Application Note 103

Polyurethane Foam as an Effective Adsorbent for Pesticides in Air (GC Analysis)

Polyurethane foam (PUF) is a lightweight, easy-to-use material for sampling pesticides in air. Low back pressure allows sampling rates of 1-5 liters/minute, ensuring short sampling times and representative samples. A PUF filter cartridge designed to attach to the front of an ORBO-1000 PUF sampling cartridge traps aerosols and particulate matter, is easily and conveniently assembled, and can be removed from the ORBO-1000 cartridge and capped separately to maintain sample integrity. Both the foam plug and the glass holder that comprise an ORBO-1000 cartridge are reusable when cleaned as described here.

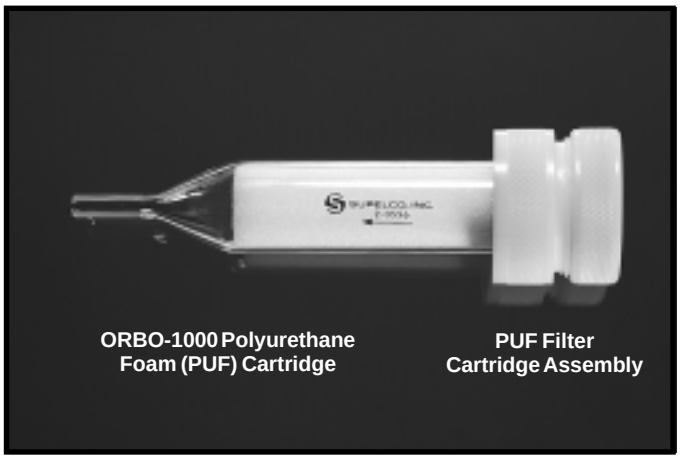
Key Words:
• pesticides • chlorinated pesticides • air monitoring

Increasing concern over the presence of pesticides in indoor and ambient air has led to the use of polyurethane foam (PUF) as a lightweight, easy-to-use sampling material for these semivolatile compounds. Cylindrical PUF plugs of appropriate density effectively trap contaminants without creating excessive back pressure. Sampling rates of 1-5 liters/minute for pesticides allow shorter sampling times and ensure more representative samples. These relatively high sampling rates also can be required to attain needed detection limits. PUF plugs sometimes are used with an additional adsorbent, such as Amberlite® XAD®-2 resin, to collect more volatile contaminants, or with a filter, to trap particles.

Our PUF filter cartridge contains a replaceable 32mm diameter quartz microfiber filter with a stainless steel support which traps aerosol and particulate forms of semivolatiles, such as pesticides and PCBs. It is designed to attach to the front of an ORBO™-1000 PUF sampling cartridge (Figure A). The low pressure drop of the PUF cartridge/filter cartridge allows high sampling volume (1-5 liters/minute). The filter cartridge does not contribute contaminants to the sample, is easily and conveniently assembled, and can be removed from the ORBO-1000 cartridge and capped separately to maintain sample integrity.

Applications citing a 22mm diameter PUF plug include American Society for Testing and Materials (ASTM) Method D4861 (*Sampling and Analysis of Pesticides and Polychlorinated Biphenyls in Air*), ASTM D4947 (*Chlordane and Heptachlor Residues in Indoor Air*), US EPA Method IP-8 (*Determination of Organochlorine Pesticides in Indoor Air*), and US EPA Method TO10 (*Determination of Organochlorine Pesticides in Ambient Air*).

Figure A. Polyurethane Foam (PUF)/ORBO-1000 Pesticide Sampling Device



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The low detection limits required for these methods necessitate extensive cleaning of the PUF material, and meticulous handling during sampling and analysis. Table 1 summarizes the cleaning, sampling, and chromatographic procedures we use to evaluate the PUF plugs used with ORBO-1000 cartridges. We store the clean PUF plugs in sealed containers, protected from light, to maintain their purity.

We compared background and pesticide recovery from cleaned and uncleaned PUF plugs, to verify that our cleaning procedures do not alter the performance of the plugs. Figure B clearly shows clean plugs are essential to achieving the low background levels and detection limits required in pesticides methodology. A mix of 0.5µg of each pesticide in hexane was spiked onto a cleaned or uncleaned PUF plug, then extracted, concentrated, and analyzed as described in Table 1. Octachloronaphthalene was used as a surrogate, to monitor extraction efficiency. The high pesticide spiking concentration masked any interference by contaminants in the uncleaned foam plugs. Recovery rates for pesticides spiked onto cleaned plugs and uncleaned plugs were not significantly different (Table 2), showing that our cleaning process had no adverse effect on adsorbent performance. SPB-608 fused silica capillary columns, used in the chromatographic analyses of these analytes, are specifically tested for analyses of chlorinated pesticides.

Our investigations confirm that cleaned polyurethane foam is an effective adsorbent for pesticides in air. ORBO-1000 PUF sampling cartridges are lightweight, portable, and easy to handle during sample collection. Each consists of a cleaned PUF plug in a glass holder, capped at both ends and ready to use. The 1/4 inch (6mm) neck on the glass holder makes ORBO-1000 cartridges compatible with personal sampling pumps having sampling rates of 1 liter/minute or greater. Both foam plug and glass holder are reusable when cleaned as described in Table 1.

Table 1. Cleaning, Sampling, and Analysis for Organochlorine Pesticides (US EPA IP-8)

Sampling Medium
ORBO-1000 cartridge
(7.6cm x 22mm polyurethane foam plug; density = 0.022g/cm^3)

*PUF Plug Preparation**
Using Soxhlet apparatus, wash plug with acetone for 14-24 hr, followed by ether/hexane (5:95) for 16 hr. Vacuum dry 2-4 hr at room temperature. Place in glass sampling cartridge and seal until sample collection.

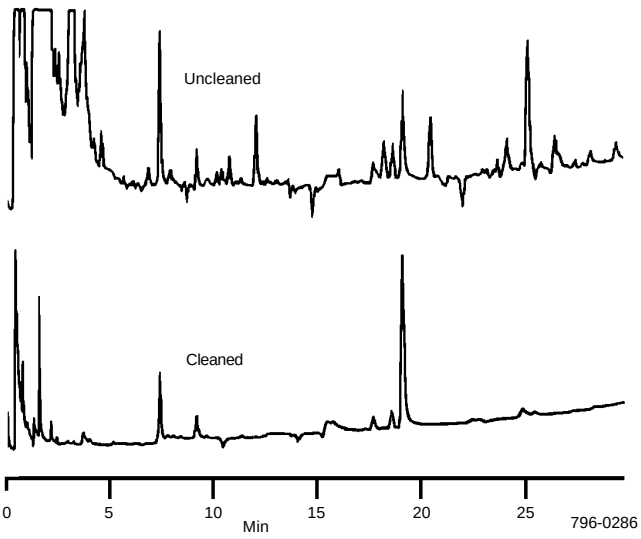
Sample Collection
1-5 liters/min for 4-24 hr. Pesticide concentration: 0.01-50µg/m^3.

Sample Preparation
Using Soxhlet apparatus, extract plug with ether/hexane (5:95) for 16 hr. Concentrate extract to 10.0 mL.

GC Analysis
Column: **SPB™-608, 30m x 0.53mm ID, 0.5µm phase film**
Oven: 150°C (1 min) to 270°C at 4°C/min
Carrier: helium, 7mL/min
Det.: ECD, 320°C
Inj.: 1µL ether/hexane extract, direct injection (packed inlet sleeve), 220°C.

*Omit acetone wash when cleaning PUF cartridge for reuse.

Figure B. Background in PUF Cartridges for Pesticide Analysis (GC-ECD)



GC column and conditions described in Table 1.

Table 2. Pesticide Recovery from Cleaned vs. Uncleaned PUF Plugs

Pesticide	% Recovery (0.5µg Spike) Cleaned	Uncleaned
Dichlorvos	68	74
2,4,5-Trichlorophenol	68	91
Pentachlorobenzene	67	56
2,4-D methyl ester	95	91
Hexachlorobenzene	71	72
α-BHC	67	73
γ-BHC (Lindane)	77	84
β-BHC	95	80
Heptachlor	79	76
Chlorothalonil	87	72
Aldrin	73	76
Ronnel	87	94
Chlorpyrifos	96	88
Heptachlor epoxide	86	84
trans-Nonachlor	90	86
Dieldrin	94	95
4,4'-DDE/Captan	99	95
4,4'-DDT	104	85
Mirex	102	85
Methoxychlor	111	82

Ordering Information:

Description	Cat. No.
ORBO-1000 PUF Cartridges, pk. of 3	**20557**
Glass Holder for ORBO-1000 Cartridge	**20556**
Cleaned PUF Plug, pk. of 3	**20600-U**
PUF Filter Cartridge Assembly cartridge, quartz filter, stainless steel screen, 2 endcaps (replacement parts available)	**21031**
SPB-608 Capillary Column 30m x 0.53mm ID, 0.5µm film	**25312**

Reference

1. *Compendium of Methods for the Determination of Air Pollutants in Indoor Air* US EPA, Research Triangle Park, North Carolina, USA (April 1990).
   Chapter IP-8 - Determination of Organochlorine Pesticides in Indoor Air
   Request as publication PB90-200288/AS from: NTIS, 5285 Port Royal Road, Springfield, VA 22161 USA (In USA, call 800-553-NTIS).

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