Permeability to Methyl Bromide of Plastic Films and Plastic- and Rubber-Coated Fabrics[1]

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The practice of fumigating commodities, equipment, and even buildings under tarpaulins has become increasingly prevalent in recent years. A number of new materials have become available, and studies were conducted at Hoboken, N. J.,[2] and Manhattan, Kans., to determine the relative permeability of several of these.

PROCEDURE.—The degree of permeability of the different fabrics was determined by measuring the amount of methyl bromide gas that escaped from a test chamber, through the test fabric. The test chamber consisted of a 55-gallon steel drum with one end removed. About 1 square yard of the material to be tested was placed over the open end of the drum and sealed with Scotch masking tape (fig. 1). The gas concentrations in the drums were measured by the thermal conductivity method.

The drum fumigator was placed on its side, and two sampling tubes were inserted through rubber stoppers in holes made for the introduction of the gas and the withdrawal of gas samples. The sample of gas for analysis was drawn out through one tube, passed through the analysis unit, and returned to the fumigator through the other tube. Thus, gas could escape only through the test material, since in each test the seal was checked with a halide leak detector.

A series of three tests was conducted with each type of test fabric, a total of 25 materials being tested. A dosage of 4 pounds of volatilized methyl bromide per 1000 cubic

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[2] The portion of the work done at Hoboken, was under the general guidance of H. H. Richardson, entomologist in charge at that station.

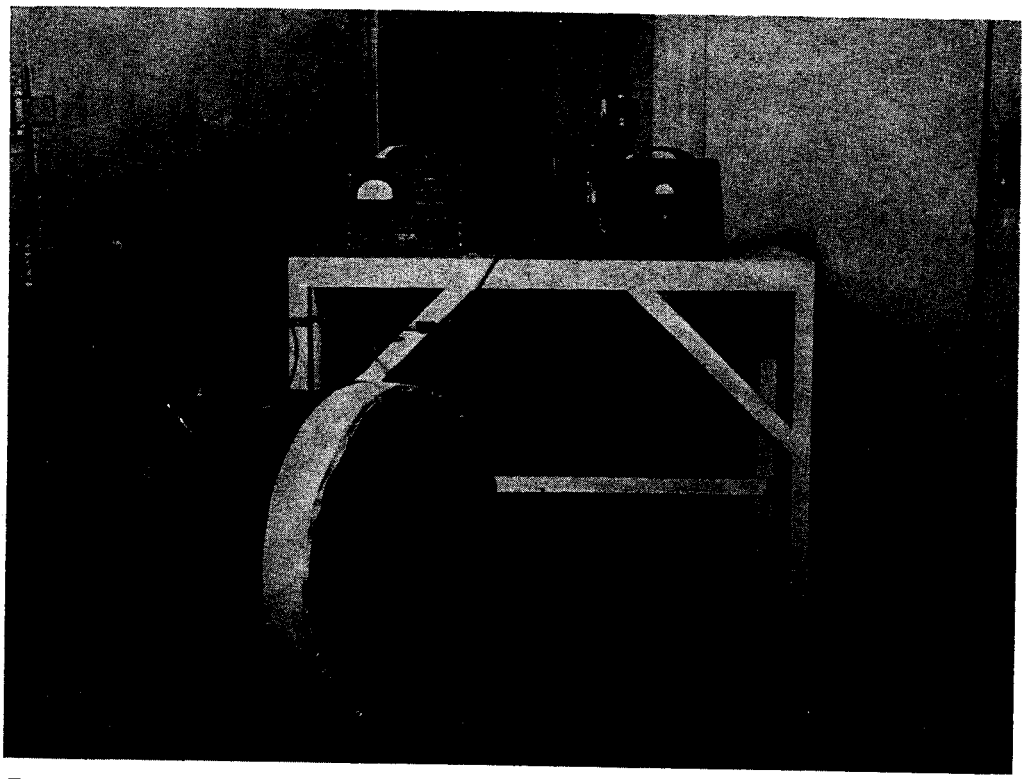

FIG. 1.—Drum-type fumigator used to test the permeability of sheetings. The gas analysis unit on the table and the drum are connected by sampling tubes.

feet was used in each replicate, and circulated within the fumigator only at the time that the gas was introduced.

Five gas samples were taken at intervals after the methyl bromide was introduced, at 10 minutes, 1, 2, 4, and 18 hours.

Liquid methyl bromide was also applied to each sample to observe the effects of direct contact.

Samples to be tested were obtained from the following firms: U. S. Rubber Company, Plastic Film Corporation, Firestone Tire and Rubber Company, H. T. McGill Company, Visking Corporation, Chemilene Company, Thermoplastic Fabric Corporation, Duracote Corporation, Larvicide Products, Inc., Monsanto Chemical Company, and Vulcan Rubber Company. There are many more coated fabrics and plastic films on the market than were included in these tests but it was believed that those used would be sufficient to give some indication of the degree and range of permeability which new films possess.

Sample #1 was used as a standard and the other test materials were compared with it. The fabric in sample #1 consisted of two pieces of cotton sheeting cemented together and coated on the outer sides with neoprene. (This coated fabric, developed by the Quartermaster Corps, was used in delousing bags during World War II (Latta *et al.* 1946)). Although unused, this fabric was taken from a bag which had been in stock 10 years. Another fabric, sample #1A, was of similar construction, but was taken from a used bag also approximately 10 years old; it was included to determine the effect of use on permeability.

RESULTS.—The loss of gas through the sheetings ranged from a minimum of 6.5% to a maximum of 63.1% after 18 hours of exposure (table 1).

A comparison of the materials shows that all but two were equal to or better than the standard (sample #1). The performance of the standard was considered good, since it lost only slightly more than one-fourth of the original amount of gas in an 18-hour period. The permeability of the material from the used delousing bag was considerably greater than that of the unused bag material employed as a standard.

Some of the sheetings were softened by contact with liquid methyl bromide, but were not injured unless pressure was exerted while the film was wet. Only one material (sample #2) was severely damaged by the liquid methyl bromide.

DISCUSSION.—These tests show that polyethylene and vinyl films and synthetic rubbers, or materials coated with them, are very effective in retaining methyl bromide. Accidental contact of the films or coatings with liquid methyl bromide is not serious if the tarpaulin is not under stress when the contact occurs.

Even though the films will not withstand much handling or rough usage in comparison with the coated fabrics, it is probable that both types will be useful, depending on the job to be done and the amount of re-use contemplated.

The permeability was different for each of the 4-mil polyethylene films (samples 5, 6, and 7) and for those of the vinyl films (samples 3, 8, and 18). According to Jones & McGlamery (1956) different processes are used by the

Table 1.—Loss of methyl bromide during 18 hours and the effect of spraying liquid methyl bromide on the materials.

SAMPLE NUMBER	MATERIAL[a]	PERCENTAGE LOSS OF GAS[b]	RESULTS OF SPRAYING LIQUID METHYL BROMIDE ON MATERIAL
23	Vulcan 5712 Coverlite (nylon fabric treated both sides)	6.5	No injury
3	Velon vinyl film F. R. 1001—polyvinyl chloride (0.004 inch thickness)	10.3	Softened, but no injury unless pressure exerted when wet
13	Fiberthin 79631—neoprene coated nylon (one sheet of nylon fabric coated on each side)	10.8	No injury
8	Velon vinyl film (0.004 inch thickness)	12.2	Softened when wet; no injury unless pressure exerted when wet
17	Fumi-cover; vinyl plastic film (0.004 inch thickness)	12.9	No injury
20	Vulcan Coverlite 5716 (neoprene coated nylon similar to No. 19 but slightly heavier)	13.3	No injury
5	Polyethylene film (0.004 inch thickness)	13.6	No injury
11	Fortron-X (similar to No. 10, but with a looser weave of fiberglass, $\frac{1}{4}'' \times \frac{1}{4}''$ mesh)	13.6	Softened when wet; no injury unless pressure exerted when wet
21	Flexfirm. Acron. 26 grey coated nylon (coated both sides)	14.2	No injury
6	Visqueen; (clear polyethylene film, 0.004 inch thickness)	14.3	No injury
12	Fortron 120 L.G. (similar to, but heavier than No. 10, and with a closer weave of fiberglass fabric) $\frac{1}{16}'' \times \frac{1}{16}''$ mesh	15.0	No injury
14	Fiberthin 79636; vinyl plastic coated nylon (one sheet of nylon fabric coated on each side)	15.0	Slight injury
15	V-55 (Fiberglass fabric with fairly heavy vinyl plastic coats on each side)	15.0	No injury
24	Fortron—plastic fabric, same as No. 10, except clear. $\frac{1}{4}'' \times \frac{1}{4}''$ mesh	16.5	Softened when wet; no injury unless pressure exerted when wet
18	UL 7—Ultron. Vinyl film (0,008 inch thickness)	16.8	Softened when wet; no injury unless pressure exerted when wet
16	T-55 (Fiberglass fabric with fairly heavy vinyl plastic coats on each side) similar to No. 15 except finer fiberglass fiber used	18.3	No injury
7	Polyethylene film (0.004 inch thickness)	19.3	No injury
22	Flexfirm. USDA 885 yellow coated nylon (coated both sides)	19.6	No injury
4	Velon polyethylene film P.F. 1A (0.002 inch thickness)	22.2	No injury
10	Fortron No. 100-R-48 (vinyl plastic with loose weave fiberglass fabric embedded in center mesh $\frac{1}{4}'' \times \frac{1}{8}''$)	22.5	Softened when wet; no injury unless pressure exerted when wet
19	Vulcan Coverlite 5715 (neoprene coated nylon: one sheet nylon fabric coated on each side)	26.1	No injury
1	Neoprene coated cotton sheeting, new material (2 sheets of cotton fabric cemented together and coated on outer sides with neoprene; delousing bag)	26.6	No injury
2	Plastin 55. Vinyl coated cotton fabric (coated one side only)	33.5	Severe injury, plastic dissolved
9	Nylon, rubber center (two sheets of nylon fabric cemented together)	38.2	No injury
1A	Neoprene coated cotton sheeting, used material[c]	63.1	No injury

[a] Trade names are used only to identify the product. Their use does not constitute endorsement by the U. S. Department of Agriculture.
[b] Mean of three tests.
[c] Two sheets of cotton fabric stuck together and coated with neoprene. Taken from a used army delousing bag. This material was included to provide a comparison of the new and used fabrics.

various manufacturers in making polyethylene films, and the permeability as well as the chemical resistance of the films differ with the process used. Some minor differences in the permeability of the sheets may have been the results of minute defects in the samples tested. In selecting the most suitable film for use as a fumigation tarpaulin, therefore, consideration should be given to each manufacturer's product rather than to the type of material in general.

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