acetochlor (F 20%; NF 0 %), metolachlor (F 15 %; NF 0 %), and atrazine (F 0%; 1 NF, 5 %). Alachlor had no detectable levels inside any homes. Among the samples that had detectable levels of pesticide, the maximum amount of residue found in farm homes was 24.76 ng/cm² for chlorpyrifos, 2.48 ng/cm² for acetochlor, 8.50 ng/cm² for metolachlor. In the non-farm homes the maximum amount was 3.77 ng/cm² for chlorpyrifos. Only one sample was positive for atrazine in the non-farm home with a value of 161.46 ng/cm². Similar results were found inside the vehicles. Chlorpyrifos was detected most often (F 50 %, max=8.00 ng/cm²; NF 26 % max=10.74 ng/cm²) followed by acetochlor (F 30 %, max= 38.76 ng/cm²; NF 16 %, max=6.20 ng/cm²), metolachlor (F 15 %, max=678.47 ng/cm²; NF 5 %, max=5.17 ng/cm²), atrazine (F 15 %, max=412.98 ng/cm²; NF 0 %) and alachlor (F 5 %, max=1.18 ng/cm²; NF 5 %, max=3.54 ng/cm²). In the dust samples, all the pesticides except chlorpyrifos were detected more often in the farm homes. Chlorpyrifos was detected most often (F 85 %, NF 95%) followed by metolachlor (F 85 %, NF 79 %), atrazine (F 95 %, NF 58 %), acetochlor (F 50 %, NF 37 %), and alachlor (F 15 %, NF 5%). The maximum pesticide level in dust among the detectable samples in farms and non-farms respectively was 0.72 and 3.65 ng/cm² for chlorpyrifos, 2.64 and 1.40 ng/cm² for acetochlor, 25.43 and 1.32 ng/cm² for metolachlor, 12.78 and 0.08 ng/cm² for atrazine, and 0.06 and 0.01 ng/cm² for alachlor. These measurements indicate that pesticides can be detected in most homes. Crop herbicides were detected somewhat more frequently in farm homes, while chlorpyrifos appears to be ubiquitous. Pesticides appear to accumulate to a greater extent in house dust than on hard surfaces.

10757 - Can metal concentrations in indoor dust be predicted from soil geochemistry?
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Pre-schoolers, especially older infants and toddlers, ingest household dust through normal, repetitive hand-to-mouth activities. Accordingly, knowledge of the chemical composition of common household dust is required to accurately estimate childhood exposures. Currently there is a scarcity of metal concentration data for indoor environments, and as a result, many studies rely on exterior soil geochemical data for predicting indoor exposures. However, urban dust studies in North America, Europe, and Australia commonly report higher total concentrations of certain metals (including lead, mercury, arsenic and cadmium) in indoor dust than in exterior soil, pointing to the overriding influence of indoor sources and/or accumulation processes. Overall, there are wide variations in indoor to outdoor concentration ratios from one element to another within the same residence, and from one residence to another within the same community. Thus, it is extremely difficult, if not impossible, to accurately estimate total metal concentrations in indoor dust based on exterior soil data. The complexity increases when differences in metal speciation and potential bioavailability are considered. Experimental *in vitro* extraction data show that even though garden soil and settled house dust may have identical total metal concentrations, the same *in vitro* extraction can yield completely different estimates of metal bioavailability for the two different sample types. These observations underscore the need to collect separate indoor versus exterior environmental quality data for residential exposure assessments.