

Analysis of Aged In-Home Carpeting to Determine the Distribution of Pesticide Residues between Dust, Carpet, and Pad Compartments

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Notice

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Foreword

The National Exposure Research Laboratory, Research Triangle Park, North Carolina, conducts intramural research in the chemical, physical, and biological sciences. This research is intended to characterize and quantify ambient air pollutant levels and the resulting exposures of humans and ecosystems; to develop and validate models to predict changes in air pollution levels; to determine source–receptor relationships affecting ambient air quality and pollutant exposures; and to solve problems relating to EPA's mission through long-term investigation in the areas of atmospheric methods, quality assurance, biomarkers, spatial statistics, exposure assessment, and modeling. The laboratory provides support to Program and Regional offices and state and local groups in the form of technical advice, methods research and development, quality assurance, field monitoring, instrument development, and modeling for quantitative risk assessment and regulation. The laboratory also collects, organizes, manages, and distributes data on air quality, human and ecosystem exposures and trends for the Program and Regional offices, the Office of Research and Development, the scientific community, and the public.

The information in this report was obtained by using existing methods, as well as methods that were developed for this study, to determine the nature and distribution of pesticide residues in aged carpets in the residential environment. This information is needed to further the understanding of the bioavailability of pesticide residues in the home and thereby permit better assessments of the potential for human exposures.

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Abstract

A total of eight volunteer test homes located in the area surrounding Research Triangle Park, NC, were selected for sampling of their used carpets to further our understanding of the nature and distribution of pesticide residues within the home environment. The U.S. Environmental Protection Agency is interested in the potential bioavailability of such residues, particularly with respect to the risk of exposure for infants and toddlers. The test homes were selected on the basis of the homeowners' responses to a survey regarding the past history of pesticide use in the home, the age and location of the carpets, the presence of pets in the home, the use of professional exterminators, and other such factors. Participants in the study were paid a small stipend following completion of the testing.

One sample of dust from each home was analyzed for screening purposes, and those results were used to select six homes for complete sample analysis from the eight that were tested. Each home was tested according to sampling procedures that were identical to those used in every other home in the study. In each home a first sample was collected from a 1-m² area of carpet as near as possible to the main entrance to the home from outside. A second sample was collected from a carpeted area, also 1 m², within the interior living area of the home, such as in the center of the living room or family room. Each sample collected consisted of seven separate sample fractions that were later analyzed for pesticide residues: (1) surface-dislodgeable residues, (2) vacuum-dislodgeable residues, (3) deeply embedded dust residues, (4) carpet fiber residues, (5) carpet binder residues, (6) carpet padding residues, and (7) residues contained in the dust found beneath the carpet padding on the subfloor.

The samples were analyzed by use of established laboratory procedures involving Soxhlet extraction followed by gas chromatography/mass spectrometry (GC/MS) analysis of the extracts for a target list of 39 neutral pesticides, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). In addition, samples from two of the homes were analyzed to determine acid herbicides and phenols. The results of the sampling and analysis varied widely, both in terms of the amount of dust collected by the various sampling methods employed and in the variety and concentration of the pesticide residues found. The most ubiquitous neutral pesticides found were *cis*- and *trans*-permethrin. In one case the total contribution from all seven sample fractions from a 1-m² area of carpet sampled was more than 1 gram of *trans*-permethrin. It was also not uncommon to find two to five different pesticides in each carpet test area that were in the 10–100-mg/m² concentration range. The only two acidic pesticides found in moderate concentrations were 2,4-D and pentachlorophenol.

In terms of the relative distribution of pesticide residues among the seven different types of samples analyzed, it was shown that the predominant reservoir for these residues is in the carpet fibers and binder and, to a lesser degree, in the carpet padding. Relatively little, if any, residues were found on the surface as measured with the Southwest Research Institute (SwRI) polyurethane foam (PUF) roller apparatus. The data show some differences between the two samples from different locations within the home that appear to be target compound specific, but in general the levels are higher for the sample taken near the main entrance to the home. As with other work relating to the distribution of pesticide residues in household dust as a function of particle size, the data from this study confirm the finding that pesticide concentrations increase as the particle size of the dust decreases.

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Section 1 Introduction

The U.S. Environmental Protection Agency is concerned about the exposure of humans to pesticide residues contained in carpets used in residential environments. Studies have been conducted to evaluate a variety of available methods for sampling surface-dislodgeable residues, which are those that are most readily available for transfer to human skin. These surface residues are thereby available for ingestion by infants and toddlers through mouthing activities involving their fingers, hands, feet, and toys. In a nine-home pilot study (Lewis et al., 1994) designed to evaluate monitoring methods in the field that may be used to assess the potential exposures of children aged 6 months to 5 years to pesticides found in the home environment, a variety of new and existing methods were used to measure pesticide residues in indoor air, carpet dust, and outdoor soil, and on the hands of children. The results of that study indicated that the greatest number of pesticides and highest concentrations were found in carpet dust. In the five years since those results were reported, additional laboratory and field studies have been conducted to further evaluate and refine the techniques available to perform these measurements (Camann et al., 1996; Fortune, 1997). These studies and others have resulted in the development of a variety of standard test procedures that have been adopted by the American Society for Testing and Materials (ASTM) relating to the collection and measurement of pesticide residues.

Since household carpets potentially represent the single largest reservoir of pesticide residues available for human exposure, a complete analysis of in-home used carpet was deemed essential in order to more accurately determine the transport and fate of pesticides used within and around the home. The emphasis in this study, therefore, was placed on determining the distribution of a variety of pesticide, polycyclic aromatic hydrocarbon (PAH), polychlorinated biphenyl (PCB), and herbicide residues in residential carpeting throughout the various zones of the floor coverings from the surface down to the dust below the carpet padding. In sampling the used residential carpets from eight homes located in the Research Triangle Park, NC, area, seven different sample fractions were collected in a top-to-bottom manner. The samples include the surface-dislodgeable residues, vacuum-dislodgeable residues, deeply embedded dust residues, carpet fiber residues, carpet binder residues, carpet padding residues, and, finally, the residues contained in dust found beneath the carpet padding on the subfloor.

Participants who volunteered for the study and were subsequently selected to have their homes tested were paid a small stipend for their cooperation. Homeowners completed a detailed questionnaire that was designed to obtain critical information concerning the age and history of their carpets, particularly with respect to the use of pesticides in and around the home. Sections of the carpets in two different locations within the home were

tested, one located as near as possible to the primary entrance into the home and a second located in an interior living area. Some of the sampling was conducted on-site, while other tests were performed following removal of the carpet and padding and transport to the ManTech laboratory. All samples were weighed, inventoried, packaged, and shipped to Southwest Research Institute (SwRI) in San Antonio, TX, for analysis. For each test home, a sample of the vacuum-dislodgeable dust from the interior location sample was designated for screening analysis to determine the approximate level of neutral pesticide residues present. Using this information, six of the eight homes tested were selected to have a complete sample analysis performed on all of the test samples collected from those homes. In a similar manner, a sample of the deeply embedded dust collected from the carpet section located nearest the outside entrance to the homes was designated for screening analysis to determine the approximate levels of acid herbicides and phenols present in the dust. Based on those results, two of the test homes were selected to have all of the collected sample fractions analyzed for acidic pesticide residues.

In addition to the work involving the sampling and analysis of the test samples for both neutral and acidic pesticide residues, a significant amount of methods development activity was conducted as a result of this study. Tests were conducted to confirm the hypothesis that fine-particle-size dust trapped in the fibers of paper vacuum cleaner bags constitutes a large percentage of the pesticide burden attributed to a sample fraction. In a recent study that involved analysis of a size-fractionated bulk sample of residential carpet dust, the concentrations of nearly all target analytes increased dramatically in the two smallest size fractions tested, i.e., 4–25 μm and $< 4 \mu\text{m}$ in diameter (Lewis et al., 1999). A considerable effort was also expended by the analytical laboratory, SwRI, to successfully develop improved techniques for the extraction, derivatization, and analysis of acid herbicides and phenols in house dust.

Section 2 Conclusions

1. A variety of techniques were employed to successfully recruit potential volunteers to participate in this study of in-home used carpets. Eight test candidates were selected from a pool of 30 respondents. The two most successful recruiting techniques employed were newspaper advertisements and word-of-mouth discussions with friends and colleagues.
2. Three existing sampling methods were used to collect the surface-dislodgeable residues (polyurethane foam [PUF] roller), the vacuum-dislodgeable residues (high-volume small surface sampler [HVS3] sampler), and the deeply embedded dust residues (Hoover Dirtfinder vacuum cleaner). New techniques were successfully developed for this study to permit representative sampling of carpet fibers, binder and padding, and also the subfloor dust samples.
3. Laboratory methods used in previous studies to extract and analyze neutral pesticide residues in environmental samples were successfully adapted for use in analyzing the seven different sample types collected during this study. Problems with laboratory methods for analyzing acid herbicides and phenols, however, required substantial methods development in this area. But after some delay, sample screening and analysis of selected carpet samples for the acidic compound target list was completed.
4. Screening analysis of a vacuum-dislodgeable dust sample from each home served its intended purpose well, that is, to aid in selection of the six most viable candidate test homes of the eight homes sampled. Since these samples were sieved to separate particles greater than 150 μm in diameter, both coarse and fine particle size fractions were analyzed, and the resulting data provided further evidence that pesticide residue concentrations increase markedly as the particle size of the dust decreases.
5. The six homes selected for complete sample characterization of neutral pesticides provided a wide range of carpet dust loadings and a corresponding variety in the nature and concentration of residues detected in the different sample zones that were tested. Dust loadings from samples in homes 4 and 8 were atypically high, and home 1 yielded the highest single pesticide concentration (1.05 g/m^2 of *trans*-permethrin). All six homes displayed a general trend, as expected, toward higher dust loadings in the area sampled nearest the primary entrance into the home.
6. With few exceptions, the bulk of the pesticide residues, for both neutral and acidic target analytes detected in these samples, were distributed primarily in the carpet fibers, binder, and padding.

7. Recovery and weighing of the deeply embedded dust samples from the paper vacuum bags used in the Hoover Dirtfinder vacuum cleaner revealed that a substantial portion of fine-size dust was not recovered for analysis. Extraction and analysis of selected "empty" bag samples showed that from 60% to 85% of the total sample concentration for the most abundant target analytes was represented by the residual fine dust contained in the paper fibers of the vacuum bags. These data, again, point to the significance of particle size relative to pesticide residue concentrations.

Section 3 Experimental Methods

3.1 Recruitment of Study Volunteers

A target number of eight test homes was set as a goal for meeting the study requirement of a minimum of six homes that would yield carpet residue samples containing pesticide residues of sufficient variety and concentration to provide meaningful data for inclusion in this study. Initial volunteer recruitment efforts were directed toward the placement of printed flyers in conspicuous locations within EPA facilities and in two local retail carpet sales outlets. The flyers briefly described the purpose of the study, summarized the sampling procedures to be performed (including the fact that the carpets and padding would be removed for testing), and stated the requirement for documenting in-home and outside use of pesticides. A \$100 “reward” was offered as an incentive for all volunteers selected to participate in the study. Conflict of interest arguments led to exclusion of both EPA and ManTech employees as participants.

The response to these efforts at volunteer recruitment was minimal; we therefore placed short, inexpensive advertisements to run one time in each of two local, weekly specialty newspapers. The response to these ads was immediate and substantial. Throughout the recruitment process, approximately 30 inquiries were received from interested parties. Of these, 25 individuals requested the more detailed information sheet and two-page questionnaire forms that we prepared for mailing to potential volunteers. Eighteen of those individuals completed the questionnaire and returned it for our use in screening volunteers for participation in the study. No inquiries were received as a result of the flyers that were posted in the retail carpet sales outlets. Of the eight study participants that were eventually selected, two were respondents to the flyers posted in EPA facilities, three were friends and neighbors who learned of the study by word of mouth from ManTech employees, and three were respondents to the newspaper ads. Copies of the flyer, information sheet, and questionnaire have been included in the appendix to this report.

3.2 Test Procedures

As a preliminary procedure at the test home, a rough sketch was drawn of the outside drive and walkways leading to the main entrance of the home, including porches, with the actual dimensions measured and noted on the sketch. The dimensions of the interior areas of the home that were used for sample collection were also taken and noted on the sketch of the home’s floor plan. The actual areas of the floor where the test samples were collected were also noted on the sketch and labeled with the A and B designations. To provide additional documentation on the location of the sampled areas with respect to

the layout of the home, a series of color slide film pictures were taken from both within and outside the home by using a 35-mm camera. Documentation of the actual test sample collection procedures was provided by operating an 8-mm Camcorder mounted on a tripod during most of the sampling activities that were performed in each home.

To document all of the ancillary data associated with conducting each of the carpet section sampling protocols, a three-page data sheet was prepared specifically for use with this study. (A copy is included in the appendix.) The sheets were broken down into seven separate sections, one for each of the seven sample fractions that were collected from each 1-m² sample area. Data fields were available for filling in the results of carpet moisture level checks, sample identification numbers, indoor and outdoor temperature and relative humidity readings at various times throughout the day, tare weights, final weights, and net weights of sample fractions, instrument operating conditions and settings, and notes and observations including descriptions of the general weather conditions at the time of the test.

In each test that was performed, a 1-m² section of carpet was marked off for sample collection. Seven different sample fractions were collected from each test section, and two test sections were sampled at each volunteer home. In a top-down approach, the following samples were collected: surface-dislodgeable residues, vacuum-dislodgeable residues, deeply embedded dust residues, carpet fiber residues, carpet binder residues, carpet padding residues, and subfloor dust residues. The procedures used to collect each of these seven sample fractions are described below.

3.2.1 *Surface-Dislodgeable Residues*

Homeowners were asked to refrain from normal cleaning and vacuuming activities of the carpet test areas for several weeks prior to the testing that was conducted. After the 1-m² test area was marked off, a Delmhorst Instrument Co. Model BD-2000 electronic test meter with 4-in. metal probes was used to test the carpet surface for moisture content. Nine separate readings were taken within the 1-m² test area, and if the area was dry (i.e., no moisture readings greater than 10% on the 0–100 range), the wooden template for use with the SwRI PUF roller method was then placed in position in the center of the test area. Following an established protocol, ASTM Standard Practice D 6333 (ASTM 1999a), a fresh PUF ring was placed on the PUF roller, and a sample was collected by making two passes, one forward and one reverse, over a 1-m distance on the carpet surface. Upon completion of the sampling, the PUF ring was removed from the sampler and placed back into its tin container. The lid of the container was then sealed with Teflon tape, and the sample was stored for later shipment.

Before beginning the collection of the remaining samples from the test carpet, a large area (about 1.2 by 1.8 m) was marked off around the 1-m² test section such that an

approximately 4-in. border of carpet surrounded the marked test area on three sides and an approximately 28-in. border was left on the fourth side. A small hole was cut into each of the four corners of the marked 1-m² test area, and a black marking pen was used to mark the location of the corners on the carpet padding below. The large 1.2- by 1.8-m carpet section was then cut with a carpet knife, and the entire section of carpet was removed from its location on the floor and placed on plastic sheeting in a different area of the floor that had previously been cleared to allow continuation of the sample collection. This procedure was employed so that the sequential sampling operations using motorized vacuum cleaners would not disturb the dust residues contained in the carpet padding and on the subfloor below the padding in the original sample location.

3.2.2 Vacuum-Dislodgeable Residues

The HVS3 was used to collect the vacuum-dislodgeable residues. An established protocol, ASTM Standard Practice D 5438 (ASTM 1999b) was followed in performing these tests. Prior to starting the test, the sampler components were disassembled, cleaned, and then reassembled. The sampler was then positioned in a location outside the test area on the carpet, the unit was turned on, and the flow rate and pressure-drop meters were adjusted to the proper settings for the type of carpet being tested. In all tests performed during this study, plush-style carpets were tested, and the standard settings used were 8 in. of water for the flow and 9 in. of water for the pressure drop. After adjustment of these settings, the sample container was removed from the cyclone, and a preweighed, clean Teflon sample bottle was installed on the unit. A clean manilla envelope was then used to block off the vacuum cleaner's nozzle, and a leak check of the unit was performed by starting the motor and monitoring the flow meter. A zero reading of the meter indicated a good leak test. After all preliminary adjustments and checks were completed, the sampling operation was initiated. This was performed by starting the unit and completing eight passes (four forward and four reverse) over each of nine strips (about 4 in. wide each) until the entire 1-m² test area was sampled. After completion of the sampling operation, the sample bottle was removed from the sampler and tightly capped for storage. Upon return to the laboratory, the net weight of the dust sample collected was then determined by reweighing the sample bottle. The bottle was properly labeled, and the cap was sealed with Teflon tape prior to shipping for analysis.

3.2.3 Deeply Embedded Dust Residues

Immediately following the collection of the vacuum-dislodgeable dust from the 1-m² test area, the deeply embedded dust was collected by using a Hoover Dirtfinder vacuum cleaner. This vacuum cleaner incorporates a mechanical beater bar, a specially designed paper collection bag, and an electronic sensor designed to detect the presence of dirt particles in the suction zone during operation. When dust particles are detected in the sample stream, a red indicator light comes on and remains on until no particles are

detected, at which point a green indicator light comes on. This feature gives the user some measure of the cleanliness of different areas of the carpet being vacuumed. For these tests, each 1-m² test area was vacuumed by using a cleaned unit with a new, preweighed vacuum cleaner bag attached. The 1-m width of the test area incorporated four test strips as determined by the width of the vacuum cleaner's nozzle area. A total of 128 passes were made over the carpet surface with the vacuum cleaner, making 10 passes over one strip of carpet and moving left to right and back again multiple times over each strip before moving to the adjacent strip. The status of the sensor indicator lights was noted on the sample data sheet, including whether the red light was on at the start of a pass, and if so, how long the light stayed on. At the conclusion of sample collection, the vacuum bag was carefully removed from the vacuum cleaner, folded in half, and placed in a labeled Ziploc bag for storage. Upon return to the laboratory, the sample bag was reweighed to determine the amount of deeply embedded dust collected in the sample. The sample was then shipped to the analytical laboratory in the sealed Ziploc bag.

After the carpet was sampled for deeply embedded dust, a straightedge was used to mark out the 1-m² test area on the carpet padding. The previously marked corners of the test area were used for this purpose. By using a pair of ordinary scissors, the carpet padding sample was cut out and carefully removed from the sample area. The carpet padding sample was then placed on the plastic sheeting used during the carpet vacuuming sequences, and the carpet sample itself was then placed on top of the padding in the proper orientation with respect to its original location on the floor of the home. The carpet and carpet padding samples were then rolled up inside the plastic sheeting with both ends of the roll and the seam secured with tape. The carpet roll was then marked with the sample designation and was stored in the vehicle for transport back to the laboratory for further sample processing.

3.2.4 Subfloor Dust Residues

After the carpet padding sample was cut out and rolled up with the carpet sample for storage, any dust found on the exposed 1-m² area of flooring below the padding was collected for analysis. A clean, dry, 2-in.-wide camel's hair brush was used to gently sweep the subfloor dust into one or several small piles, depending on the distribution of the dust. A preweighed, hexane-washed, 18- by 18-in. square of heavy-duty aluminum foil was placed on a clean area of the floor next to the dust sample, and a clean, 3-in.-wide metal spatula was used to transfer the dust to the foil. The camel's hair brush and the metal spatula were used as a broom and dustpan to accomplish this task. After all of the dust sample was transferred to the aluminum foil, the foil was carefully folded several times in order to seal the sample properly. The foil was then placed into a labeled glass sample jar for storage.

After both sets of test samples were collected at the volunteer participant's home, the two rolled-up carpet and padding sections were returned to the mobile laboratory located in the EPA Environmental Research Center Annex parking lot, where additional sample processing was performed to collect the remaining three sample fractions.

3.2.5 Carpet Fiber Residues

The test section of carpet and padding was unrolled and laid out flat on the laboratory floor, in a manner that maintained the proper orientation of the carpet padding to the carpet and kept both on top of the plastic sheeting used to contain the sample. With a special steel cutting tool, five 3-in.-diameter plugs were cut out of the 1-m² test area of the carpet. The cutting tool used consists of a sharpened, circular, stainless-steel, tapered cutting edge with a 3-in. diameter that is attached to a 36-in. steel pipe fitted at the top with a detachable T-bar handle. With the handle removed, the tool can be placed in a lathe for resharpener as required. The plugs were removed in a set pattern from each test sample by taking one plug from the exact center of the square test area and four plugs equidistant from the center and corners of the square along the diagonals. The five test plugs of the carpet sample were placed on an 18- by 18-in. square of hexane-washed, preweighed, heavy-duty aluminum foil on the laboratory bench. Using stainless-steel surgical scissors the carpet fibers were trimmed away from the carpet binder and were collected in a pile on the aluminum foil. After all five plugs were treated, the sample fibers were folded up inside the treated foil, and the sample was placed in a labeled glass sample jar.

3.2.6 Carpet Binder Residues

After the carpet fibers were removed from each of the 3-in.-diameter plugs of the carpet sample, the remaining carpet binder samples, five in total, were placed in a labeled glass sample jar.

3.2.7 Carpet Padding Residues

With the five 3-in.-diameter plugs of carpet having been removed from the 1-m² test area of the carpet sample, care was taken to properly orient the 1-m² carpet padding sample under the carpet in the exact position in which it was located before its removal from the test home. Using the same steel cutting tool, the holes where the carpet sample test plugs were removed were used as guides to cut 3-in.-diameter plugs from the carpet padding sample. The five test plugs of the carpet padding sample were then placed in a labeled glass sample jar.

This action completed the procedure for sample collection, and the carpet and carpet padding sample were then rolled back up inside the plastic sheeting, which was

then sealed with tape as before. The rolled-up carpet sample was then moved to a separate area for storage.

3.3 Additional Carpet Sample Collection

During the early phases of recruiting volunteers to participate in this study, discussions with Mr. David Camann of SwRI resulted in a decision to attempt to acquire additional sections of used carpets from two of the homes selected for testing. These additional carpet samples could then be used in tests involving the application of various methods for sampling the transfer of pesticide residues to human skin from direct contact with the carpet surface. By using samples of used carpet from areas adjacent to those that were sampled in this study, the researchers would have the advantage of using actual test surfaces that have been thoroughly characterized as to the pesticide concentrations present, as well as their relative distribution within the various zones of the carpet components. Consequently, two additional samples of the carpet only were collected from test homes 3 and 8 for this purpose. Each of these homeowners was paid an additional stipend of \$100 by SwRI. These additional carpet samples were rolled up separately in heavy-duty polyethylene sheeting and sealed with tape. The two separate rolls were then combined and rolled up together in additional layers of polyethylene sheeting, after which the entire package was sealed thoroughly with heavy-duty tape. These samples were shipped at the same time that the test samples from the homes were shipped, with all shipments made through FedEx priority overnight service.

3.4 Test Sample Handling and Analysis

Before conducting each sampling test, the capped and numbered 250-mL Teflon sample bottles for use with the HVS3 sampler were weighed on an analytical balance. The numbered paper vacuum sample bags used with the Hoover Dirtfinder vacuum cleaner and the hexane-washed, 18- by 18-in. squares of heavy-duty aluminum foil used to contain the carpet fibers and the subfloor dust samples were preweighed with an electronic pan balance. After all test samples were collected from both the A and B carpet samples, the net weight of each sample fraction was determined by reweighing each sample and subtracting the tare weight of the bottle, vacuum bag, or aluminum foil used to contain the sample. The carpet binder and carpet padding samples (five 3-in.-diameter plugs of each) were weighed directly on the pan balance. The PUF roller sample matrix did not require weighing.

When the sample weighing procedures were completed, the samples were secured for shipment to the analytical laboratory by replacing them in their containers and sealing the lids of the Teflon bottles, glass sample jars, and PUF roller tins by wrapping 1-in.-wide Teflon tape around the junction of the lid and the container. The paper vacuum cleaner bags were shipped inside sealed Ziploc bags. All of the samples except the vacuum

cleaner bags were then wrapped in a layer of newspaper and packed inside a cardboard box along with additional foam packing material. The vacuum bag samples were placed on the top of the other samples in the box. A sample inventory sheet was prepared for inclusion with each shipment of samples. This sheet contained the sample collection date, sample shipment date, total number of samples shipped, and the identification code, description, and net weight of each sample fraction contained in the shipment. A copy of the inventory sheet was also faxed directly to the laboratory on the day following the shipment. All sample shipments to the laboratory in San Antonio, TX, were made by FedEx priority overnight service.

3.4.1 Sample Handling

For a typical test performed in a volunteer participant's home, a total of 14 samples were collected and shipped to the analytical laboratory for extraction and analysis. These included two samples each of the PUF sample matrix, the dust collected by the HVS3 sampler, the vacuum bags containing dust collected by the Hoover Dirtfinder vacuum cleaner, carpet fibers cut away from the five 3-in.-diameter plugs cut from the carpet sample, the carpet binder and remaining thin layer of fibers on the five 3-in.-diameter carpet plugs, five 3-in.-diameter plugs cut from the carpet padding, and the dust collected from the 1-m² area on the subfloor directly under the carpet test sections. Approximately half of most carpet fractions, but no more than 2 g of dust samples, and the entire PUF sample matrix were selected and prepared for extraction. The other portions were held in reserve in case major problems were encountered with any of the initial extractions. These reserve portions were then also available for alternate analytical analysis, such as extraction and analysis for acid herbicides.

3.4.2 Sample Screening Procedures

A system was developed to provide the necessary preliminary information concerning the actual nature and amounts of pesticide residues present in the test samples collected from each home that was tested. The vacuum-dislodgeable dust sample collected from the carpet test section located in the interior living area of the home (sample B) was designated the neutral pesticide screening sample for each test. The one exception to this was the designation of sample A from test home 2 for screening, since both of the samples collected from that home were located in an upstairs living area. The entire dust sample was sieved with a #100 screen that retains particles greater than approximately 150 µm in diameter. Both the coarse and fine fractions were then split in half so that each sample fraction could be extracted and analyzed to determine both the neutral pesticides and the acid herbicides. In addition, this procedure would also generate some information regarding the distribution of the target analytes in the dust sample relative to particle size. With regards to screening the test home samples for acid herbicides and phenols, it was determined that the deeply embedded dust samples collected near the

entrance to the home, the A samples, would provide the best representation of the acidic pesticides that might be present. A 2-g representative split sample of the dust collected in the vacuum bag of these samples from each of the eight test homes was analyzed for screening purposes. A “representative split” sample is defined as the collection of equal amounts of dust from six locations after splitting open the vacuum bag: center and near wall of the top third, of the center third, and of the bottom third of the bag.

Ultimately, the results of the screening sample analyses were used to determine which of the eight test homes sampled in the study were chosen to undergo complete sample analysis for a target list of 39 neutral pesticides, PAHs, and PCBs and a target list of four acid herbicides and pentachlorophenol.

3.4.3 Sample Extraction for Neutral Pesticides

Split sample fractions of each sample were spiked with a surrogate (*p*-terphenyl-*d*₁₄) solution and then extracted with 100 or 150 mL (dust), 200 mL (fibers, binder, and padding), or 300 mL (PUF samples) of diethyl ether:*n*-hexane (6:94) in a Soxhlet extractor for approximately 16 h. The volume of the carpet fraction extracts was reduced to 10, 7.5, 5.0, or 2.5 mL. A 1-mL aliquot of the extract was passed through a Florisil column, and the final volume of each cleaned extract was adjusted to 2 mL.

3.4.4 GC/MS Analysis of Neutral Pesticides

Analysis for the target analytes (23 pesticides, 10 PAHs, and 6 PCB congeners) was performed by using a Fisons VG-MD800 GC/MS instrument in selected ion monitoring mode. A DB-5.625, 30-m by 0.25-mm-i.d. column was used for the analysis. Quantitation based on a five-point standard calibration curve and internal standards was performed. Continuing calibration was performed by using the mid-level standard. Extracts with a target analyte concentration above the calibration range were diluted and reanalyzed to bring each concentration within the range of the calibration curve.

3.4.5 Sample Extraction for Acid Herbicides and Pentachlorophenol

Because some problems have been encountered in the past with less than desirable performance of the sample extraction protocols and subsequent analytical results for analysis of environmental samples for acid herbicides, the SwRI laboratory initiated a program to investigate those problems and to seek either modification of the existing protocols or adoption of new procedures altogether. That process was just recently completed, and it resulted in the development of two new protocols that outline the procedures to be used for the extraction of acid herbicides and phenols from house dust and the subsequent derivatization of the extracts in preparation for GC/MS analysis. These

new procedures were used to analyze selected samples from this study, and the specific steps involved in the sample extraction and derivatization process are outlined here.

An appropriate amount of each sample fraction is selected and weighed to determine the sample size for extraction. All samples are spiked with 100 μL (i.e., about 4 μg) of 3,5-dichlorobenzoic acid (3,5-DCBA) as the acid herbicide surrogate. The sample container is covered and allowed to sit for approximately 30 min to allow the surrogate to incorporate into the sample matrix. The samples are then extracted in 25 mL of an acetonitrile (ACN):phosphate buffer (adjusted to a pH of 3) by sonication in an ultrasonic bath for 30 min. The mixture is then centrifuged at 1200–1300 RPM for about 2 min, and then 20 mL of the filtrate is removed. Then 10 mL of deionized water is added to the 20 mL of extract, and the pH of the mixture is adjusted to 12 using concentrated sodium hydroxide (NaOH) solution. The N-EVAP analytical evaporator is set to a temperature of 35–40 $^{\circ}\text{C}$ under dry nitrogen, and approximately 15 mL of ACN is removed from the extract. The concentrated extract is then partitioned twice with 20 mL of hexanes, allowing the layers to separate and then discarding the hexanes layers. Then 175 mL of deionized water is added to the aqueous phase, and the pH is adjusted to 1 using concentrated hydrochloric acid.

The acidic aqueous extract is cleaned up by using an octadecyl hydrocarbon-bonded silica solid-phase extraction cartridge (Baker C18 SPE; 6-mL, 500-mg loading). The extraction cartridge is preconditioned in sequence with 10 mL of methanol, 10 mL of deionized water, and then 4 mL of 1:10 ACN:phosphoric acid (0.025M). The acidified water extract is then loaded onto the extraction cartridge. The cartridge is dried for about 2 h and is then eluted with 20 mL of 1:1 diethyl ether:hexanes. The eluent is concentrated with warm water (40 $^{\circ}\text{C}$) and zero nitrogen to about 200 μL and is then adjusted to a final volume of 10 mL with ACN for derivatization.

Cleaned extracts containing acid herbicides and phenols are prepared for analysis using the silylation method of derivatization with N-methyl-N-(t-butyldimethylsilyl)-trifluoroacetamide (MTBSTFA). An aliquot of 400 μL of the acid and phenol extract is removed and placed into a 1.5-mL amber vial. Internal standard solution (2,4-dichlorophenylacetic acid) is added such that the final concentration is in the range of 0.1–0.2 $\text{ng}/\mu\text{L}$. Then 50 μL of the derivatization reagent (MTBSTFA) is added, and the meniscus of the extract is marked on the vial. The vial is then capped and sealed with Teflon tape. Using a heating block set at 60 $^{\circ}\text{C}$, the vial is gently heated for 30–40 min. After the solution cools down, the volume of extract in the vial is checked and, if less than half of the extract remains, a new aliquot is derivatized using the above procedure. GC/MS analysis of the derivatized extract is performed within 24 to 48 h of completion of the derivatization procedure.

3.4.6 GC/MS Analysis of Acid Herbicides and Pentachlorophenol

Analysis for the target analytes (four acid herbicides and pentachlorophenol) was performed using an HP 6890 GC equipped with an HP 5973 MSD operated under selected ion monitoring mode. A DB-5.625, 30-m by 0.25-mm-i.d. column was used for the analysis. Quantitation was performed using an internal standard (2,4-DCPA) that was added before derivatization. A five-point initial standard calibration curve was analyzed to establish the linearity and performance of the GC/MS system. The mid-level standard was processed at the beginning and end of the injection sequence to demonstrate instrument stability. Quantitation of the target analytes and the acid herbicide surrogate (3,5-DCBA) was based on the relative response factors obtained from the mid-level calibration standard at the beginning of the sequence.

Section 4 Results and Discussion

A total of 16 sets of samples were collected during the study, two each from eight separate volunteer test homes in the local area. These samples represent a total of 112 separate sample fractions that were shipped to SwRI for extraction and analysis. A sample of the vacuum-dislodgeable dust from each home was sieved to produce both a coarse and a fine particle size sample fraction. The fine particle size sample fraction from each test home was analyzed for neutral pesticide screening purposes. Based on those results, and to a lesser degree on the location of the test samples relative to the exterior entrance to the house, all of the samples collected from six of the eight homes were analyzed for a target list of 39 neutral pesticides, PAHs, and PCBs. Samples from homes 2 and 6 were not analyzed. In addition, a sample of the deeply embedded dust from each of the eight test homes was analyzed to screen for acid herbicides and phenols. Based on those results, all of the available samples from homes 4 and 8 were analyzed for a target list of four acid herbicides and pentachlorophenol.

The results of the neutral pesticides analysis of the HVS3 screening samples for all eight homes were tabulated, and the complete sample analysis results for homes 1, 3, 4, 5, 7, and 8 have been reduced for reporting in both tabular and graphical formats. The results of the acidic pesticides analysis of the deeply embedded dust screening samples for all eight homes were also tabulated, and the complete sample analysis results for homes 4 and 8 have been reduced for reporting in both tabular and graphical formats. These results, a summary of the environmental conditions recorded during the testing process at each of the eight homes involved in the study, and a summary of the owner-reported pesticide use history for each home are reported in the following sections.

4.1 Gravimetric Analysis of Carpet Residue Sample Fractions

In the sample collection process, all samples of the vacuum-dislodgeable residues (HVS3 sampler) and the deeply embedded dust residues (Hoover Dirtfinder vacuum) were collected in a preweighed bottle or vacuum bag so that the net sample weight could be determined. Beginning with test home 3, all remaining test sample fractions were also collected in a manner that would allow determination of the net sample weight before shipment to the analytical laboratory. (The PUF roller sample was not weighed.) The analytical laboratory also determined the weight of each sample received, and any discrepancies between the reported sample weight on the sample inventory sheet and the laboratory results were noted and investigated. Comparison of the initial weight with the analytical laboratory's results indicated that there were some slight losses in mass determined at the analytical laboratory due to retention of fine dust particles in the sample container used for the HVS3 samples and, in some instances, for the samples contained

in aluminum foil. There were more significant differences in the reported masses for the dust collected in the Hoover vacuum bags, however, and it appears that the paper bags retained some dust after the laboratory's attempts at removal were completed. For these reasons it was decided that the initial sample weights determined before shipping the sample fractions for analysis would be used to calculate the overall sample pesticide residue concentrations, and no other corrections were applied to the data.

The weights of the individual sample fractions are reported in Table 1 for the 16 samples collected and processed. As explained above, the sample A designation represents the carpet sample taken near the outside entrance to the home, and the sample B designation represents the sample collected from the interior living area. As mentioned above, some of the sample fractions for test homes 1 and 2 were not weighed before shipment to the laboratory for analysis. The laboratory-determined weights for the missing sample fractions for home 1 are reported; however, since the samples collected from home 2 were not selected for analysis in this study, the missing data for home 2 are not available.

Table 1. Gravimetric Analysis of Sample Fractions from In-Home Carpet Tests

Sample ID	Sample Fraction Weight (g)					
	HVS3 Dust	Deeply Embedded Dust	Carpet Fibers	Carpet Binder	Carpet Padding	Subfloor Dust
Home 1-A	1.89	28.4	8.7	29.2	5.3	148.5
Home 1-B	1.53	15.5	7.9	28.9	4.8	65.1
Home 2-A	1.52	11.0	na ¹	na	na	na
Home 2-B	1.44	12.5	na	na	na	na
Home 3-A	2.63	9.1	12.7	33.5	5.6	4.5
Home 3-B	2.06	0.8	11.6	38.7	5.3	1.3
Home 4-A	27.26	150.7	15.3	57.2	7.8	1.8
Home 4-B	13.49	49.3	16.6	42.6	5.3	52.6
Home 5-A	1.23	11.9	15.8	51.0	6.3	85.1
Home 5-B	0.41	7.5	15.1	45.6	5.4	8.9
Home 6-A	5.30	86.5	16.9	36.9	23.7	38.9
Home 6-B	0.95	7.6	13.2	35.3	20.5	9.0
Home 7-A	0.78	8.4	15.5	29.4	13.1	60.6
Home 7-B	0.61	14.7	14.5	31.3	11.2	4.4
Home 8-A	33.04	366.9	22.3	56.3	42.6	3.1
Home 8-B	16.95	217.2	24.2	61.4	42.8	1.2

¹Not available

4.2 Results of Neutral Pesticide Analyses for HVS3 Screening Samples

Gravimetric analysis data for the HVS3 screening samples for all eight test homes are presented in Table 2. ManTech determined the sample weight by weighing the sample container before and after sample collection, and SwRI determined the sample weight by difference also, but in reverse order, that is, by first weighing the sample as received in its container and then transferring the dust sample from the container and reweighing the empty bottle. The gravimetric data comparing the coarse and fine sample fractions after sieving the samples at a cut point of 150 μm show that the samples ranged in composition of the fine dust fraction from a low of 40% to a high of 93% of the total sample.

Table 2. Mass Data for HVS3 Screening Samples Before and After Sieving

Sample ID	ManTech Sample Wt. (g)	SwRI Gravimetric Measurements (g)				Fine Particles Percent of Total
		Total Sample Wt.	Correction Factor ¹	Fine Fraction ²	Coarse Fraction	
001-PB02	1.526	1.222	0.304	1.304	0.222	85.5%
002-PA02	1.522	1.419	0.103	0.687	0.835	45.1%
003-PB02	2.062	1.953	0.109	1.828	0.233	88.7%
004-PB02	13.492	13.730	-0.238	12.569	0.923	93.2%
005-PB02	0.407	0.302	0.105	0.245	0.162	60.2%
006-PB02	0.949	0.825	0.124	0.682	0.267	71.9%
007-PB02	0.614	0.470	0.144	0.244	0.370	39.7%
008-PB02	16.950	16.873	0.077	10.516	6.031	62.0%

¹Difference between ManTech-determined sample weight and SwRI-determined sample weight

²Amounts corrected for losses of fine particles on transfer from sample containers

The results of the screening analysis of the HVS3 fine-fraction dust samples from the interior living area carpet sections in the eight test homes are presented in Table 3. For screening purposes, only the fine fraction of the sieved dust sample was analyzed. All results have been reduced to yield sample concentrations in terms of mass per unit area, that is, micrograms per square meter.

Table 3. Vacuum-Dislodgeable Dust Screening Sample Analysis Results

	Carpet Sample Concentrations (µg/m ²)							
Test Home ID:	1	2	3	4	5	6	7	8
Sample ID:	1-PB02	2-PA02	3-PB02	4-PB02	5-PB02	6-PB02	7-PB02	8-PB02
Sample Wt. (g):	1.526	1.522	2.062	13.492	0.407	0.949	0.614	16.950
Alachlor								
Aldrin	1.532							1.536
Atrazine								
Bendiocarb				0.648				
Carbaryl	0.147	0.139	0.658	0.877			3.665	2.947
alpha-Chlordane	0.130	0.027	1.322	0.121	0.173	0.110	0.313	9.808
gamma-Chlordane	0.267	0.084	3.353	0.270	0.429	0.231	0.472	28.781
Chlorpyrifos	12.696	1.749	1.163	49.273	0.466		1.186	11.187
Dacthal								1.585
4,4'-DDE				0.216				
4,4'-DDT				0.917		0.395		7.243
Diazinon			0.058	19.267	0.087			49.797
Dichlorvos								5.203
Dicofol	0.772							2.237
Dieldrin	2.249							
Heptachlor	0.096	0.117	4.485	0.445	0.494			60.857
Lindane								0.862
Malathion				0.890				
Methoxychlor	0.288		0.746	0.944				
cis-Permethrin	398.286	4.006	134.030	58.016	0.766	16.418	19.598	
trans-Permethrin	587.510	6.613	184.755	81.222	0.328	22.017	27.551	2.941
o-Phenylphenol	1.378	0.187	0.493	0.715	0.039	0.054	0.478	14.182
Propoxur	2.533	0.314	0.056		0.113			1.401
Benzo[a]anthracene	0.157	0.884	0.590	1.444	0.100		3.507	6.040
Benzo[b]fluoranthene	0.412	2.695	1.163	2.267	0.213		7.097	17.155
Benzo[k]fluoranthene	0.211	1.172	0.796	1.916	0.048		1.798	5.933
Benzo[ghi]perylene	0.151	1.111	0.584	1.525	0.118		4.315	12.426
Benzo[a]pyrene	0.443	2.907	0.819	2.806	0.103		3.929	8.116
Chrysene	0.311	1.839	1.173	2.321	0.177		5.086	19.809
Coronene	0.204	0.910	0.546	1.498	0.177		5.522	5.375
Dibenz[a,h]anthracene	0.200	0.253	0.095	0.742	0.031		0.924	1.791
Dibenzo[a,e]pyrene	0.031	0.180	0.107	0.297	0.045		1.439	4.534
Indeno[1,2,3-cd]pyrene	0.131	0.976	0.530	1.376	0.122		4.187	11.906
PCB 105: 2,3,3',4,4'								0.394
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								1.759
PCB 153: 2,2',4,4',5,5'								1.117
PCB 170: 2,2',3,3',4,4',5								0.353
PCB 180: 2,2',3,4,4',5,5'								

4.3 Analysis Results for Neutral Pesticides, PAHs, and PCBs in Residential Carpets

Complete sample analysis results for each test home selected for full sample analysis from the eight volunteer homes that were sampled are presented in the following sections. The results of the laboratory analyses were reported in terms of micrograms of target analyte detected per gram of sample extracted. By using the known total weight of each sample fraction submitted for analysis, the sample concentration relative to the total 1-m² area of carpet sampled was calculated. For the surface-dislodgeable residue sample fraction, the laboratory reported the results in terms of total micrograms per sample, since the entire PUF sample matrix was extracted in every case. Conversion factors for each sample fraction were applied accordingly and were based on the relationship of the area covered during the collection of each sample fraction relative to the total area of the carpet sample tested.

After a decision was made to perform the complete analysis of all sample fractions from a given set of test samples collected from a particular home, the coarse sample fraction from the split of the sieved HVS3 dust sample, whose fine fraction was analyzed earlier for screening purposes, was analyzed along with the rest of the samples from that test batch. A table showing the coarse and fine sample analysis results for this sample is presented for each selected test home.

Tables of data are presented that show the reduced sample concentrations in terms of micrograms per square meter for all seven sample fractions for both A and B sample sections for each home. A graphical representation of this data is also presented to compare the two different sample areas tested in terms of the total sample concentrations for each target analyte. The total sample concentration in this case is defined as the sum of the individual contributions of each of the seven sample fractions for a given test carpet area.

Tables of data are also presented that show the relative distribution of pesticide residues from each carpet area tested in terms of the percent contribution of each sample fraction to the total sample concentration. These data are also presented graphically.

4.3.1 Results of Carpet Sample Fraction Analysis for Test Home 1

The following tables and figures present the reduced analytical data for tests that were conducted at a ranch-style home located in Durham, NC. The sampling was performed on November 4, 1997. Sample A was collected from an area just inside the rear main entrance to the home, and sample B was collected from an area in the center of the living room. A floor plan of the home with the sample locations shown schematically is presented in Figure 1.

The vacuum-dislodgeable dust screening sample that was collected from the area located in the center of the living room (sample B) was sieved to separate coarse particles from fine particles at a cut point of 150 μm in geometric diameter. Both the coarse and fine sample fractions were analyzed and the results are presented in Table 4.

The analytical results in terms of target analyte concentration per unit area for neutral pesticides, PAHs, and PCBs for all seven sample fractions collected from each of the two carpet sections in test home 1 are presented in Tables 5 and 6. The total sample concentration results for each target analyte for both sample A and sample B are presented graphically in Figure 2. The sample results are also presented in terms of the percentage contribution of each individual sample fraction to the total sample concentration for each target analyte. Those results are shown in Tables 7 and 8, and the same data are presented graphically in Figures 3 and 4.

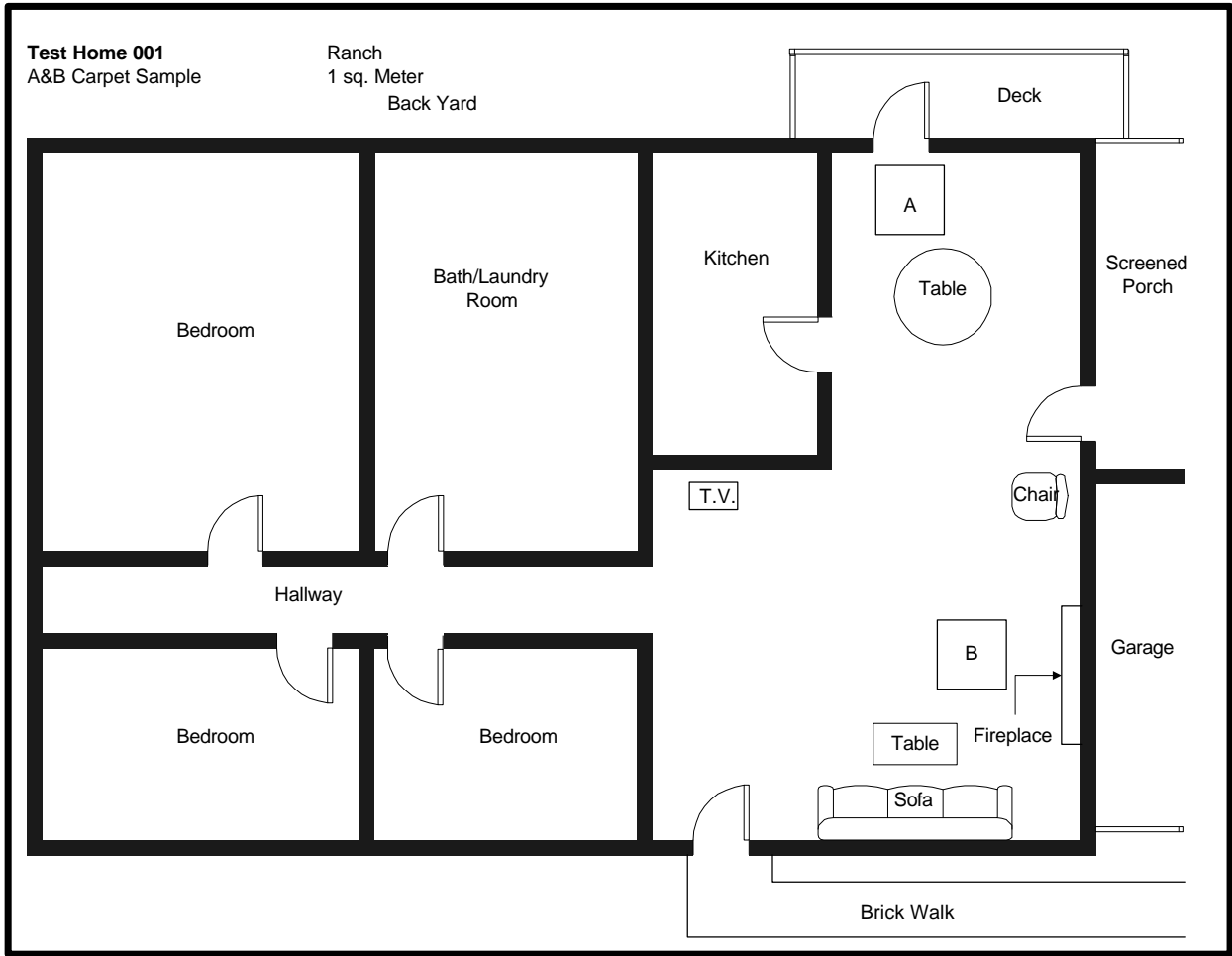


Figure 1. Representation of floor plan for test home 1.

Table 5. In-Home Carpet Test Results—Sample Residue Concentrations for Home 1, Sample A

Test Home: Ranch style, located in Durham, NC

Date of Test: 11/04/97

Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	001-PA01	001-PA02	001-PA03	001-PA04	001-PA05	001-PA06	001-PA07	
Sample Wt. (g):	na	1.89	28.4	8.7	29.2	5.3	148.5	
Alachlor								
Aldrin		0.74	9.2	68.2	2578.7	2052.5	183.8	4893.1
Atrazine								
Bendiocarb		0.87	13.0	492.4	434.5	208.6	10.4	1159.8
Carbaryl		1.82	40.3	7557.3	1345.8	111.5	7.9	9064.5
alpha-Chlordane		0.09			28.4	36.2		64.7
gamma-Chlordane		0.18		15.4	55.5	109.8		181.0
Chlorpyrifos	2.57	37.69	333.6	11493.8	72366.8	53381.5	2038.6	139654.6
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol		0.99	7.4	103.0	268.8	127.7		507.7
Dieldrin		1.70	10.3	166.0	752.9	576.2	22.6	1529.8
Heptachlor					152.3	188.1		340.3
Lindane								
Malathion								
Methoxychlor		0.15		56.2	31.9	11.2		99.5
cis-Permethrin	14.18	206.97	2141.2	525829.9	44176.1	3067.3	309.0	575744.7
trans-Permethrin	22.08	319.54	3675.8	974508.4	63293.0	4006.7	161.0	1045986.4
o-Phenylphenol		1.57	25.9	7150.3	5536.4	7964.3	50.1	20728.5
Propoxur		1.91	28.9	4715.4	3337.4	4066.3	71.4	12221.3
Benz[a]anthracene		0.19		22.5	8.1			30.8
Benzo[b]fluoranthene		0.39						0.4
Benzo[k]fluoranthene		0.25						0.3
Benzo[ghi]perylene		0.33				63.6		63.9
Benzo[a]pyrene		0.96	2.3		22.5	0.0	7.4	33.2
Chrysene		0.34	1.4	12.5	13.4	9.6		37.3
Coronene		0.09				0.0		0.1
Dibenz[a,h]anthracene						18.2		18.2
Dibenzo[a,e]pyrene								
Indeno[1,2,3-cd]pyrene		0.26			260.9			261.2
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Table 6. In-Home Carpet Test Results—Sample Residue Concentrations for Home 1, Sample B

Test Home: Ranch style, located in Durham, NC

Date of Test: 11/04/97

Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	001-PB01	001-PB02	001-PB03	001-PB04	001-PB05	001-PB06	001-PB07	
Sample Wt. (g):	na	1.53	15.5	7.9	28.9	4.8	65.1	
Alachlor								
Aldrin		1.45	6.1	43.6	2620.8	2288.4	57.1	5017.5
Atrazine								
Bendiocarb				141.2	109.2	88.1		338.5
Carbaryl		0.16		95.3	81.6			177.0
alpha-Chlordane		0.11			32.1	38.7		70.9
gamma-Chlordane		0.26		9.7	59.6	99.3		168.8
Chlorpyrifos	4.87	12.50	62.4	538.6	18998.4	16551.3	388.8	36556.8
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol		0.83	2.9	191.9	197.2	17.4		410.3
Dieldrin		1.92	5.6	77.9	670.4	1204.3	16.4	1976.5
Heptachlor		0.08			134.6	160.0		294.7
Lindane								
Malathion								
Methoxychlor		0.27		12.9	16.8	8.1		38.1
cis-Permethrin	6.42	372.84	515.6	14112.9	8994.0	219.8	38.9	24260.5
trans-Permethrin	3.48	555.13	829.2	25208.4	7815.1	320.0	62.6	34793.9
o-Phenylphenol		1.39	4.6	1682.3	3390.2	2114.7	15.8	7209.1
Propoxur		2.50	7.8	999.0	2949.2	4012.8	43.7	8015.1
Benzo[a]anthracene		0.13	1.1			9.1		10.4
Benzo[b]fluoranthene		0.35	0.9					1.3
Benzo[k]fluoranthene		0.18	1.0					1.1
Benzo[ghi]perylene		0.13	0.9			78.4	2.9	82.3
Benzo[a]pyrene		0.41	1.5		16.7	10.4	5.9	35.0
Chrysene		0.27	1.3	8.1	8.8			18.4
Coronene		0.17						0.2
Dibenz[a,h]anthracene		0.17				33.8		33.9
Dibenzo[a,e]pyrene		0.03						0.0
Indeno[1,2,3-cd]pyrene		0.11	0.7					0.9
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Home #1

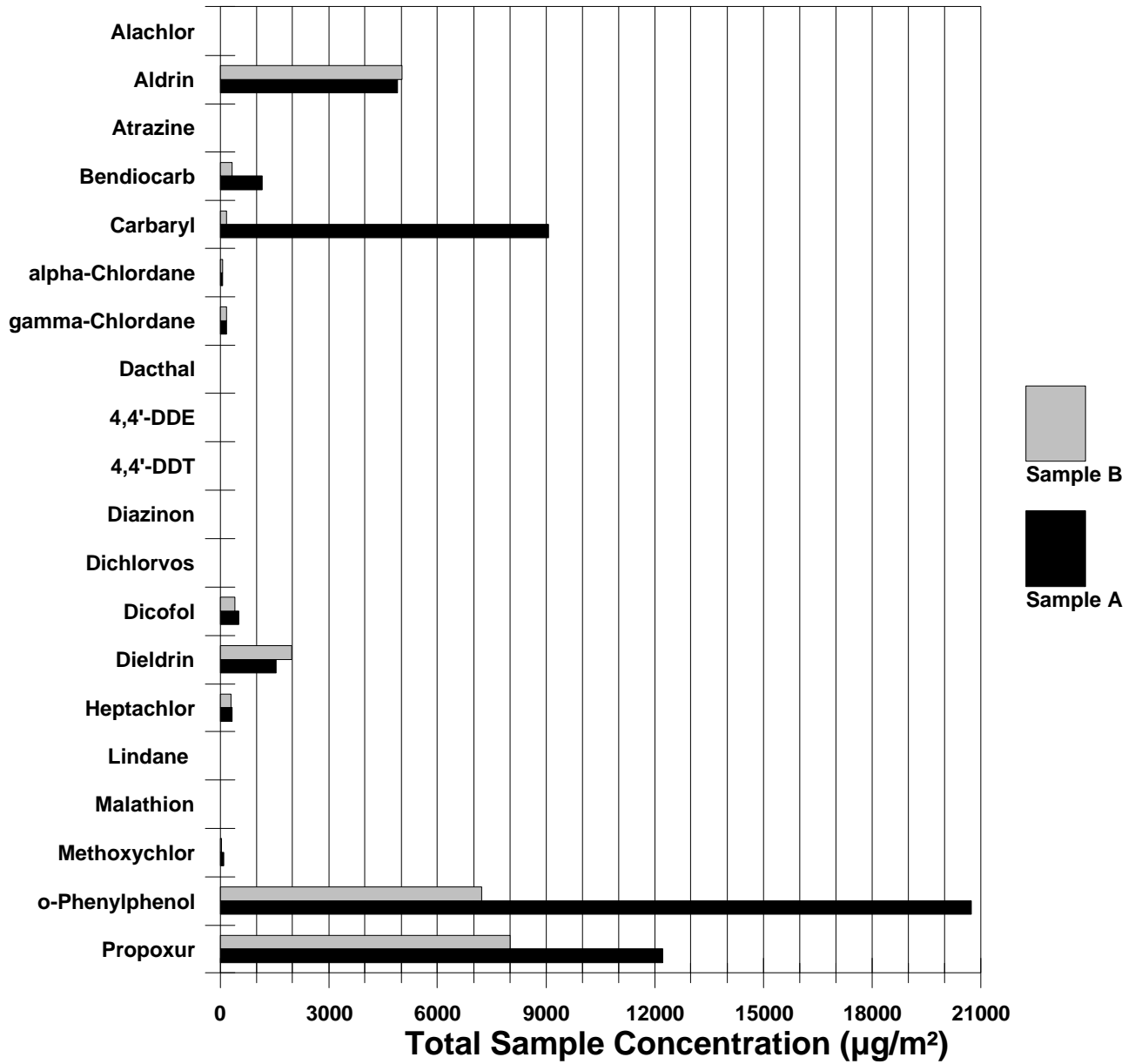


Figure 2. Total residue concentrations for samples A and B for test home 1.

(continued)

Home #1 (Cont.)

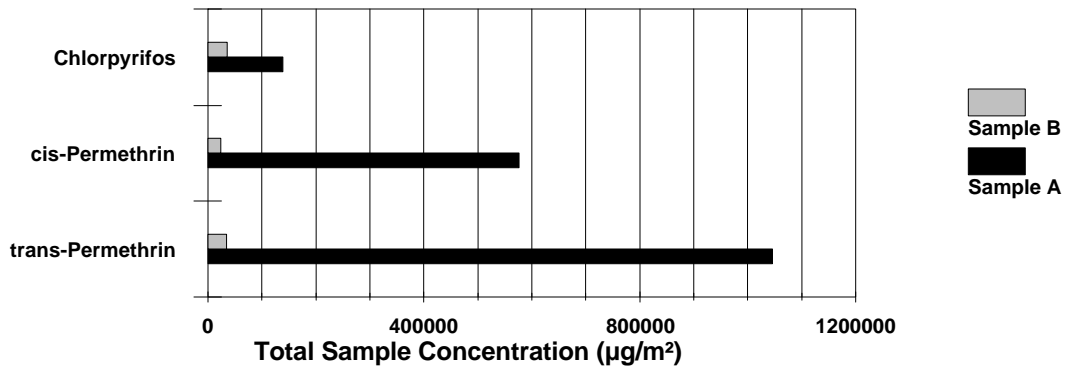


Figure 2 (continued). Total residue concentrations for samples A and B for test home 1.

(continued)

Home #1 (Cont.)

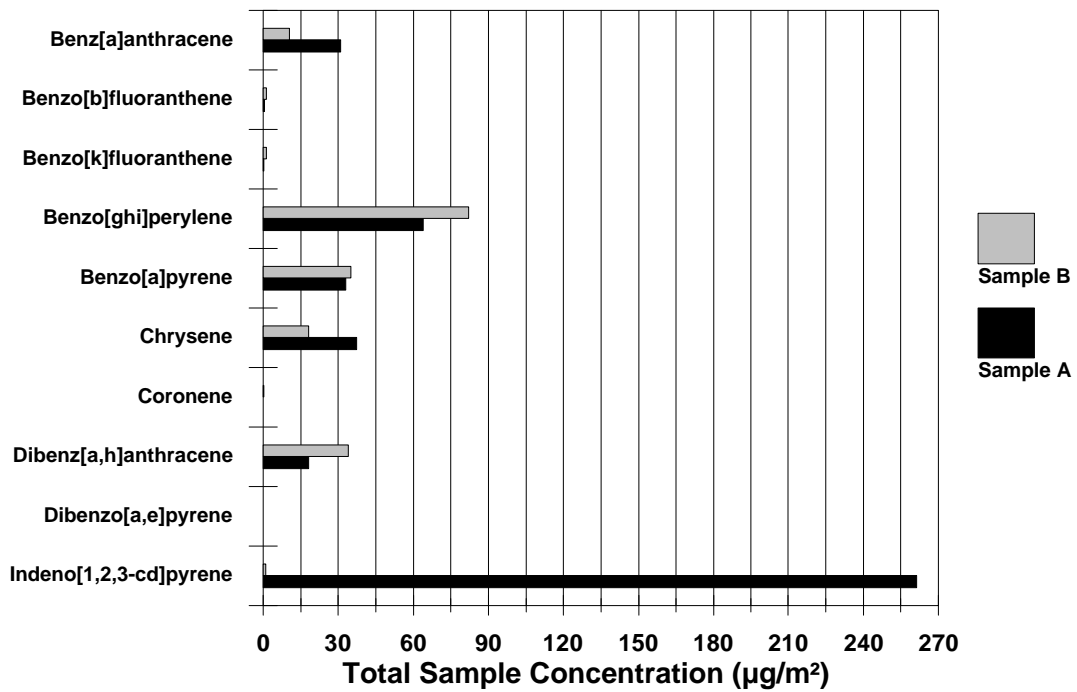


Figure 2 (continued). Total residue concentrations for samples A and B for test home 1.

Table 7. In-Home Carpet Test Results—Residue Distribution Percentage for Home 1, Sample A

Test Home: Ranch style, located in Durham, NC

Date of Test: 11/04/97

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	001-PA01	001-PA02	001-PA03	001-PA04	001-PA05	001-PA06	001-PA07	
Sample Wt. (g):	na	1.89	28.4	8.7	29.2	5.3	148.5	
Alachlor								
Aldrin		0.02	0.19	1.39	52.70	41.95	3.76	100.0
Atrazine								
Bendiocarb		0.08	1.12	42.46	37.47	17.98	0.90	100.0
Carbaryl		0.02	0.44	83.37	14.85	1.23	0.09	100.0
alpha-Chlordane		0.14			43.90	55.96		100.0
gamma-Chlordane		0.10		8.53	30.68	60.69		100.0
Chlorpyrifos								
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol		0.19	1.45	20.28	52.93	25.14		100.0
Dieldrin		0.11	0.68	10.85	49.22	37.66	1.48	100.0
Heptachlor								
Lindane								
Malathion								
Methoxychlor		0.15		56.49	32.08	11.28		100.0
cis-Permethrin								
trans-Permethrin								
o-Phenylphenol		0.01	0.12	34.49	26.71	38.42	0.24	100.0
Propoxur		0.02	0.24	38.58	27.31	33.27	0.58	100.0
Benz[a]anthracene		0.62		73.18	26.20			100.0
Benzo[b]fluoranthene		100.00						100.0
Benzo[k]fluoranthene		100.00						100.0
Benzo[ghi]perylene		0.52				99.48		100.0
Benzo[a]pyrene		2.90	6.78		67.94		22.38	100.0
Chrysene		0.92	3.82	33.64	35.99	25.64		100.0
Coronene		100.00						100.0
Dibenz[a,h]anthracene						100.00		100.0
Dibenzo[a,e]pyrene								
Indeno[1,2,3-cd]pyrene		0.10			99.90			100.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Table 8. In-Home Carpet Test Results—Residue Distribution Percentage for Home 1, Sample B

Test Home: Ranch style, located in Durham, NC

Date of Test: 11/04/97

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	001-PB01	001-PB02	001-PB03	001-PB04	001-PB05	001-PB06	001-PB07	
Sample Wt. (g):	na	1.53	15.5	7.9	28.9	4.8	65.1	
Alachlor								
Aldrin		0.03	0.12	0.87	52.23	45.61	1.14	100.0
Atrazine								
Bendiocarb				41.72	32.26	26.02		100.0
Carbaryl		0.09		53.82	46.09			100.0
alpha-Chlordane		0.16			45.28	54.56		100.0
gamma-Chlordane		0.15		5.77	35.27	58.81		100.0
Chlorpyrifos	0.01	0.03	0.17	1.47	51.97	45.28	1.06	100.0
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol		0.20	0.72	46.78	48.06	4.24		100.0
Dieldrin		0.10	0.29	3.94	33.92	60.93	0.83	100.0
Heptachlor		0.03			45.69	54.29		100.0
Lindane								
Malathion								
Methoxychlor		0.72		33.86	44.23	21.19		100.0
cis-Permethrin	0.03	1.54	2.13	58.17	37.07	0.91	0.16	100.0
trans-Permethrin	0.01	1.60	2.38	72.45	22.46	0.92	0.18	100.0
o-Phenylphenol		0.02	0.06	23.34	47.03	29.33	0.22	100.0
Propoxur		0.03	0.10	12.46	36.80	50.07	0.55	100.0
Benz[a]anthracene		1.29	11.01			87.70		100.0
Benzo[b]fluoranthene		27.86	72.14					100.0
Benzo[k]fluoranthene		15.70	84.30					100.0
Benzo[ghi]perylene		0.16	1.09			95.24	3.51	100.0
Benzo[a]pyrene		1.17	4.41		47.66	29.85	16.92	100.0
Chrysene		1.45	6.83	43.95	47.77			100.0
Coronene		100.00						100.0
Dibenz[a,h]anthracene		0.50				99.50		100.0
Dibenzo[a,e]pyrene		100.00						100.0
Indeno[1,2,3-cd]pyrene		13.04	86.96					100.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Home #1, Sample A

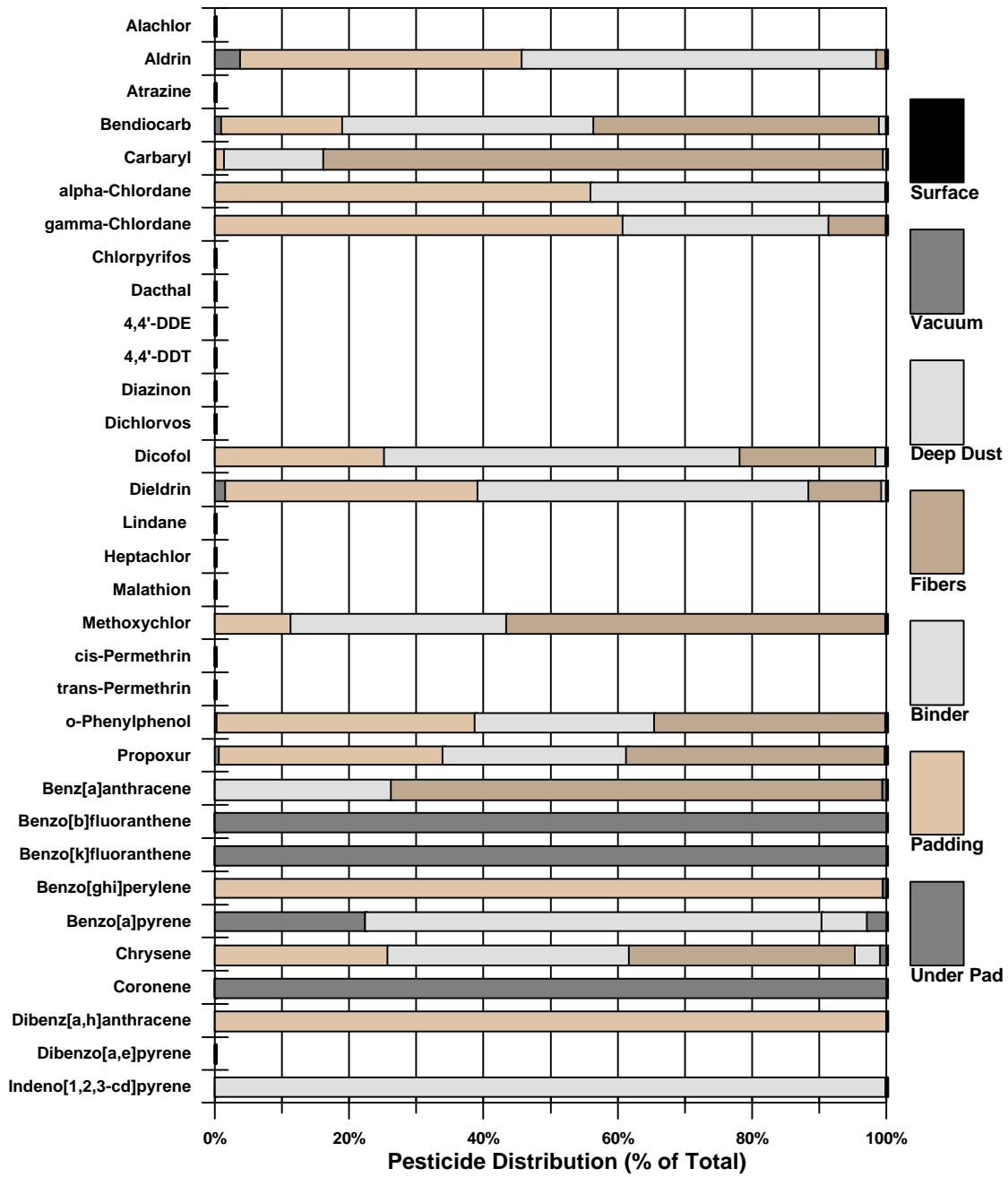


Figure 3. Pesticide residue distribution in carpet sample fractions—home 1, sample A.

Home #1, Sample B

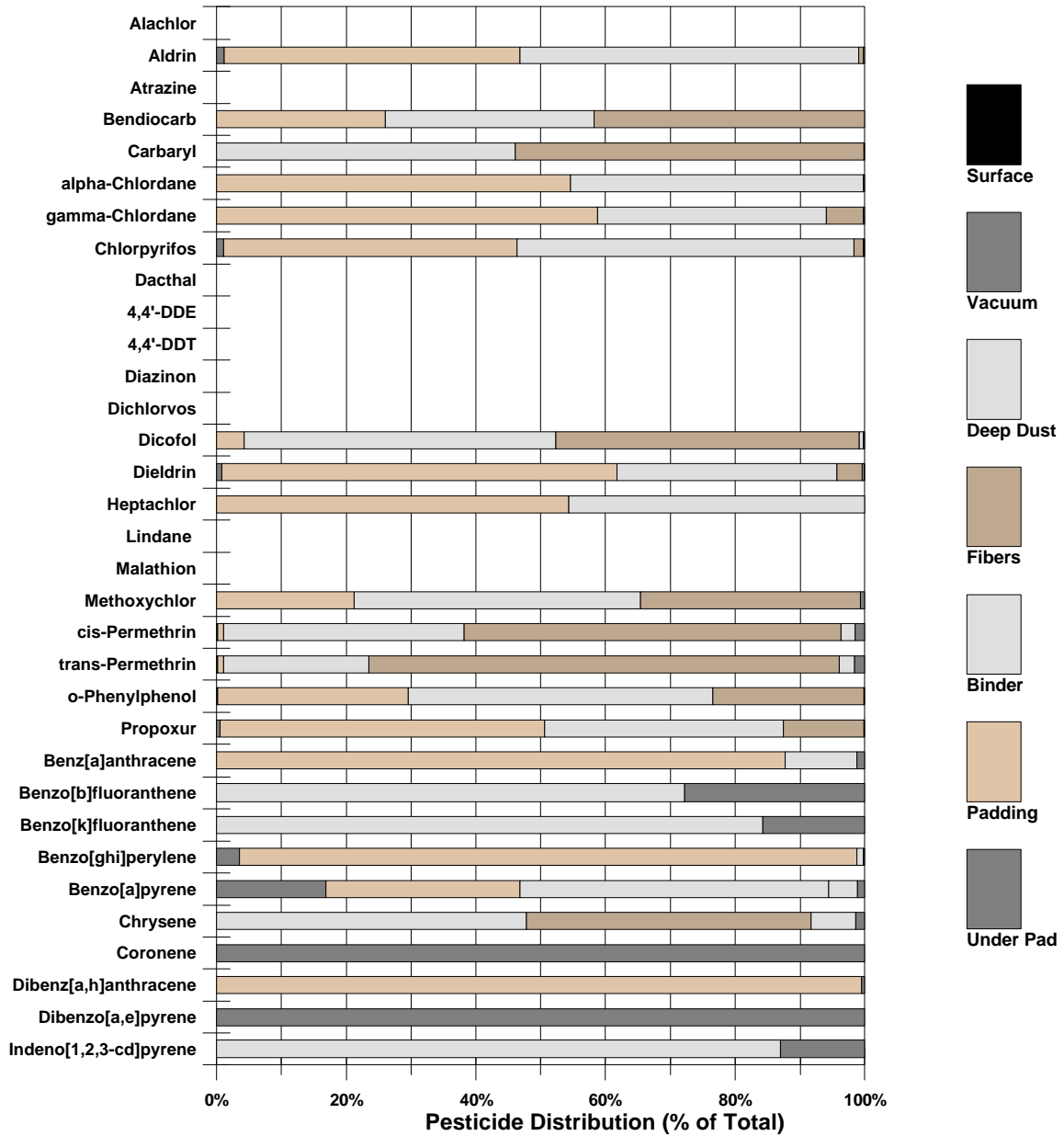


Figure 4. Pesticide residue distribution in carpet sample fractions—home 1, sample B.

4.3.2 Results of Carpet Sample Fraction Analysis for Test Home 2

Tests were conducted at a split-level-style home located in Chapel Hill, NC, on December 31, 1997. Except for the stairs and upstairs level of the home, the flooring was hardwood and vinyl with area rugs in the downstairs living areas. Sample A was collected from an area near the top of the carpeted stairs, and the sample B was collected from an open area in the master bedroom. A floor plan of the home with the sample locations shown schematically is presented in Figure 5.

The vacuum-dislodgeable dust screening sample that was collected from the area located near the top of the stairway (sample A) was sieved to separate coarse particles from fine particles at a cut point of 150 μm in geometric diameter. The fine sample fraction was analyzed, and those results were presented earlier in Table 3.

Due to limited resources, a maximum of six homes were to be selected for complete sample fraction analysis from the pool of eight homes that were tested. After reviewing the screening sample analysis results, as well as taking into consideration the upstairs location of these samples, the decision was made to exclude home 2 (along with home 6) from the pool of six homes selected for complete analysis of test samples collected.

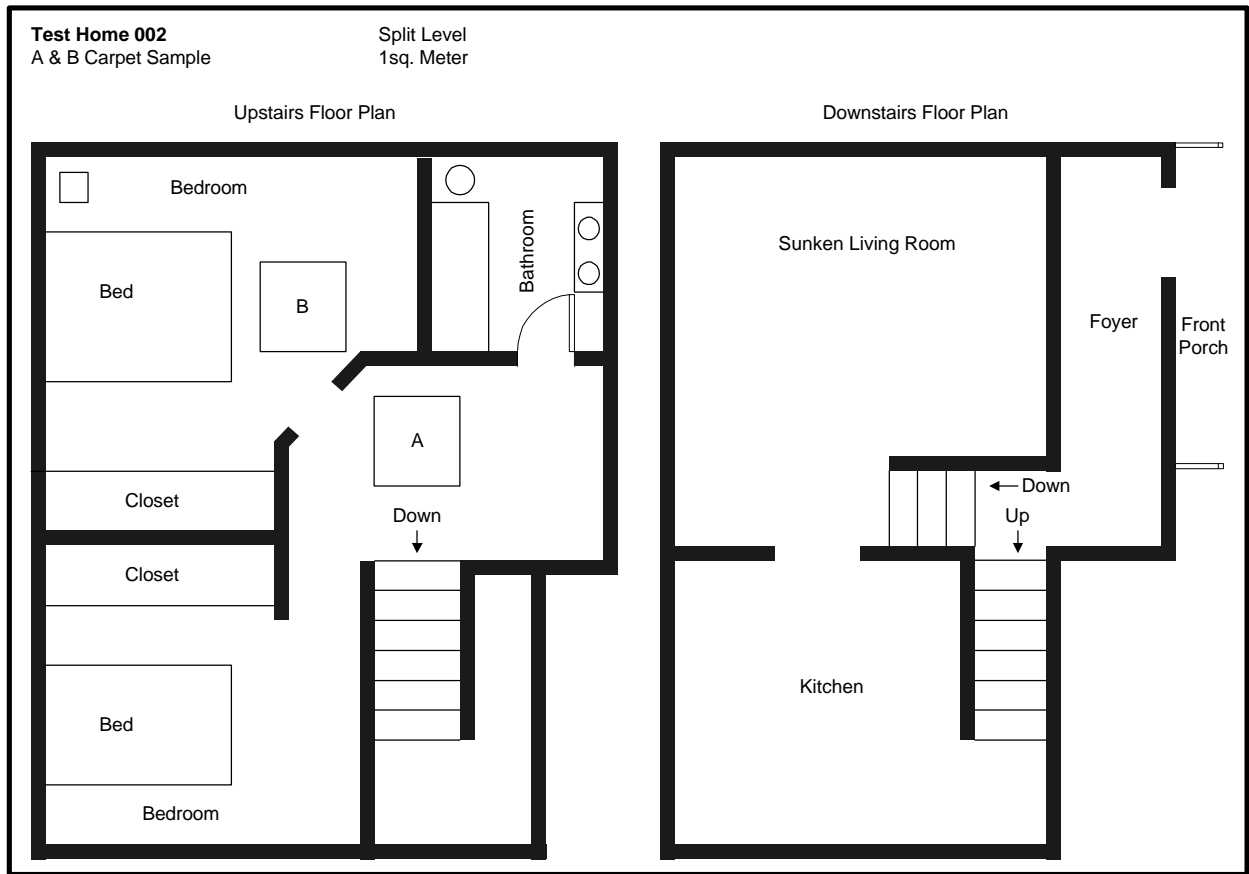


Figure 5. Representation of floor plan for test home 2.

4.3.3 Results of Carpet Sample Fraction Analysis for Test Home 3

The following tables and figures present the reduced analytical data for tests that were conducted at a split-level-style home located in Cary, NC. The sampling was performed on February 9, 1998. Sample A was collected from an area just inside the front main entrance to the home, and sample B was collected from an area in the center of the family room located on the same level as the main entrance. A floor plan of the home with the sample locations shown schematically is presented in Figure 6. This home was one of the two homes tested from which additional carpet samples were collected for use in other studies that are currently ongoing. The two additional samples are indicated in the floor plan representation by the crosshatched rectangles labeled A' and B'.

The vacuum-dislodgeable dust screening sample collected from the area located in the center of the living room (sample B) was sieved to separate coarse particles from fine particles at a cut point of 150 μm in geometric diameter. Both the coarse and fine sample fractions were analyzed, and those results are presented in Table 9.

The target analyte concentration per unit area results for neutral pesticides, PAHs, and PCBs for all seven sample fractions collected from each of the two carpet sections in test home 3 are presented in Tables 10 and 11. The total sample concentration results for each target analyte for both sample A and sample B are presented graphically in Figure 7. The sample results are also presented in terms of the percentage contribution of each individual sample fraction to the total sample concentration for each target analyte. Those results are shown in Tables 12 and 13, and the same data are presented graphically in Figures 8 and 9.

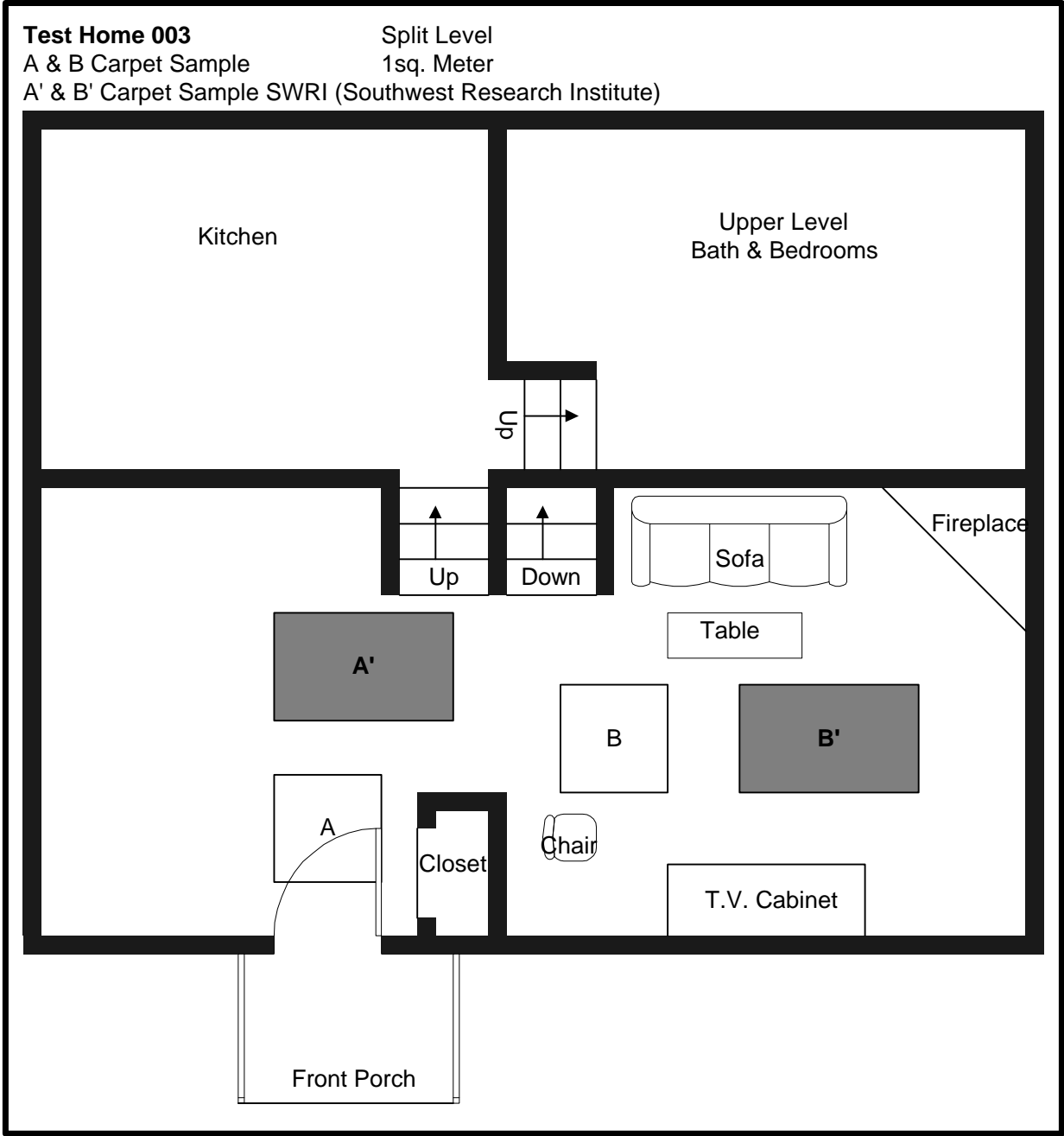


Figure 6. Representation of floor plan for test home 3.

Table 10. In-Home Carpet Test Results—Sample Residue Concentrations for Home 3, Sample A

Test Home: Split-level style, located in Cary, NC

Date of Test: 02/04/98

Carpet Sample Fraction Analysis Results (µg/m²)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	003-PA01	003-PA02	003-PA03	003-PA04	003-PA05	003-PA06	003-PA07	
Sample Wt. (g):	na	2.63	9.1	12.7	33.5	5.6	4.5	
Alachlor						36.5		36.5
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl		1.29	3.0	982.0	46.8	1171.1	0.42	2204.6
alpha-Chlordane		0.45	0.3	58.2	270.2	227.5	0.14	556.9
gamma-Chlordane		0.89	0.7	179.0	670.0	824.0	0.42	1675.1
Chlorpyrifos		0.77	1.2	82.5	1178.9	474.3	0.23	1738.0
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon					68.9	76.0		144.9
Dichlorvos								
Dicofol								
Dieldrin			1.0					1.0
Heptachlor		1.88	1.4	241.6	5308.2	5385.3	3.18	10941.6
Lindane								
Malathion								
Methoxychlor		0.19	0.2	27.5		158.1	0.26	186.2
cis-Permethrin		14.89	6.2	988.4	258.9			1268.4
trans-Permethrin		22.63	10.6	1482.5	121.9			1637.6
o-Phenylphenol		0.24	0.7	1491.2	726.1	421.6	0.10	2640.0
Propoxur				79.1	36.3	96.7	0.05	212.2
Benz[a]anthracene		1.61	2.5	53.2	124.7	85.5	0.99	268.5
Benzo[b]fluoranthene		2.43	4.0	103.2	151.1	108.8	2.26	371.8
Benzo[k]fluoranthene		1.80	1.7	29.5	71.1	36.9	0.55	141.6
Benzo[ghi]perylene		1.77	1.9	25.7	46.5	31.8	0.98	108.7
Benzo[a]pyrene		1.85	2.1	25.0	51.9	40.6	0.46	121.9
Chrysene		2.94	3.7	182.1	185.2	128.0	1.43	503.3
Coronene		3.33	2.8	28.3	53.0	25.8	1.07	114.3
Dibenz[a,h]anthracene		0.54	0.7	4.6	8.4	9.5	0.27	24.0
Dibenzo[a,e]pyrene		1.18	1.1	10.6	12.5	8.1	0.29	33.7
Indeno[1,2,3-cd]pyrene		1.96	2.0	34.7	53.0	35.0	1.01	127.8
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Table 11. In-Home Carpet Test Results—Sample Residue Concentrations for Home 3, Sample B

Test Home: Split-level style, located in Cary, NC

Date of Test: 02/04/98

Carpet Sample Fraction Analysis Results (µg/m²)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	003-PB01	003-PB02	003-PB03	003-PB04	003-PB05	003-PB06	003-PB07	
Sample Wt. (g):	na	2.06	0.8	11.6	38.7	5.3	1.3	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl		0.80	0.3	328.6	55.0	58.2	0.1	443.0
alpha-Chlordane		1.22		90.1	478.7	276.9	0.3	847.2
gamma-Chlordane		3.10		249.4	1182.6	1035.5	1.0	2471.5
Chlorpyrifos		1.22		91.3	1796.2	1199.0	0.5	3088.3
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon		0.05			59.9	65.3	0.1	125.3
Dichlorvos								
Dicofol								
Dieldrin	0.33							0.3
Heptachlor		4.13		262.7	4023.2	5720.1	6.0	10016.1
Lindane								
Malathion								
Methoxychlor		1.35		58.9	80.6	21.2	0.1	162.1
cis-Permethrin	2.10	141.49	4.2	10610.6	862.1			11620.5
trans-Permethrin	3.47	187.95	7.2	16604.4	563.2			17366.2
o-Phenylphenol		0.51		747.6	597.4	457.7	0.4	1803.6
Propoxur		0.05		39.8	71.6	97.3	0.1	208.7
Benz[a]anthracene		0.56		35.4	47.2	10.9	0.1	94.2
Benzo[b]fluoranthene		1.35		71.7	56.8	24.5	0.1	154.4
Benzo[k]fluoranthene		0.79		15.9	16.3	16.2	0.1	49.3
Benzo[ghi]perylene		0.56		21.8	47.3	4.0	0.1	73.8
Benzo[a]pyrene		0.76		20.3	25.2	5.2	0.1	51.5
Chrysene		1.12		79.0	69.7	13.2	0.1	163.2
Coronene		0.56		30.1	30.6	5.4	0.1	66.8
Dibenz[a,h]anthracene		0.10		3.6	5.0	6.8		15.5
Dibenzo[a,e]pyrene		0.12		6.3	6.8	1.2		14.5
Indeno[1,2,3-cd]pyrene		0.56		23.2	15.5	3.6	0.1	43.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Home #3

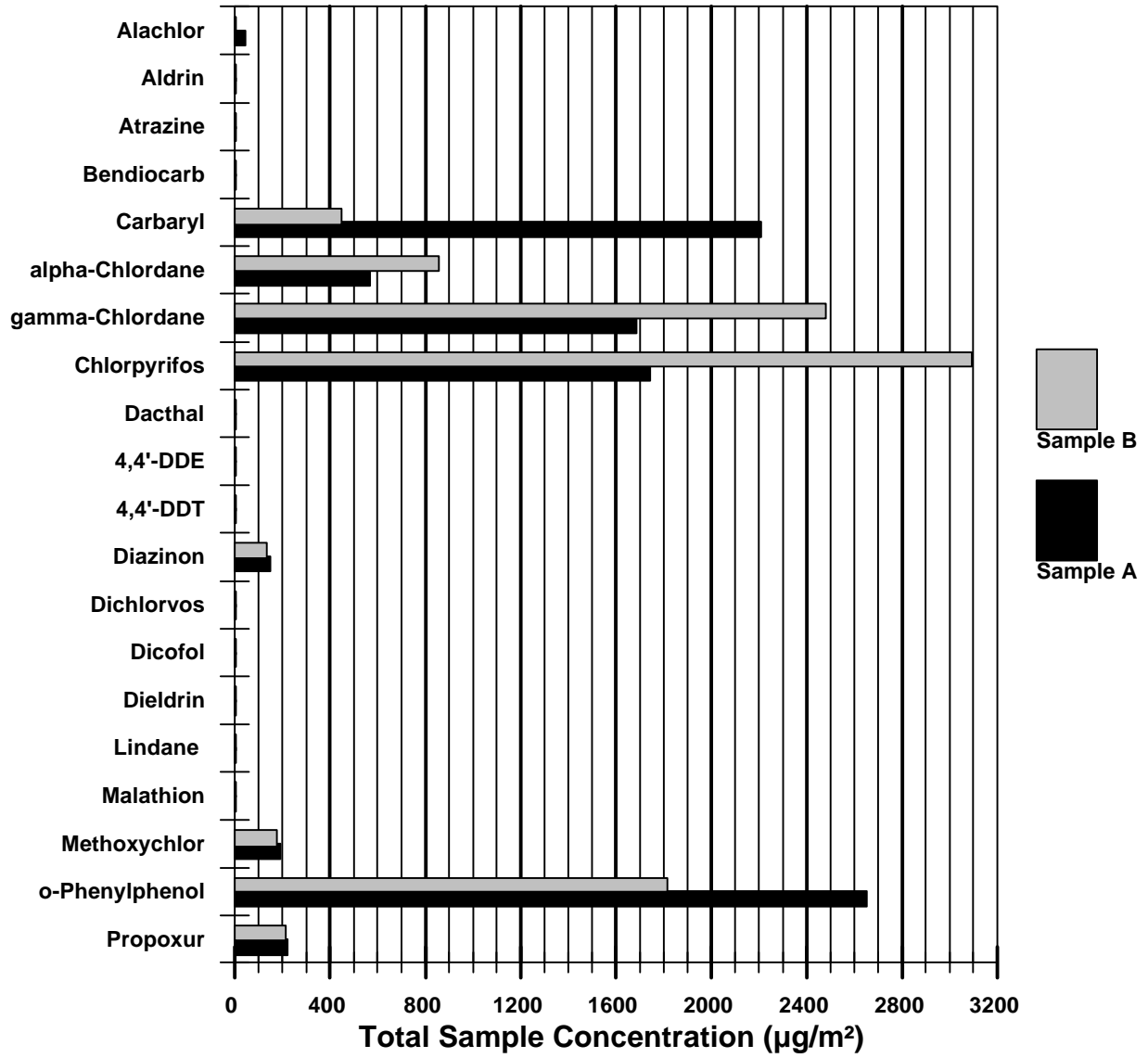


Figure 7. Total residue concentrations for samples A and B for test home 3.

(continued)

Home #3 (Cont.)

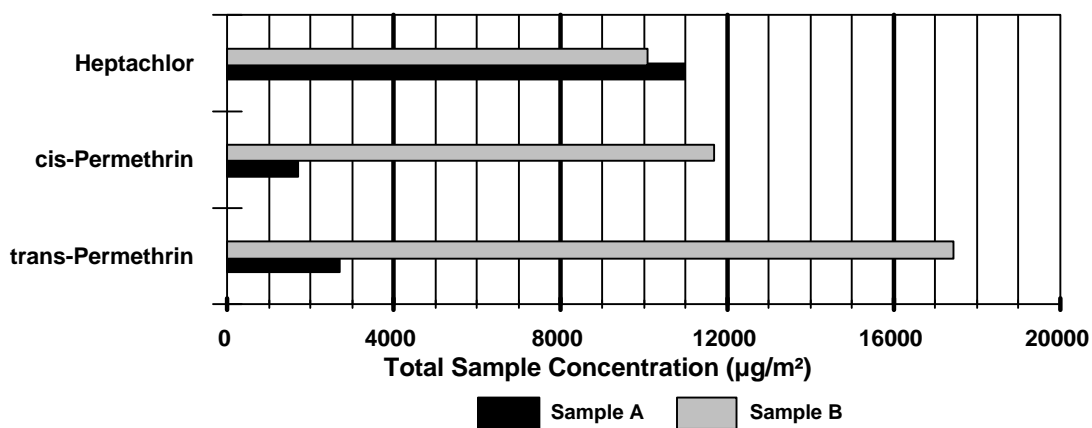


Figure 7 (continued). Total residue concentrations for samples A and B for test home 3.

(continued)

Home #3 (Cont.)

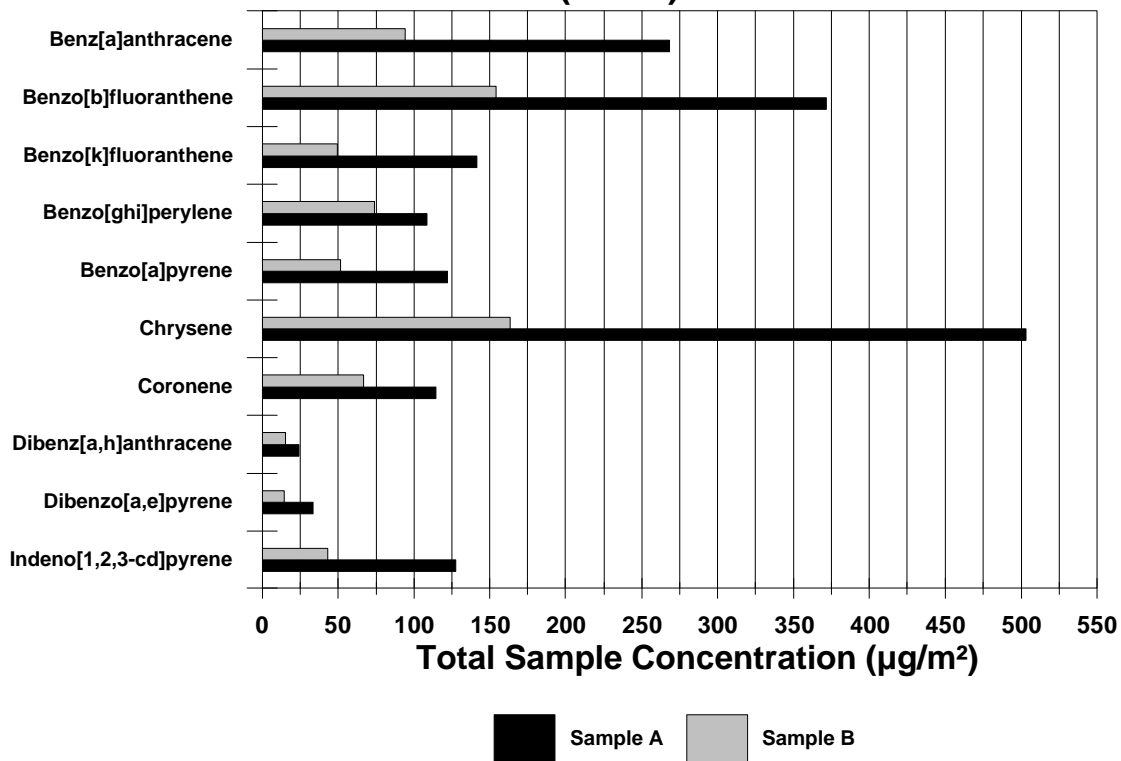


Figure 7 (continued). Total residue concentrations for samples A and B for test home 3.

Table 12. In-Home Carpet Test Results—Residue Distribution Percentage for Home 3, Sample A

Test Home: Split-level style, located in Cary, NC

Test Date: 02/04/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	003-PA01	003-PA02	003-PA03	003-PA04	003-PA05	003-PA06	003-PA07	
Sample Wt. (g):	na	2.63	9.1	12.7	33.5	5.6	4.5	
Alachlor						100.00		100.0
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl		0.06	0.14	44.54	2.12	53.12	0.02	100.0
alpha-Chlordane		0.08	0.06	10.46	48.52	40.85	0.02	100.0
gamma-Chlordane		0.05	0.04	10.69	40.00	49.19	0.02	100.0
Chlorpyrifos		0.04	0.07	4.75	67.83	27.29	0.01	100.0
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon					47.58	52.42		100.0
Dichlorvos								
Dicofol								
Dieldrin			100.00					100.0
Heptachlor		0.02	0.01	2.21	48.51	49.22	0.03	100.0
Lindane								
Malathion								
Methoxychlor		0.10	0.08	14.78		84.90	0.14	100.0
cis-Permethrin		1.17	0.49	77.92	20.41			100.0
trans-Permethrin		1.38	0.65	90.53	7.44			100.0
o-Phenylphenol		0.01	0.03	56.49	27.50	15.97	0.004	100.0
Propoxur				37.29	17.11	45.57	0.02	100.0
Benz[a]anthracene		0.60	0.92	19.82	46.44	31.85	0.37	100.0
Benzo[b]fluoranthene		0.65	1.08	27.77	40.64	29.25	0.61	100.0
Benzo[k]fluoranthene		1.27	1.22	20.81	50.21	26.10	0.39	100.0
Benzo[ghi]perylene		1.63	1.76	23.64	42.78	29.28	0.90	100.0
Benzo[a]pyrene		1.52	1.73	20.52	42.58	33.28	0.38	100.0
Chrysene		0.58	0.73	36.18	36.81	25.42	0.29	100.0
Coronene		2.91	2.47	24.77	46.38	22.53	0.93	100.0
Dibenz[a,h]anthracene		2.25	2.79	19.19	35.13	39.52	1.12	100.0
Dibenzo[a,e]pyrene		3.51	3.24	31.54	36.93	23.93	0.86	100.0
Indeno[1,2,3-cd]pyrene		1.53	1.60	27.18	41.50	27.39	0.79	100.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Table 13. In-Home Carpet Test Results—Residue Distribution Percentage for Home 3, Sample B

Test Home: Split-level style, located in Cary, NC

Date of Test: 02/04/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	003-PB01	003-PB02	003-PB03	003-PB04	003-PB05	003-PB06	003-PB07	
Sample Wt. (g):	na	2.06	0.8	11.6	38.7	5.3	1.3	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl		0.18	0.06	74.17	12.42	13.15	0.01	100.0
alpha-Chlordane		0.14		10.63	56.51	32.68	0.03	100.0
gamma-Chlordane		0.13		10.09	47.85	41.90	0.04	100.0
Chlorpyrifos		0.04		2.96	58.16	38.82	0.02	100.0
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon		0.04			47.81	52.09	0.06	100.0
Dichlorvos								
Dicofol								
Dieldrin	100.00							100.0
Heptachlor		0.04		2.62	40.17	57.11	0.06	100.0
Lindane								
Malathion								
Methoxychlor		0.83		36.34	49.74	13.05	0.03	100.0
cis-Permethrin	0.02	1.22	0.04	91.31	7.42			100.0
trans-Permethrin	0.02	1.08	0.04	95.61	3.24			100.0
o-Phenylphenol		0.03		41.45	33.12	25.38	0.020	100.0
Propoxur		0.02		19.06	34.29	46.59	0.04	100.0
Benz[a]anthracene		0.60		37.58	50.12	11.62	0.07	100.0
Benzo[b]fluoranthene		0.88		46.46	36.77	15.84	0.05	100.0
Benzo[k]fluoranthene		1.60		32.30	32.98	32.95	0.17	100.0
Benzo[ghi]perylene		0.76		29.60	64.18	5.37	0.08	100.0
Benzo[a]pyrene		1.48		39.44	48.83	10.15	0.11	100.0
Chrysene		0.68		48.41	42.75	8.11	0.05	100.0
Coronene		0.83		45.05	45.86	8.14	0.12	100.0
Dibenz[a,h]anthracene		0.66		23.46	31.96	43.80	0.11	100.0
Dibenzo[a,e]pyrene		0.80		43.59	47.22	8.25	0.13	100.0
Indeno[1,2,3-cd]pyrene		1.31		53.99	36.15	8.40	0.14	100.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Home #3, Sample A

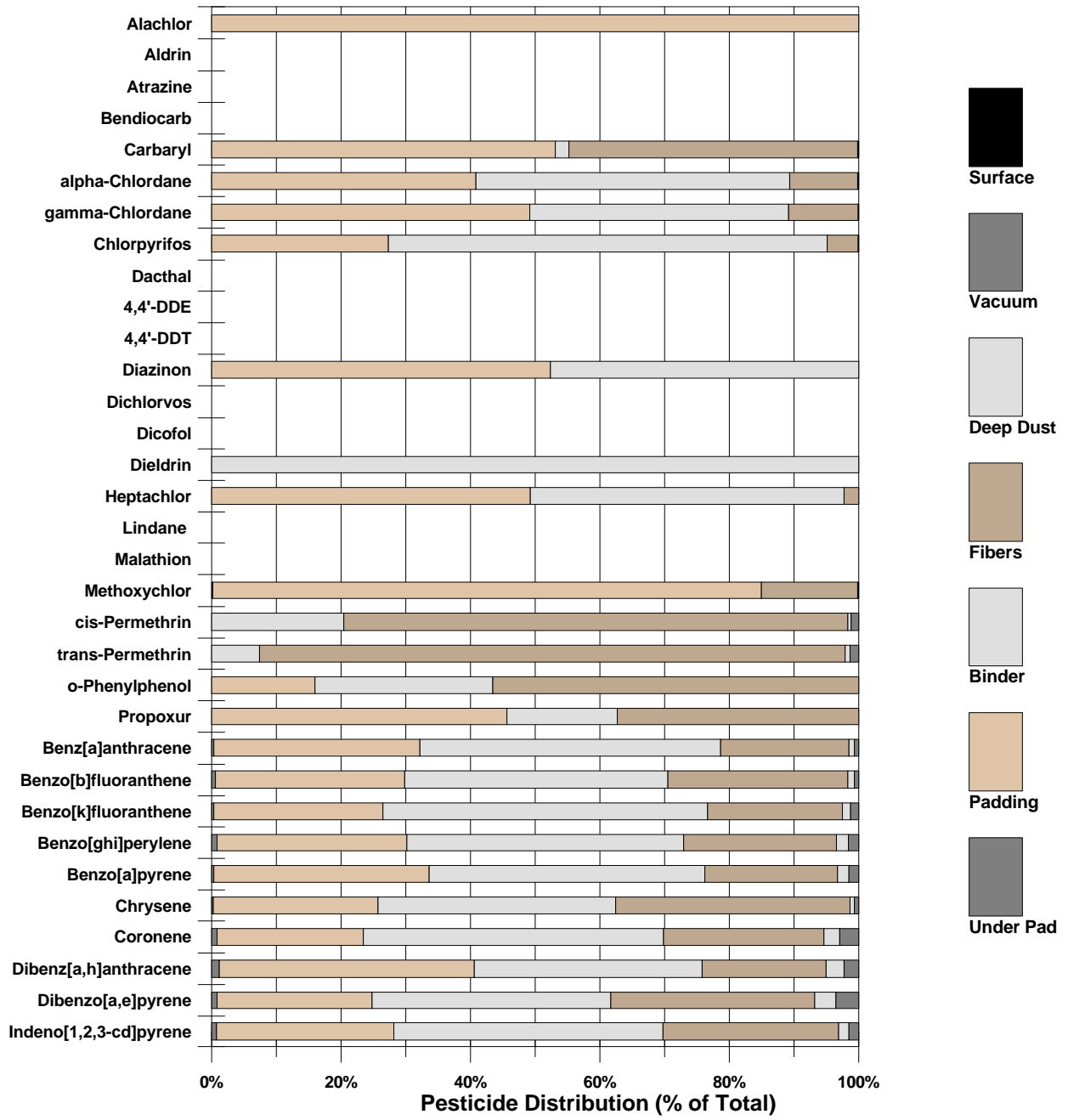


Figure 8. Pesticide residue distribution in carpet sample fractions—home 3, sample A.

Home #3, Sample B

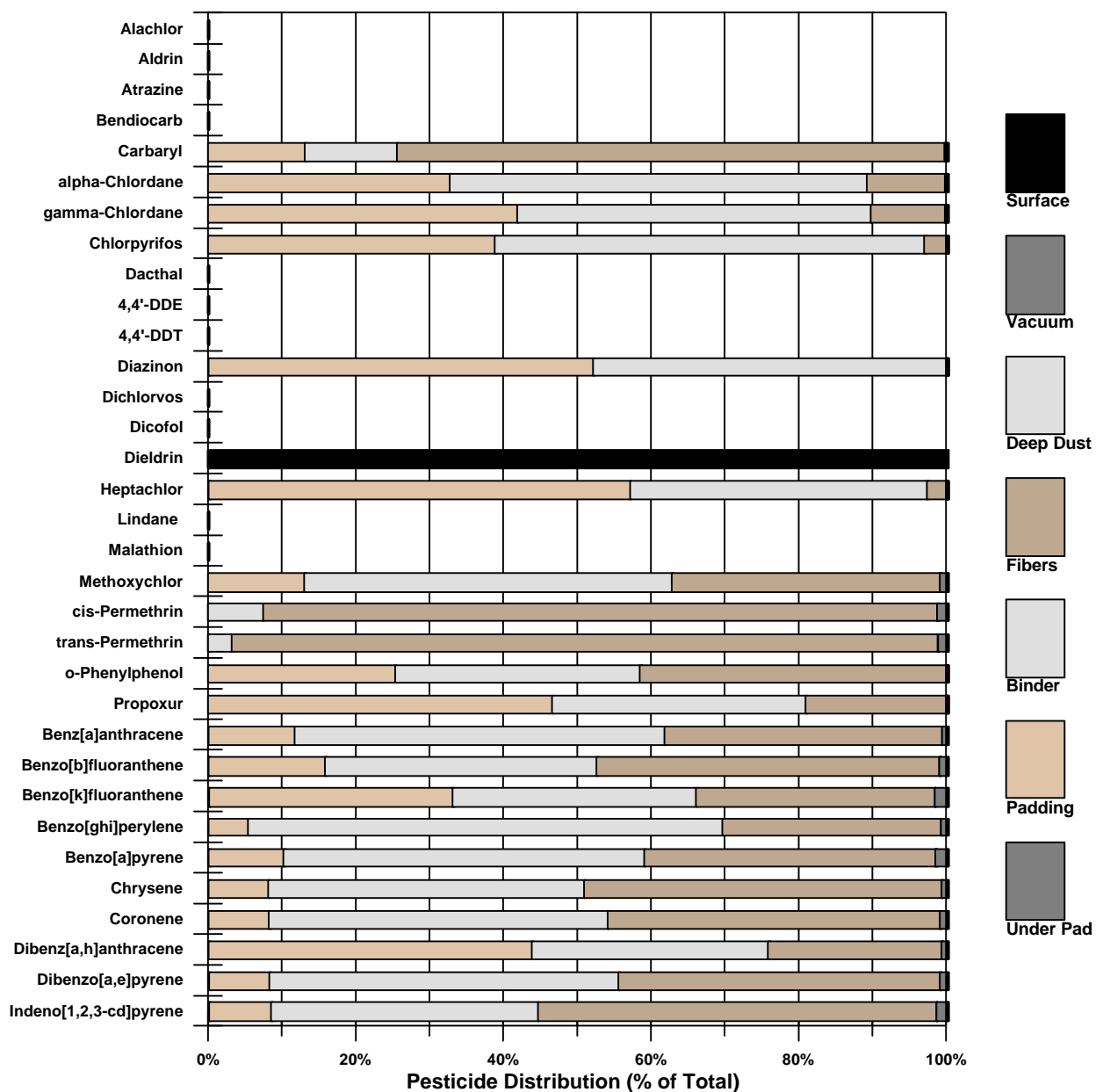


Figure 9. Pesticide residue distribution in carpet sample fractions—home 3, sample B.

4.3.4 Results of Carpet Sample Fraction Analysis for Test Home 4

The following tables and figures present the reduced analytical data for tests that were conducted at a ranch-style home located in a rural area of Durham County, NC. The sampling was performed on February 13, 1998. Sample A was collected from an area just inside the entrance to a hallway leading to the bedrooms and bathroom. Sample B was collected from an area in the center of a bedroom used by a teenaged child. The carpeted hallway and bedrooms were located a short distance from the main entrance to the home, and the floors in all other living areas were hardwood. A floor plan of the home with the sample locations shown schematically is presented in Figure 10.

The vacuum-dislodgeable dust screening sample that was collected from the area located in the center of the bedroom (sample B) was sieved to separate coarse particles from fine particles at a cut point of 150 μm in geometric diameter. After setting aside two 2-g aliquots of the fine-fraction dust for screening analysis, the remainder of the fine dust was recombined with the coarse-fraction dust. The fine sample fraction was analyzed for neutral target analytes (see Table 3 above), but the coarse sample fraction was not analyzed separately. Instead, the recombined fine dust remainder (8.807 g) and coarse sample fraction (0.923 g) was analyzed, and those results are presented along with the results for other sample B carpet residue fractions in Table 15.

The analytical results in terms of target analyte concentration per unit area for neutral pesticides, PAHs, and PCBs for all seven sample fractions collected from each of the two carpet sections in test home 4 are presented in Tables 14 and 15. The total sample concentration results for each target analyte for both sample A and sample B are presented graphically in Figure 11. The sample results are also presented in terms of the percentage contribution of each individual sample fraction to the total sample concentration for each target analyte. Those results are shown in Tables 16 and 17, and the same data are presented graphically in Figures 12 and 13.

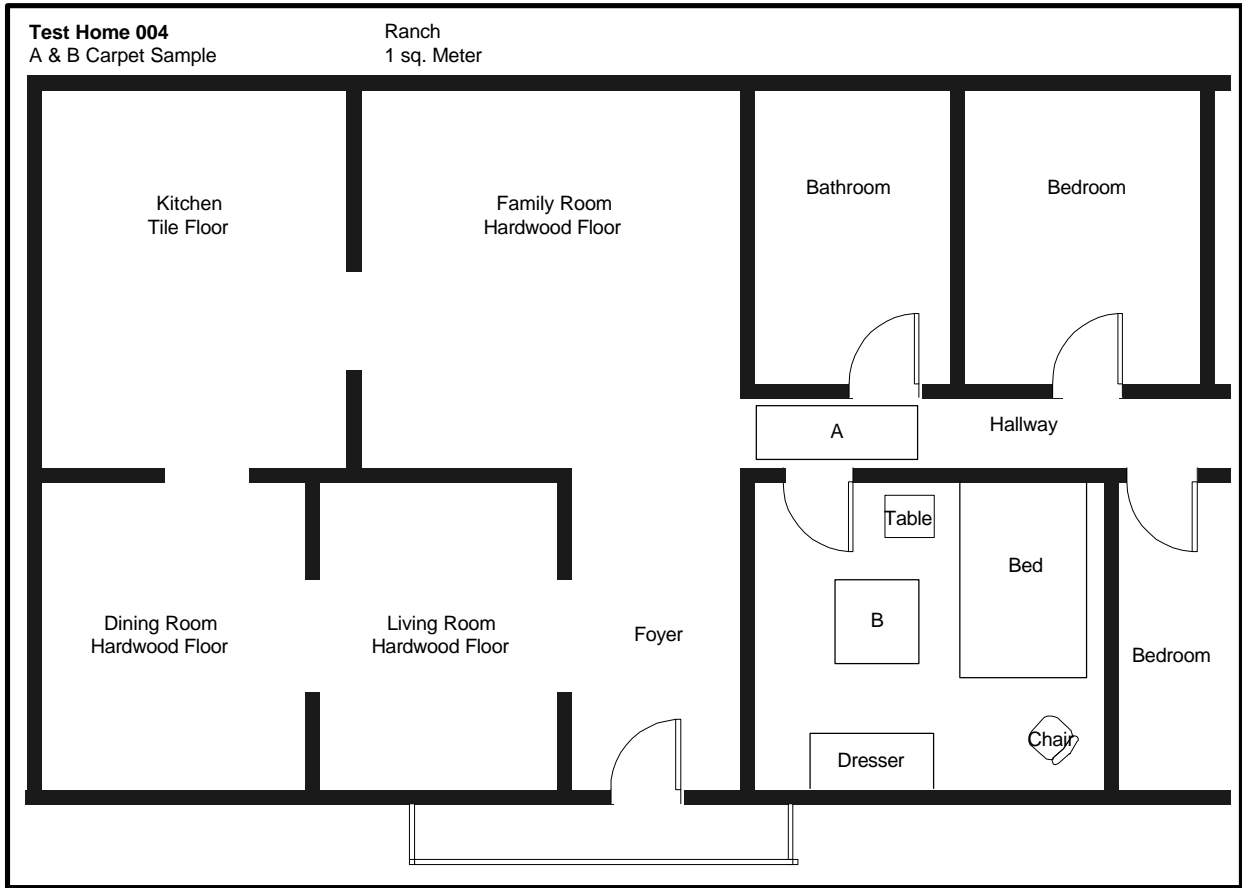


Figure 10. Representation of floor plan for test home 4.

Table 14. In-Home Carpet Test Results—Sample Residue Concentrations for Home 4, Sample A

Test Home: Ranch style, in rural area of Durham County, NC

Date of Test: 02/13/98

Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	004-PA01	004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07	
Sample Wt. (g):	na	27.3	150.7	15.3	57.2	7.8	1.8	
Alachlor						68.8		68.8
Aldrin								
Atrazine	2.65							2.7
Bendiocarb		6.61	41.2	171.3	909.1	21089.5	18.3	22236.1
Carbaryl	0.56	23.07	129.9	1295.2	1624.4	3309.4	4.2	6386.7
alpha-Chlordane					69.3	48.3		117.6
gamma-Chlordane		2.65	9.8	12.8	154.1	142.6	0.1	322.1
Chlorpyrifos	1.94	417.66	2357.7	2751.9	72217.7	50166.9	52.5	127966.2
Dacthal								
4,4'-DDE		1.96	8.1	9.1	139.1	21.5		179.7
4,4'-DDT		6.28	25.1	32.4	336.4	62.3	0.1	462.5
Diazinon	0.72	92.14	351.7	915.4	43557.8	115060.6	76.7	160055.0
Dichlorvos					18.9	31.3		50.3
Dicofol				9.8				9.8
Dieldrin					44.4			44.4
Heptachlor					541.3	699.9	0.8	1242.0
Lindane								
Malathion		42.93	91.9	45.3				180.1
Methoxychlor					348.4	75.7		424.1
cis-Permethrin	1.68	2527.73	10226.5	9831.6	26743.4	102.3	5.0	49438.2
trans-Permethrin	2.38	3946.56	15889.8	17419.6	40325.6	156.1	7.8	77747.9
o-Phenylphenol		3.58	22.6	257.7	546.9	455.7	0.4	1286.8
Propoxur		2.75	14.0	45.4	175.2	426.8	0.2	664.4
Benz[a]anthracene		5.53	21.7	39.4	270.0	13.6	0.1	350.2
Benzo[b]fluoranthene		8.06	32.9	50.4	285.6		0.2	377.1
Benzo[k]fluoranthene		1.73	14.9	22.1	77.1			115.8
Benzo[ghi]perylene		5.75	24.0	28.7	169.7		0.1	228.3
Benzo[a]pyrene		4.08	19.1	20.9	179.8		0.1	224.0
Chrysene		7.90	32.3	61.4	287.1	30.5	0.2	419.3
Coronene		2.74	11.7	10.3	56.6			81.3
Dibenz[a,h]anthracene					45.1			45.1
Dibenzo[a,e]pyrene		3.70	16.4	13.8	87.0			120.9
Indeno[1,2,3-cd]pyrene		5.09	19.9	31.8	166.2		0.1	223.1
PCB 105: 2,3,3',4,4'					3.4			3.4
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		0.76	2.6	3.1				6.4
PCB 153: 2,2',4,4',5,5'		0.49			19.3			19.7
PCB 170: 2,2',3,3',4,4',5					4.6			4.6
PCB 180: 2,2',3,4,4',5,5'								

Table 15. In-Home Carpet Test Results—Sample Residue Concentrations for Home 4, Sample B

Test Home: Ranch style, in rural area of Durham County, NC

Date of Test: 02/13/98

Carpet Sample Fraction Analysis Results (µg/m²)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	004-PB01	004-PB02	004-PB03	004-PB04	004-PB05	004-PB06	004-PB07	
Sample Wt. (g):	na	13.49	49.3	16.6	42.6	5.3	52.6	
Alachlor				17.2				17.2
Aldrin					11.4			11.4
Atrazine	1.07		19.2					20.3
Bendiocarb		3.04	4.0	127.9	253.1	287.3		675.4
Carbaryl		1.36	4.5	485.0	231.4	251.4	3.2	976.9
alpha-Chlordane					38.4	15.0		53.4
gamma-Chlordane		0.80		15.7	88.0	53.2		157.7
Chlorpyrifos	1.46	21.61	176.6	2111.2	29648.4	5489.2	50.0	37498.5
Dacthal								
4,4'-DDE				11.9				11.9
4,4'-DDT		0.91	2.2	28.2	78.2	21.5	2.5	133.5
Diazinon		35.40	78.5	1913.5	51693.9	43284.1	462.3	97467.8
Dichlorvos				7.6	13.3	15.8		36.7
Dicofol		0.80		13.8				14.6
Dieldrin					40.7			40.7
Heptachlor				32.8	516.8	409.6		959.2
Lindane								
Malathion		2.26	6.0	21.0			2.4	31.6
Methoxychlor		1.20	3.2		152.5	36.8	12.6	206.3
cis-Permethrin	1.65	165.54	153.1	2147.0	1147.1	111.4	7.8	3733.6
trans-Permethrin	2.27	207.47	210.9	3630.8	1310.4	150.7	10.5	5523.1
o-Phenylphenol		1.08	4.0	715.2	331.9	182.6	2.9	1237.7
Propoxur				40.9	34.5	15.7		91.2
Benz[a]anthracene		1.89	7.6	21.8	45.9		19.1	96.3
Benzo[b]fluoranthene		2.97	9.6	17.5	32.4		30.3	92.8
Benzo[k]fluoranthene		1.08	3.6		10.6		12.1	27.3
Benzo[ghi]perylene		2.08	6.8	9.5	24.0		17.9	60.3
Benzo[a]pyrene		1.94	6.4	8.7	24.9		20.0	62.0
Chrysene		2.44	8.8	37.3	44.2	15.2	25.0	132.8
Coronene		0.82					4.2	5.0
Dibenz[a,h]anthracene							3.4	3.4
Dibenzo[a,e]pyrene		0.85	2.1		7.4		5.1	15.4
Indeno[1,2,3-cd]pyrene		1.36	5.1		22.4		16.1	45.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'					3.5		3.4	6.9
PCB 153: 2,2',4,4',5,5'					7.4		3.4	10.7
PCB 170: 2,2',3,3',4,4',5							2.0	2.0
PCB 180: 2,2',3,4,4',5,5'							3.4	3.4

Home #4

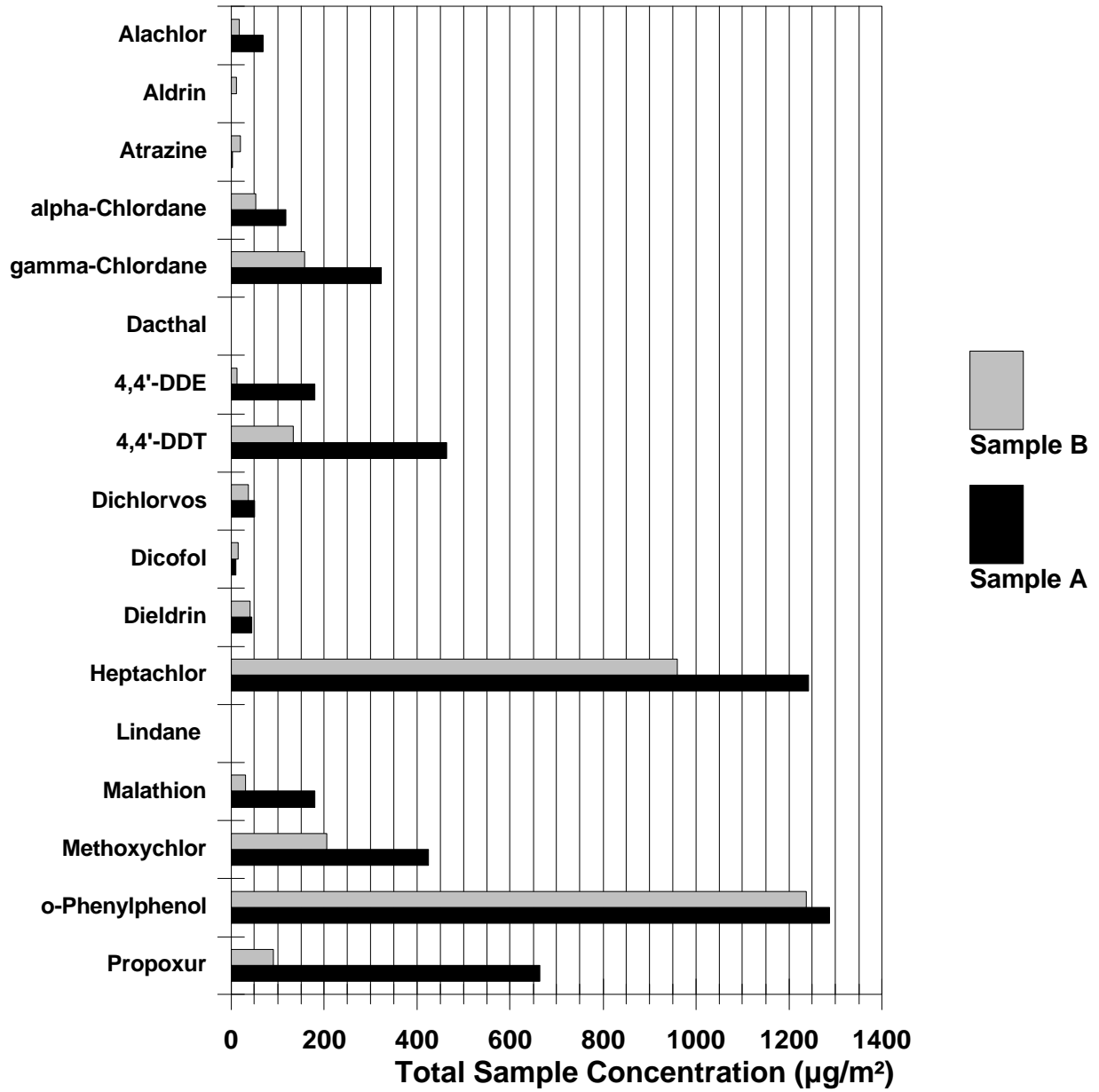


Figure 11. Total residue concentrations for samples A and B for test home 4.

(continued)

Home #4 (Cont.)

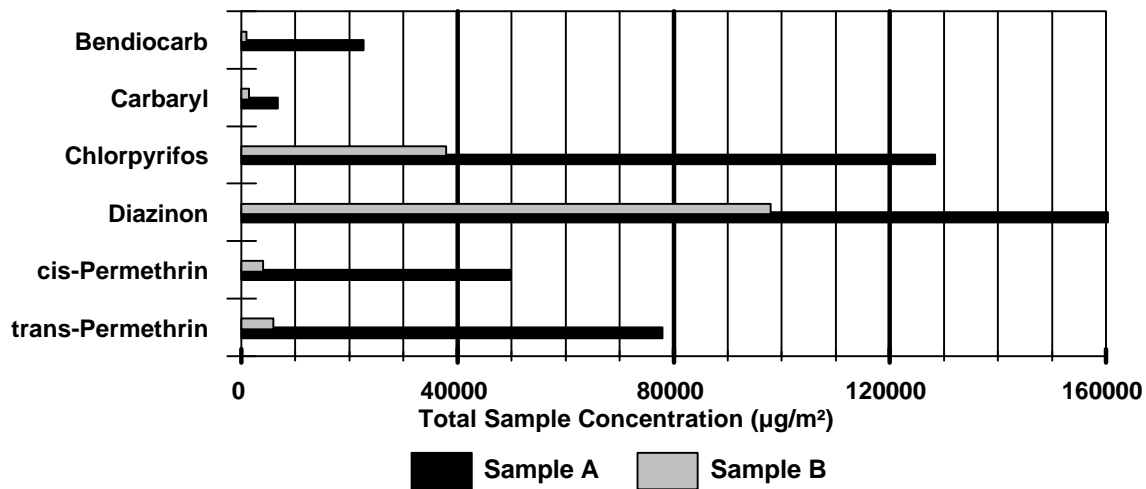


Figure 11 (continued). Total residue concentrations for samples A and B for test home 4.

(continued)

Home #4 (Cont.)

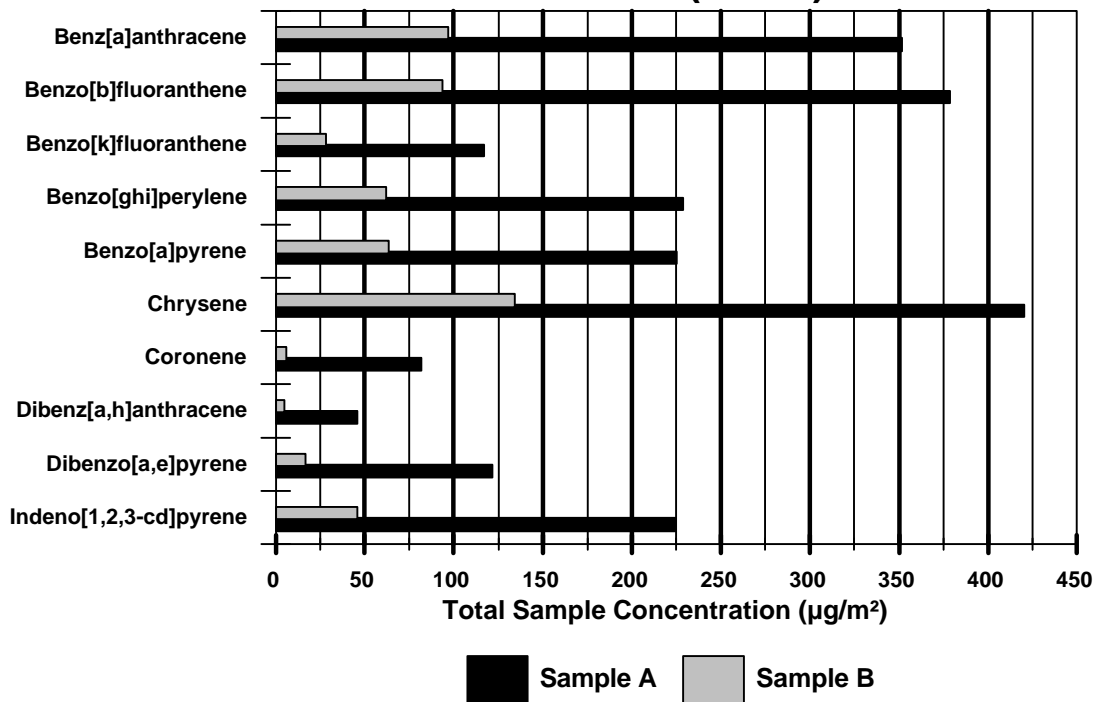


Figure 11 (continued). Total residue concentrations for samples A and B for test home 4.

Table 16. In-Home Carpet Test Results—Residue Distribution Percentage for Home 4, Sample A

Test Home: Ranch style, in rural area of Durham County, NC

Date of Test: 02/13/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	004-PA01	004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07	
Sample Wt. (g):	na	27.26	150.7	15.3	57.2	7.8	1.8	
Alachlor						100.00		100.0
Aldrin								
Atrazine	100.00							100.0
Bendiocarb		0.03	0.19	0.77	4.09	94.84	0.08	100.0
Carbaryl	0.01	0.36	2.03	20.28	25.43	51.82	0.07	100.0
alpha-Chlordane					58.92	41.08		100.0
gamma-Chlordane		0.82	3.04	3.97	47.85	44.27	0.04	100.0
Chlorpyrifos	0.002	0.33	1.84	2.15	56.43	39.20	0.04	100.0
Dacthal								
4,4'-DDE		1.09	4.51	5.05	77.38	11.96		100.0
4,4'-DDT		1.36	5.42	7.01	72.73	13.46	0.03	100.0
Diazinon	0.0005	0.06	0.22	0.57	27.21	71.89	0.05	100.0
Dichlorvos					37.64	62.36		100.0
Dicofol				100.00				100.0
Dieldrin					100.00			100.0
Heptachlor					43.58	56.36	0.06	100.0
Lindane								
Malathion		23.83	51.00	25.17				100.0
Methoxychlor					82.16	17.84		100.0
cis-Permethrin	0.003	5.11	20.69	19.89	54.09	0.21	0.01	100.0
trans-Permethrin	0.003	5.08	20.44	22.41	51.87	0.20	0.01	100.0
o-Phenylphenol		0.28	1.76	20.03	42.50	35.41	0.03	100.0
Propoxur		0.41	2.11	6.84	26.37	64.23	0.04	100.0
Benz[a]anthracene		1.58	6.19	11.24	77.08	3.87	0.04	100.0
Benzo[b]fluoranthene		2.14	8.71	13.37	75.73		0.05	100.0
Benzo[k]fluoranthene		1.49	12.83	19.09	66.59			100.0
Benzo[ghi]perylene		2.52	10.53	12.58	74.32		0.05	100.0
Benzo[a]pyrene		1.82	8.54	9.34	80.25		0.05	100.0
Chrysene		1.88	7.70	14.64	68.46	7.27	0.05	100.0
Coronene		3.38	14.35	12.63	69.64			100.0
Dibenz[a,h]anthracene					100.00			100.0
Dibenzo[a,e]pyrene		3.06	13.56	11.42	71.96			100.0
Indeno[1,2,3-cd]pyrene		2.28	8.94	14.26	74.48		0.04	100.0
PCB 105: 2,3,3',4,4'					100.00			100.0
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		11.88	40.18	47.94				100.0
PCB 153: 2,2',4,4',5,5'		2.49			97.51			100.0
PCB 170: 2,2',3,3',4,4',5					100.00			100.0
PCB 180: 2,2',3,4,4',5,5'								

Table 17. In-Home Carpet Test Results—Residue Distribution Percentage for Home 4, Sample B

Test Home: Ranch style, in rural area of Durham County, NC

Date of Test: 02/13/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	004-PB01	004-PB02	004-PB03	004-PB04	004-PB05	004-PB06	004-PB07	
Sample Wt. (g):	na	13.49	49.3	16.6	42.6	5.3	52.6	
Alachlor				100.00				100.0
Aldrin					100.00			100.0
Atrazine	5.28		94.72					100.0
Bendiocarb		0.45	0.59	18.94	37.48	42.54		100.0
Carbaryl		0.14	0.46	49.65	23.69	25.73	0.33	100.0
alpha-Chlordane					71.84	28.16		100.0
gamma-Chlordane		0.51		9.93	55.81	33.75		100.0
Chlorpyrifos	0.004	0.06	0.47	5.63	79.07	14.64	0.13	100.0
Dacthal								
4,4'-DDE				100.00				100.0
4,4'-DDT		0.68	1.65	21.13	58.54	16.11	1.89	100.0
Diazinon		0.04	0.08	1.96	53.04	44.41	0.47	100.0
Dichlorvos				20.62	36.26	43.12		100.0
Dicofol		5.47		94.53				100.0
Dieldrin					100.00			100.0
Heptachlor				3.42	53.88	42.71		100.0
Lindane								
Malathion		7.15	19.00	66.29			7.56	100.0
Methoxychlor		0.58	1.53		73.91	17.85	6.12	100.0
cis-Permethrin	0.04	4.43	4.10	57.51	30.72	2.98	0.21	100.0
trans-Permethrin	0.04	3.76	3.82	65.74	23.73	2.73	0.19	100.0
o-Phenylphenol		0.09	0.33	57.78	26.82	14.75	0.23	100.0
Propoxur				44.88	37.87	17.26		100.0
Benz[a]anthracene		1.96	7.94	22.65	47.60		19.85	100.0
Benzo[b]fluoranthene		3.20	10.39	18.84	34.95		32.62	100.0
Benzo[k]fluoranthene		3.94	13.23		38.69		44.13	100.0
Benzo[ghi]perylene		3.45	11.35	15.67	39.86		29.68	100.0
Benzo[a]pyrene		3.13	10.25	14.11	40.15		32.36	100.0
Chrysene		1.84	6.59	28.05	33.27	11.43	18.82	100.0
Coronene		16.44					83.56	100.0
Dibenz[a,h]anthracene							100.00	100.0
Dibenzo[a,e]pyrene		5.50	13.43		47.93		33.15	100.0
Indeno[1,2,3-cd]pyrene		3.03	11.34		49.81		35.81	100.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'					51.19		48.81	100.0
PCB 153: 2,2',4,4',5,5'					68.54		31.46	100.0
PCB 170: 2,2',3,3',4,4',5							100.00	100.0
PCB 180: 2,2',3,4,4',5,5'							100.00	100.0

Home #4, Sample A

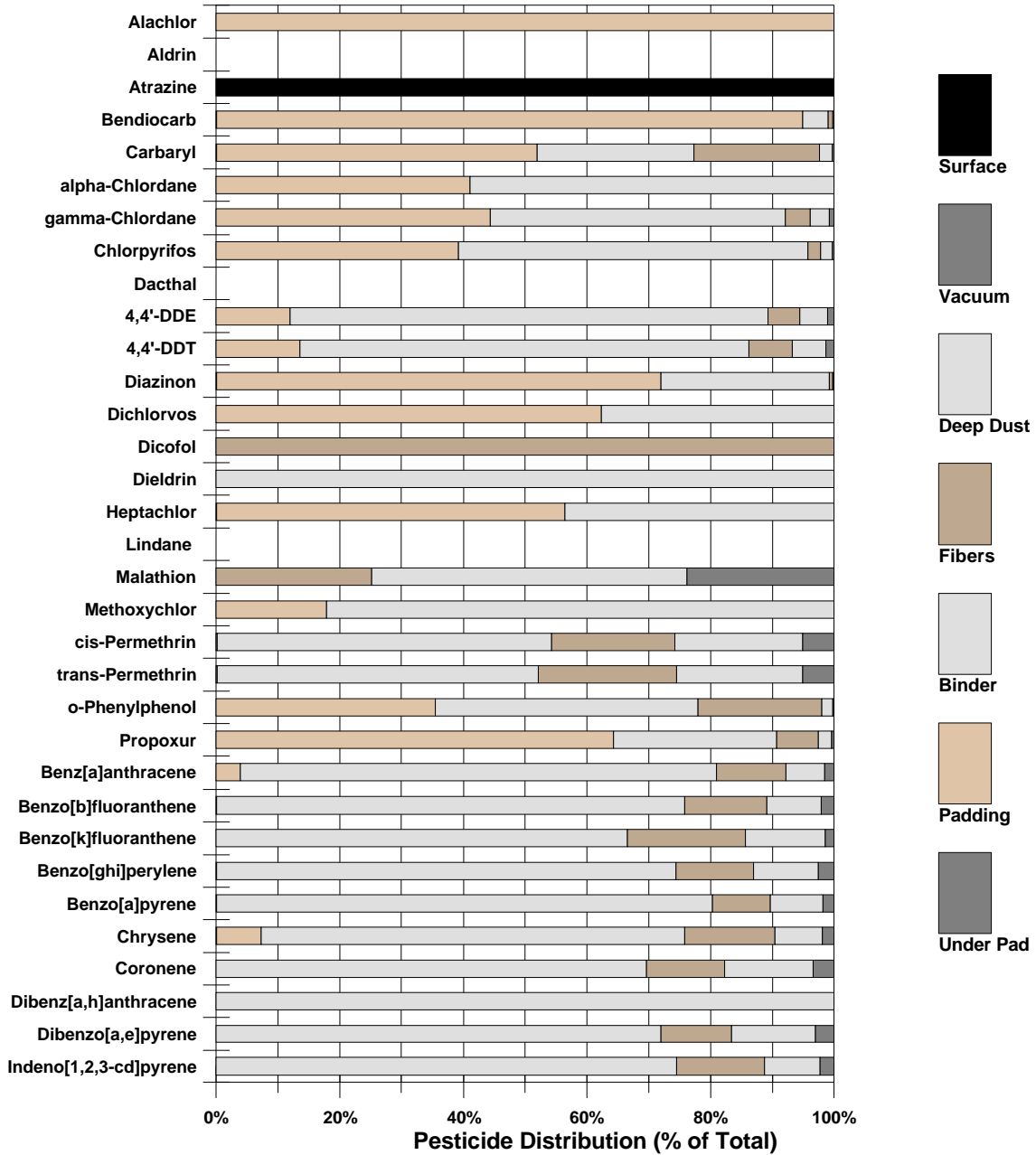


Figure 12. Pesticide residue distribution in carpet sample fractions—home 4, sample A.

Home #4, Sample B

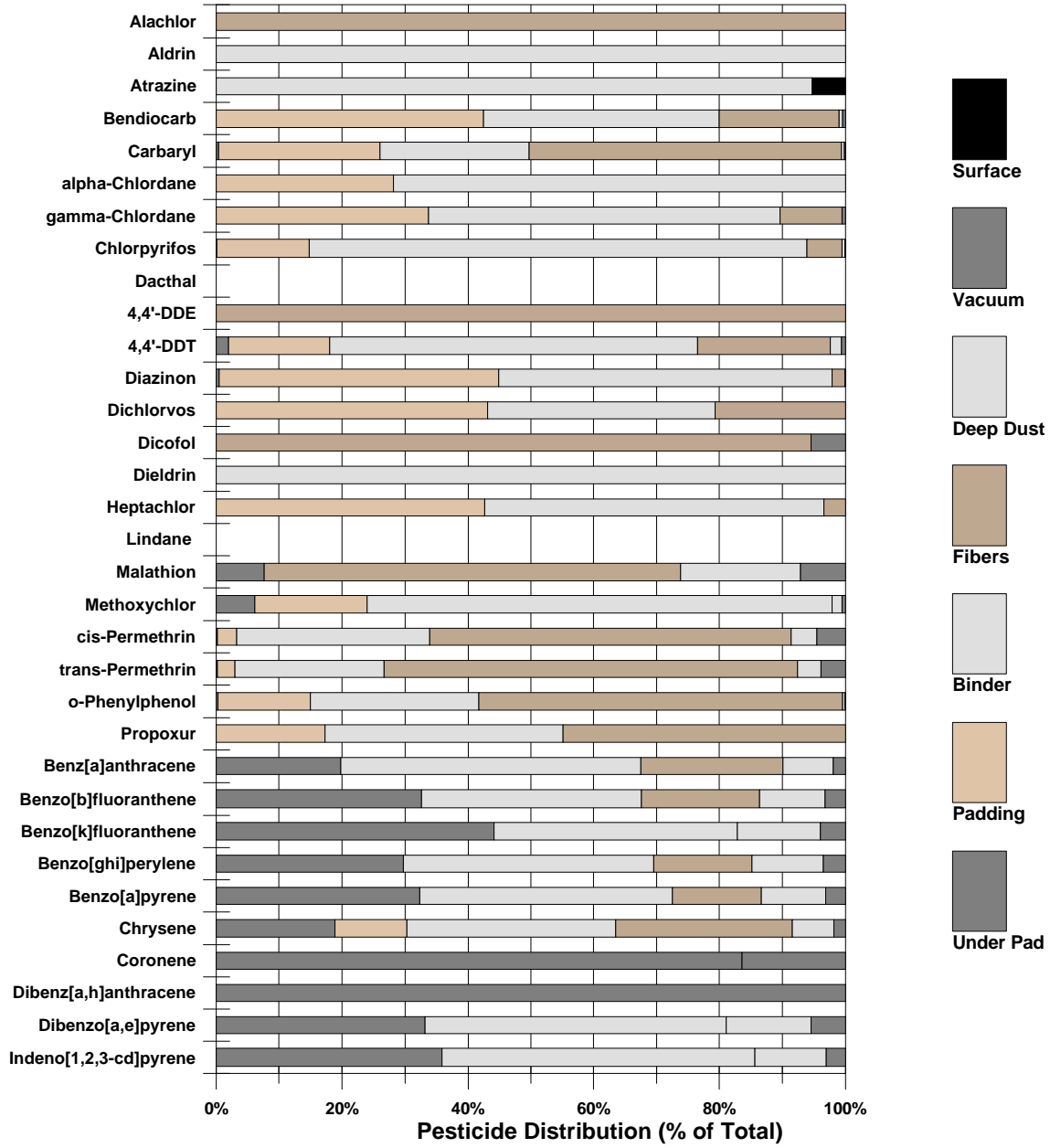


Figure 13. Pesticide residue distribution in carpet sample fractions—home 4, sample B.

4.3.5 Results of Carpet Sample Fraction Analysis for Test Home 5

The following tables and figures present the reduced analytical data for tests that were conducted at a ranch-style home located in Durham, NC. The sampling was performed on March 3, 1998. Sample A was collected from an area just inside the side entrance to the home (from a screened-in porch), and the sample B was collected from an area in the center of the living room. A floor plan of the home with the sample locations shown schematically is presented in Figure 14.

The vacuum-dislodgeable dust screening sample that was collected from the area located in the center of the living room (sample B) was sieved to separate coarse particles from fine particles at a cut point of 150 μm in geometric diameter. Both the coarse and fine sample fractions were analyzed, and those results are presented in Table 18.

The analytical results in terms of target analyte concentration per unit area for neutral pesticides, PAHs, and PCBs for all seven sample fractions collected from each of the two carpet sections in test home 5 are presented in Tables 19 and 20. The total sample concentration results for each target analyte for both sample A and sample B are presented graphically in Figure 15. The sample results are also presented in terms of the percentage contribution of each individual sample fraction to the total sample concentration for each target analyte. Those results are shown in Tables 21 and 22, and the same data are presented graphically in Figures 16 and 17.

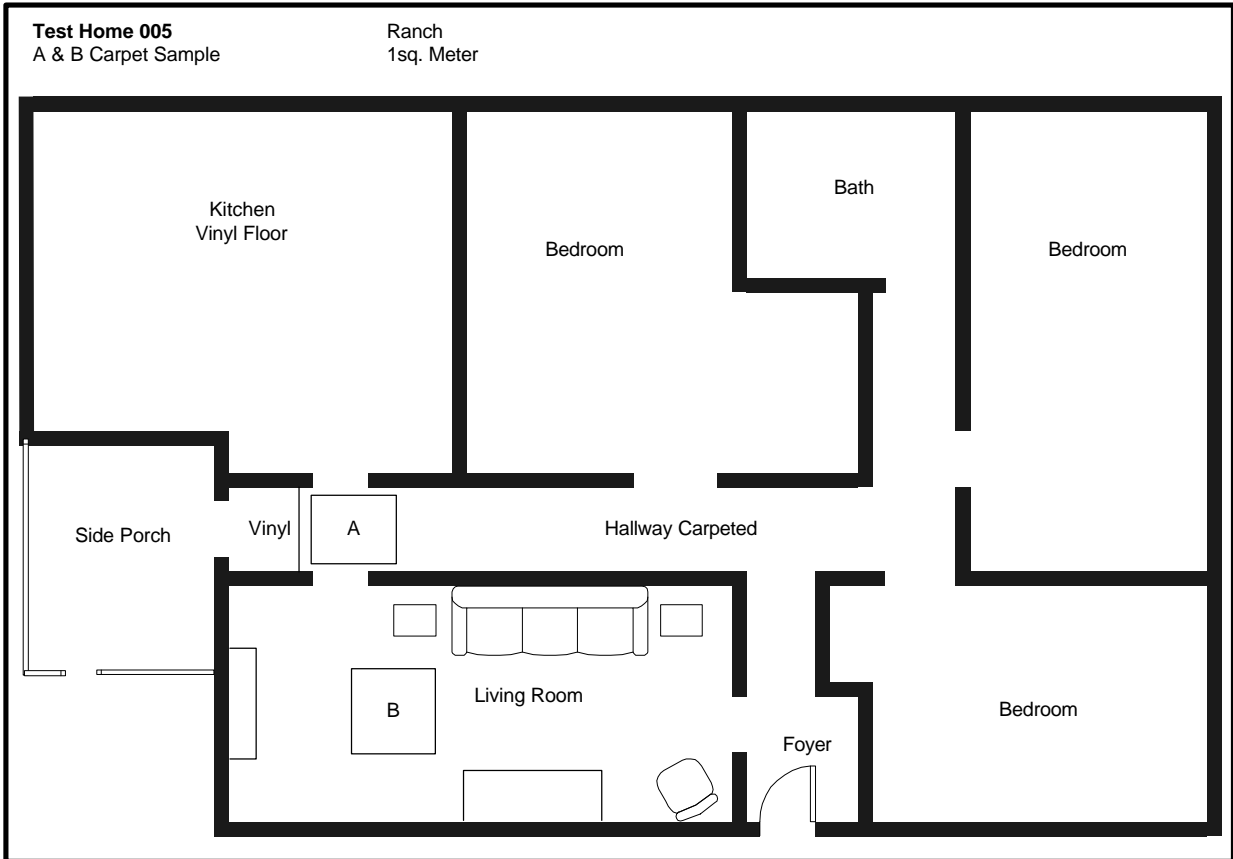


Figure 14. Representation of floor plan for test home 5.

Table 19. In-Home Carpet Test Results—Sample Residue Concentrations for Home 5, Sample A

Test Home: Ranch style, located in Durham, NC

Date of Test: 03/03/98

Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	005-PA01	005-PA02	005-PA03	005-PA04	005-PA05	005-PA06	005-PA07	
Sample Wt. (g):	na	1.23	11.9	15.8	51.0	6.3	85.1	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl				19.2				19.2
alpha-Chlordane		0.39	0.9	44.1	268.2	353.0		666.6
gamma-Chlordane		1.10	2.5	121.6	777.1	1509.0	4.9	2416.1
Chlorpyrifos	5.24	3.82	17.0	272.8	3197.6	242.6	4.5	3743.6
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol		0.79	2.0	54.8				57.6
Dieldrin								
Heptachlor		1.50	2.6	171.0	5666.8	4251.9	18.3	10112.1
Lindane								
Malathion								
Methoxychlor						10.6		10.6
cis-Permethrin		0.54	2.2	47.1				49.9
trans-Permethrin		0.35	1.3	30.0				31.7
o-Phenylphenol		0.18	0.7	240.1	610.4	179.8		1031.1
Propoxur		0.52	2.3	125.4	390.7	690.0		1208.9
Benz[a]anthracene		0.30	2.3	29.7	69.7	41.7	9.2	152.9
Benzo[b]fluoranthene		0.55	3.4	33.6	53.1	41.8	13.1	145.6
Benzo[k]fluoranthene		0.43	2.3	23.4	35.3	32.5	12.0	106.0
Benzo[ghi]perylene		0.45	2.5	20.5	32.9	23.5	10.6	90.5
Benzo[a]pyrene		0.49	2.8	23.3	86.5	52.0	9.0	174.1
Chrysene		0.67	3.4	72.2	164.6	76.2	13.9	330.9
Coronene			0.5					0.5
Dibenz[a,h]anthracene								
Dibenzo[a,e]pyrene								
Indeno[1,2,3-cd]pyrene		0.43	2.6	19.8	36.3	25.9	11.7	96.7
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		0.06		4.2				4.3
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Table 20. In-Home Carpet Test Results—Sample Residue Concentrations for Home 5, Sample B

Test Home: Ranch style, located in Durham, NC

Date of Test: 03/03/98

Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	005-PB01	005-PB02	005-PB03	005-PB04	005-PB05	005-PB06	005-PB07	
Sample Wt. (g):	na	0.41	7.5	15.1	45.6	5.4	8.9	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl				74.8				74.8
alpha-Chlordane	1.85	0.24	0.5	75.4	308.9	365.4		752.3
gamma-Chlordane	2.22	0.48	1.1	193.9	677.5	970.5	0.7	1846.5
Chlorpyrifos	3.36	0.60	1.9	154.9	5620.3	226.0	0.6	6007.6
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon		0.05						0.1
Dichlorvos								
Dicofol		0.13	1.8					1.9
Dieldrin								
Heptachlor		0.67		218.7	6107.0	4771.3	3.2	11100.9
Lindane								
Malathion								
Methoxychlor		0.17		11.8		16.6		28.6
cis-Permethrin		0.89	1.0	30.9				32.7
trans-Permethrin		0.50	1.7	59.7				61.9
o-Phenylphenol		0.13	0.7	714.8	1023.5	233.9		1973.0
Propoxur		0.15	0.9	691.0	1371.2	1548.7	1.5	3613.5
Benz[a]anthracene	1.57	0.14	0.3	16.5	18.6	11.1	0.4	48.7
Benzo[b]fluoranthene		0.23	0.5	15.3	15.2	8.0	0.4	39.7
Benzo[k]fluoranthene		0.11	0.4	11.4				11.9
Benzo[ghi]perylene		0.16	0.3		8.0	7.9		16.4
Benzo[a]pyrene		0.18	0.4	15.0	43.8	15.4	0.4	75.2
Chrysene		0.15	0.8	62.1	81.6	32.4	0.5	177.5
Coronene		0.19						0.2
Dibenz[a,h]anthracene		0.02						0.02
Dibenzo[a,e]pyrene		0.16						0.2
Indeno[1,2,3-cd]pyrene		0.25	0.4		7.8		0.4	8.8
PCB 105: 2,3,3',4,4'		0.03						0.03
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		0.03		3.6		6.3		10.0
PCB 153: 2,2',4,4',5,5'		0.02				3.8		3.8
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Home #5

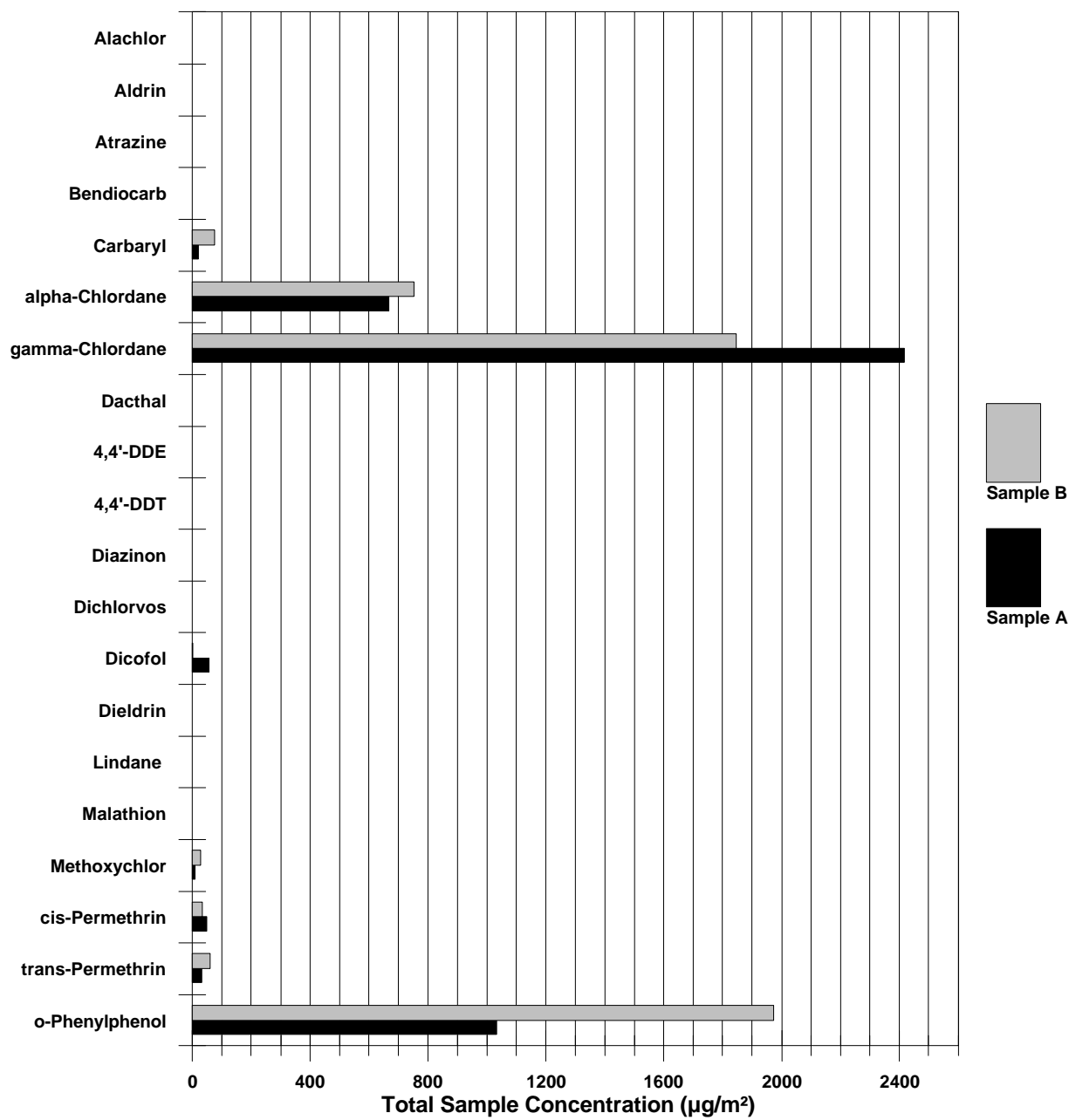


Figure 15. Total residue concentrations for samples A and B for test home 5.

(continued)

Home #5 (Cont.)

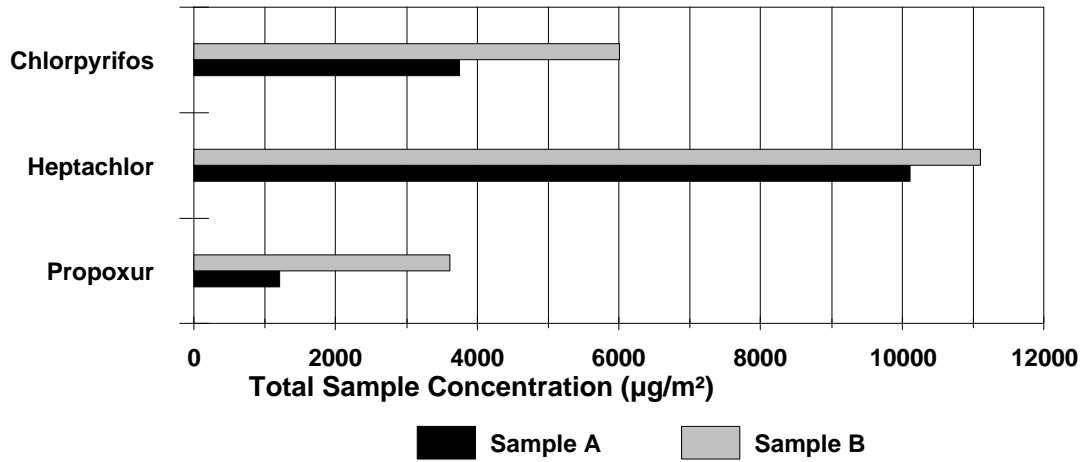


Figure 15 (continued). Total residue concentrations for samples A and B for test home 5. (continued)

Home #5 (Cont.)

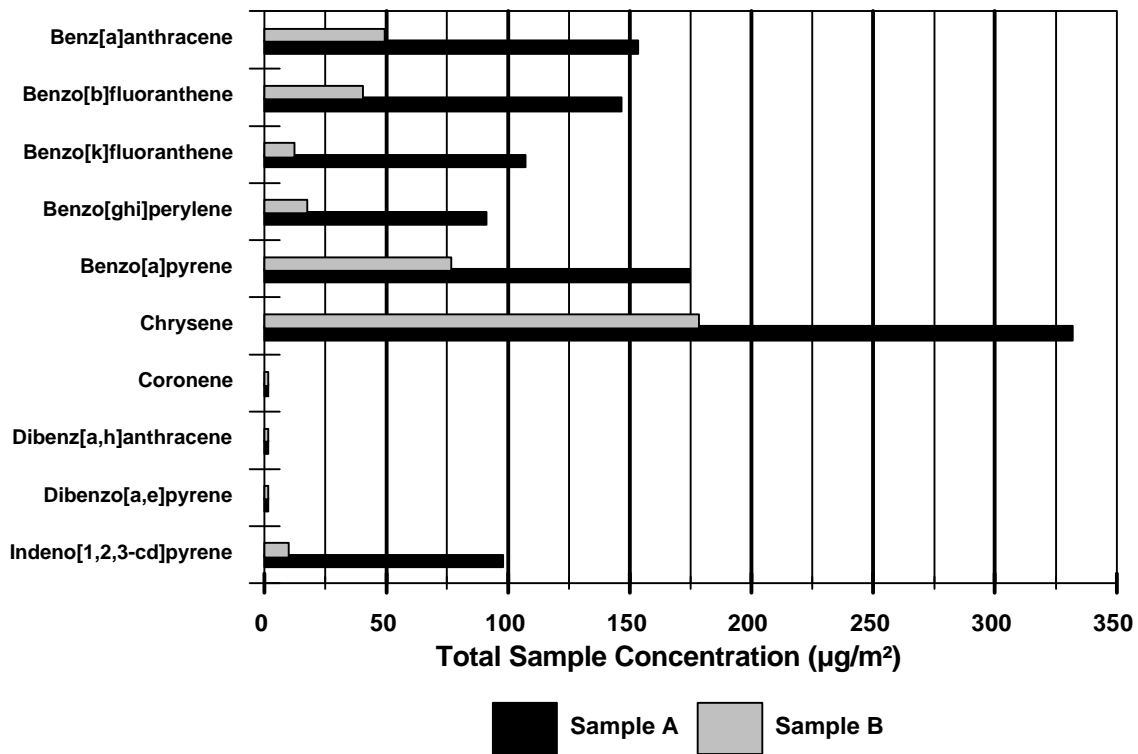


Figure 15 (continued). Total residue concentrations for samples A and B for test home 5.

Table 21. In-Home Carpet Test Results—Residue Distribution Percentage for Home 5, Sample A

Test Home: Ranch style, located in Durham, NC

Date of Test: 03/03/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	005-PA01	005-PA02	005-PA03	005-PA04	005-PA05	005-PA06	005-PA07	
Sample Wt. (g):	na	1.23	11.9	15.8	51.0	6.3	85.1	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl				100.00				100.0
alpha-Chlordane		0.06	0.14	6.61	40.23	52.96		100.0
gamma-Chlordane		0.05	0.10	5.03	32.16	62.46	0.20	100.0
Chlorpyrifos	0.14	0.10	0.45	7.29	85.42	6.48	0.12	100.0
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol		1.37	3.46	95.16				100.0
Dieldrin								
Heptachlor		0.01	0.03	1.69	56.04	42.05	0.18	100.0
Lindane								
Malathion								
Methoxychlor						100.00		100.0
cis-Permethrin		1.09	4.41	94.51				100.0
trans-Permethrin		1.11	4.17	94.73				100.0
o-Phenylphenol		0.02	0.06	23.28	59.20	17.44		100.0
Propoxur		0.04	0.19	10.38	32.31	57.07		100.0
Benz[a]anthracene		0.20	1.53	19.41	45.56	27.29	6.01	100.0
Benzo[b]fluoranthene		0.38	2.34	23.08	36.48	28.72	9.00	100.0
Benzo[k]fluoranthene		0.41	2.14	22.10	33.28	30.71	11.36	100.0
Benzo[ghi]perylene		0.50	2.80	22.64	36.36	25.94	11.76	100.0
Benzo[a]pyrene		0.28	1.61	13.40	49.66	29.89	5.16	100.0
Chrysene		0.20	1.04	21.80	49.74	23.02	4.20	100.0
Coronene			100.00					100.0
Dibenz[a,h]anthracene								
Dibenzo[a,e]pyrene								
Indeno[1,2,3-cd]pyrene		0.44	2.66	20.43	37.57	26.80	12.10	100.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		1.37		98.63				100.0
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Table 22. In-Home Carpet Test Results—Residue Distribution Percentage for Home 5, Sample B

Test Home: Ranch style, located in Durham, NC

Date of Test: 3/03/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	005-PB01	005-PB02	005-PB03	005-PB04	005-PB05	005-PB06	005-PB07	
Sample Wt. (g):	na	0.41	7.5	15.1	45.6	5.4	8.9	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl				100.00				100.0
alpha-Chlordane	0.25	0.03	0.06	10.03	41.06	48.57		100.0
gamma-Chlordane	0.12	0.03	0.06	10.50	36.69	52.56	0.04	100.0
Chlorpyrifos	0.06	0.01	0.03	2.58	93.55	3.76	0.01	100.0
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon		100.00						100.0
Dichlorvos								
Dicofol		6.66	93.34					100.0
Dieldrin								
Heptachlor		0.01		1.97	55.01	42.98	0.03	100.0
Lindane								
Malathion								
Methoxychlor		0.58		41.37		58.05		100.0
cis-Permethrin		2.71	2.95	94.34				100.0
trans-Permethrin		0.80	2.71	96.49				100.0
o-Phenylphenol		0.01	0.04	36.23	51.88	11.85		100.0
Propoxur		0.00	0.02	19.12	37.95	42.86	0.04	100.0
Benz[a]anthracene	3.24	0.29	0.66	33.91	38.31	22.77	0.81	100.0
Benzo[b]fluoranthene		0.57	1.32	38.60	38.15	20.24	1.12	100.0
Benzo[k]fluoranthene		0.92	3.44	95.64				100.0
Benzo[ghi]perylene		0.97	2.00		48.98	48.05		100.0
Benzo[a]pyrene		0.24	0.55	19.89	58.31	20.45	0.56	100.0
Chrysene		0.09	0.44	35.01	45.95	18.22	0.30	100.0
Coronene		100.00						100.0
Dibenz[a,h]anthracene		100.00						100.0
Dibenzo[a,e]pyrene		100.00						100.0
Indeno[1,2,3-cd]pyrene		2.81	4.37		88.51		4.32	100.0
PCB 105: 2,3,3',4,4'		100.00						100.0
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		0.25		36.06		63.69		100.0
PCB 153: 2,2',4,4',5,5'		0.57				99.43		100.0
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Home #5, Sample A

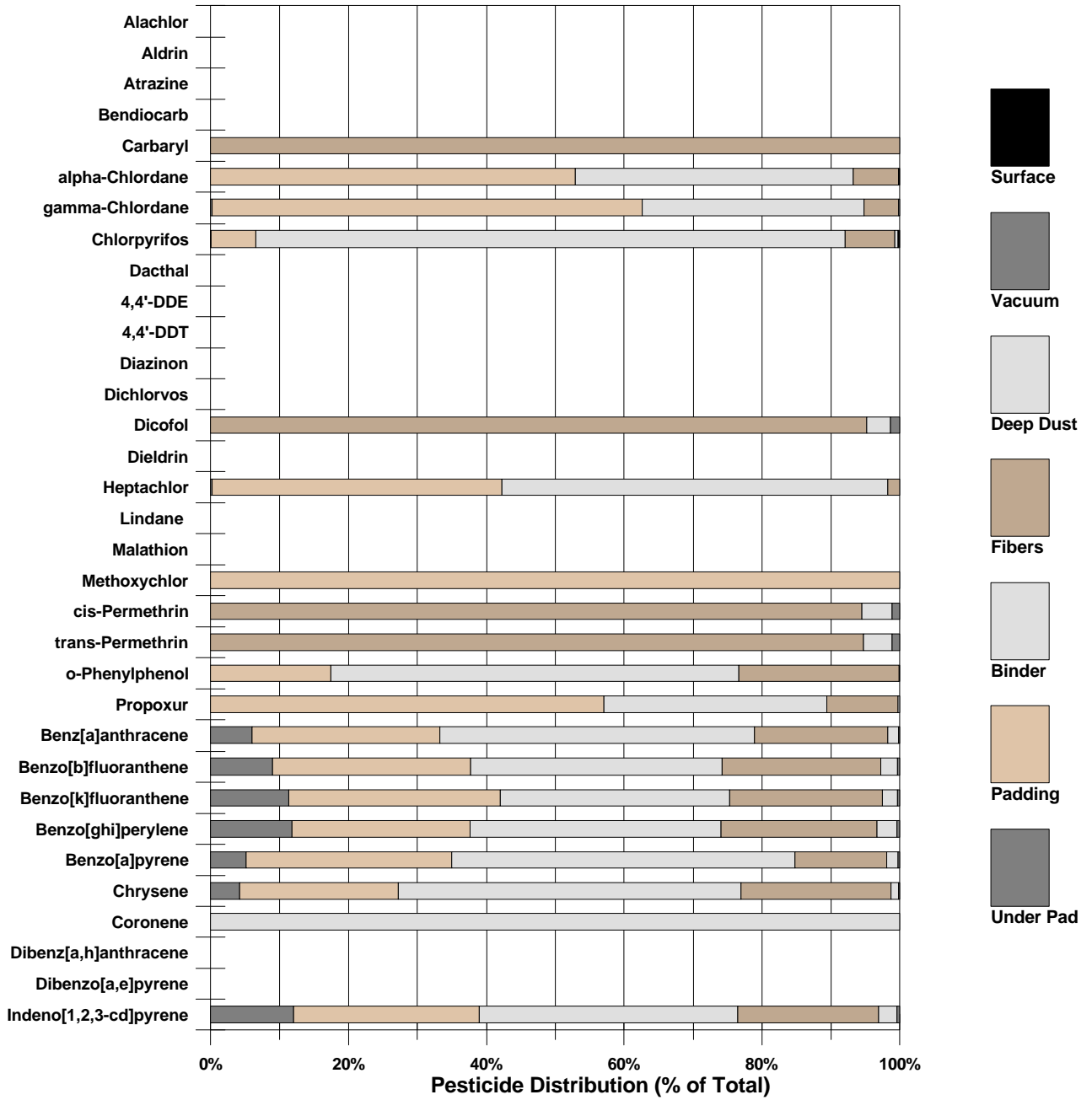


Figure 16. Pesticide residue distribution in carpet sample fractions—home 5, sample A.

Home #5, Sample B

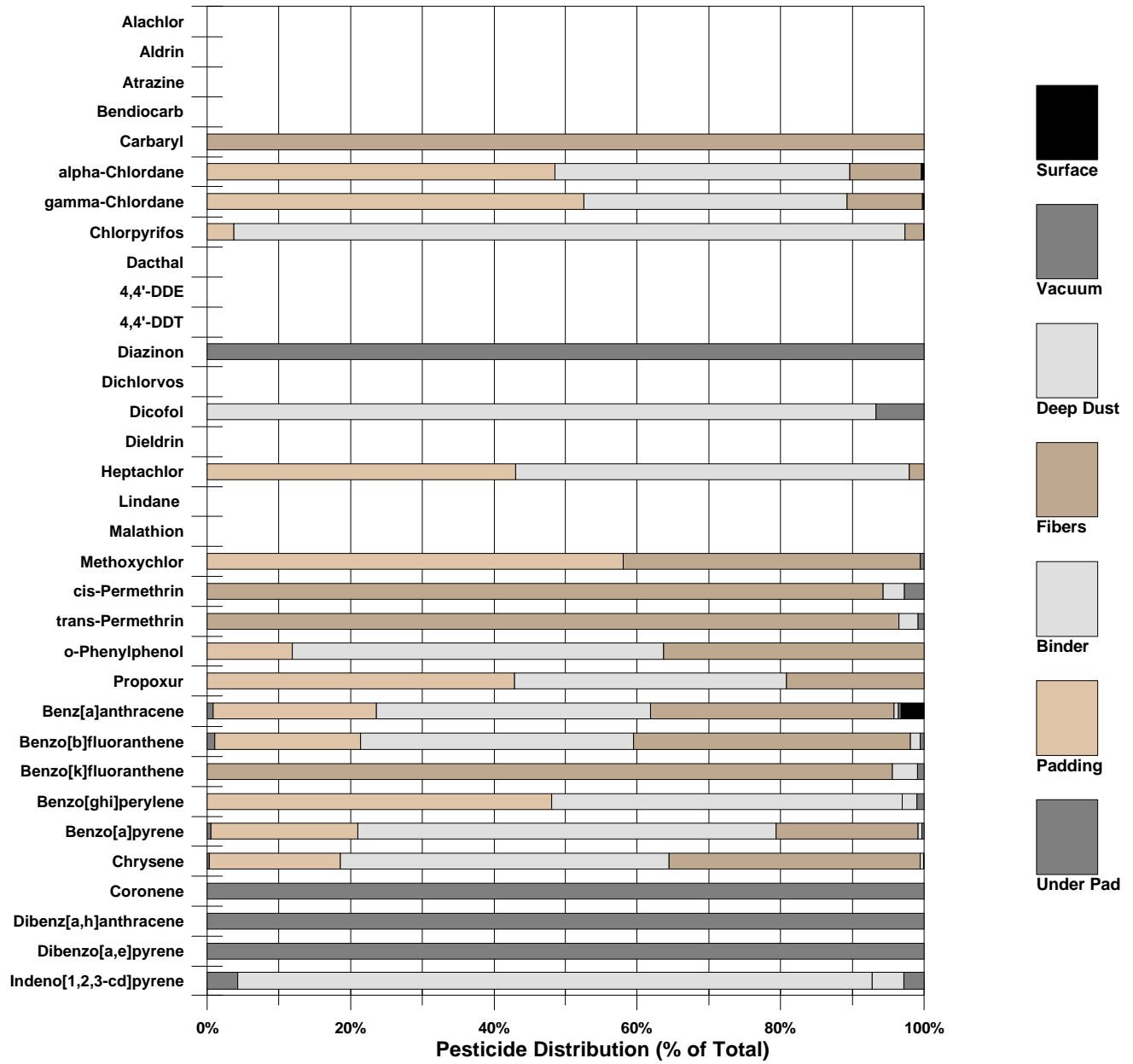


Figure 17. Pesticide residue distribution in carpet sample fractions—home 5, sample B.

4.3.6 Results of Carpet Sample Fraction Analysis for Test Home 6

Tests were conducted at a ranch-style home located in Chapel Hill, NC, on March 6, 1998. Sample A was collected from an area near the entrance to the living room and just off a vinyl floor surface leading from the main entrance. Sample B was collected from an open area in the center of the living room. A floor plan of the home with the sample locations shown schematically is presented in Figure 18.

The vacuum-dislodgeable dust screening sample that was collected from the area located near the center of the living room (sample B) was sieved to separate coarse particles from fine particles at a cut point of 150 μm in geometric diameter. The fine sample fraction was analyzed, and those results were presented earlier in Table 3.

Due to limited resources, a maximum of six homes were to be selected for complete sample fraction analysis from the pool of eight homes that were tested. After reviewing the screening sample analysis results, and taking into consideration the location of these samples relative to the main entrance of the home, the decision was made to exclude home 6 (along with home 2) from the pool of six homes selected for complete analysis of test samples collected.

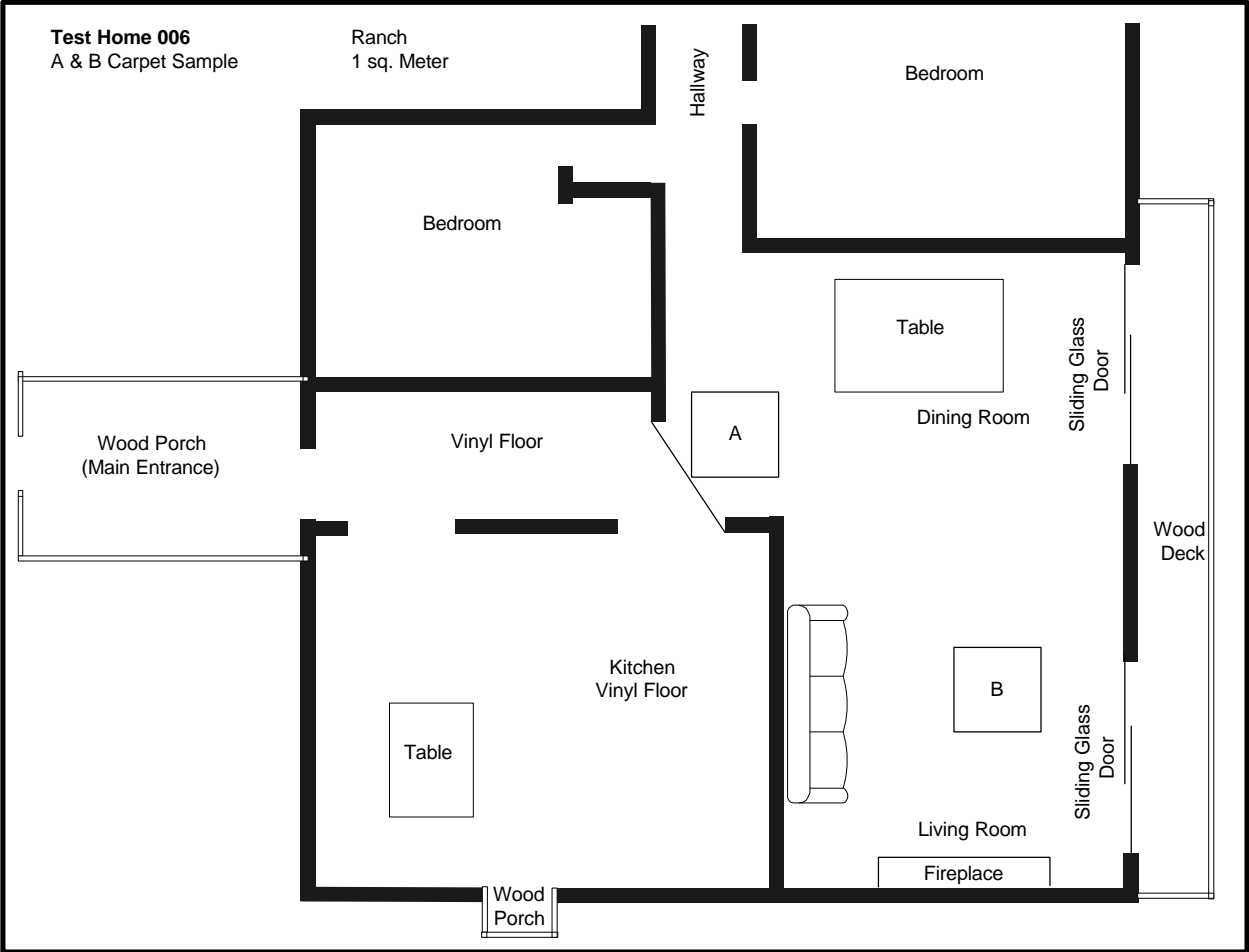


Figure 18. Representation of floor plan for test home 6.

4.3.7 Results of Carpet Sample Fraction Analysis for Test Home 7

The following tables and figures present the reduced analytical data for tests that were conducted at a two-story-style home located in Raleigh, NC. The sampling was performed on March 7, 1998. Sample A was collected from an area a short distance inside the front main entrance to the home (at the edge of the living room), and sample B was collected from an area near the center of the living room. A floor plan of the home with the sample locations shown schematically is presented in Figure 19.

The vacuum-dislodgeable dust screening sample that was collected from the area located in the center of the living room (sample B) was sieved to separate coarse particles from fine particles at a cut point of 150 μm in geometric diameter. Both the coarse and fine sample fractions were analyzed, and those results are presented in Table 23 below.

The analytical results in terms of target analyte concentration per unit area for neutral pesticides, PAHs, and PCBs for all seven sample fractions collected from each of the two carpet sections in test home 7 are presented in Tables 24 and 25. The total sample concentration results for each target analyte for both sample A and sample B are presented graphically in Figure 20. The sample results are also presented in terms of the percentage contribution of each individual sample fraction to the total sample concentration for each target analyte. Those results are shown in Tables 26 and 27, and the same data are presented graphically in Figures 21 and 22.

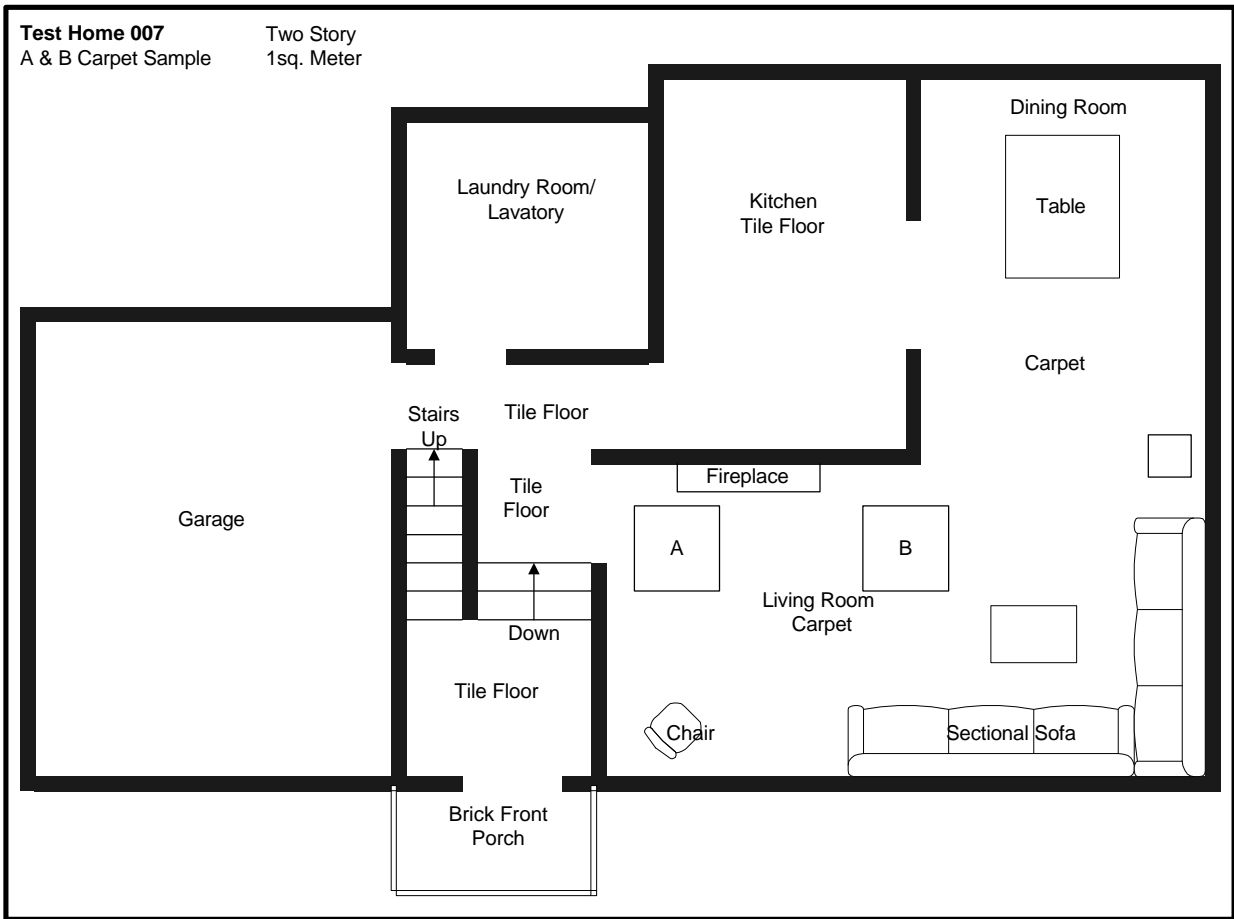


Figure 19. Representation of floor plan for test home 7.

Table 24. In-Home Carpet Test Results—Sample Residue Concentrations for Home 7, Sample A

Test Home: Two-story style, located in Raleigh, NC

Date of Test: 03/07/98

Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	007-PA01	007-PA02	007-PA03	007-PA04	007-PA05	007-PA06	007-PA07	
Sample Wt. (g):	na	0.78	8.4	15.5	29.4	13.1	60.6	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl		0.37	2.5	706.0	109.6	78.7	3.6	900.7
alpha-Chlordane		0.55	1.0	58.6	319.2	476.4	6.1	861.9
gamma-Chlordane		0.66	1.1	71.0	365.3	1100.4	6.7	1545.1
Chlorpyrifos	1.13	1.07	7.3	215.8	2481.9	3571.7	37.3	6316.2
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol								
Dieldrin								
Heptachlor		0.18			516.1	1410.1	23.2	1949.6
Lindane		0.14	3.3					3.4
Malathion								
Methoxychlor		3.18	1.7	248.0	19.9		2.8	275.6
cis-Permethrin		31.79	73.1	5958.6	6814.7	603.9	91.0	13572.9
trans-Permethrin	1.43	41.06	86.6	8493.6	7568.6	806.4	122.9	17120.7
o-Phenylphenol		1.69	8.7	11517.1	7299.0	86972.5	106.1	105905.1
Propoxur		0.11		278.5	171.6	1225.9	3.8	1679.9
Benz[a]anthracene		1.52	9.3	49.0	63.7	47.7	62.0	233.3
Benzo[b]fluoranthene		3.95	18.0	116.7	118.2	47.2	109.3	413.2
Benzo[k]fluoranthene		2.32	12.1	77.9	73.3	36.6	74.9	277.1
Benzo[ghi]perylene		2.20	9.6	57.7	68.2	29.5	67.0	234.2
Benzo[a]pyrene		2.12	10.5	58.9	74.5	35.7	70.1	251.9
Chrysene		3.25	17.2	145.0	121.5	69.8	107.1	463.8
Coronene		0.50	1.9	14.3	17.3		13.2	47.3
Dibenz[a,h]anthracene		0.42	1.9	9.9	12.6	7.8	15.2	47.7
Dibenzo[a,e]pyrene		0.38	1.9	9.7	13.1		13.4	38.5
Indeno[1,2,3-cd]pyrene		2.41	10.7	69.7	68.9	30.6	74.7	257.1
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Table 25. In-Home Carpet Test Results—Sample Residue Concentrations for Home 7, Sample B

Test Home: Two-story style, located in Raleigh, NC

Date of Test: 03/07/98

Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	007-PB01	007-PB02	007-PB03	007-PB04	007-PB05	007-PB06	007-PB07	
Sample Wt. (g):	na	0.61	14.7	14.5	31.3	11.2	4.4	
Alachlor								
Aldrin						127.9		127.9
Atrazine								
Bendiocarb				437.4				437.4
Carbaryl		2.60	69.5	5459.1	857.8	1594.6	20.0	8003.6
alpha-Chlordane		0.51	1.8	61.5	325.0	411.0	0.2	800.1
gamma-Chlordane		0.67	2.1	75.6	371.8	786.1	0.3	1236.6
Chlorpyrifos	0.93	1.97	18.2	490.2	11404.0	9493.9	8.4	21417.7
Dacthal								
4,4'-DDE								
4,4'-DDT					48.9			48.9
Diazinon								
Dichlorvos								
Dicofol								
Dieldrin								
Heptachlor					578.5	1539.7	0.9	2119.2
Lindane								
Malathion								
Methoxychlor		2.44	4.5	419.1		18.6	0.8	445.4
cis-Permethrin		34.81	330.9	6643.7	17759.1	2652.4	10.1	27431.1
trans-Permethrin	0.75	46.01	411.7	9053.1	19801.5	3536.5	14.6	32864.2
o-Phenylphenol		1.06	8.2	4792.0	1798.2	8841.4	1.0	15441.7
Propoxur		0.10	2.0	242.1	160.9	1141.8	0.2	1547.2
Benz[a]anthracene		2.32	62.4	80.8	198.3	183.1	19.6	546.5
Benzo[b]fluoranthene		4.89	123.1	183.9	236.7	281.9	35.0	865.5
Benzo[k]fluoranthene		2.20	62.8	126.1	142.0	218.2	18.3	569.7
Benzo[ghi]perylene		2.98	70.0	96.1	122.0	191.4	23.6	506.0
Benzo[a]pyrene		2.72	69.7	91.1	188.3	198.9	30.3	581.1
Chrysene		4.01	114.2	202.4	254.6	322.4	34.0	931.6
Coronene		2.50	14.3	22.1	30.5	40.0	5.4	114.7
Dibenz[a,h]anthracene		0.60	15.5	18.1	29.5	42.6	5.1	111.4
Dibenzo[a,e]pyrene		0.79	14.2	16.7	27.3	40.2	5.3	104.5
Indeno[1,2,3-cd]pyrene		3.01	129.3	108.9	228.8	219.3	46.8	736.1
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5'								
PCB 138: 2,2',3,4,4',5'						3.3		3.3
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5'								
PCB 180: 2,2',3,4,4',5,5'								

Home #7

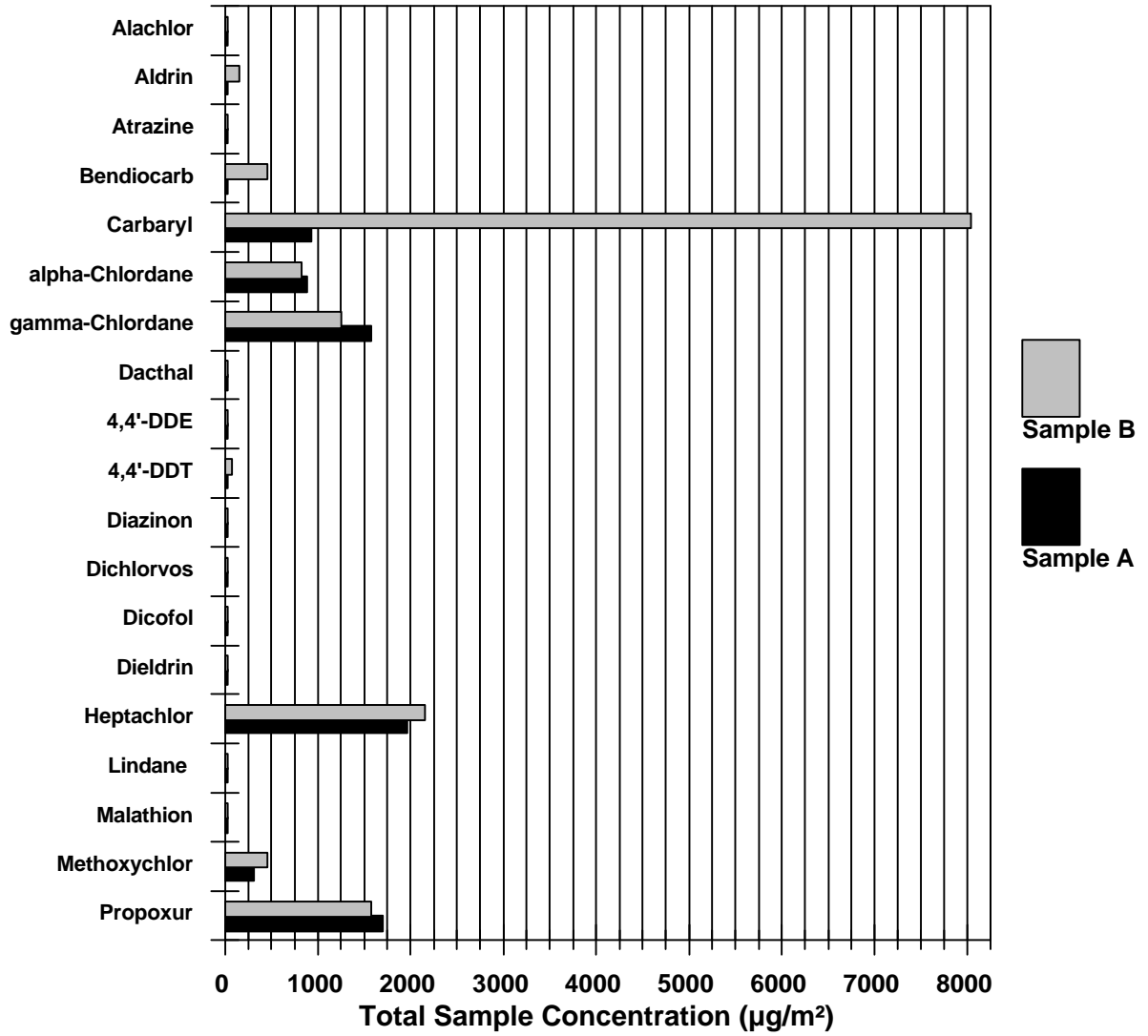


Figure 20. Total residue concentrations for samples A and B for test home 7.

(continued)

Home #7 (Cont.)

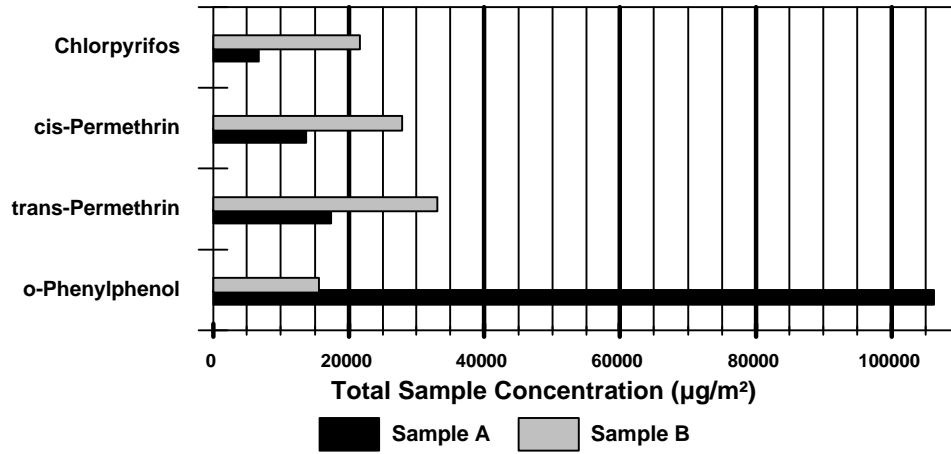


Figure 20 (continued). Total residue concentrations for samples A and B for test home 7.

(continued)

Home #7 (Cont.)

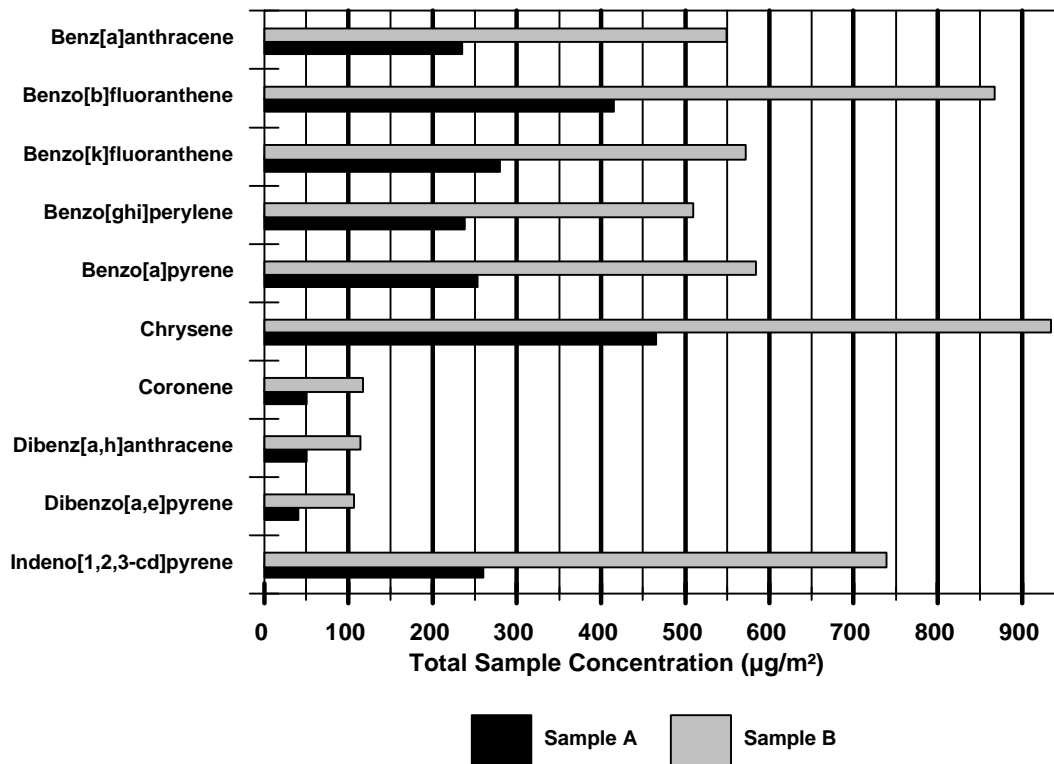


Figure 20 (continued). Total residue concentrations for samples A and B for test home 7.

Table 26. In-Home Carpet Test Results—Residue Distribution Percentage for Home 7, Sample A

Test Home: Two-story style, located in Raleigh, NC

Date of Test : 03/07/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	007-PA01	007-PA02	007-PA03	007-PA04	007-PA05	007-PA06	007-PA07	
Sample Wt. (g):	na	0.78	8.4	15.5	29.4	13.1	60.6	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl		0.04	0.28	78.38	12.17	8.73	0.40	100.0
alpha-Chlordane		0.06	0.11	6.80	37.04	55.28	0.71	100.0
gamma-Chlordane		0.04	0.07	4.59	23.64	71.22	0.43	100.0
Chlorpyrifos	0.02	0.02	0.12	3.42	39.29	56.55	0.59	100.0
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol								
Dieldrin								
Heptachlor		0.01			26.47	72.33	1.19	100.0
Lindane		3.95	96.05					100.0
Malathion								
Methoxychlor		1.15	0.61	89.98	7.22		1.03	100.0
cis-Permethrin		0.23	0.54	43.90	50.21	4.45	0.67	100.0
trans-Permethrin	0.01	0.24	0.51	49.61	44.21	4.71	0.72	100.0
o-Phenylphenol		0.002	0.01	10.87	6.89	82.12	0.10	100.0
Propoxur		0.01		16.58	10.21	72.98	0.23	100.0
Benz[a]anthracene		0.65	3.99	21.02	27.31	20.46	26.57	100.0
Benzo[b]fluoranthene		0.95	4.35	28.23	28.60	11.42	26.44	100.0
Benzo[k]fluoranthene		0.84	4.36	28.11	26.46	13.21	27.03	100.0
Benzo[ghi]perylene		0.94	4.08	24.64	29.13	12.60	28.61	100.0
Benzo[a]pyrene		0.84	4.15	23.40	29.59	14.18	27.84	100.0
Chrysene		0.70	3.70	31.26	26.19	15.06	23.09	100.0
Coronene		1.07	4.09	30.34	36.56		27.95	100.0
Dibenz[a,h]anthracene		0.87	3.95	20.78	26.34	16.30	31.76	100.0
Dibenzo[a,e]pyrene		0.99	4.81	25.32	34.04		34.83	100.0
Indeno[1,2,3-cd]pyrene		0.94	4.16	27.13	26.82	11.90	29.06	100.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Table 27. In-Home Carpet Test Results—Residue Distribution Percentage for Home 7, Sample B

Test Home: Two-story style, located in Raleigh, NC

Date of Test : 03/07/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	007-PB01	007-PB02	007-PB03	007-PB04	007-PB05	007-PB06	007-PB07	
Sample Wt. (g):	na	0.61	14.7	14.5	31.3	11.2	4.4	
Alachlor								
Aldrin						100.00		100.0
Atrazine								
Bendiocarb				100.00				100.0
Carbaryl		0.03	0.87	68.21	10.72	19.92	0.25	100.0
alpha-Chlordane		0.06	0.22	7.69	40.62	51.37	0.03	100.0
gamma-Chlordane		0.05	0.17	6.11	30.07	63.57	0.02	100.0
Chlorpyrifos	0.004	0.01	0.09	2.29	53.25	44.33	0.04	100.0
Dacthal								
4,4'-DDE								
4,4'-DDT					100.00			100.0
Diazinon								
Dichlorvos								
Dicofol								
Dieldrin								
Heptachlor					27.30	72.66	0.04	100.0
Lindane								
Malathion								
Methoxychlor		0.55	1.01	94.09		4.17	0.17	100.0
cis-Permethrin		0.13	1.21	24.22	64.74	9.67	0.04	100.0
trans-Permethrin	0.002	0.14	1.25	27.55	60.25	10.76	0.04	100.0
o-Phenylphenol		0.01	0.05	31.03	11.64	57.26	0.01	100.0
Propoxur		0.01	0.13	15.65	10.40	73.80	0.01	100.0
Benz[a]anthracene		0.42	11.42	14.78	36.28	33.51	3.59	100.0
Benzo[b]fluoranthene		0.57	14.23	21.25	27.34	32.57	4.04	100.0
Benzo[k]fluoranthene		0.39	11.02	22.14	24.93	38.31	3.22	100.0
Benzo[ghi]perylene		0.59	13.83	18.98	24.11	37.82	4.66	100.0
Benzo[a]pyrene		0.47	12.00	15.67	32.40	34.24	5.22	100.0
Chrysene		0.43	12.26	21.73	27.32	34.61	3.65	100.0
Coronene		2.18	12.42	19.23	26.59	34.86	4.72	100.0
Dibenz[a,h]anthracene		0.54	13.90	16.29	26.44	38.26	4.57	100.0
Dibenzo[a,e]pyrene		0.76	13.59	16.00	26.17	38.45	5.03	100.0
Indeno[1,2,3-cd]pyrene		0.41	17.57	14.79	31.08	29.79	6.36	100.0
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'						100.00		100.0
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

Home #7, Sample A

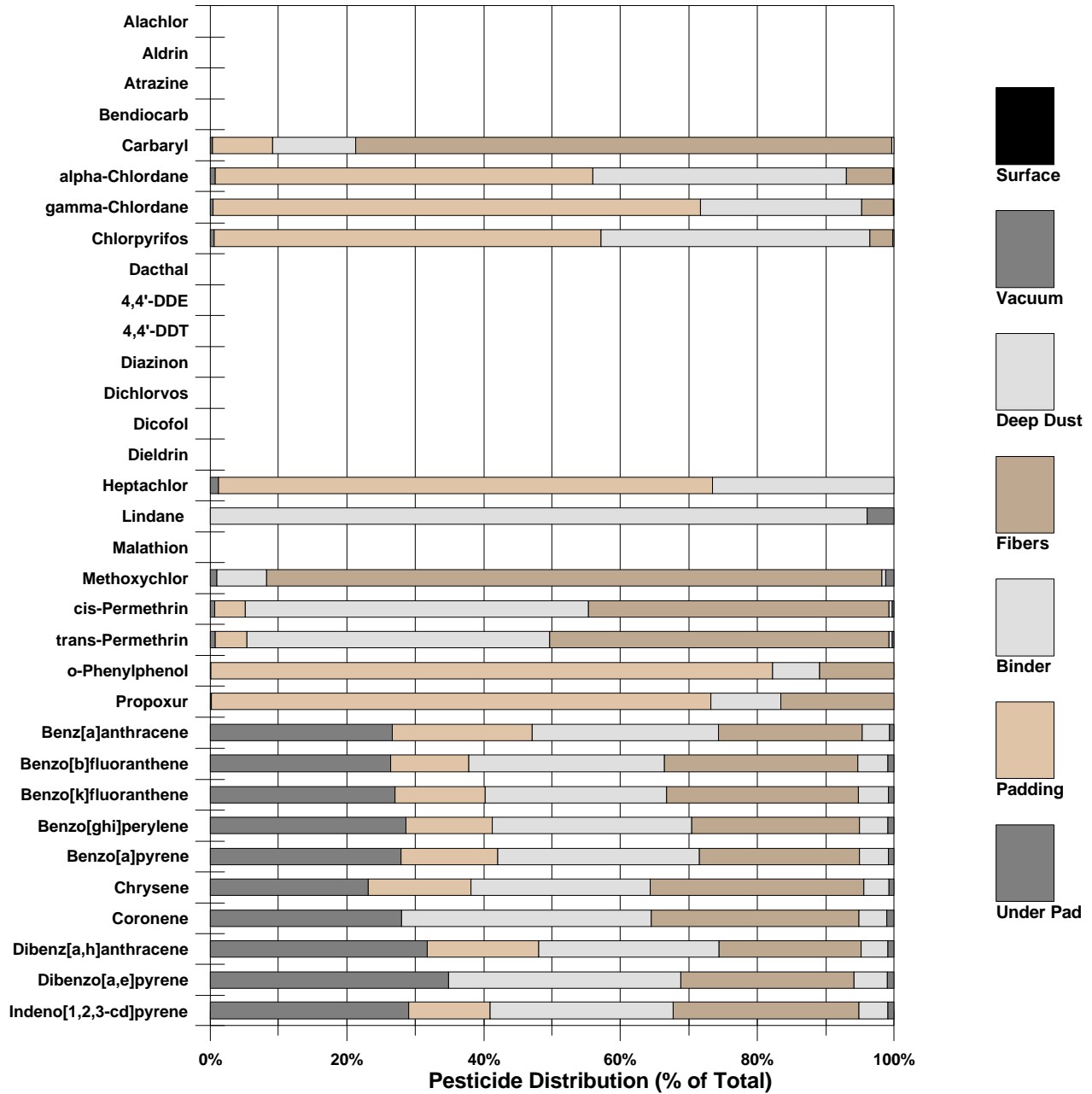


Figure 21. Pesticide residue distribution in carpet sample fractions—home 7, sample A.

Home #7, Sample B

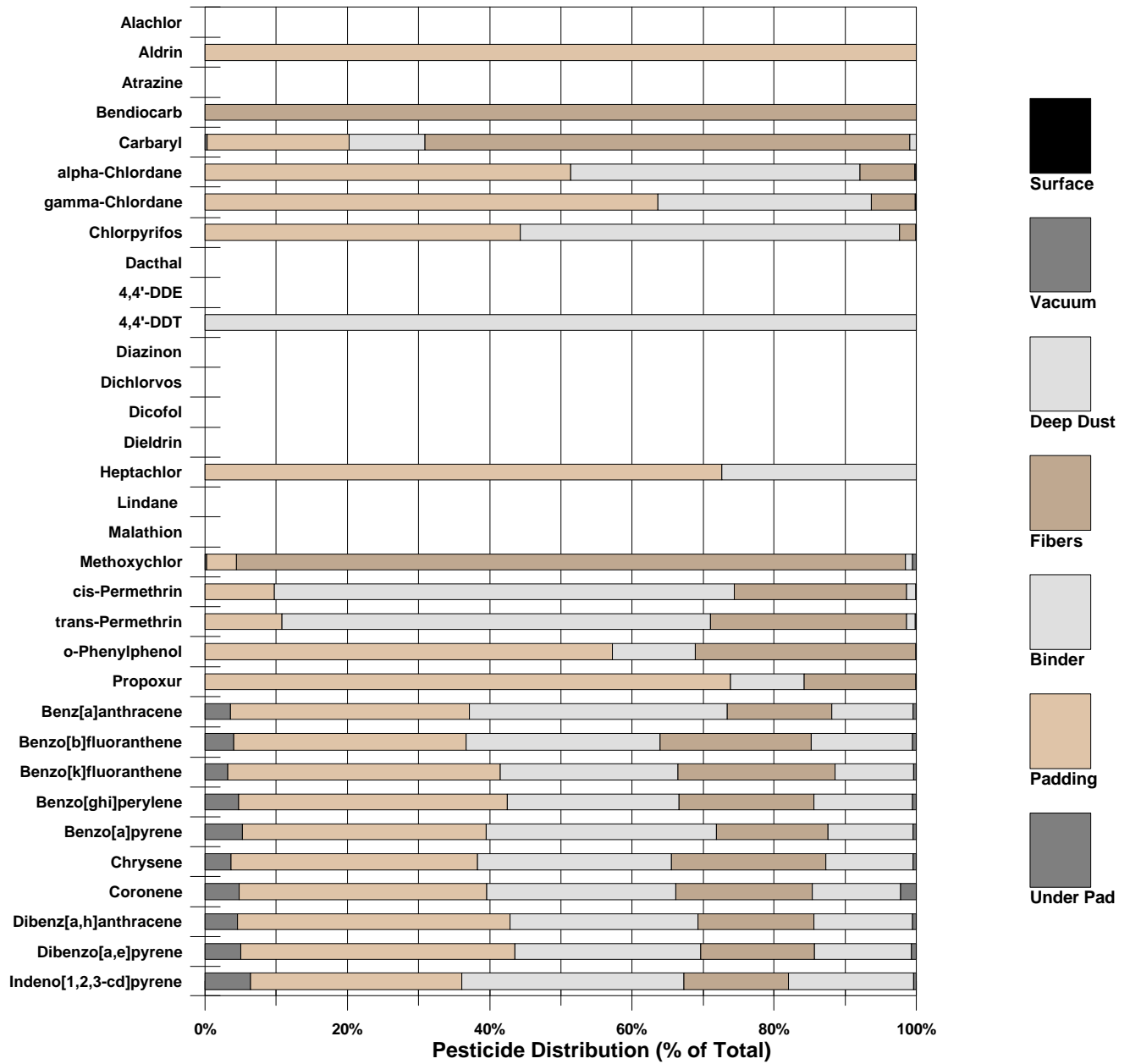


Figure 22. Pesticide residue distribution in carpet sample fractions—home 7, sample B.

4.3.8 Results of Carpet Sample Fraction Analysis for Test Home 8

The following tables and figures present the reduced analytical data for tests that were conducted at a split-level-style home located in Raleigh, NC. The sampling was performed on May 12, 1998. Sample A was collected from an area just inside the front main entrance to the home, and sample B was collected from a central location between the foyer and the kitchen on the same level as the main entrance. A floor plan of the home with the sample locations shown schematically is presented in Figure 23. This home was one of the two homes that were tested from which additional carpet samples were collected for use in other studies that are currently ongoing. The two additional samples are indicated in the floor plan representation by the crosshatched rectangles that are labeled A' and B'.

The vacuum-dislodgeable dust screening sample that was collected from the area located in the center of the living room (sample B) was sieved to separate coarse particles from fine particles at a cut point of 150 μm in geometric diameter. Both the coarse and fine sample fractions were analyzed, and those results are presented in Table 28.

The analytical results in terms of target analyte concentration per unit area for neutral pesticides, PAHs, and PCBs for all seven sample fractions collected from each of the two carpet sections in test home 8 are presented in Tables 29 and 30. The total sample concentration results for each target analyte for both sample A and sample B are presented graphically in Figure 24. The sample results are also presented in terms of the percentage contribution of each individual sample fraction to the total sample concentration for each target analyte. Those results are shown in Tables 31 and 32, and the same data are presented graphically in Figures 25 and 26.

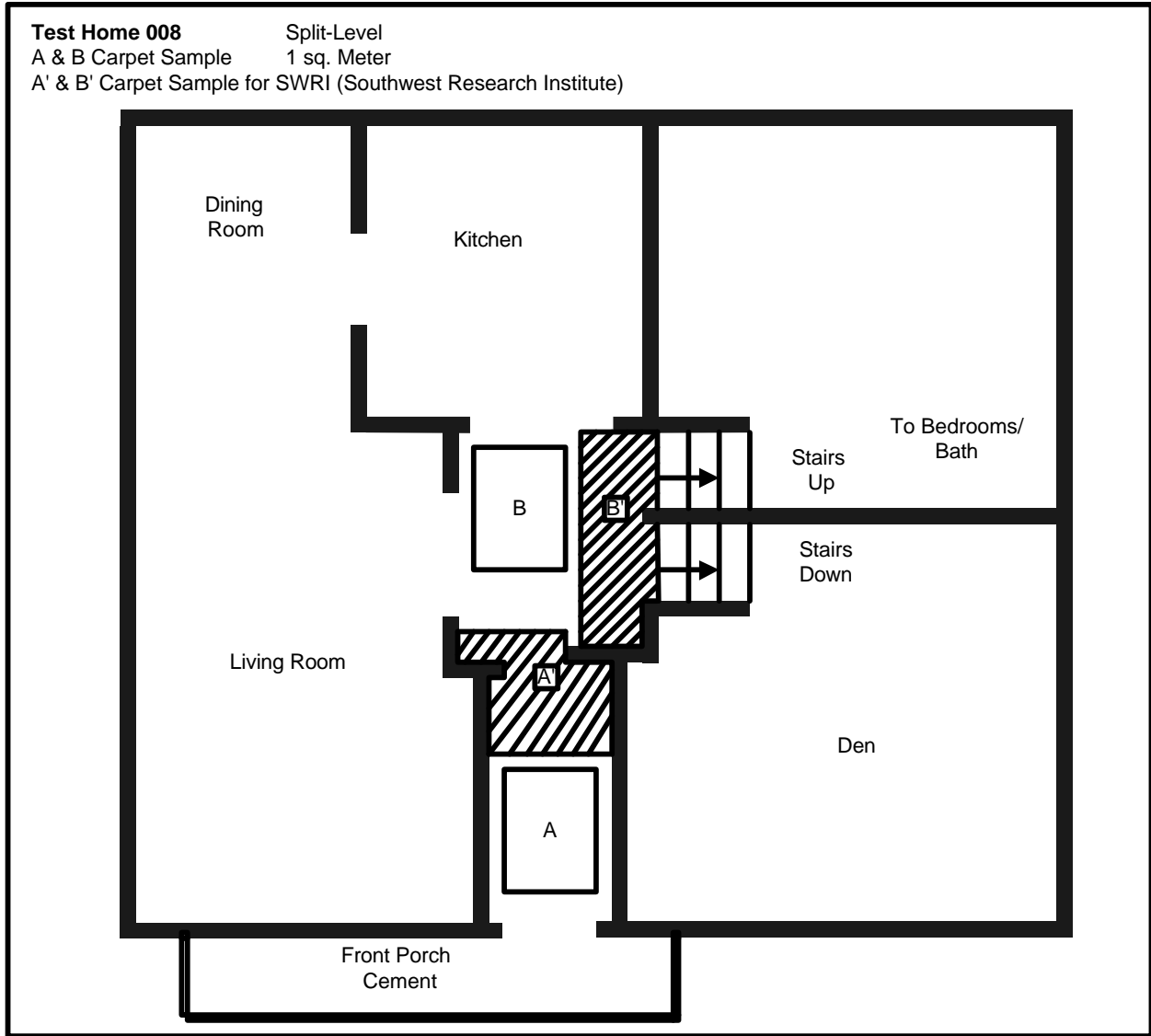


Figure 23. Representation of floor plan for test home 8.

Table 29. In-Home Carpet Test Results—Sample Residue Concentrations for Home 8, Sample A

Test Home: Split-level style, located in Raleigh, NC

Date of Test: 5/12/98

Carpet Sample Fraction Analysis Results (µg/m²)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	008-PA01	008-PA02	008-PA03	008-PA04	008-PA05	008-PA06	008-PA07	
Sample Wt. (g):	na	33.04	366.9	22.3	56.3	42.6	3.1	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl		3.34	34.9	42.9				81.1
alpha-Chlordane		27.22	150.4	90.9	464.5	899.2	3.7	1635.9
gamma-Chlordane		70.34	366.4	216.8	1752.7	2598.8	9.5	5014.4
Chlorpyrifos	3.75	15.10	215.9	147.6	192.4			574.8
Dacthal		6.77	67.7	88.4	569.6	3701.2	0.7	4434.3
4,4'-DDE								
4,4'-DDT								
Diazinon		122.15	849.0	2397.0	42134.5	348919.6	13.3	394435.5
Dichlorvos				66.1				66.1
Dicofol								
Dieldrin								
Heptachlor		162.62	710.0	629.1	10490.9	46366.6	10.0	58369.2
Lindane								
Malathion								
Methoxychlor		5.45	41.7	32.4	91.7			171.2
cis-Permethrin								
trans-Permethrin								
o-Phenylphenol		29.24	196.5	325.2	1393.7	1678.3	0.9	3623.9
Propoxur			33.8				0.9	34.7
Benz[a]anthracene		17.54	120.2	93.2	235.4		0.4	466.7
Benzo[b]fluoranthene		47.15	224.9	197.6	359.1		0.4	829.1
Benzo[k]fluoranthene		24.81	158.0	105.1	254.5		0.3	542.7
Benzo[ghi]perylene		32.25	139.3	79.0	313.7		0.3	564.5
Benzo[a]pyrene		34.86	172.4	95.3	245.6		0.4	548.5
Chrysene		38.36	231.4	240.9	588.9		0.7	1100.4
Coronene		10.80	42.8	17.1	110.9			181.6
Dibenz[a,h]anthracene		5.25	26.3	17.8	68.0			117.3
Dibenzo[a,e]pyrene		6.54	21.6	11.4	55.9			95.4
Indeno[1,2,3-cd]pyrene		29.87	135.3	88.4	345.5		0.2	599.3
PCB 105: 2,3,3',4,4'			30.2				0.3	30.6
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		2.31	82.1	25.2			1.0	110.6
PCB 153: 2,2',4,4',5,5'		1.52	42.5	14.8			0.6	59.4
PCB 170: 2,2',3,3',4,4',5			10.8				0.1	10.9
PCB 180: 2,2',3,4,4',5,5'			12.6	5.7			0.1	18.4

Table 30. In-Home Carpet Test Results—Sample Residue Concentrations for Home 8, Sample B

Test Home: Split-level style, located in Raleigh, NC

Date of Test: 05/12/98

Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	008-PB01	008-PB02	008-PB03	008-PB04	008-PB05	008-PB06	008-PB07	
Sample Wt. (g):	na	16.95	217.2	24.2	61.4	42.8	1.2	
Alachlor								
Aldrin		0.95						1.0
Atrazine								
Bendiocarb								
Carbaryl		2.71	60.4	132.4				195.5
alpha-Chlordane		9.03	66.1	183.9	509.7	645.0	0.3	1414.0
gamma-Chlordane	0.98	25.54	174.7	390.9	1312.7	1508.0	0.9	3413.6
Chlorpyrifos	1.34	10.28	240.8	305.1	304.7		0.2	862.4
Dacthal		0.98	20.0	113.0	289.9	838.3	0.1	1262.4
4,4'-DDE								
4,4'-DDT		4.49						4.5
Diazinon		45.25	999.1	969.7	9360.3	27856.8	40.7	39271.9
Dichlorvos		3.23						3.2
Dicofol		1.39						1.4
Dieldrin								
Heptachlor	1.93	58.58	506.1	942.0	14070.6	27373.5	12.1	42964.7
Lindane		0.53						0.5
Malathion								
Methoxychlor		0.64	67.2	686.7	292.5			1047.0
cis-Permethrin								
trans-Permethrin		1.82						1.8
o-Phenylphenol	0.93	15.05	342.3	1178.0	1196.2	671.4	0.6	3404.4
Propoxur		1.63	14.7					16.3
Benz[a]anthracene		4.39	63.5	147.4	119.1		0.2	334.6
Benzo[b]fluoranthene		12.15	101.1	564.3	143.6			821.1
Benzo[k]fluoranthene		4.72	47.3	611.2	74.4			737.7
Benzo[ghi]perylene		8.92	62.1	139.7	75.3			286.0
Benzo[a]pyrene		7.01	79.8	176.2	97.2			360.2
Chrysene		14.23	101.5	499.1	282.0		0.4	897.2
Coronene		3.33	15.6	33.1				52.0
Dibenz[a,h]anthracene		1.11	15.6	42.4				59.0
Dibenzo[a,e]pyrene		2.81	9.6	44.3				56.7
Indeno[1,2,3-cd]pyrene		8.27	99.6	177.1	99.8			384.8
PCB 105: 2,3,3',4,4'		0.24	11.8	86.0	82.4			180.5
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		1.68	42.2	193.1	243.4			480.5
PCB 153: 2,2',4,4',5,5'		0.97	26.2	89.7	153.2			270.2
PCB 170: 2,2',3,3',4,4',5		0.22	4.7	21.7	15.8			42.4
PCB 180: 2,2',3,4,4',5,5'			10.0	36.5	62.2			108.7

Home #8

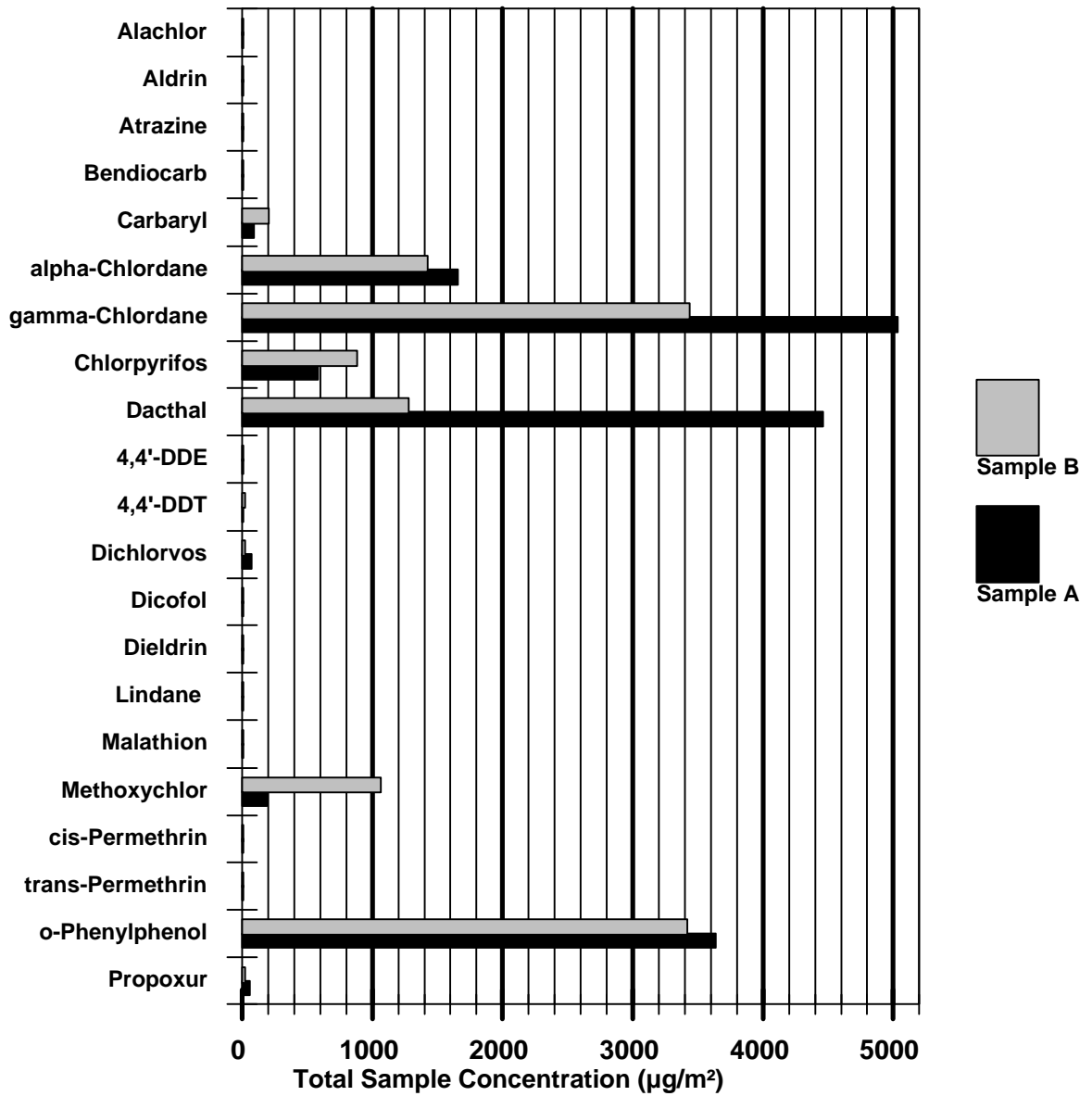


Figure 24. Total residue concentrations for samples A and B for test home 8.

(continued)

Home #8 (Cont.)

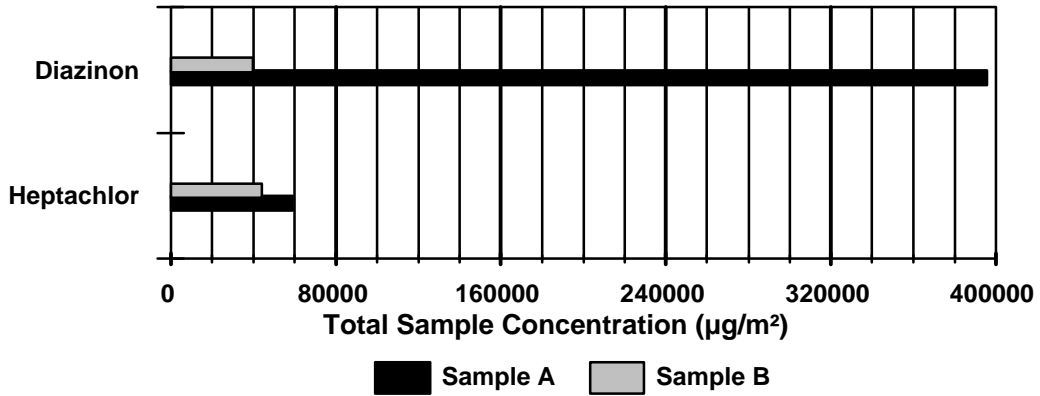


Figure 24 (continued). Total residue concentrations for samples A and B for test home 8. (continued)

Home #8 (Cont.)

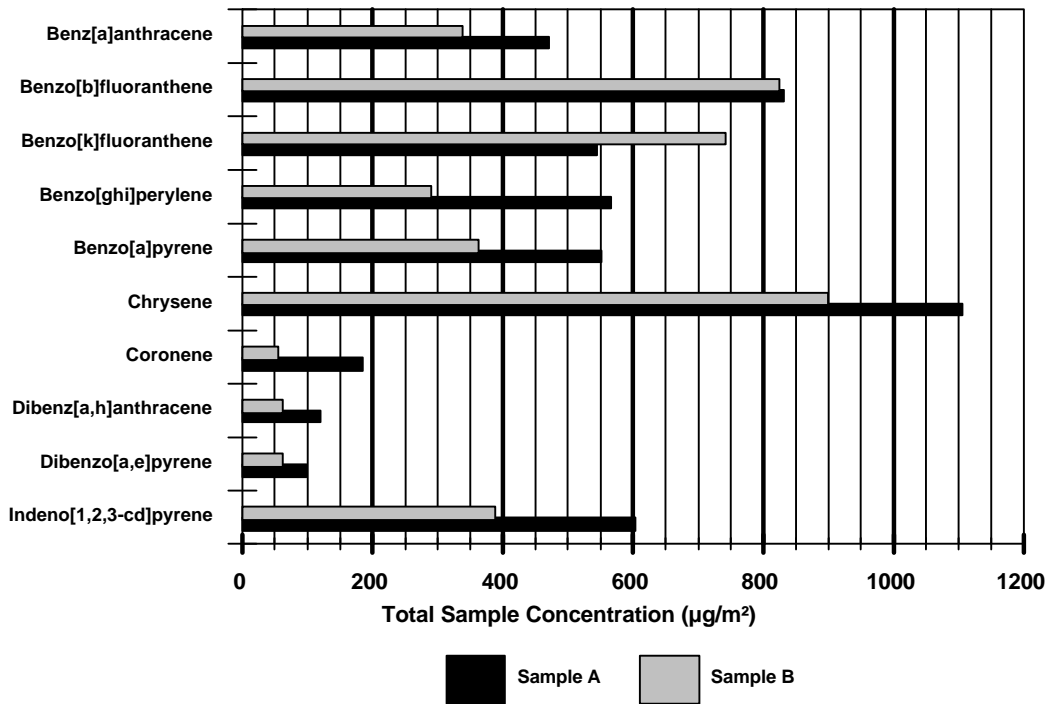


Figure 24 (continued). Total residue concentrations for samples A and B for test home 8.

Table 31. In-Home Carpet Test Results—Residue Distribution Percentage for Home 8, Sample A

Test Home: Split-level style, located in Raleigh, NC

Date of Test: 05/12/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
Sample ID:	008-PA01	008-PA02	008-PA03	008-PA04	008-PA05	008-PA06	008-PA07	
Sample Wt. (g):	na	33.04	366.9	22.3	56.3	42.6	3.1	
Alachlor								
Aldrin								
Atrazine								
Bendiocarb								
Carbaryl		4.11	43.04	52.84				100.0
alpha-Chlordane		1.66	9.20	5.55	28.39	54.97	0.22	100.0
gamma-Chlordane		1.40	7.31	4.32	34.95	51.83	0.19	100.0
Chlorpyrifos	0.65	2.63	37.57	25.68	33.48			100.0
Dacthal		0.15	1.53	1.99	12.85	83.47	0.02	100.0
4,4'-DDE								
4,4'-DDT								
Diazinon		0.03	0.22	0.61	10.68	88.46	0.00	100.0
Dichlorvos				100.00				100.0
Dicofol								
Dieldrin								
Heptachlor		0.28	1.22	1.08	17.97	79.44	0.02	100.0
Lindane								
Malathion								
Methoxychlor		3.18	24.38	18.90	53.53			100.0
cis-Permethrin								
trans-Permethrin								
o-Phenylphenol		0.81	5.42	8.97	38.46	46.31	0.02	100.0
Propoxur			97.48				2.52	100.0
Benz[a]anthracene		3.76	25.76	19.97	50.44		0.08	100.0
Benzo[b]fluoranthene		5.69	27.13	23.83	43.31		0.04	100.0
Benzo[k]fluoranthene		4.57	29.11	19.37	46.90		0.05	100.0
Benzo[ghi]perylene		5.71	24.67	13.99	55.58		0.05	100.0
Benzo[a]pyrene		6.36	31.43	17.38	44.77		0.07	100.0
Chrysene		3.49	21.03	21.90	53.52		0.07	100.0
Coronene		5.95	23.58	9.40	61.08			100.0
Dibenz[a,h]anthracene		4.48	22.39	15.16	57.97			100.0
Dibenzo[a,e]pyrene		6.86	22.63	11.93	58.59			100.0
Indeno[1,2,3-cd]pyrene		4.98	22.58	14.75	57.65		0.04	100.0
PCB 105: 2,3,3',4,4'			98.87				1.13	100.0
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		2.09	74.16	22.82			0.93	100.0
PCB 153: 2,2',4,4',5,5'		2.56	71.55	24.87			1.03	100.0
PCB 170: 2,2',3,3',4,4',5			99.37				0.63	100.0
PCB 180: 2,2',3,4,4',5,5'			68.38	30.89			0.73	100.0

Table 32. In-Home Carpet Test Results—Residue Distribution Percentage for Home 8, Sample B

Test Home: Split-level style, located in Raleigh, NC

Date of Test: 05/12/98

Carpet Sample Fraction Residues—Percentage Distribution (%)

Sample Fraction:	Surface	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
Sample ID:	008-PB01	008-PB02	008-PB03	008-PB04	008-PB05	008-PB06	008-PB07	
Sample Wt. (g):	na	16.95	217.2	24.2	61.4	42.8	1.2	
Alachlor								
Aldrin		100.00						100.0
Atrazine								
Bendiocarb								
Carbaryl		1.39	30.87	67.74				100.0
alpha-Chlordane		0.64	4.68	13.00	36.04	45.62	0.02	100.0
gamma-Chlordane	0.03	0.75	5.12	11.45	38.45	44.17	0.03	100.0
Chlorpyrifos	0.16	1.19	27.92	35.38	35.34		0.02	100.0
Dacthal		0.08	1.59	8.95	22.96	66.41	0.01	100.0
4,4'-DDE								
4,4'-DDT		100.00						100.0
Diazinon		0.12	2.54	2.47	23.83	70.93	0.10	100.0
Dichlorvos		100.00						100.0
Dicofol		100.00						100.0
Dieldrin								
Heptachlor	0.00	0.14	1.18	2.19	32.75	63.71	0.03	100.0
Lindane		100.00						100.0
Malathion								
Methoxychlor		0.06	6.42	65.59	27.93			100.0
cis-Permethrin								
trans-Permethrin		100.00						100.0
o-Phenylphenol	0.03	0.44	10.05	34.60	35.14	19.72	0.02	100.0
Propoxur		9.97	90.03					100.0
Benz[a]anthracene		1.31	18.99	44.04	35.59		0.07	100.0
Benzo[b]fluoranthene		1.48	12.31	68.72	17.49			100.0
Benzo[k]fluoranthene		0.64	6.42	82.85	10.09			100.0
Benzo[ghi]perylene		3.12	21.70	48.85	26.33			100.0
Benzo[a]pyrene		1.95	22.14	48.92	26.99			100.0
Chrysene		1.59	11.31	55.63	31.43		0.04	100.0
Coronene		6.41	29.93	63.66				100.0
Dibenz[a,h]anthracene		1.88	26.37	71.75				100.0
Dibenzo[a,e]pyrene		4.96	16.92	78.13				100.0
Indeno[1,2,3-cd]pyrene		2.15	25.88	46.03	25.94			100.0
PCB 105: 2,3,3',4,4'		0.14	6.56	47.64	45.66			100.0
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'		0.35	8.79	40.20	50.67			100.0
PCB 153: 2,2',4,4',5,5'		0.36	9.71	33.21	56.72			100.0
PCB 170: 2,2',3,3',4,4',5		0.52	11.07	51.23	37.19			100.0
PCB 180: 2,2',3,4,4',5,5'			9.22	33.57	57.20			100.0

Home #8, Sample A

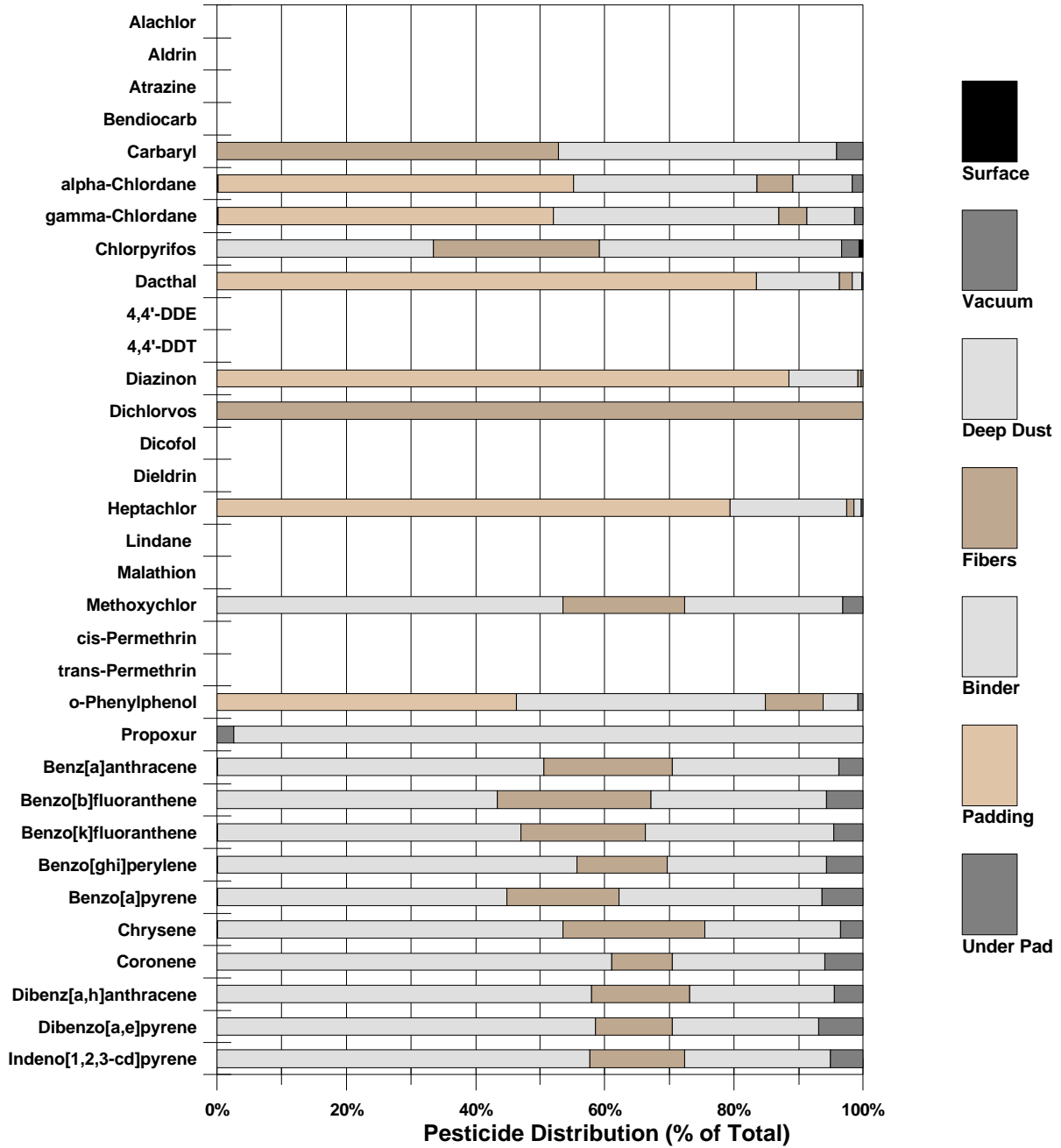


Figure 25. Pesticide residue distribution in carpet sample fractions—home 8, sample A.

Home #8, Sample B

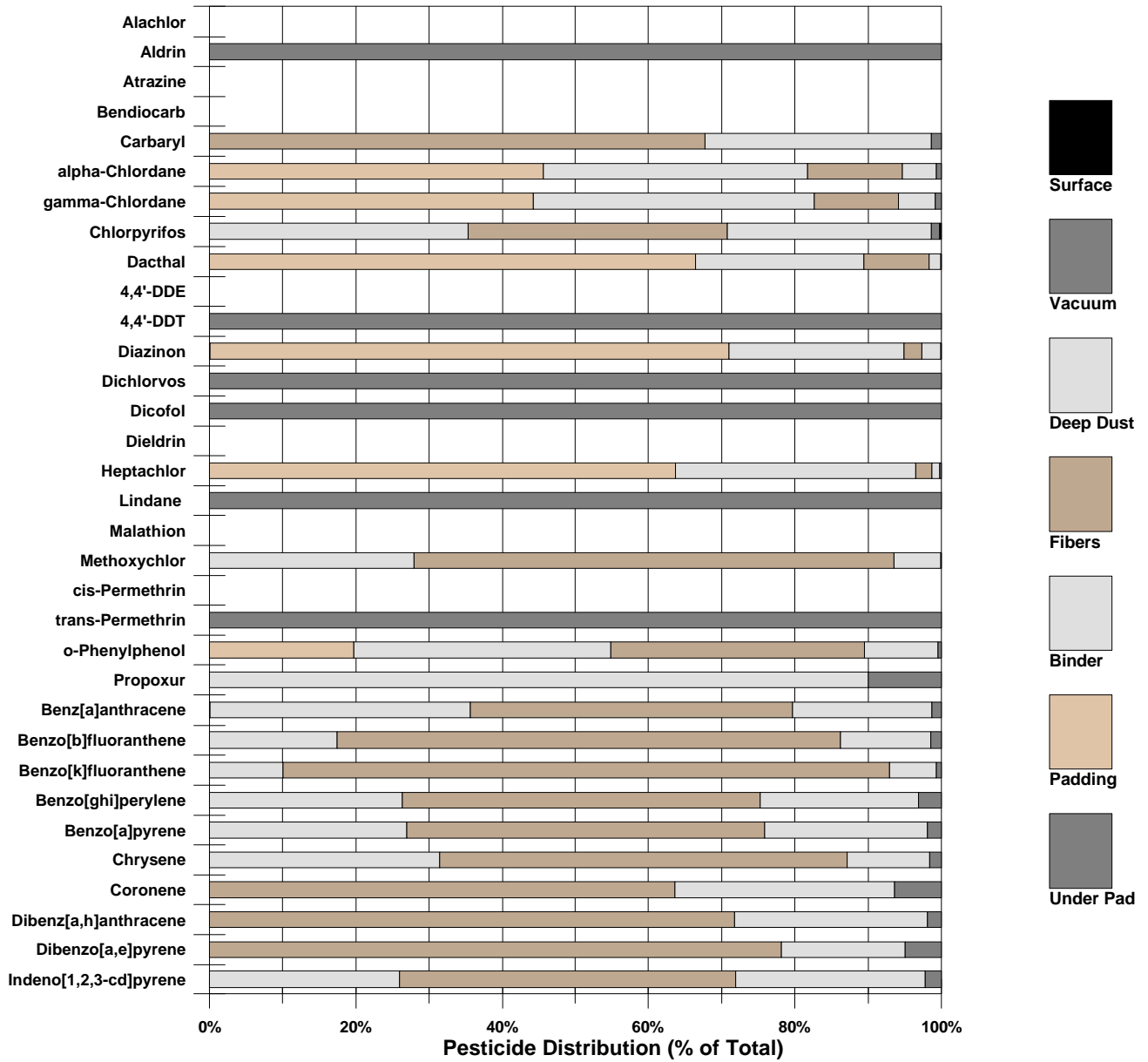


Figure 26. Pesticide residue distribution in carpet sample fractions—home 8, sample B.

4.4 Analysis of Residual Dust in Emptied Vacuum Cleaner Bags

The weight of deeply embedded dust collected from carpets with the Hoover Dirtfinder vacuum cleaner was determined by weighing the paper bag before and after sampling. The weight of the dust determined by SwRI after carefully removing as much material as possible from the bag was consistently lower than that determined by ManTech. Presumably, a substantial portion of the collected dust mass passed through the inner wall of the vacuum cleaner bag and was retained between its inner and outer walls. This residual dust must have a very small particle diameter and, as indicated by the results of our earlier size-fractionated dust study, would presumably have a higher concentration of the target analytes present in the bulk dust sample removed from the bag. In order to test this hypothesis, four of the emptied vacuum bags were extracted in total, and the extracts were analyzed for the neutral target analytes. The gravimetric analysis data presented in Table 33, along with the percentage of fine (<150 μm) dust represented in the HVS3 screening samples, was used to select the four candidate samples for analysis. This test was performed after the study was well under way, and unfortunately, four of the “best” empty bag samples (from homes 3 and 4) were already discarded, their contents having been removed and analyzed earlier. Of the remaining samples, samples A and B from home 1, sample B from home 5, and sample A from home 7 were selected and analyzed.

The results of those analyses are presented for all four samples in Table 34. The results for each sample are presented in terms of the residue concentration in the dust sample ($\mu\text{g/g}$) and in terms of the residue concentration in the carpet area sampled ($\mu\text{g/m}^2$). In Table 35 the residue dust concentrations for the residual dust samples are compared to the dust concentrations reported earlier for the bulk deep dust samples removed from the vacuum bags. These data show that our hypothesis concerning the expected higher concentrations of pesticide residues in the residual dust was correct. In most cases the target analyte concentrations in the residual dust were about tenfold higher than those in the bulk dust sample. In some cases the ratios were greater than 50 to 1. For the 12 vacuum bag samples analyzed in this study, the average mass of residual dust not recovered from the bag represented 24.5% of the total mass determined by difference. This value will vary considerably, of course, depending on the mass of the dust sample collected in the bag. The impact of this unrecovered fraction is, however, magnified because of the generally much higher concentrations found in the lower particle size dust samples. For the four samples that had their empty vacuum bags analyzed, the carpet sample concentrations ($\mu\text{g/m}^2$) of the deeply embedded dust were examined for five representative target analytes. The mean percentage of the deep dust sample fractions represented by the residual or “lost” dust fraction was 84% for gamma-chlordane, 82% for chlorpyrifos, 64% for *cis*-permethrin, 61% for *trans*-permethrin, and 75% for *o*-phenylphenol. While these numbers are quite significant with respect to the accuracy of the representation of the pesticide residue concentrations in the deep dust sample

fractions reported in this study, the overall impact is minimal with respect to the total carpet residue concentrations reported.

Table 33. Gravimetric Analysis Results for Deeply Embedded Dust Collected in Vacuum Bags

House #-Sample ID	Deep Dust Mass (g)		Dust Lost in Bag		% Fine (<150 µm) Dust in HVS3 sample fraction
	ManTech	SwRI	Mass (g)	% of Total	
1-PA03	28.4	23.95	4.45	15.7%	
1-PB03	15.5	12.03	3.47	22.4%	85.5%
2-PA03	11.0	na			45.1%
2-PB03	12.5	na			
3-PA03	9.1	5.495	3.605	39.6%	
3-PB03	0.8	0.104	0.696	87.0%	88.7%
4-PA03	150.7	120.0	30.7	20.4%	
4-PB03	49.3	33.4	15.9	32.3%	93.2%
5-PA03	11.9	10.35	1.55	13.0%	
5-PB03	7.5	5.74	1.76	23.5%	60.2%
6-PA03	86.5	na			
6-PB03	7.6	na			71.9%
7-PA03	8.4	6.81	1.59	18.9%	
7-PB03	14.7	12.74	1.96	13.3%	39.7%
8-PA03	366.9	354.89	12.01	3.3%	
8-PB03	217.2	207.74	9.46	4.4%	62.0%

Table 34. Emptied Vacuum Bag Analysis Results—Residual Deep Dust Sample Concentrations

Sample ID:	Sample Concentrations per Unit Mass (µg/g) and per Unit Carpet Area (µg/m ²)							
	001-PA03		001-PB03		005-PB03		007-PA03	
	Sample Wt. (g): 4.45		3.47		1.76		1.59	
Concentration Units:	(µg/g)	(µg/m ²)	(µg/g)	(µg/m ²)	(µg/g)	(µg/m ²)	(µg/g)	(µg/m ²)
Alachlor								
Aldrin			1.26	4.37				
Atrazine								
Bendiocarb	0.56	2.48						
Carbaryl	3.00	13.36					1.91	3.04
alpha-Chlordane	0.15	0.68	0.21	0.73	0.80	1.40	0.78	1.25
gamma-Chlordane	0.38	1.68	0.39	1.36	2.03	3.58	1.08	1.73
Chlorpyrifos	113.43	504.75	47.16	163.65	113.41	199.60	95.00	151.05
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol								
Dieldrin								
Heptachlor								
Lindane								
Malathion								
Methoxychlor								
cis-Permethrin	1023.20	4553.25	298.34	1035.25			60.33	95.93
trans-Permethrin	995.06	4428.00	440.99	1530.25			93.19	148.18
o-Phenylphenol	7.30	32.47	18.41	63.88			17.77	28.25
Propoxur	2.75	12.24	3.64	12.64				
Benz[a]anthracene							2.04	3.25
Benzo[b]fluoranthene	0.78	3.48	1.08	3.73			2.47	3.92
Benzo[k]fluoranthene			0.44	1.53			1.96	3.12
Benzo[ghi]perylene			0.10	0.35			0.99	1.57
Benzo[a]pyrene	0.20	0.91	0.21	0.74			2.52	4.01
Chrysene							2.13	3.38
Coronene								
Dibenz[a,h]anthracene							0.16	0.25
Dibenzo[a,e]pyrene								
Indeno[1,2,3-cd]pyrene					0.15	0.27	1.44	2.28
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170:								
PCB 180: 2,2',3,4,4',5,5'								

Table 35. Comparison of Vacuum Bag Residual Dust Concentrations to Bulk Deep Dust Levels

Sample ID:	Residual and Bulk Deep Dust Sample Concentrations per Unit Mass (µg/g)							
	001-PA03		001-PB03		005-PB03		007-PA03	
	Residual	Bulk	Residual	Bulk	Residual	Bulk	Residual	Bulk
	Sample Fraction:	Sample Wt. (g):	Sample Fraction:	Sample Wt. (g):	Sample Fraction:	Sample Wt. (g):	Sample Fraction:	Sample Wt. (g):
	4.45	23.95	3.47	12.03	1.76	5.74	1.59	6.81
Alachlor								
Aldrin		0.32	1.26	0.39				
Atrazine								
Bendiocarb	0.56	0.46						
Carbaryl	3.00	1.42					1.91	0.30
alpha-Chlordane	0.15		0.21		0.80	0.06	0.78	0.12
gamma-Chlordane	0.38		0.39		2.03	0.15	1.08	0.13
Chlorpyrifos	113.43	11.75	47.16	4.03	113.41	0.25	95.00	0.87
Dacthal								
4,4'-DDE								
4,4'-DDT								
Diazinon								
Dichlorvos								
Dicofol		0.26		0.19		0.23		
Dieldrin		0.36		0.36				
Heptachlor								
Lindane								0.39
Malathion								
Methoxychlor								0.20
cis-Permethrin	1023.20	75.39	298.34	33.27		0.13	60.33	8.70
trans-Permethrin	995.06	129.43	440.99	53.50		0.22	93.19	10.31
o-Phenylphenol	7.30	0.91	18.41	0.29		0.10	17.77	1.04
Propoxur	2.75	1.02	3.64	0.50		0.12		
Benz[a]anthracene				0.07		0.04	2.04	1.11
Benzo[b]fluoranthene	0.78		1.08	0.06		0.07	2.47	2.14
Benzo[k]fluoranthene			0.44	0.06		0.05	1.96	1.44
Benzo[ghi]perylene			0.10	0.06		0.04	0.99	1.14
Benzo[a]pyrene	0.20	0.08	0.21	0.10		0.06	2.52	1.24
Chrysene		0.05		0.08		0.10	2.13	2.04
Coronene								0.23
Dibenz[a,h]anthracene							0.16	0.22
Dibenzo[a,e]pyrene								0.22
Indeno[1,2,3-cd]pyrene				0.05	0.15	0.05	1.44	1.27
PCB 105: 2,3,3',4,4'								
PCB 126: 3,3',4,4',5								
PCB 138: 2,2',3,4,4',5'								
PCB 153: 2,2',4,4',5,5'								
PCB 170: 2,2',3,3',4,4',5								
PCB 180: 2,2',3,4,4',5,5'								

4.5 Results of Acidic Pesticide Analyses for Deeply Embedded Dust Screening Samples

Using newly developed procedures for the extraction and derivatization of acid herbicides and phenols, a sample of the deeply embedded dust from the carpet sample nearest the outside entrance for each of the eight test homes was analyzed for screening purposes. The target list used for these analyses included four acid herbicides and pentachlorophenol. In addition to the sample unknowns and solvent blanks, a solvent matrix spike and a household dust sample matrix spike were also prepared and analyzed by the laboratory staff. All samples were spiked prior to extraction with the surrogate compound, 3,5-dichlorobenzoic acid.

The results of the screening analyses of the deeply embedded dust samples for each of the eight test homes and the corresponding surrogate recovery percentages for each analysis are presented in Table 36. All results have been reduced to yield sample concentrations in terms of mass per unit area, that is, micrograms per square meter.

Table 36. Deeply Embedded Dust Screening Sample Results for Acid Herbicides and Phenols

Test Home ID:	Carpet Sample Concentrations ($\mu\text{g}/\text{m}^2$)							
	1	2	3	4	5	6	7	8
Sample ID:	1-PA03	2-PA03	3-PA03	4-PA03	5-PA03	6-PA03	7-PA03	8-PA03
Sample Wt. (g):	28.4	11.0	9.1	150.7	11.9	86.5	8.4	366.9
Dicamba								
MCPA								
2,4-D				53.6		17.7	1.4	119.1
2,4,5-T								
Pentachlorophenol			1.9	88.6	1.3			56.1
Surrogate ¹ Recovery	92%	103%	94%	92%	101%	99%	98%	77%

¹3,5-Dichlorobenzoic acid

A solvent blank and a 2-g aliquot of the 4-PA03 dust sample were spiked with approximately 5 μg each of the target analytes. The results for these samples and those for analysis of the normal laboratory solvent blank, along with the corresponding surrogate recovery percentages for each analysis, are presented in Table 37. All results have been reduced to yield sample concentrations in terms of total mass per sample, that is, total micrograms per 20 mL extract.

Table 37. Solvent Blank and Matrix Spike Sample Results for Acid Herbicides and Phenols

Sample ID:	Sample Concentrations (µg/extract)				
	Solvent	Solvent		4-PA03 Dust	
Sample Type:	Blank	Matrix Spike		Matrix Spike	
Extract Volume (mL):	20.0	20.0		20.0	
	Results	Results	% Recovery	Results	%Recovery
Dicamba	<0.231	2.010	41	2.066	42
MCPA	<0.441	2.214	45	2.644	53
2,4-D	<0.231	3.056	61	4.186	69
2,4,5-T	<0.451	2.962	58	3.552	69
Pentachlorophenol	<0.259	3.534	71	3.712	51
Surrogate ¹ Recovery	95%	84%		87%	

¹3,5-Dichlorobenzoic acid

The surrogate recovery results for these analyses ranged from 77% to 103%. The matrix spike sample recovery results showed that the dust sample spike recoveries compared favorably to the recoveries for the solvent spike, indicating that the dust sample matrix did not interfere with the analytical method.

4.6 Analysis Results for Acidic Pesticides and Phenols in Residential Carpets

Based on the results of the screening sample analyses, homes 4 and 8 were selected for analysis of all available sample fractions for acid herbicides and pentachlorophenol. The surface-dislodgeable sample fraction (PUF roller method) was not available for analysis as the entire sample is required for extraction, and all of those samples were extracted for neutral pesticides analysis. The complete sample analysis results for these two test homes are presented in the following sections. The results of the laboratory analyses were reported in terms of micrograms of target analyte detected per gram of sample extracted. By using the known total weight of each sample fraction submitted for analysis, the sample concentration relative to the total 1-m² area of carpet sampled was calculated. Conversion factors for each sample fraction were applied accordingly and are based on the relationship of the area covered during the collection of each sample fraction relative to the total area of the carpet sample tested.

Tables of data are presented that show the reduced sample concentrations in terms of micrograms per square meter for six sample fractions for both the A and B sample sections for each home. A graphical representation of this data is also presented to show the comparison of the two different sample areas tested in terms of the total sample concentrations for each target analyte. The total sample concentration in this case is

defined as the sum of the individual contributions of each of the six sample fractions for a given test carpet area.

Tables of data are also presented that show the relative distribution of acid herbicide and phenol residues from each carpet area tested in terms of the percent contribution of each sample fraction to the total sample concentration. These data are also presented graphically.

4.6.1 Results of Carpet Sample Fraction Analysis for Test Home 4

The following tables and figures present the reduced analytical data for tests that were conducted at a ranch-style home located in a rural area of Durham County, NC. This test site was described and a representation of the floor plan of the home was presented in section 4.3.4.

The analytical results in terms of target analyte concentration per unit area for acid herbicides and pentachlorophenol for six of the seven sample fractions collected from each of two carpet sections in test home 4 are presented in Tables 38 and 39. The total sample concentration results for each target analyte for both sample A and sample B are presented graphically in Figure 27. The sample results are also presented in terms of the percentage contribution of each individual sample fraction to the total sample concentration for each target analyte. Those results are shown in Tables 40 and 41, and the same data are presented graphically in Figures 28 and 29.

Table 38. In-Home Carpet Test Results—Acidic Residue Concentrations for Home 4, Sample A

Test Home: Ranch style, in rural area of Durham County, NC

Date of Test: 02/13/98

Sample Fraction:	Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)							Totals for Sample A
	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad		
	Sample ID: 004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07		
Sample Wt. (g):	27.26	150.7	15.3	57.2	7.8	1.8		
Dicamba	8.72							8.7
MCPA								
2,4-D	22.26	53.6	197.6	678.1	59.1			1010.7
2,4,5-T								
Pentachlorophenol	49.95	88.6	2946.6	1972.0	1371.3	2.6		6431.1

Table 39. In-Home Carpet Test Results—Acidic Residue Concentrations for Home 4, Sample B

Test Home: Ranch style, in rural area of Durham County, NC

Date of Test: 02/13/98

Sample Fraction:	Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)							Totals for Sample B
	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad		
	Sample ID: 004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07		
Sample Wt. (g):	13.49	49.3	16.6	42.6	5.3	52.6		
Dicamba								
MCPA								
2,4-D	2.45	12.1	111.7	int. ¹	int. ¹	5.9		132.2
2,4,5-T								
Pentachlorophenol	8.65	36.6	3652.9	1228.2	721.9	38.9		5687.1

¹Imprecise quantitation due to presence of interfering peak

Home #4

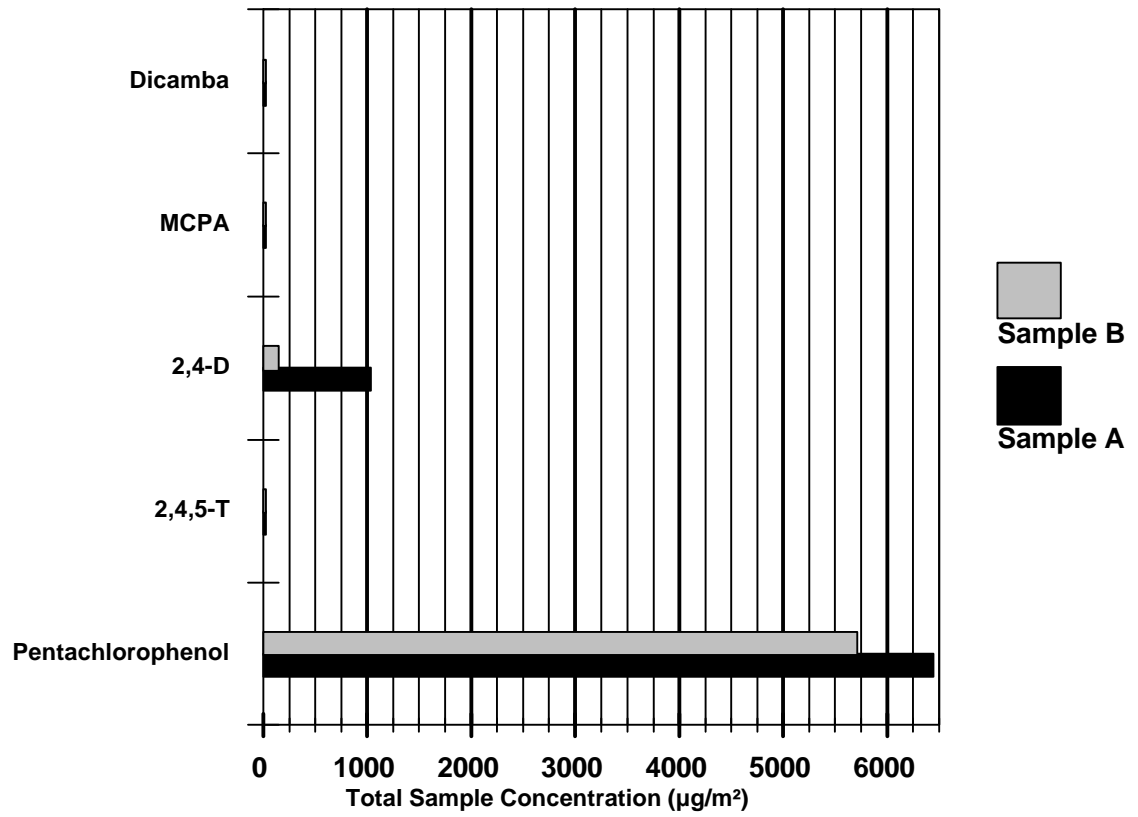


Figure 27. Total acidic residue concentrations for samples A and B for test home 4.

Table 40. In-Home Carpet Test Results—Acidic Residues % Distribution for Home 4, Sample A

Test Home: Ranch style, in rural area of Durham County, NC

Date of Test: 02/13/98

Sample Fraction:	Carpet Sample Fraction Residues—Percentage Distribution (%)						
	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
	Sample ID: 004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07	
Sample Wt. (g):	27.26	150.7	15.3	57.2	7.8	1.8	
Dicamba	100.00						100.0
MCPA							
2,4-D	2.20	5.30	19.55	67.09	5.85		100.0
2,4,5-T							
Pentachlorophenol	0.78	1.38	45.82	30.66	21.32	0.04	100.0

Table 41. In-Home Carpet Test Results—Acidic Residues % Distribution for Home 4, Sample B

Test Home: Ranch style, in rural area of Durham County, NC

Date of Test: 02/13/98

Sample Fraction:	Carpet Sample Fraction Residues—Percentage Distribution (%)						
	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
	Sample ID: 004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07	
Sample Wt. (g):	13.49	49.3	16.6	42.6	5.3	52.6	
Dicamba							
MCPA							
2,4-D	1.85	9.18	84.49			4.48	100.0
2,4,5-T							
Pentachlorophenol	0.15	0.64	64.23	21.60	12.69	0.68	100.0

Home #4, Sample A

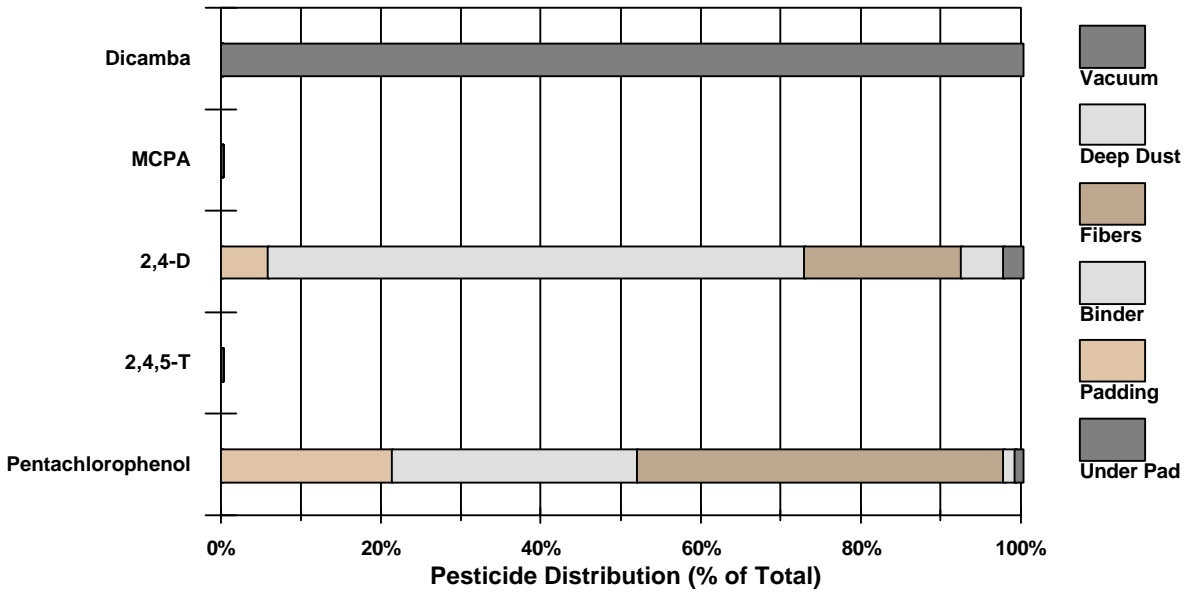


Figure 28. Acidic residue distribution in carpet sample fractions—home 4, sample A.

Home #4, Sample B

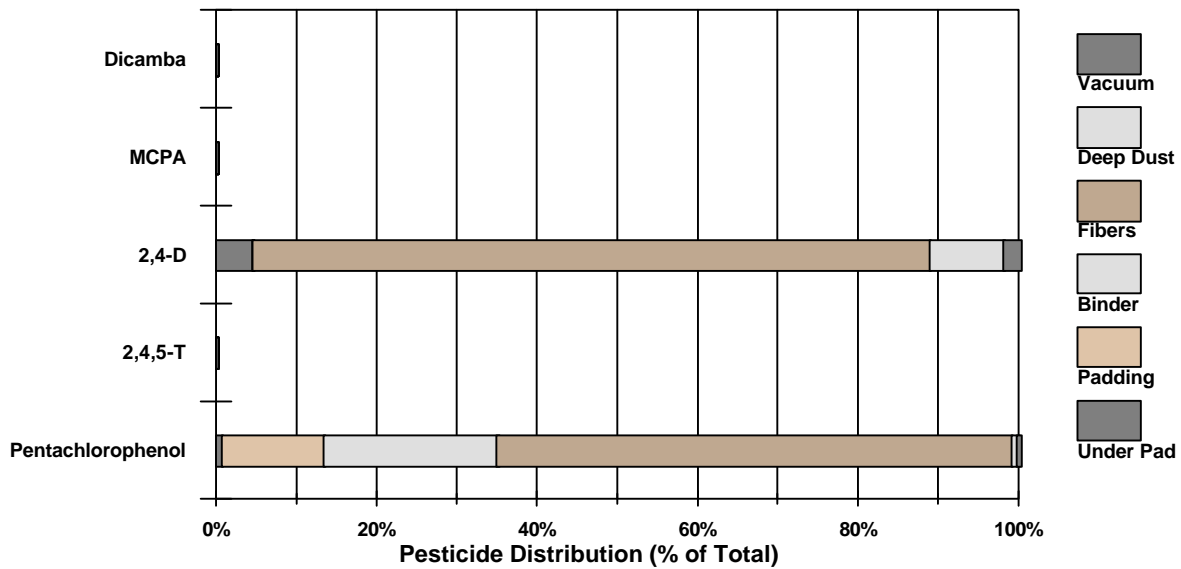


Figure 29. Acidic residue distribution in carpet sample fractions—home 4, sample B.

4.6.2 Results of Carpet Sample Fraction Analysis for Test Home 8

The following tables and figures present the reduced analytical data for tests that were conducted at a split-level-style home located in Raleigh, NC. This test site was described and a representation of the floor plan of the home was presented in section 4.3.8.

The analytical results in terms of target analyte concentration per unit area for acid herbicides and pentachlorophenol for six of the seven sample fractions collected from each of two carpet sections in test home 8 are presented in Tables 42 and 43. The total sample concentration results for each target analyte for both sample A and sample B are presented graphically in Figure 30. The sample results are also presented in terms of the percentage contribution of each individual sample fraction to the total sample concentration for each target analyte. Those results are shown in Tables 44 and 45, and the same data are presented graphically in Figures 31 and 32.

Table 42. In-Home Carpet Test Results—Acidic Residue Concentrations for Home 8, Sample A

Test Home: Split-level style, located in Raleigh, NC

Date of Test: 05/12/98

Sample Fraction:	Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)							Totals for Sample A
	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad		
	Sample ID: 004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07		
Sample Wt. (g):	33.04	366.9	22.3	56.3	42.6	3.1		
Dicamba								
MCPA					143.1			143.1
2,4-D	12.51	119.2	143.4	66.0	198.6			539.8
2,4,5-T								
Pentachlorophenol	19.33	56.1	128.2	565.8	627.1	0.9		1397.3

Table 43. In-Home Carpet Test Results—Acidic Residue Concentrations for Home 8, Sample B

Test Home: Split-level style, located in Raleigh, NC

Date of Test: 05/12/98

Sample Fraction:	Carpet Sample Fraction Analysis Results ($\mu\text{g}/\text{m}^2$)							Totals for Sample B
	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad		
	Sample ID: 004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07		
Sample Wt. (g):	16.95	217.2	24.2	61.4	42.8	1.2		
Dicamba		65.8						65.8
MCPA								
2,4-D	5.35	130.8	54.9	118.5	142.3			451.8
2,4,5-T								
Pentachlorophenol	11.22	305.2	126.2	390.0	2025.6	1.0		2859.3

Home #8

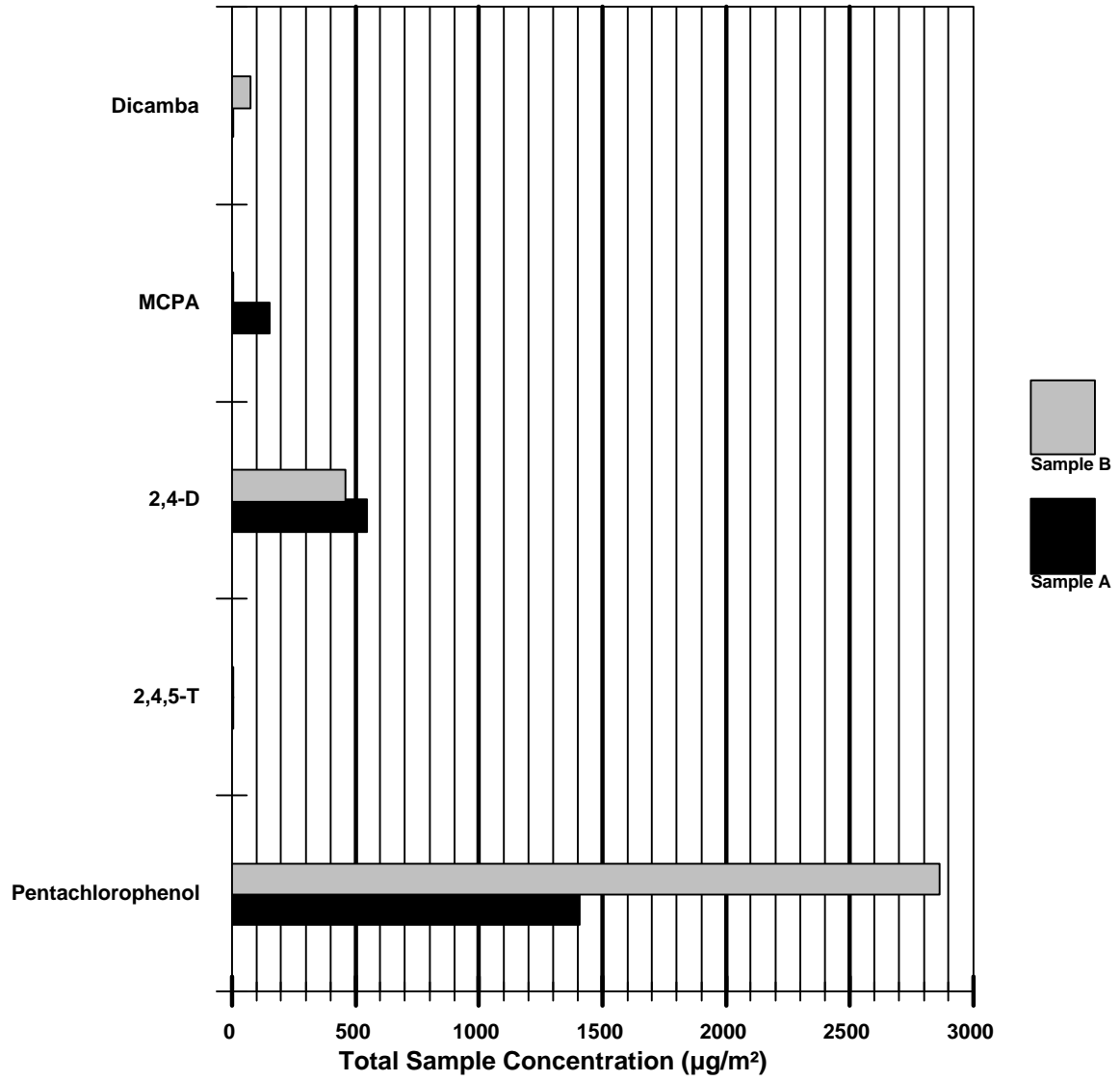


Figure 30. Total acidic residue concentrations for samples A and B for test home 8.

Table 44. In-Home Carpet Test Results—Acidic Residues % Distribution for Home 8, Sample A

Test Home: Split-level style, located in Raleigh, NC

Date of Test: 05/12/98

Sample Fraction:	Carpet Sample Fraction Residues—Percentage Distribution (%)						
	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample A
	Sample ID: 004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07	
Sample Wt. (g):	33.04	366.9	22.3	56.3	42.6	3.1	
Dicamba							
MCPA					100.00		100.0
2,4-D	2.32	22.09	26.57	12.23	36.80		100.0
2,4,5-T							
Pentachlorophenol	1.38	4.02	9.17	40.49	44.87	0.06	100.0

Table 45. In-Home Carpet Test Results—Acidic Residues % Distribution for Home 8, Sample B

Test Home: Split-level style, located in Raleigh, NC

Date of Test: 05/12/98

Sample Fraction:	Carpet Sample Fraction Residues—Percentage Distribution (%)						
	Vacuum	Deep Dust	Fibers	Binder	Padding	Under Pad	Totals for Sample B
	Sample ID: 004-PA02	004-PA03	004-PA04	004-PA05	004-PA06	004-PA07	
Sample Wt. (g):	16.95	217.2	24.2	61.4	42.8	1.2	
Dicamba		100.00					100.0
MCPA							
2,4-D	1.18	28.94	12.16	26.23	31.49		100.0
2,4,5-T							
Pentachlorophenol	0.39	10.67	4.41	13.64	70.84	0.03	100.0

Home #8, Sample A

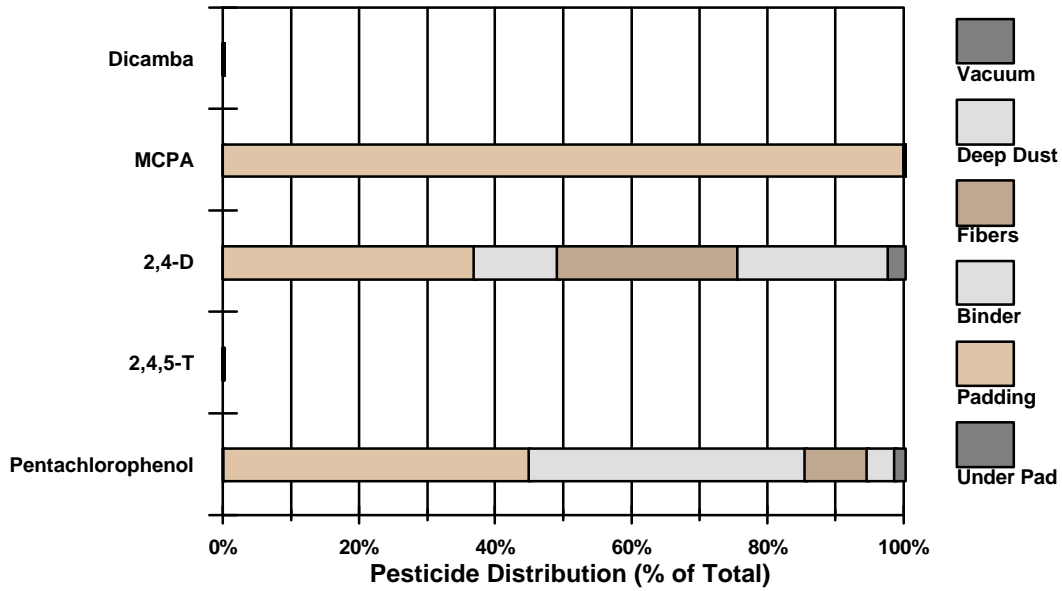


Figure 31. Acidic residue distribution in carpet sample fractions—home 8, sample A.

Home #8, Sample B

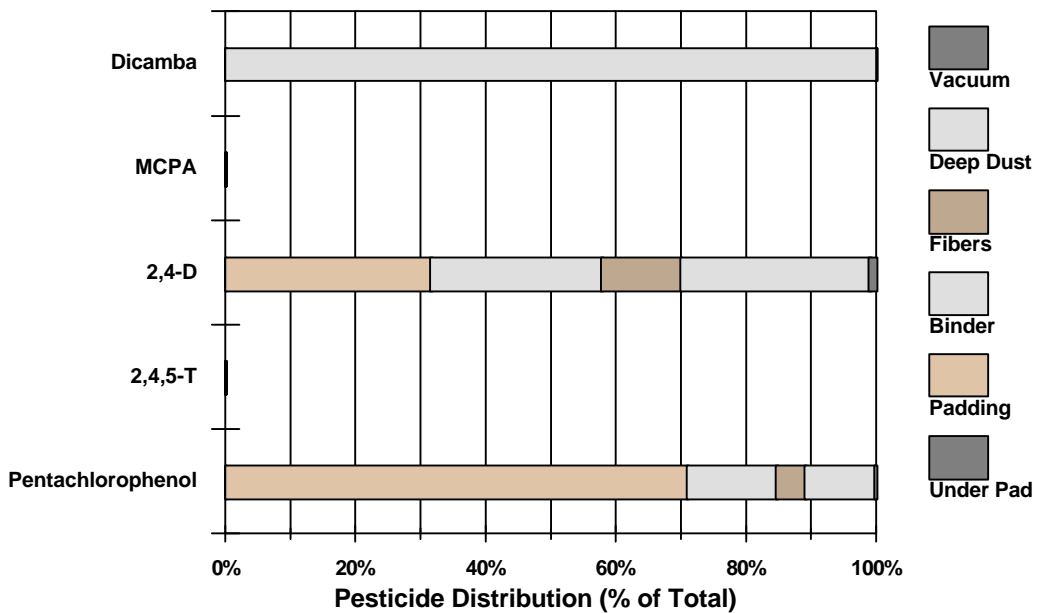


Figure 32. Acidic residue distribution in carpet sample fractions—home 8, sample B.

4.7 Ambient Temperature and % Relative Humidity Data Records from Tests Performed

A summary of all recorded data for ambient temperature and relative humidity readings that were taken during the eight testing periods is presented in Table 46. In general, outdoor measurements were made once at the beginning of the approximately 4-h testing period and once again at the conclusion of the period. Indoor measurements were generally made at the beginning and end of the collection procedures performed for each of the two carpet areas tested. A general statement of the weather conditions prevailing at the time of the testing was also recorded on the data sheets and is summarized in the table, as well.

Table 46. Indoor and Outdoor Atmospheric Conditions During Test Home Sampling Periods

Home ID:	1		2		3		4		5		6		7		8	
Sample ID:	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
<u>Indoor Temperature Reading (°F)</u>																
1	71	71	68	68	67	71	66	66	69	70	68		70	71	66	70
2	71	71	68		70	73	67	67	69	70	72	73	72	71	72	71
3		71	68		72	73	67	68	70	70	73	75	72	73	72	72
4	70	70	68	68		72		67		71		75	71	73	66	71
Average:	71	71	68	68	70	72	66	67	69	70	71	74	71	72	69	71
<u>Indoor % Relative Humidity</u>																
1	45	45	47	46	47	50	48	53	47	42	37		52	49	69	66
2	45	46	47		47	45	48	51	43	44	41	40	46	48	62	62
3		47	44		44	43	47	49	43	43	38	39	47	46	62	63
4	42	41	44	47		42		49		42		39	48	46	68	61
Average:	44	45	46	47	46	45	48	51	44	43	39	39	48	47	62	63
<u>Outdoor Temperature Reading (°F)</u>																
1	57	66	40		50	53	52	50	47	53	54	54	58	62	66	69
2	66	64		58		52		55		55		53		61		65
Average:	62	65	40	58	50	52	52	52	47	54	54	54	58	61	66	67
<u>Outdoor % Relative Humidity</u>																
1	49	37	41		74	50	40	45	52	37	37	42	49	47	65	68
2	37	36		35		55		39		35		38		55		73
Average:	43	37	41	35	74	53	40	42	52	36	37	40	49	51	65	71
<u>Weather Conditions:</u>																
	Sunny, clear, cool		Sunny, clear, cold		Rainy, windy, cool		Partly cloudy, cool		Overcast to partly sunny, cool		Cloudy, cool		Overcast, cool		Overcast to cloudy, cool	

4.8 Homeowner-Reported Residential Pesticide Application History

Based on responses to the questionnaire that was used to evaluate all potential candidates for participation in this study, the following summary of pesticide usage at each of the eight test homes was prepared.

Table 47. Summary History of Pesticide Use in Test Homes as Reported by Owners

Test Home ID:	Homeowner responses to questionnaire ("X" = positive response)							
	1	2	3	4	5	6	7	8
<u>INSIDE HOME USE</u>								
Insecticides	X	X	X	X	X	X	X	X
<u>Yearly Applications¹</u>								
One Time			X					X
Several Times			X			X	X	X
Regular Basis	X	X		X	X			
<u>Applicator</u>								
Professional	X		X	X	X			
Occupant		X	X			X	X	X
<u>OUTSIDE HOME USE</u>								
Herbicides	X			X			X	X
Fungicides								X
Insecticides		X	X	X	X	X		X
<u>Yearly Applications</u>								
One Time								
Several Times			X	X		X	X	X
Regular Basis	X	X			X			
<u>Applicator</u>								
Professional	X		X	X	X	X		X
Occupant		X		X		X	X	X

¹Multiple responses indicate references to use of more than one pesticide formulation.

Section 5 References

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ASTM (1999b). D 5438. Standard practice for collection of floor dust for chemical analysis. *Ibid.*, 509–515.

Camann, D.E., Harding, H.J., Geno, P.W., and Agrawal, S.R. (1996). Comparison of methods to determine dislodgeable residue transfer from floors. EPA/600/R-96/089, U.S. Environmental Protection Agency, Research Triangle Park, NC.

Fortune, C.R. (1997). Round-robin testing of methods for collecting dislodgeable residues from carpets. EPA/600/R-97/119, U.S. Environmental Protection Agency, Research Triangle Park, NC.

Lewis, R.G., Fortmann, R.C., Camann, D.E. (1994). Evaluation of methods for monitoring the potential exposure of small children to pesticides in the residential environment. *Arch. Environ. Contam. Toxicol.* **26**:37-46.

Lewis, R.G., Fortune, C.R., Willis, R.D., Camann, D.E., and Antley, J.T. (1999). Distribution of pesticides and polycyclic aromatic hydrocarbons in house dust as a function of particle size. *Environ. Health Perspect.* **107**:721–726.

Appendix

1. Flyer posted in prominent locations
2. Study information sheet
3. Two-page questionnaire
4. Three-page data sheet for test samples

N O T I C E

VOLUNTEERS NEEDED

ManTech Environmental Technology, Inc. is conducting a study for the U. S. Environmental Protection Agency to evaluate the potential for human exposure to pesticide residues in carpets.

A small number of local residences whose owners are planning to have household carpeting replaced in the near future will be selected for testing. The tests will be performed during a 3 to 6 hour period on a single day prior to the removal of the old carpet and padding.

Homeowners who are selected to participate in the study will receive a gratuity of \$100 for their participation.

If you, or someone you know, are interested in becoming a volunteer in this important study, please contact Mr. Chris Fortune at 541-3960 in the Research Triangle Park to receive further information.

INFORMATION SHEET

U.S. EPA STUDY OF PESTICIDE RESIDUES IN USED RESIDENTIAL CARPETS

Background: Over time, pesticides used in and around the home may accumulate in carpets. The availability of these pesticide residues for human exposure is not adequately understood. A complete analysis of aged carpets that have been exposed to pesticides is necessary to better understand the distribution and fate of residues and the potential for human exposure.

Volunteers: The U.S. EPA is currently seeking volunteers who are planning to remove used carpeting and padding from their homes. Ideally, the homes that will be selected for use in this study will be ones that have older, well-used carpets, and where pesticides have been used during the life of the carpeting. The pesticide use might have included indoor use of foggers or spray insecticides, outdoor use of lawn and garden treatments with pesticides, or both. The testing that will be performed in each home will involve cutting out samples of the carpet and padding, hence the requirement that the homeowner plans to dispose of the used carpet following the testing.

The work required to perform the testing of a single home will be conducted all on one day at a pre-arranged time and date that is convenient to the homeowner. The testing will require from three to six hours to complete, and all volunteers who are accepted for participation in this study will receive a stipend of \$100.00 for their cooperation.

Test Samples: Two sample sets will be collected from each home, one near the most often used entrance, and one in an interior living area. Each test sample will consist of seven (7) separate fractions: surface-dislodgeable residues; vacuum-dislodgeable residues; deeply embedded dust; residues contained in the carpet fibers, binder, padding, and in deposits beneath the carpet padding. Each fraction will be analyzed for pesticide content, and the data will be used to determine the percentage contribution of each fraction to the total pesticide content.

Interested? Participants will be selected primarily from responses to a written questionnaire that all potential volunteers will be asked to complete. The results and findings of the study may be reported in published technical reports at some later time, but all results will be reported anonymously to protect the privacy of all volunteer subjects. Interested test subjects will receive copies of the published study results, where, for instance, the data from their carpet tests may be referred to as "Test Home #3".

How to Apply: Contact the study coordinator, Mr. Chris Fortune of ManTech Environmental Technology, Inc. in Research Triangle Park (Tel: 919-541-3960). You will be asked to complete a questionnaire form by filling in the requested information as completely as possible. After completing the questionnaire, return it to the study coordinator. The information you provide will be reviewed immediately, and you will then be contacted to discuss your participation in the study. All information provided by homeowners will be maintained in the strictest confidence to protect their privacy.

NOTE: If you think that you may be interested in participating as a volunteer in this study, please refrain from vacuuming or cleaning the carpets you are planning to replace before you are contacted by the study coordinator. It is important that the test homes have carpets that have not been cleaned or vacuumed recently. Thank you very much for your time and interest.

RESIDENTIAL CARPET PESTICIDE RESIDUE STUDY QUESTIONNAIRE

Homeowner Information:

Name _____ Address _____ _____ Daytime Telephone No. _____	Number of Occupants _____	Adults: _____ Children: _____ Years lived at this address? _____ Approximate date you are planning to remove old carpets? _____
---	---------------------------	--

Do you have any pets? Yes _____ No _____ If yes, are any of your pets allowed inside of your house? Yes _____ No _____ Indicate below the number of each type of pet.

Dogs: _____	Cats: _____	Other (list): _____
-------------	-------------	---------------------

House Information: _____ What is the approximate age of your home? _____

Building Style: 1 Story _____ 2 Story _____ Other _____
 Basement? Yes _____ No _____

Check below each room of your home that is carpeted now and will have its carpeting removed during the current renovation:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Foyer (entrance)	Kitchen	Dining Room	Living Room
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Family Room	Den or Study	Master Bedroom	Other Bedrooms

Check the type of carpet(s) that you are going to have removed (more than one is possible):

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Plush	Level-loop	Flat	Multilevel	Shag	(Not Sure)

What is the approximate age of the carpets being removed? _____

What type of vacuum cleaner do you use? _____

About when was the last time your old carpets were cleaned or vacuumed? _____

Household Pesticide Use Information: (Indoor Applications)

Please check all boxes below that apply concerning the past use of pesticides inside your home by you, another resident of your home, or a professional exterminator that you are personally aware of. Check here if no pesticides are used inside your home _____.

Applicator		Pesticides Used Inside Home (The pesticides listed below may include sprays, bombs, powders, crystals, etc.)	How Often Used In a Year?		
Occupant	Professional		One Time	Several Times	Regular Basis
		Insecticides for flea control			
		Insecticides for crawling or flying insects			
		Rodenticides for mice or rats			
		Other (list): _____			

List the approximate date of the most recent use of pesticides in your home _____.

**RESIDENTIAL CARPET PESTICIDE RESIDUE STUDY QUESTIONNAIRE
(Continued)**

Household Pesticide Use Information: (Outdoor Applications)

Please check all boxes below that apply concerning the past use of pesticides outside your home by you, another resident of your home, or a professional exterminator that you are personally aware of. Check here if no pesticides are used outside your home _____.

Applicator		Pesticides Used Outside Home (The pesticides listed below may include sprays, bombs, powders, liquids, etc.)	How Often Used In a Year?		
Occupant	Professional		One Time	Several Times	Regular Basis
		Herbicides (weedkillers) for lawn & garden			
		Fungicides for treatment of diseased lawn			
		Insecticides for fleas, termites, etc.			
		Other (list):			

List the approximate date of the most recent use of pesticides outside your home _____.

Please use this space to write any comments or notes you may wish to make:

REMINDER! If you think that you may be interested in participating as a volunteer in this study, please refrain from vacuuming or cleaning the carpets you are planning to replace before you are contacted by the study coordinator. It is important that the test homes have carpets that have not been cleaned or vacuumed recently. (It is OK to clean any upstairs room or any bedroom as these rooms will not be used for this study).

The information you provide on this form will be reviewed immediately after it is received by us and will be treated in a strictly confidential manner. You will be contacted very soon thereafter to discuss your participation in the study. If you have any problems or questions concerning the completion of this questionnaire, you may contact the study coordinator, Mr. Chris Fortune, at telephone number 919-541-3960; Address: ManTech Environmental Technology, Inc., P.O. Box 12313, Research Triangle Park, NC 27709.

IN-HOME USED CARPET TEST DATA FORM

TEST HOME NO. _____ SAMPLE LOCATION _____

TEST DATE _____ OUTDOOR TEMP/HUMIDITY _____°F _____%RH @ _____

GENERAL WEATHER CONDITIONS _____

TYPE OF CARPET: Plush ___ Level Loop ___ Multilevel ___ Shag ___ Other ___

<u>Carpet %Moisture Check</u>				<u># Test Points</u>	<u>Average Value</u>	<u>High Value</u>
	Time of Day _____					

1. SURFACE DISLODGEABLE RESIDUE SAMPLE (PUF ROLLER METHOD)

Sample ID No.	Time of Day	Temperature	Relative Humidity
DRS97A-____-____-____		°F	%

Comments

2. VACUUM DISLODGEABLE RESIDUE SAMPLE (HVS3 SAMPLER)

Sample area _____ m² No. passes per strip _____ No. strips _____

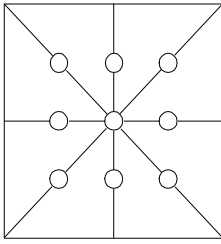
Sampler flow check? ___Yes ___No Sampler cleaned? ___Yes ___No

Flow Δp _____" H₂O Nozzle Δp _____" H₂O Total sample time _____ min

Sample ID No.	Time of Day	Temperature	Relative Humidity
DRS97A-____-____-____		°F	%

Bottle final weight _____g Tare weight _____g Net weight _____g

Comments Using Teflon bottle # _____

3. DEEPLY EMBEDDED DUST SAMPLE (HOOVER POWER DRIVE VACUUM)			
Vacuum cleaned before use? <input type="checkbox"/> Yes <input type="checkbox"/> No Vacuum bag identification number _____ Target coverage with vacuum =128 passes per m ² . Number of passes this test _____/m ² "Dirt Finder" setting used <input type="checkbox"/> Med <input type="checkbox"/> Hi Total sampling time _____ min Red light "on" ? at Start <input type="checkbox"/> Yes <input type="checkbox"/> No at End <input type="checkbox"/> Yes <input type="checkbox"/> No Approximate total number of passes completed before green light is "on" _____			
Sample ID No.	Time of Day	Temperature	Relative Humidity
DRS97A-____-____-____		°F	%
Bag final weight _____g Bag tare weight _____g Dust sample weight _____g			
<u>Comments</u>			
4. CARPET FIBERS SAMPLE			
(from 3-inch diameter plugs cut from vacuumed carpet sample)			
5. CARPET BINDER SAMPLE			
<u>Sample Collection:</u> Return the test carpet sections to the laboratory. Cut 4-6 plugs from the carpet sample. Indicate the approximate location of the test plugs removed by filling in those areas on the schematic drawing on the right.			
No. of plugs collected _____ Date _____ Time _____			
Remove the carpet fibers from each plug using a razor knife. Combine all fibers in a single sample container and do the same for the carpet binder samples. This action was performed by:			
Operator _____ Date _____ Time _____			
Fiber Sample ID: DRS97A-____-____-____ Binder Sample ID: DRS97A-____-____-____			

Comments: (on carpet fiber and binder sample collection)

Fibers sample net wt. _____ (Gross wt. _____ - Tare wt. _____)

Binder sample net wt. _____

6. CARPET PADDING SAMPLE (3-INCH DIAMETER PLUGS CUT FROM FOAM PAD)

Sample Collection:

Cut 4-6 plugs from the carpet padding in the same locations that the carpet test plugs were cut (the padding samples may be cut at the same time that the carpet test plugs are cut by aligning the pad properly beneath the test carpet sample during the cutting operation). Describe the procedure used to collect these samples:

Procedure:

Sample ID: DRS97A-____-____-____ Collected by: _____ Time: _____

Comments:

Carpet padding sample net wt. _____

7. RESIDUE UNDER PADDING SAMPLE (FROM SUB-FLOOR SURFACE BELOW PAD)

Describe the residue found and give details of the procedure used to collect the sample:

Residue sample net wt. _____ (Gross wt. _____ - Tare wt. _____)

Sample ID: DRS97A-____-____-____ Collected by: _____ Time: _____

Final Temperature
and Relative Humidity
Readings

Indoor: _____°F _____%RH Time _____

Outdoor: _____°F _____%RH Time _____