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Field and Laboratory Glove Permeation Studies with Pesticide Formulations

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While the standard ASTM method for permeation has been a useful screening method to rank-order the protectiveness of gloves when challenged with chemicals, there is still need to develop more realistic screening protocols for both laboratory and the field that involve whole glove studies. The results of such protocols also require comparison with those from the standard ASTM method.

In the present study, aqueous emulsions of Captan, Benomyl, and Folpet wettable powder formulations at their highest field spraying concentrations were evaluated separately by the ASTM method using isopropanol as collection solvent for benomyl and folpet, and hexane for captan. The collection side was analyzed for pesticide by either capillary gas chromatography-electron capture (GC-ECD) or capillary gas chromatography-mass spectrometry (GC-MS). Benomyl was analyzed as the pentafluorobenzyl derivative of carbendazim. Folpet was monitored as its on-column pyrolysis product phthalimide. The challenged and inner glove surfaces were examined by attenuated total reflectance Fourier transform infrared (ATR-FTIR) analysis also to assess if this technique had the sensitivity and selectivity to detect surface residues of pesticides. All of the pesticides permeated slightly by 8 hours (less than 100 ng/cm²/min calculated on a time weighted average basis) but more than 250 ng/cm². Pesticide was definitely detected on the dried surface of the challenge side, but not of the collection side by ATR-FTIR.

Since benomyl tended to decompose to the animal carcinogen carbendazim in water and folpet required strict column temperature control conditions to prevent on-column pyrolysis, captan which did not decompose in water or on-column was selected for further method development with a portable ATR-FTIR, the TravelIR. The optimized method involved solvent casting on nitrile glove material, and resulted in least quantifiable limits of 1.9 microgram/cm² (working linear range 3.7-34 microgram/cm²) for the inner surface, and 0.20 microgram/cm² (working linear range 0.75-29 microgram/cm²) for the outer surface at a wavelength of 1735 wave numbers at 128 scans per analysis. This sensitivity is adequate to detect beneath the ASTM flux threshold of 250 ng/cm². Thus, at least for captan, the sensitivity and selectivity of quantitation for ATR-FTIR are sufficient for use as a feasible field screening technique.

Experiments are still in progress using moving and stationary mechanical hands with whole gloves to evaluate the permeation of aqueous captan emulsions, with those results to be reported at the Conference.

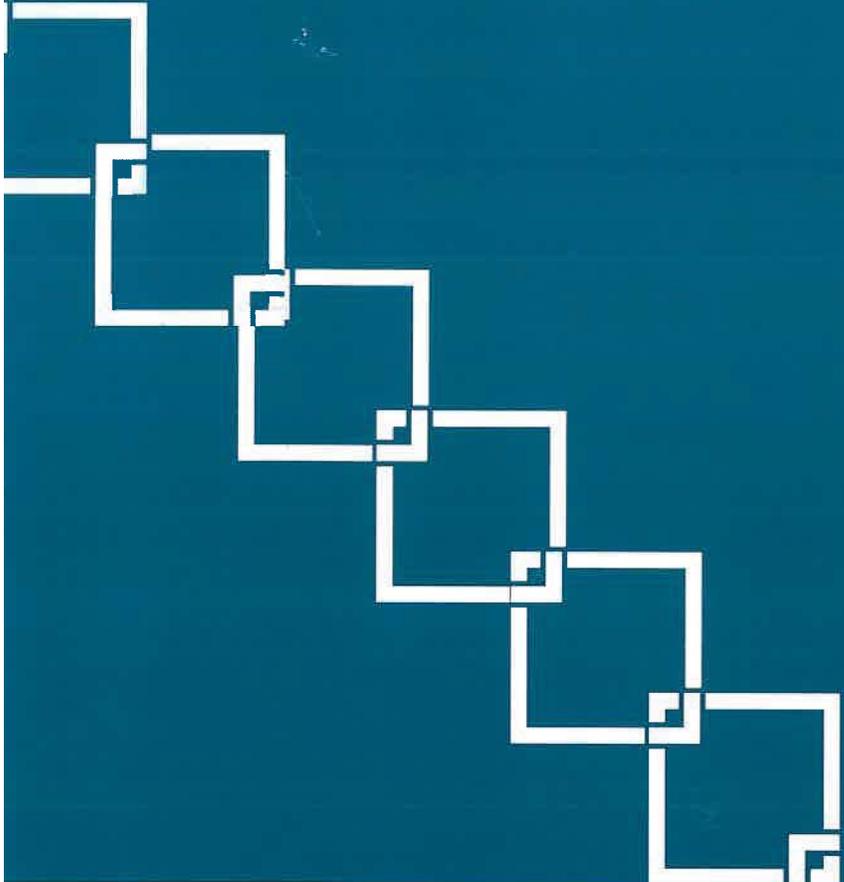
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