RESEARCH NOTE

PERMEABILITY OF COATED FIBERBOARD PANELS, PLYWOOD SHEETS, POLYURETHANE FOAM, AND PLASTIC COATINGS TO PHOSPHINE

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Sealing materials that effectively retain phosphine gases (PH_3) were fiberboard panel with 2-or 4-mil polyethylene sheet glued to one side, polyurethane foam, 2-or 4-mil polythylene sheet and coatings of either latex-acrylic or polyvinyl chloride plastic.

INTRODUCTION

Modification of doors, vents, windows and skylights is frequently made to agricultural storages. These modifications create openings in the building structure that vary in size and shape from long, narrow tracks to several square meters. Building contractors frequently seal small openings in storages with latex or vinylite plastic coatings, polyurethane foam or, if openings are large, with fiberboard or plywood panels. These tests were to determine the permeability of sealing materials to phosphine (PH_3), a fumigant possessing good penetration characteristics.

MATERIALS AND METHODS

The materials tested for fumigant permeability are given in **Table 1.** These were evaluated in a 0.28-m^3 (10-ft^3) fumatorium that was built in two equal sized sections. The test material was located across the fumatorium horizontal mid-plane and separated the fumatorium into 0.14-m^3 top and bottom sections. Fiberboard panel and polyethylene (PE) sheet test materials extended completely across the fumatorium mid-plane, 0.37-m^2 (4 ft^2), whereas the other test materials were cemented to a metal mat that had a central opening of 0.09-m^2 (1 ft^2). Phosphine evolved from ca. 600 mg of aluminum phosphide that was inserted in the bottom section of the empty fumatorium. This dosage generated a PH_3 concentration of ca. 1,000 ppm in the treated section. Air samples were removed from both ends of the fumatorium at 24-hour intervals over a 96-hr period. Phosphine concentration was measured with indicator tubes.

Phosphine movement into the untreated section of the fumatorium is shown in **Table 1** as % of A/A + B where A is the top and B the bottom fumatorium sections. Further details of the test procedure have been reported by Childs and Overby (1).

RESULTS AND DISCUSSION

Data presented in **Table 1** indicate PE is semipermeable to PH_3. However, PE of 2-mil thickness is frequently used as a tarpaulin

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Type of sealing material	Percent of phosphine recovered in untreated fumatorium section after			
	24 hr	48 hr	72 hr	96 hr
Pressed fiberboard panel-0.32-cm (0.125-in.) thick, tempered				
Untreated	49.0	-	-	-
Polyurethane sealer-2 coats on one side	35.7	45.2	48.9	-
Latex glue on one side	27.3	35.1	-	47.2
2-mil PE sheet glued to one side	0.1	1.2	2.6	3.5
4-mil PE sheet glued to one side	0.0	Tr	Tr	0.1
PE sheet-low density				
2-mil thickness	Tr	3.7	5.8	8.5
4-mil thickness	Tr	2.0	3.7	7.0
Plywood sheet-CDX, 1.27-cm (0.50-in.) thick				
Untreated	8.5	17.2	25.4	37.2
Latex paint-1 coat on one side	3.2	12.3	14.0	17.2
Pool paint, rubberized 1 coat on one side	8.9	13.6	24.7	38.4
Polyurethane foam				
2.54 cm-0.91 kg (1 in.-2 lb) density	0.0	Tr	Tr	Tr
2.54 cm-0.91 kg (1 in.-2 lb) density 1 coat acrylic-latex on one side	0.0	0.0	Tr	Tr
Latex based-acrylic coating				
20-mil thickness	0.0	Tr	Tr	Tr
50-mil thickness	0.0	0.0	0.0	Tr
Polyvinyl chloride "Cocoon" coating				
22-mil thickness	0.0	Tr	Tr	Tr

Table 1. Permeation of various panels, sheets and coating by phosphine.

over stacked tobacco bales, cases, or hogsheads and occasionally over storage warehouses to retain PH_3 for periods of 96 to 120 hr. Concentration of PH_3 under the tarpaulin at the end of the fumigation is usually ca. 100 ppm which is sufficient to kill insect pests. Therefore, we used 2-mil PE as a reference, and test materials permitting less than 8.5% PH_3 transfer after 96-hr exposure were considered suitable for fumigant containment.

Pressed fiberboard, with and without sealer coats, was permeable to PH_3. Either 2- or 4-mil PE sheet glued to one face of the board essentially prevented PH_3 penetration. Plywood sheet was too porous to be considered a good sealing material even when one side was coated with a latex or a rubberized swimming pool paint. Polyurethane foam was nearly imperviable to PH_3 penetration, and it was even less permeable when one side was coated with an acrylic-latex paint. Spray-on plastics such as latex-based acrylic coatings or the polyvinyl coating were practically impervious to PH_3 at thickness of 20-22 mil. These are film thicknesses suggested by the manufacturers for sealing small openings in agricultural storages. In some storage conversions, the latex material of ca. 50-mil thickness has been used to close screened areas of several square meters.

LITERATURE CITED

1. Childs, D.P., and J.E. Overby. Permeability of paper, plastic and apertured films to phosphine. **Tob. Sci.** 18:95-97. 1974.