FORMULATING AN IMPROVED INSECT REPELLENT WITH WACKER CYCLODEXTRINS

Formulating an insect repellent is more challenging today than ever. Consumers want maximum relief, minimum number of applications, an extended protection time and a choice of natural or synthetic active ingredients. Most insect repellents, both natural and synthetic, are very volatile, which complicates the process of offering an effective and long-lived product. WACKER cyclodextrins provide increased flexibility for the formulator to meet today's consumer demands.

Variety of Natural and Synthetic Actives

WACKER's cyclodextrins can extend the protection time of most volatile substances, for example:
- Plant extract oils: citronella, camphor, cinnamon, clove, etc.
- Pure natural ingredients: geraniol, limonene, p-menthane-3,8-diol, etc.
- Synthetic ingredients: pyrethroids, DEET, etc.

Extended Protection with Proven Efficacy

Tests with female Aedes aegypti mosquitoes have shown that CAVASOL® cyclodextrin derivatives can extend the protection time of commercial formulations by up to 80% (@ 0.05% CAVASOL® W7HP added to the commercial formulation).

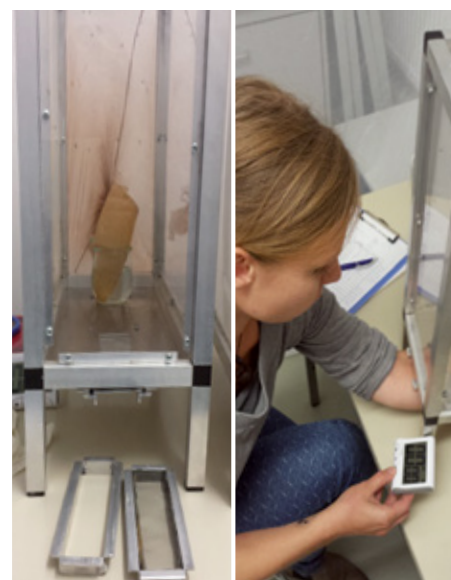**Figure 1: Volatile Repellent Forms Barrier around Treated Area**
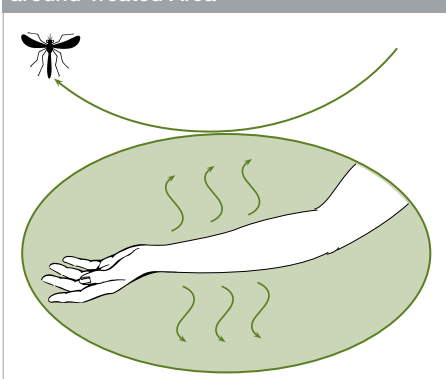
As long as the surrounding air is saturated with the active ingredient, all mosquitoes are deterred.

Test setup at mosquito laboratory.

Innovation by WACKER

Formulations containing WACKER cyclodextrins, i.e. complexes of cyclodextrin and volatile insect repellent, can help meet the formulation challenge of:
- Extended protection time
- Increasing solubility of active
- Ability to use water-insoluble actives
- Utilization in a variety of application modes (pump spray, aerosol and cream)
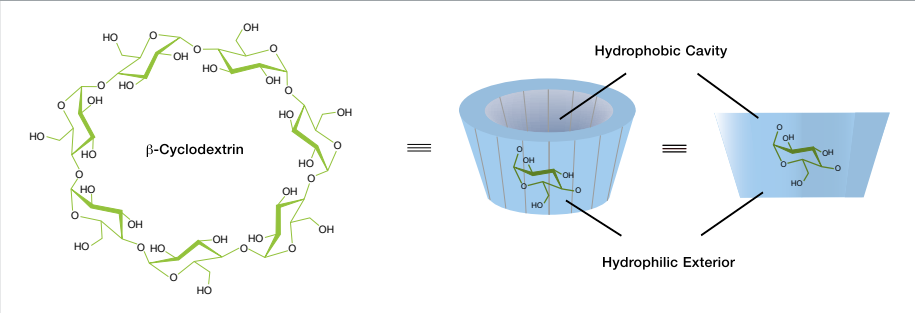
Product	Protection Time
Commercial formulation	2.30 hours
Commercial formulation with CAVASOL® W7HP	4.30 hours

Protection time of formulations with and without cyclodextrins.

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Figure 2: Cyclodextrin Structure

β-Cyclodextrin

Hydrophobic Cavity

Hydrophilic Exterior

Advantages at a Glance

WACKER cyclodextrins
- Can be added as inert ingredients
- Increase the protection time of repellency products at small percentage additions
- Enable the use of highly volatile substances which usually dissipate too quickly for effective use
- Have been tested on a wide variety of commercially used insect repellents

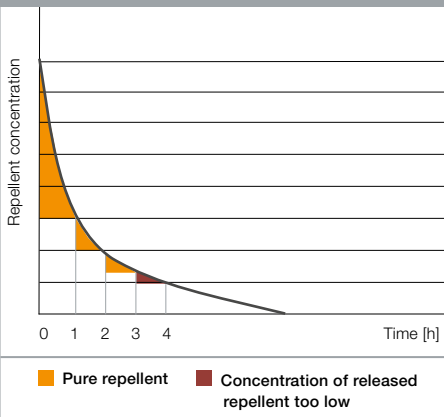## Figure 3: The Graph Shows the Decreasing Concentration of Repellent over 4 Hours

Repellent concentration

0 1 2 3 4   Time [h]

■ Pure repellent   ■ Concentration of released repellent too low

Figure 4: The Addition of Cyclodextrins as Inert Ingredients Can Influence the Release of the Active Ingredient

Repellent concentration

Physical mixture of repellent with CAVASOL® W7HP (1:1)

Physical mixture of repellent with CAVASOL® W7HP (1:0.05)

0 1 2 3 4 5 6 7   Time [h]

■ Pure repellent   ■ Concentration of released repellent too low
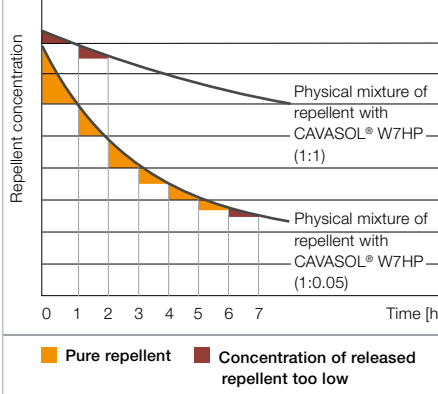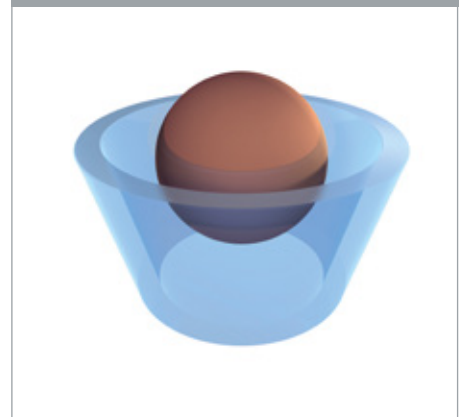
Figure 5: Schematic Representation of a Cyclodextrin-Guest Complex

WACKER Cyclodextrins – How They Work

Cyclodextrins are cyclic oligosaccharides, containing at least six D-(+)-glucopyranose units, attached by α-(1,4) glycosidic bonds. With their lipophilic inner cavities and hydrophilic outer surfaces, they are capable of interacting with a large variety of guest molecules to form non-covalent inclusion complexes (see Fig. 2 and Fig. 5).

WACKER cyclodextrins will slow down the initial boost of active ingredient. They will ensure that the repellency product is released more evenly over a longer period of time. In order to obtain this effect, only low concentrations of CAVASOL® cyclodextrins need to be added.

CAVAMAX®

CAVASOL®