United States
Environmental Protection
Agency

Environmental Monitoring
Systems Laboratory
Research Triangle Park NC 27711

Research and Development

EPA/600/S4-88/036 Jan. 1989

EPA

Project Summary

Development of a High Volume Surface Sampler for Pesticides in Floor Dust

J. W. Roberts and M. G. Ruby

House dust and the pollutants carried with house dust are potentially important contributors to exposure through the pathways of inhalation, ingestion and skin penetration, especially for small children. Pesticides may be one of the more important contaminants of house dust.

A high volume surface sampler (HVS2) for the collection of house dust and the semivolatile organics in house dust has been designed and tested. The sampler consists of an intake nozzle, cyclone, and filter. The position of the nozzle is regulated by the static pressure in the nozzle. The HVS2 operates at approximately 9.5 L/s (20 cfm) and can collect more than 2 g of floor dust from a rug in an average clean residence in less than 4 min. Over 95% of the sample is retained in the cyclone and would, thus, be usable as a bulk sample for bioassays.

The HVS2 collects approximately 30% of the dust less than 150 µm from level loop and plush carpets. It collects 93.4% of the total dust from a smooth bare floor.

Previous studies of ambient sampling for pesticides suggested that semivolatile organics in house dust would not be retained on the filter and a polyurethane foam (PUF) absorbent would be necessary to collect them from house dust and a test dust was spiked with 10 or 20 ppm chlorpyrifos and dieldrin and 50 or 100 ppm diazinon. Virtually all the pesticide was retained in the cyclone or on the filter. Although a PUF filter does not appear to be necessary, it can be used with the HVS2.

Several alternative sampling methods were also studied. The collection efficiency for fine dust of conventional upright and canister-type vacuum cleaners, as well as small hand-held vacuum cleaners, was not sufficient and use as required here would have been difficult or impossible.

This Project Summary was developed by EPA's Environmental Monitoring Systems Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Recent studies of human exposure to air pollutants have increasingly recognized the importance of pathways other than inhalation. Ingestion of air pollutants deposited in water or on soil is potentially the source of a significant portion of an individual's total pollutant burden, especially for very young children, with their lower body weight and frequent hand-to-mouth activity. Dust can be both a medium for the transfer of pollutants from sources to people and a medium for the accumulation of pollutants. Failure to consider dust as a pathway for air pollution may result in a significant underestimation of health risks.

Literature Review

Particulate matter, especially fine, carbonaceous particulate matter, has

0.254 µg, for PCP, chlorpyrifos, and dieldrin, respectively. If the collected sample were 2 g, this would correspond to 0 35 ppm, 0.57 ppm, and 0.20 ppm, in the same order (correcting to an assumed 100% extraction efficiency instead of the lower, measured, extraction efficiency).

Thus under this worst case, using the field cleanup procedure might cause a pristine location to be categorized as a background situation, but would have little if any effect on the classification of sites with any significant amount of pesticides present.

Alternative Sampling Methods

Several alternative test methods were evaluated, both to determine how they compare with the HVS2 method and to determine if any of them should be explored as possibly better approaches to determining the concentration and loading of dust on floors.

Several studies of house dust have collected grab samples from the bags of residents' vacuum cleaners. While this is a quick way to collect a large number of samples in a retrospective study, it provides neither a consistent sampling efficiency nor any assurance that the samples have retained any semivolatile materials. The principal problem with the canister cleaner is inherent in the design: all the air passes through the collected sample during the entire period of collection.

Both an upright and a canister vacuum cleaner were tested for cleaning efficiency using the ASTM procedures previously described. A convertible upright vacuum cleaner with a power-driven agitator was found to have a fine materials recovery of less than 2.3% of the test dust. A canister vacuum, without a power-driven agitator head, collected fine materials of 1.3% of the test dust. It was observed that a considerable amount of the collected sample, which may have been a significant fraction of the fines, could not be removed from the bags after the test. In addition, the power-driven agitator and nozzle of the upright could not be cleaned without excessive effort.

A small hand-held vacuum cleaner gave a fine materials recovery of 4.7% of the test dust on a level loop carpet but only 0.6% on a plush carpet. This unit may have been even more efficient than the conventional vacuum cleaners in picking up the fine material, but it did not retain it. The fines were observed to pass directly through the unit and exit the exhaust as a white cloud, which was directly into the face of the user.

Conclusions and Recommendations

The high volume surface sampler (HVS2) constructed by Cascade Stack Sampling Systems (CS3) is an effective and efficient way to collect samples of fine surface dust. A bulk sample of more than 2 g can be collected in about 4 min in an average clean residence.

The static pressure in the nozzle was found to be the best measure of the appropriate height for the nozzle on carpets. When operated at the defined optimal settings, the fine materials (less than 150 µm) collected from carpets by the HVS2 are approximately 6% of the total load of a standard test dust and approximately 30% of the fine materials in the test dust. Better than 93% of the test dust is collected from a bare, hard surface.

Semivolatile organic materials on the test dusts were retained on the collected dust. Experiments with a test dust which contained organic material, elemental carbon, sand, and talc found that a polyurethane foam (PUF) absorbent filter was not necessary for collection of the three pesticides tested. When both house dust and the test dust were spiked with 10 or 20 ppm of chlorpyrifos and dieldrin and 50 or 100 ppm of diazinon, less than 0.1% of the pesticide was found on the PUF filter.

The HVS2 can be used to measure complex mixtures of metals, solids, and organics on a variety of surfaces. Perhaps one of the most obvious uses is in support of studies of the health effects of indoor air pollutants and studies of the relative importance of pollutant pathways. Outdoors, the sampler could be used to measure pollutant accumulations in potentially air-mobilized soil surfaces. This might be useful in investigations of the potential risks associated with fugitive dust from hazardous waste land disposal sites, for example.

A field test of the HVS2 would be an important next step for evaluating this instrument and the recommended procedures provided in this report. Because surface dust is an integrated record of the pollutants introduced into the air above the surface, it is important that such a field test include air sampling during a period before and between the collection of surface samples.

The size distribution of house dust, the size distribution of dust on the hands of small children, and the size of particles which pass the cyclone and are found the HVS2 filter should all be measurec order to more properly characterize results obtained from the HVS2.

Although the tests reported h support a conclusion that no P absorbent filter is required for so semivolatile organics, this should confirmed for more volatile compound is suspected that the same conclus will be reached, as the more vola compounds will also be less likely to found in the dust.

While the tests of alternative p cedures did not find a simple proced which can meet the performance gc for the HVS2, an exploration of st methods should continue, perhaps v the goal of finding a screening meth which would not yield data that m rigorous standards but could be us inexpensively for large, prelimin samples.

References

Amer. Soc. Testing and Materi (ASTM). 1987. Evaluation of carp embedded dirt removal effectivene of household vacuum cleaners (F6 79). In: Annual Book of AS Standards. Amer. Soc. Testing a Materials, Vol. 15.07: Philadelphia, pp.

Boubel, R. W. 1971. A high volume st sampler. J. Air Poll. Control As 21:783-787

Gillette, D. A., J. Adams, A. Endo, Smith, R. Kihl. 1980. Thresh velocities for input of soil particles i the air by desert soils. J. Geoph Res. 85C:5621-5630

Krause, C., N. Englert, P. Dube. 19 Petachlorophenol containing wo preservatives: Analyses and evaluat In: Proceedings; Indoor Air '87, Vol B. Seifert, H Esdorn, M. Fischer, Ruden, J. Wegner, eds. Inst. for Wa Soil and Air Hygiene. Berlin, pp. 2 224

LaGoy, P. K. 1987. Estimated s ingestion rates for use in ri assessment. Risk Analysis 7:335-3

Lewis, R. G. and M. D. Jackson. 19 Modification and evaluation of a h volume air sampler for pesticides a other semivolatile industrial orga chemicals. Analytical Chem. 54:5 594

Que-Hee, S. S., B. Peace, C. S. Cl J. R. Boyle, R. L. Bornschein, P. Hammond. 1985. Evolution of effici methods to sample lead sources, su as house dust and hand dust, in homes of children. Environ. R 38:75-95

J. W. Roberts and M. G. Ruby are with Engineering Plus, Seattle, WA 98122.
***Nancy K. Wilson,** is the EPA Project Officer (see below).*
The complete report, entitled "Development of a High Volume Surface Sampler for Pesticides in Floor Dust," (Order No. PB 89-124 630/AS; Cost: $15.95, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Environmental Monitoring Systems Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

United States Environmental Protection Agency

Center for Environmental Research Information
Cincinnati OH 45268

Official Business
Penalty for Private Use $300

EPA/600/S4-88/036