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LENS TO DROP DIAMETER CONVERSION FACTORS VS. TIME FOR AZAMETHIPHOS 100 ULV SPRAY ON TEFLON SLIDES

by

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LENS TO DROP DIAMETER CONVERSION FACTORS VS. TIME

FOR AZAMETHIPHOS 100 ULV SPRAY ON TEFLON SLIDES

In response to a request for a spread factor to apply to droplets of Azamethiphos 100 ULV on teflon coated slides we have examined the behaviour of this formulation. The sampling system is to be used in calibrating the output performance of cold fogging equipment with this chemical for biting fly studies to be conducted by DRB during 1978 in cooperation with Ciba-Geigy Canada Ltd.

Materials and Method

The spray formulation, sample supplied by Ciba-Geigy Canada Ltd., is a proprietary mixture said to contain 10% w/v active ingredient in a low vapour pressure solvent-diluent with a percentage of low viscosity, higher vapour pressure fluid (cyclohexanone) to enhance atomization. The teflon slides used (available commercially) consisting of a regular glass microscope slide with an applied layer of self adhesive teflon film were from a lot originally used to sample mosquito sprays at St. Pierre, Manitoba in 1975. They were cleaned by flooding with successive rinses of acetone, ethyl alcohol and distilled water. Drops of the fluid, produced by a rotary droplet generator fed by a multi-ratio gearmotor driven displacement pipette, nominal emitted diameter 317 µm, were run onto a prepared slide. Within a minute the diameter and profile height of a selected drop lens were measured and again at intervals of minutes, hours and days thereafter until no further shrinkage was detectable. The diameter of the spherical drop equivalent to a lens of measured diameter and profile height is given by the equation:-

$$d = [h(h^2 + 3r^2)]^{1/3}$$

where h is the profile height and r is the radius of the fluid lens (a segment of a sphere) in contact with the slide.

The ratio of the calculated diameter to the nominal emitted diameter constitutes a residual diameter fraction, and its cube is a measure of the proportion of the original drop volume present at the moment of measurement. The ratio of original spherical drop diameter to measured lens diameter constitutes a lens to drop diameter conversion factor at that point in time.

Results and Conclusions

The residual volume fractions, as calculated from successive lens measurements, are graphed vs. time in Figure I. The first measurement at drop age of only a minute or so yielded a residual volume fraction of about 0.8 which indicates that about 20% of the original volume, presumably the cyclohexanone had flash evaporated by the time the measurements were made. From this point residual volume declined steadily to 0.2 at *ca.* 25 hours. Beyond this the line gradually levels off, approaching a base level beyond which there is no appreciable change. On the basis of 10% w/v involatile solute with stated specific gravity 1.6 the expected level would be 0.063.

The corresponding conversion factor/time curve is also plotted in Figure I. The indicated (instantaneous) initial value is about 0.67, but loss of the volatile diluent raises it to 0.72 by the time of first measurement. The line rises in a compound sigmoidal manner, finally levelling off and approaching a value 1.63 which corresponds to a residual volume of .063 in a lens with the observed residual geometry.

This curve, rough as it is, applies to only one size of drop in a narrow temperature range and is therefore of no direct use in estimating the sizes of other smaller or larger drops. The volume decay rate of a drop is directly related to its free surface to volume ratio, which is inversely proportional to the linear dimension. Accordingly, the time required for a drop lens to reach a given residual volume fraction (i.e. stage of evaporative decay) and corresponding lens to drop conversion factors should be proportional to its original diameter. Accordingly we should expect that a 10 μm drop lens would shrink to its terminal diameter, where its conversion factor would approach 1.63, in one tenth the time for a 100 μ drop lens to do the same. This relationship is illustrated in Figure II wherein original drop diameters are plotted vs. age for several given lens diameters. Note that for 200 μm lens diameter, the indicated original drop diameter measured at the earliest possible moment would be about 145 μm whereas after 54 hours when all solvent would have evaporated, the lens would represent a 326 μm drop. A 20 μm mature lens would be equivalent to a 32.6 μm drop but its maturity threshold would be only 5.4 hours.

If the largest drop expected on the slides is say 40 μm, with equivalent mature lens diameter about 25 μm, the expected maturity age would be about seven hours at 23°C. As vapour pressure and attendant evaporation rates are temperature dependent, maturity age will be greater at lower temperatures and less at higher temperatures. At around 10° and 30° , the indicated maturity ages should be adjusted by about 3X and 0.5X respectively. As it is obviously not practical to estimate drop sizes corresponding to various immature lens diameters, each with its unique conversion factor vs. time relationship, one must wait until the largest drops have 'dried out' before undertaking measurements. Cold storage only prolongs the waiting period. Accelleration of drying by judicious use of heat can be considered if time is short.

In attempting to compare the atomization of Azamethiphos 100 ULV 1978 formulation with the results of 1977 tests with CGA 18809 100 ULV which had a different-behaving solvent system, caution should be exercised.

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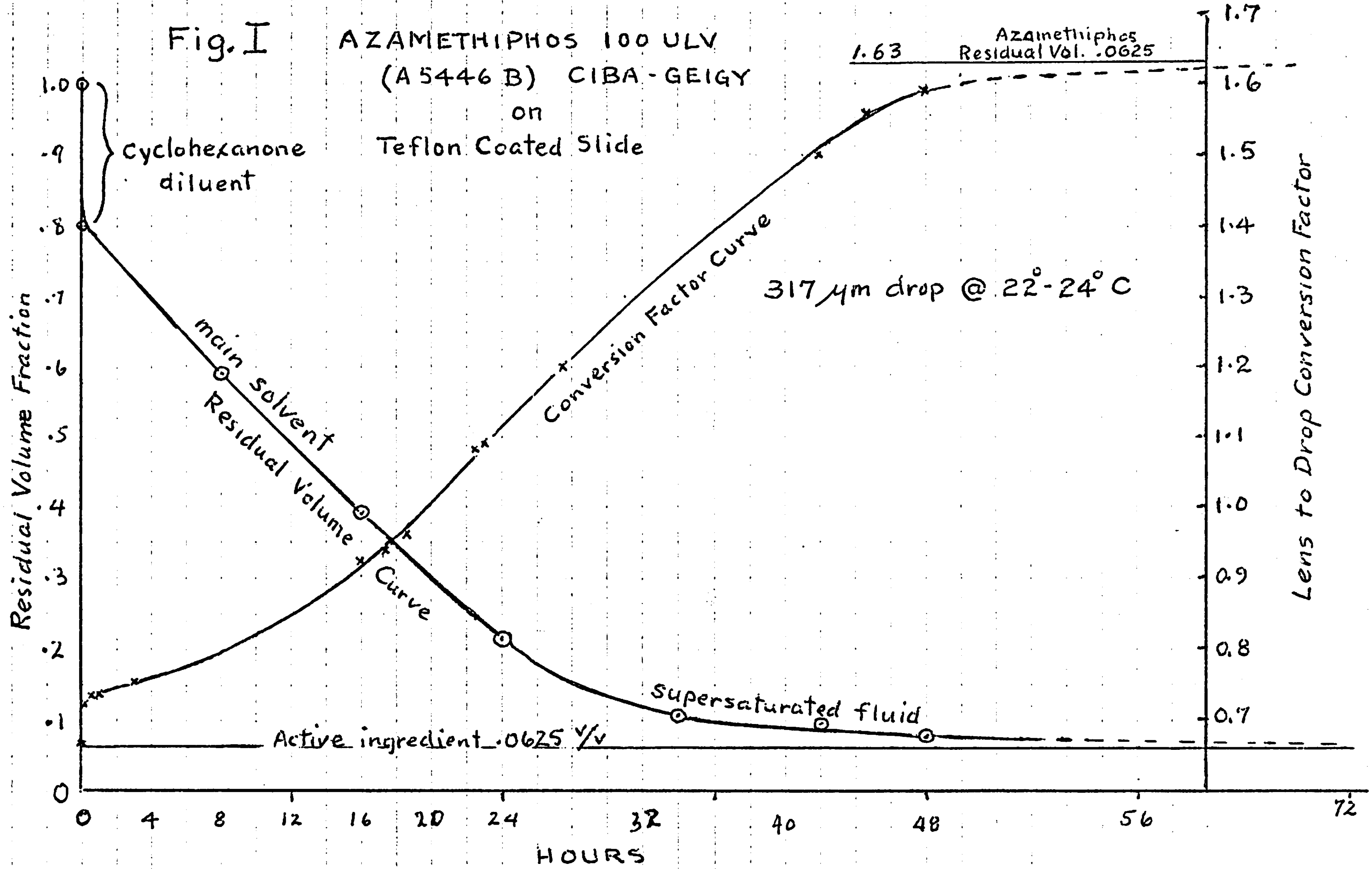

Fig. I
AZAMETHIPHOS 100 ULV
(A 5446 B) CIBA-GEIGY
on
Teflon Coated Slide
Cyclohexanone diluent
317 μm drop @ 22°-24° C
Azamethiphos Residual Vol. .0625
1.63
main solvent
Residual Volume Curve
Conversion Factor Curve
supersaturated fluid
Active ingredient .0625 v/v
Residual Volume Fraction
Lens to Drop Conversion Factor
HOURS
0
4
8
12
16
20
24
32
40
48
56
72
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7

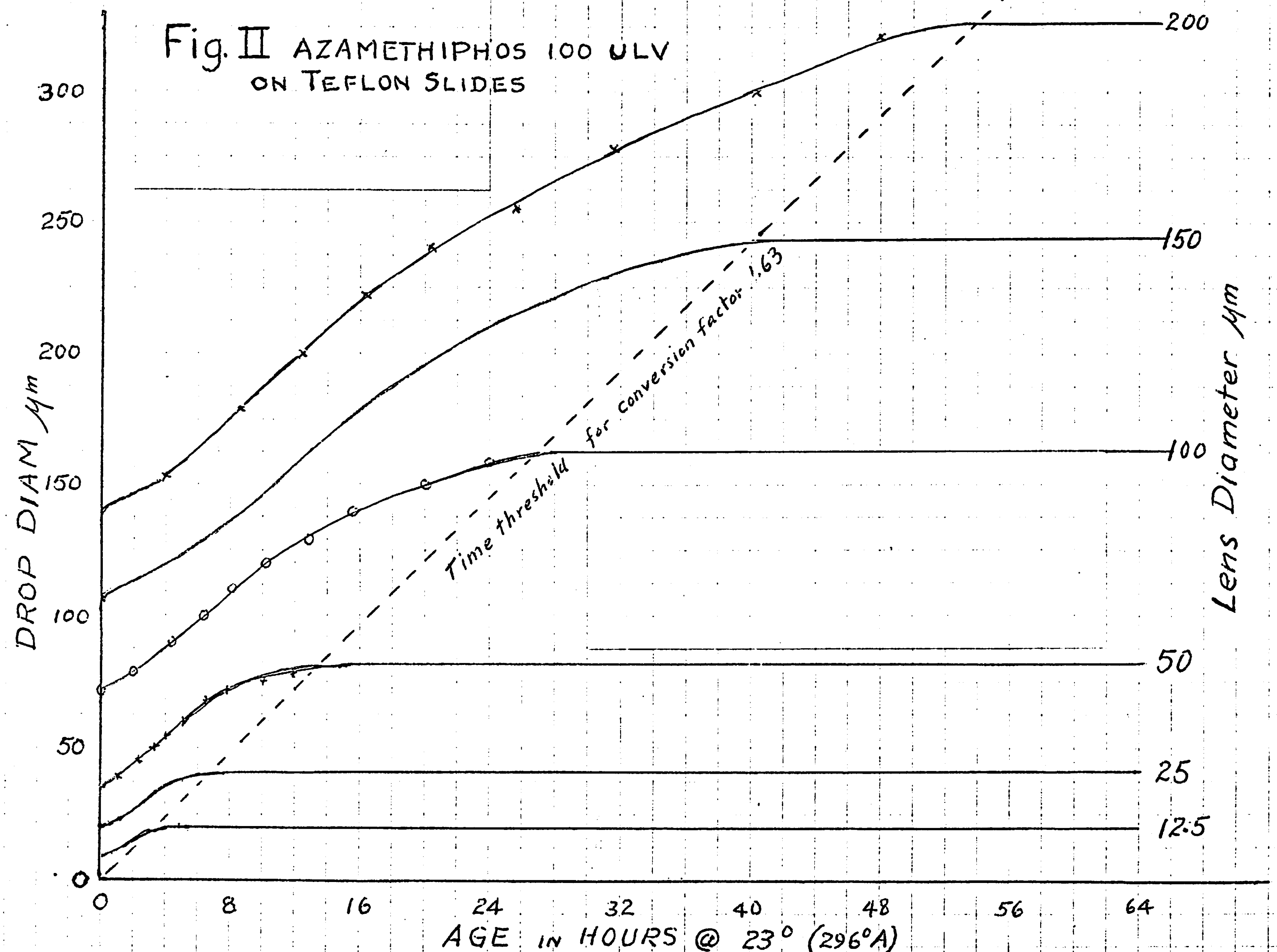

Fig. II AZAMETHIPHOS 100 ULV
ON TEFLON SLIDES
DROP DIAM μm
300
250
200
150
100
50
0
Lens Diameter μm
200
150
100
50
25
12.5
Time threshold for conversion factor 1.63
0
8
16
24
32
40
48
56
64
AGE IN HOURS @ 23° (296°A)