Implementation Programs

Microencapsulated Pheromone Products: Alternatives for Integrated Pest Management

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Although 3M markets a highly diversified range of products, few people would associate the 3M Company name with agricultural products. In fact, 3M is much better known for trademarks such as Scotch™, Post-it™, and Thinsulate™, to name a few.

Recently, our 3M Canada-based team, in collaboration with growers and academic researchers, has initiated a program aimed at the application of polymeric materials for the controlled delivery of both biorational and industrial products. Specifically, we have developed polymers for the encapsulation and controlled delivery of insect pheromones.

Pheromones are natural chemicals which are released by organisms and affect the behavior of an individual of the same species. These chemicals are social in nature and are involved in colonization, feedant attraction, alarms, sexual attraction, etc. In other words, pheromones may be considered as the chemical vocabulary of insects. Pheromones are gaining wider acceptance among practitioners of integrated pest management, especially in the capacity to effect mating disruption.

The pheromones of lepidopteran insects are often characterized as follows:

- non-polar
- insoluble in water
- evaporate readily
- subject to photo-oxidation
- relatively expensive

These characteristics obviate the need for development and optimization of delivery methods. Although significant advances have been made for the application of pheromones with hand-applied devices, insufficient research and development have been conducted for the market introduction of sprayable formulations or microencapsulated pheromones. Sprayable or microencapsulated formulations would provide the obvious benefit for using conventional spray equipment to apply the pheromones.

Microencapsulation refers to a process for coating a material in such a manner as to produce discrete capsules or reservoirs. The microcapsule, which consists of a core and shell wall, may measure from 1 to 1000 microns in diameter with the size often directly tailored to the specific application. Microcapsules are used in numerous applications including food flavoring, pesticides, biopesticides, fireproofing agents, fragrances, fracturing fluids, drugs, and

photochromic agents, just to name a few examples.

The core of the microcapsule is typically a solid, liquid, or gas, and is referred to as active, fill, internal phase, or core material. Several mechanisms may be invoked for release of the core: diffusion through the wall, dissolution of the wall, hydrolyses of the wall, or fracturing of the wall. The release rate is fine-tuned by appropriate engineering of the shell material and is controlled by such factors as particle size, wall thickness, wall permeability, crystallinity, plasticizer level, configuration, and post-treatments or coatings.

Among the terms used to refer to the capsule wall, those terms commonly used include coating, shell, or membrane. The coating may be constructed from many different materials: cross-linked polymers, carbohydrates, proteins, polysaccharides, and combinations thereof.

In addition to functioning as the carrier for the contents of the microcapsule, the wall provides protection of the core material from environmental conditions including UV degradation and oxidation. 3M microcapsules provide many advantages over non-microencapsulated formulations including aqueous based, compatible with conventional spray equipment, prolonged delivery and activity of the core material, reduced contact toxicity to applicators, and improved adhesion to substrates.

3M has applied microencapsulation technology for timed-release of chemical actives for control of agricultural and forestry pests and for residential use of pesticides. These products can be used to complement other methodologies in effective integrated pest management programs.

We propose to provide a more in-depth discussion of microencapsulated pheromone formulations. In addition, we hope to receive input from the audience on potential considerations for future design of formulations.