



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

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OFFICE OF  
PREVENTION, PESTICIDES AND  
TOXIC SUBSTANCES

MEMORANDUM

**SUBJECT:** REVIEW OF STUDY MONITORING EXPOSURE TO MIXER/HELPERS  
AND APPLICATORS TO BIFENTHRIN INSECTICIDE USED AS A  
POST CONSTRUCTION TERMITICIDE.

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Please find below the OREB review of ....

DP Barcode: D173114

Pesticide Chemical Code: 128825

EPA Reg. No.: \_\_\_\_\_

Deferral to:

PHED: N/A



Recycled/Recyclable  
Printed with Soy/Canola Ink on paper that  
contains at least 50% recycled fiber

1/14

## 1.0 INTRODUCTION

FMC Corporation has submitted a study measuring the potential dermal and respiratory exposures of workers applying Biflex TC<sup>™</sup> for termite control. Biflex TC<sup>™</sup> is an emulsifiable concentrate formulation containing 25 percent BIFENTHRIN as the active ingredient (2 pounds of active ingredient per gallon). The study was conducted under an Experimental Use Permit (No. 279-EUP-122) in support of an application to register bifenthrin for termiticide use.

The material is applied at a concentration of 0.05 percent or, under certain conditions, at a maximum concentration of 0.125 percent. The latter is prepared by mixing 66.5 ounces of Biflex TC<sup>™</sup> with 99.5 gallons of water. The formulation is intended for both pre-construction and post construction treatments. The product is intended for use by professional pest control operators only. Other sites mentioned on the Experimental Use Permit label include; posts, poles, and other constructions; spot treatment for control of wood infesting insects; broadcast treatment of wood for control of wood infesting insects outside of structures; and firewood protection. These uses are not addressed by the current submission.

### Pre-Construction Treatment

A horizontal barrier during pre-construction application is created by treating the soil at a rate of 1 gallon per 10 ft<sup>2</sup> of soil fill using a coarse spray. A rate of 1.5 gallons per 10 ft<sup>2</sup> is used if the fill is washed gravel to allow the emulsion to reach the underlying soil. Vertical barriers can be created by rodding, trenching at a rate of 4 gallons of emulsion per 10 linear feet per foot of depth. This volume is reduced to 2 gallons per 10 linear feet per foot of depth if treating hollow block voids.

### Post-Construction Treatment

Soil applications can be made at a maximum concentration of 0.125 percent by injection, rodding, trenching, and/or coarse fan spray (<25 psi). Vertical barriers for concrete slabs or basements can be established by sub-slab injection, rodding, and/or trenching with application rates of 4 gallons per 10 feet per ft of depth. Crawl spaces are also treated by rodding or trenching at a rate of 4 gallons per 10 feet per ft of depth. To avoid the construction of mud tubes, an overall soil treatment can be conducted at a rate of 1 gallon per 10 ft<sup>2</sup>. When treating crawl spaces or plenums the ventilation system is to be turned off and the crawl space exhausted to the outside until dust or spray has settled. Inaccessible crawl spaces are treated by drilling through the floor and treating at a rate of 4 gallons per 10 feet per foot of depth. Masonry voids are treated by drilling through

blocks and veneer to provide a barrier at the top of the footing. The application rate for this use is 2 gallons per 10 linear feet.

Under difficult conditions excavation treatment can be used. The soil removed from the trench is placed on a plastic sheet. The soil can be treated at a rate of 4 gallons per 10 linear feet per foot of depth of the trench. After the soil has absorbed the emulsion, the soil can be returned to the trench.

## 2.0 CONCLUSIONS

OREB has calculated the potential dermal exposures of workers applying BIFENTHRIN to structures for subterranean termite control. Dermal exposure of the body was monitored using union suits worn under long sleeved shirts, long pants, and socks. Workers wore a number of different levels of protection, preventing the evaluation of the effects of these garments. However, the clothing is considered to be representative of that normally worn by workers that would apply this material. Protective gloves, face shield and other protective garments are not required by the proposed label. Respiratory exposure contributed a negligible portion of total exposure and was not included in the exposure calculations. The daily and annual potential dermal exposures were 10.2  $\mu\text{g}/\text{kg}/\text{day}$  and 2.2  $\text{mg}/\text{kg}/\text{yr}$ , respectively

## 3.0 DESCRIPTION OF STUDY

The study was conducted at 17 houses in Pennsylvania, New Jersey, Delaware, and Florida. All treatments were performed by licensed commercial applicators using techniques commonly used for termite treatment in the United States. The material was applied at the typical use rate. One worker performed the mixing/loading task and another applied the material. Other tasks, such as drilling, trenching, or filling the drilled holes, were performed by either worker. Workers were monitored for one day or until completion of the application, whichever was shorter. The concentration of the applied emulsion was 0.125 percent, the total volume ranging from 25-150 gallons. Workers followed their normal work practices, including washing their hands before lunch and at other times. Chemical resistant gloves were worn by all mixer/helpers, most also wearing goggles or a face shield. Some of the applicators wore gloves during treatment. Each worker wore the clothing normally used for his task. Work clothing ranged from short sleeve shirts long pants and sneakers to protective coveralls for under house spraying. Mixer/helpers wore chemical resistant gloves and, in most cases, face shield or goggles. Protective gloves, face shield and other protective garments are not required by the proposed label.

Dermal exposure of the body was monitored using union suits worn

under long sleeved shirts, long pants, and socks. Additional patch dosimeters were worn on the neck, chest, and hat. Dermal exposure of the hands was measured by washing the hands with water followed by a second wash with detergent solution (210 ppb sodium dioctyl sulfosuccinate surfactant). Dosimeters or hand washes were collected at the end of the replicate, either the end of the job or completion of the workday, whichever was shorter.

Liquid samples were cooled with ice packs for shipment to the analytical laboratory. Clothing samples were chilled with dry ice. Samples were extracted with hexane and analyzed by gas chromatography using an electron capture detector. Formulation samples were dissolved in heptane/acetone (80:20 v/v%). Aqueous termiticide emulsions were analyzed after ultrasonic extraction in ethyl acetate. Air samples, clothing samples, and hand washes were extracted with hexane. The air samples (GFF) were then analyzed directly. Hand rinse samples were dried with sodium sulfate and concentrated by evaporation prior to analysis. Clothing samples were subjected to florasil cleanup prior to evaporation. All samples were diluted to a specified volume before analysis. The average recoveries for laboratory spiked samples are presented in Table 1.

Field spike samples were prepared for each matrix by delivering BIFENTHRIN emulsion using pipettes or syringes. These were exposed to the site environment for approximately the length of the study replicate. The amounts applied to each matrix and corresponding recoveries are presented in Table 2. The lower confidence limits (LCLs) ranged from 68 (low level tap water spike) to 112 (low level sock spike).

Table 1. Recoveries of Laboratory Spiked Samples of Bifenthrin Termiticide from Various Media.

| Matrix                    | Range of Spike Levels ( $\mu\text{g}$ ) | Average Recovery (%) | Range (%) |
|---------------------------|---|----------------------|-----------|
| Glass fiber filters (GFF) | 0.091-0.164                             | 104                  | 97-114    |
| Surfactant                | 25.6-119                                | 92                   | 87-97     |
| Tap Water                 | 25.6-114.3                              | 96                   | 91-126    |
| Union Suits               | 205-410                                 | 96                   | 91-98     |
| Socks                     | 41.2-228.6                              | 95                   | 91-101    |
| Patches                   | 5.1-45.7                                | 93                   | 92-113    |

Table 2. Recoveries of Field Spiked Samples of Bifenthrin Termiticide from Various Media.

| Matrix             | Number of Data Sets | Range of Spike Levels ( $\mu\text{g}$ ) | Average Recovery (%) | Range of Recoveries (%) |
|--------------------|---------------------|---|----------------------|-------------------------|
| Glass Fiber Filter | 17                  | 81-138                                  | 102                  | 87-115                  |
| (GFF)              | 17                  | 0.257-0.414                             | 94                   | 67-124                  |
| Aqueous Surfactant | 17                  | 324-552                                 | 90                   | 70-108                  |
|                    | 17                  | 4.3-7.27                                | 78                   | 59-92                   |
| Tap Water          | 16                  | 324-552                                 | 86                   | 75-97                   |
|                    | 17                  | 4.3-7.27                                | 71                   | 59-88                   |
| Union Suits        | 17                  | 1190-6550                               | 83                   | 66-99                   |
|                    | 17                  | 40.5-69.0                               | 90                   | 69-100                  |
| Socks              | 17                  | 202.5-345.0                             | 86                   | 75-95                   |
|                    | 17                  | 2.58-4.36                               | 123                  | 81-157                  |
| Patches            | 17                  | 202.5-345.0                             | 89                   | 71-107                  |
|                    | 16                  | 2.58-4.36                               | 98                   | 77-120                  |

#### 4.0 RESULTS AND CALCULATION OF EXPOSURES

The average amount handled was 2.0 and ranged from 1.0 lb to 3.0 lbs. These amounts are well within the range normally applied to structures. A summary of the average estimated potential dermal exposures for both mixer/helpers and applicators is presented in Table 3. A more detailed breakdown of the exposure values by replicate is presented in Appendix A. Although protective gloves were worn by all mixer/helpers and protective equipment was worn by some individuals, the various clothing scenarios prevented the evaluation of the protective effects of these garments. OREB considered the clothing worn to be typical of that normally worn by workers using this product. Other termiticides may require more extensive protective clothing.

Respiratory exposure contributed a relatively a small percentage of the of the total exposure. The mean respiratory exposure was 0.0030  $\mu\text{g}/\text{kg}/\text{hr}$  (0.0041  $\mu\text{g}/\text{kg}/\text{lb ai}$ ) for mixer/helpers and 0.0057  $\mu\text{g}/\text{kg}/\text{hour}$  (0.00092  $\mu\text{g}/\text{kg}/\text{lb ai}$ ) for applicators. The

corresponding geometric means were 0.0015  $\mu\text{g}/\text{kg}/\text{hr}$  (0.0041  $\mu\text{g}/\text{kg}/\text{lb ai}$ ) and 0.0034  $\mu\text{g}/\text{kg}/\text{hr}$  (0.0092  $\mu\text{g}/\text{kg}/\text{lb ai}$ ) for mixer/helpers and applicators, respectively. A more complete breakdown of each individuals respiratory exposure is presented in Appendix B.

In order to estimate the daily and annual exposures of workers to this material a number of assumptions were required:

- 1) An average worker weighs 70 kg and has a respiratory volume of 1.7  $\text{m}^3$  per hour while performing light tasks. The activities occurring during termiticide application are considered light tasks.
- 2) An average of 2.0 lbs of active ingredient is applied during a single treatment. An individual home may require more or less material, depending on structural features and soil conditions.
- 3) A worker applies the chemical for 220 days per year. In all but the southern states this must be considered to be conservative.
- 4) The protective clothing worn during this study is considered to be typical of that normally worn by workers using this product. Other termiticides may require more extensive protective clothing.
- 5) Dermal exposure values are not corrected for dermal absorption.
- 6) Since a number of types of clothing were worn during the study, no attempt has been made to determine the statistical distribution of the dermal exposures. The arithmetic mean value of 3.4  $\mu\text{g}/\text{kg}/\text{lb ai}$  was used for calculations.
- 7) Respiratory exposure is considered to be negligible compared to dermal.

The estimated potential daily dermal exposure would be:

$$\begin{aligned}\text{Daily Exposure } (\mu\text{g}/\text{kg}/\text{day}) &= 2.0 \text{ lb ai/trt} \times 1 \text{ trt/day} \times 3.4 \mu\text{g}/\text{kg}/\text{lb ai} \\ &= 6.8 \mu\text{g}/\text{kg}/\text{day}\end{aligned}$$

The annual exposure would be:

$$\begin{aligned}\text{Annual Exposure } (\mu\text{g}/\text{kg}/\text{yr}) &= 6.8 \mu\text{g}/\text{kg}/\text{day} \times 220 \text{ days/yr} \\ &= 1.5 \times 10^3 \mu\text{g}/\text{kg}/\text{yr} = 1.5 \text{ mg}/\text{kg}/\text{yr}\end{aligned}$$

Table 3. Summary of the Potential Dermal Exposure Dermal Exposures of Workers Applying Bifenthrin to Structures for Subterranean Termite Control. Workers are assumed to weigh 70 kg.

| Worker/Source of Exposure | Micrograms per lb ai handled |              |              |              | Micrograms per hour |              |              |              |
|---------------------------|------------------------------|--------------|--------------|--------------|---------------------|--------------|--------------|--------------|
|                           | MEAN                         | STD DEV      | MINIMUM      | MAXIMUM      | MEAN                | STD DEV      | MINIMUM      | MAXIMUM      |
| <b>Applicator:</b>        |                              |              |              |              |                     |              |              |              |
| Water Handwash            | 0.446                        | 0.573        | 0.014        | 2.121        | 0.172               | 0.256        | 0.004        | 1.052        |
| Detergent Handwash        | 0.156                        | 0.247        | 0.004        | 0.967        | 0.062               | 0.116        | 0.002        | 0.48         |
| Head/Neck                 | 0.280                        | 0.247        | 0.041        | 0.941        | 0.103               | 0.088        | 0.015        | 0.344        |
| Top                       | 1.478                        | 1.293        | 0.18         | 4.37         | 0.513               | 0.414        | 0.084        | 1.625        |
| Pants                     | 1.022                        | 1.143        | 0.029        | 3.924        | 0.35                | 0.346        | 0.019        | 1.128        |
| Socks                     | 0.022                        | 0.03         | 0.005        | 0.12         | 0.009               | 0.014        | 0.002        | 0.054        |
| <b>TOTAL</b>              | <b>3.404</b>                 | <b>2.243</b> | <b>0.496</b> | <b>8.635</b> | <b>1.209</b>        | <b>0.732</b> | <b>0.244</b> | <b>2.581</b> |
| <b>GEO. MEAN</b>          | <b>0.995</b>                 |              |              |              |                     |              |              |              |
| <b>Mixer/helper:</b>      |                              |              |              |              |                     |              |              |              |
| Water Handwash            | 0.162                        | 185          | 0.009        | 0.681        | 0.052               | 0.047        | 0.003        | 0.16         |
| Detergent Handwash        | 0.062                        | 0.083        | 0.007        | 0.296        | 0.02                | 0.021        | 0.002        | 0.071        |
| Head/Neck                 | 0.204                        | 0.291        | 0.02         | 1.19         | 0.065               | 0.083        | 0.008        | 0.339        |
| Top                       | 0.967                        | 1.343        | 0.033        | 4.65         | 0.322               | 0.397        | 0.011        | 1.35         |
| Pants                     | 0.413                        | 441          | 0.026        | 1.651        | 0.149               | 0.141        | 0.014        | 0.516        |
| Socks                     | 0.016                        | 0.019        | 0.004        | 0.084        | 0.006               | 0.006        | 0.001        | 0.026        |
| <b>TOTAL</b>              | <b>1.825</b>                 | <b>1.702</b> | <b>0.154</b> | <b>5.7</b>   | <b>0.614</b>        | <b>0.494</b> | <b>0.06</b>  | <b>1.66</b>  |
| <b>GEO. MEAN</b>          | <b>1.142</b>                 |              |              |              |                     |              |              |              |

cc: Correspondence file  
Chemical file (BIFENTHRIN)  
Circulation  
B. Backus (TOX II/H7509C)  
A. Nielsen (OREB/H7509C)



**APPENDIX A. POTENTIAL DERMAL EXPOSURES OF APPLICATORS DURING APPLICATION  
OF BIFENTHRIN FOR SUBTERRANEAN TERMITE CONTROL**

| Site    | EXPOSURE (UG/KG/LB AI) |           |           |       | Socks | Top   | TOTAL | LOG    |
|---------|------------------------|-----------|-----------|-------|-------|-------|-------|--------|
|         | H2O Wash               | Hand Wash | Head/Neck | Pants |       |       |       |        |
| 2       | 0.361                  | 0.119     | 0.341     | 0.819 | 0.028 | 2.412 | 4.080 | 0.611  |
| 3       | 1.371                  | 0.519     | 0.533     | 1.744 | 0.021 | 1.577 | 5.765 | 0.761  |
| 4       | 0.022                  | 0.012     | 0.053     | 0.266 | 0.007 | 3.611 | 3.971 | 0.599  |
| 5       | 0.266                  | 0.065     | 0.041     | 0.087 | 0.006 | 0.674 | 1.139 | 0.057  |
| 6       | 0.067                  | 0.032     | 0.223     | 0.146 | 0.071 | 1.115 | 1.654 | 0.219  |
| 7       | 0.162                  | 0.043     | 0.941     | 1.119 | 0.006 | 0.424 | 2.695 | 0.431  |
| 8       | 0.079                  | 0.016     | 0.116     | 0.029 | 0.011 | 0.245 | 0.496 | -0.305 |
| 9       | 0.064                  | 0.031     | 0.186     | 0.060 | 0.020 | 0.397 | 0.758 | -0.120 |
| 10      | 0.976                  | 0.232     | 0.091     | 3.558 | 0.008 | 3.770 | 8.635 | 0.936  |
| 11      | 0.638                  | 0.277     | 0.607     | 0.640 | 0.012 | 1.021 | 3.195 | 0.504  |
| 12      | 0.014                  | 0.012     | 0.372     | 3.924 | 0.013 | 1.385 | 5.720 | 0.757  |
| 13      | 0.445                  | 0.116     | 0.240     | 0.701 | 0.014 | 1.217 | 2.733 | 0.437  |
| 14      | 0.641                  | 0.112     | 0.519     | 0.358 | 0.006 | 4.370 | 6.006 | 0.779  |
| 16      | 2.121                  | 0.967     | 0.249     | 0.533 | 0.016 | 1.176 | 5.062 | 0.704  |
| 17      | 0.147                  | 0.030     | 0.091     | 1.306 | 0.010 | 0.180 | 1.764 | 0.246  |
| 18      | 0.031                  | 0.004     | 0.054     | 0.637 | 0.005 | 0.614 | 1.345 | 0.129  |
| 19      | 0.182                  | 0.058     | 0.107     | 1.449 | 0.120 | 0.930 | 2.846 | 0.454  |
| MEA     | 0.446                  | 0.156     | 0.280     | 1.022 | 0.022 | 1.478 | 3.404 | 0.423  |
| Std Dev | 0.573                  | 0.247     | 0.247     | 1.143 | 0.030 | 1.293 | 2.243 |        |
| Min     | 0.014                  | 0.004     | 0.041     | 0.029 | 0.005 | 0.180 | 0.496 |        |
| Max     | 2.121                  | 0.967     | 0.941     | 3.924 | 0.120 | 4.370 | 8.635 |        |

GEOMETRIC MEAN 2.651

APPENDIX A (Continued). POTENTIAL DERMAL EXPOSURES OF APPLICATORS DURING APPLICATION OF BIFENTHRIN FOR SUBTERRANEAN TERMITES CONTROL

| Site    | EXPOSURE (UG/KG/HR) |           |           |       |       |       | Socks | TOP    | Total | Log |
|---------|---------------------|-----------|-----------|-------|-------|-------|-------|--------|-------|-----|
|         | H2O Wash            | Hand Wash | Head/Neck | Pants |       |       |       |        |       |     |
| 2       | 0.111               | 0.037     | 0.104     | 0.251 | 0.009 | 0.738 | 1.250 | 0.097  |       |     |
| 3       | 0.448               | 0.170     | 0.174     | 0.570 | 0.007 | 0.515 | 1.884 | 0.275  |       |     |
| 4       | 0.006               | 0.004     | 0.015     | 0.076 | 0.002 | 1.038 | 1.141 | 0.057  |       |     |
| 5       | 0.095               | 0.023     | 0.015     | 0.031 | 0.002 | 0.241 | 0.407 | -0.390 |       |     |
| 6       | 0.035               | 0.017     | 0.116     | 0.076 | 0.037 | 0.577 | 0.858 | -0.067 |       |     |
| 7       | 0.059               | 0.016     | 0.344     | 0.409 | 0.002 | 0.155 | 0.985 | -0.007 |       |     |
| 8       | 0.067               | 0.013     | 0.099     | 0.024 | 0.009 | 0.209 | 0.421 | -0.376 |       |     |
| 9       | 0.021               | 0.010     | 0.060     | 0.019 | 0.006 | 0.128 | 0.244 | -0.613 |       |     |
| 10      | 0.292               | 0.069     | 0.027     | 1.064 | 0.002 | 1.127 | 2.581 | 0.412  |       |     |
| 11      | 0.224               | 0.097     | 0.213     | 0.225 | 0.004 | 0.359 | 1.122 | 0.050  |       |     |
| 12      | 0.004               | 0.004     | 0.107     | 1.128 | 0.004 | 0.398 | 1.645 | 0.216  |       |     |
| 13      | 0.106               | 0.028     | 0.057     | 0.166 | 0.003 | 0.289 | 0.649 | -0.188 |       |     |
| 14      | 0.238               | 0.042     | 0.193     | 0.133 | 0.002 | 1.625 | 2.233 | 0.349  |       |     |
| 16      | 1.052               | 0.480     | 0.123     | 0.264 | 0.008 | 0.583 | 2.510 | 0.400  |       |     |
| 17      | 0.068               | 0.014     | 0.042     | 0.606 | 0.004 | 0.084 | 0.818 | -0.087 |       |     |
| 18      | 0.012               | 0.002     | 0.021     | 0.253 | 0.002 | 0.244 | 0.534 | -0.272 |       |     |
| 19      | 0.081               | 0.026     | 0.048     | 0.649 | 0.054 | 0.416 | 1.274 | 0.105  |       |     |
| MEAN    | 0.172               | 0.062     | 0.103     | 0.350 | 0.009 | 0.513 | 1.209 | -0.002 |       |     |
| Std Dev | 0.256               | 0.116     | 0.088     | 0.346 | 0.014 | 0.414 | 0.732 |        |       |     |
| Min     | 0.004               | 0.002     | 0.015     | 0.019 | 0.002 | 0.084 | 0.244 |        |       |     |
| Max     | 1.052               | 0.480     | 0.344     | 1.128 | 0.054 | 1.625 | 2.581 |        |       |     |

GEOMETRIC MEAN

0.995

API ENDIX A (Continued). POTENTIAL DERMAL EXPOSURES OF MIXER/HELPERS DURING APPLICATION OF BIFENTHRIN FOR SUBTERRANEAN TERMITE CONTROL

| SITE    | EXPOSURES (UG/KG/LB AI) |           |           |       |       | TOTAL | LOG    |
|---------|-------------------------|-----------|-----------|-------|-------|-------|--------|
|         | H2O WASH                | HAND WASH | HEAD/NECK | PANTS | SOCKS |       |        |
| 2       | 0.123                   | 0.044     | 0.237     | 1.651 | 0.084 | 3.455 | 0.538  |
| 3       | 0.365                   | 0.105     | 0.175     | 0.438 | 0.005 | 4.325 | 0.636  |
| 4       | 0.030                   | 0.020     | 1.190     | 0.101 | 0.016 | 1.826 | 0.262  |
| 5       | 0.093                   | 0.070     | 0.411     | 0.351 | 0.015 | 1.681 | 0.226  |
| 6       | 0.039                   | 0.014     | 0.024     | 0.224 | 0.006 | 0.534 | -0.272 |
| 7       | 0.032                   | 0.015     | 0.048     | 0.638 | 0.004 | 1.241 | 0.094  |
| 8       | 0.067                   | 0.033     | 0.032     | 0.253 | 0.008 | 0.895 | -0.048 |
| 9       | 0.009                   | 0.007     | 0.061     | 0.059 | 0.014 | 0.183 | -0.738 |
| 10      | 0.443                   | 0.239     | 0.056     | 0.838 | 0.013 | 4.558 | 0.659  |
| 11      | 0.248                   | 0.078     | 0.229     | 1.209 | 0.009 | 2.514 | 0.400  |
| 12      | 0.266                   | 0.044     | 0.502     | 0.227 | 0.011 | 5.700 | 0.756  |
| 13      | 0.681                   | 0.296     | 0.256     | 0.114 | 0.024 | 1.512 | 0.180  |
| 14      | 0.164                   | 0.009     | 0.082     | 0.213 | 0.033 | 0.669 | -0.175 |
| 16      | 0.028                   | 0.019     | 0.031     | 0.026 | 0.005 | 0.154 | -0.812 |
| 17      | 0.046                   | 0.016     | 0.041     | 0.279 | 0.014 | 0.794 | -0.100 |
| 18      | 0.082                   | 0.011     | 0.020     | 0.279 | 0.006 | 0.539 | -0.268 |
| 19      | 0.040                   | 0.026     | 0.078     | 0.127 | 0.007 | 0.438 | -0.359 |
| MEAN    | 0.162                   | 0.062     | 0.204     | 0.413 | 0.016 | 1.825 | 0.057  |
| Std Dev | 0.185                   | 0.083     | 0.291     | 0.441 | 0.019 | 1.702 |        |
| Min     | 0.009                   | 0.007     | 0.020     | 0.026 | 0.004 | 0.154 |        |
| Max     | 0.681                   | 0.296     | 1.190     | 1.651 | 0.084 | 5.700 |        |

GEOMETRIC MEAN

APPENDIX A (Continued). POTENTIAL DERMAL EXPOSURES OF MIXER/HELPERS DURING APPLICATION OF BIFENTHRIN FOR SUBTERRANEAN TERMITE CONTROL

| Site           | Exposure (ug/kg/hr) |           |           |       |       |       | Total | LOG TOTAL |
|----------------|---------------------|-----------|-----------|-------|-------|-------|-------|-----------|
|                | H2O Wash            | Hand Wash | Head/Neck | Pants | Socks | Top   |       |           |
| 2              | 0.038               | 0.014     | 0.074     | 0.516 | 0.026 | 0.411 | 1.080 | 0.033     |
| 3              | 0.119               | 0.034     | 0.057     | 0.143 | 0.001 | 1.055 | 1.410 | 0.149     |
| 4              | 0.009               | 0.006     | 0.339     | 0.029 | 0.005 | 0.133 | 0.520 | -0.284    |
| 5              | 0.033               | 0.025     | 0.147     | 0.126 | 0.005 | 0.265 | 0.600 | -0.222    |
| 6              | 0.020               | 0.007     | 0.012     | 0.116 | 0.003 | 0.118 | 0.280 | -0.553    |
| 7              | 0.011               | 0.005     | 0.017     | 0.230 | 0.001 | 0.181 | 0.450 | -0.347    |
| 8              | 0.050               | 0.024     | 0.024     | 0.187 | 0.006 | 0.372 | 0.660 | -0.180    |
| 9              | 0.003               | 0.002     | 0.020     | 0.019 | 0.005 | 0.011 | 0.060 | -1.222    |
| 10             | 0.132               | 0.071     | 0.017     | 0.251 | 0.004 | 0.888 | 1.360 | 0.134     |
| 11             | 0.087               | 0.028     | 0.080     | 0.425 | 0.003 | 0.260 | 0.880 | -0.056    |
| 12             | 0.077               | 0.013     | 0.146     | 0.066 | 0.003 | 1.350 | 1.660 | 0.220     |
| 13             | 0.160               | 0.069     | 0.060     | 0.027 | 0.006 | 0.033 | 0.360 | -0.444    |
| 14             | 0.061               | 0.003     | 0.031     | 0.080 | 0.013 | 0.063 | 0.250 | -0.602    |
| 16             | 0.015               | 0.010     | 0.016     | 0.014 | 0.003 | 0.024 | 0.080 | -1.097    |
| 17             | 0.021               | 0.007     | 0.019     | 0.129 | 0.007 | 0.184 | 0.370 | -0.432    |
| 18             | 0.032               | 0.004     | 0.008     | 0.110 | 0.002 | 0.056 | 0.210 | -0.678    |
| 19             | 0.018               | 0.012     | 0.036     | 0.059 | 0.003 | 0.074 | 0.200 | -0.699    |
| MEAN           | 0.052               | 0.020     | 0.065     | 0.149 | 0.006 | 0.322 | 0.614 | -0.369    |
| Std Dev.       | 0.047               | 0.021     | 0.083     | 0.141 | 0.006 | 0.397 | 0.494 |           |
| Minimum        | 0.003               | 0.002     | 0.008     | 0.014 | 0.001 | 0.011 | 0.060 |           |
| Maximum        | 0.160               | 0.071     | 0.339     | 0.516 | 0.026 | 1.350 | 1.660 |           |
| GEOMETRIC MEAN |                     |           |           |       |       |       | 0.427 |           |

APPENDIX B. INHALATION EXPOSURES OF WORKERS APPLYING BIFENTHRIN TO HOMES FOR TERMITES CONTROL

| TASK           | SITE | LBS<br>HANDLED | TIME<br>(min) | TOTAL<br>µg FOUND | EXPOSURE |          |                 |          | LOG<br>µg/KG/LB<br>AI |                |
|----------------|------|----------------|---------------|-------------------|----------|----------|-----------------|----------|-----------------------|----------------|
|                |      |                |               |                   | µg/HR    | µg/KG/HR | LOG<br>µg/KG/HR | µg/LB AI |                       | µg/KG/LB<br>AI |
| APPLICATOR:    | 2    | 2.3            | 441           | 5.83              | 0.793    | 0.011    | -1.959          | 2.591    | 0.037                 | -1.432         |
|                | 3    | 2.5            | 459           | 5.99              | 0.783    | 0.011    | -1.959          | 2.396    | 0.034                 | -1.469         |
|                | 4    | 1.5            | 313           | 0.30              | 0.058    | 0.001    | -3.000          | 0.200    | 0.003                 | -2.523         |
|                | 5    | 2.5            | 419           | 0.61              | 0.087    | 0.001    | -3.000          | 0.244    | 0.003                 | -2.523         |
|                | 6    | 2.5            | 290           | 2.96              | 0.612    | 0.009    | -2.046          | 1.184    | 0.017                 | -1.770         |
|                | 7    | 1.8            | 287           | 1.98              | 0.414    | 0.006    | -2.222          | 1.131    | 0.016                 | -1.796         |
|                | 8    | 2.0            | 141           | 2.65              | 1.128    | 0.016    | -1.796          | 1.325    | 0.019                 | -1.721         |
|                | 9    | 1.0            | 186           | 0.07              | 0.023    | 0.001    | -3.000          | 0.070    | 0.001                 | -3.000         |
|                | 10   | 1.5            | 301           | 2.00              | 0.399    | 0.006    | -2.222          | 1.333    | 0.019                 | -1.721         |
|                | 11   | 2.5            | 427           | 1.38              | 0.194    | 0.003    | -2.523          | 0.552    | 0.008                 | -2.097         |
|                | 12   | 1.5            | 313           | 3.07              | 0.588    | 0.008    | -2.097          | 2.047    | 0.029                 | -1.538         |
|                | 13   | 2.0            | 506           | 2.46              | 0.292    | 0.004    | -2.398          | 1.230    | 0.018                 | -1.745         |
|                | 14   | 1.5            | 242           | 3.68              | 0.912    | 0.013    | -1.886          | 2.453    | 0.035                 | -1.456         |
|                | 16   | 2.0            | 242           | 0.46              | 0.114    | 0.002    | -2.699          | 0.230    | 0.003                 | -2.523         |
|                | 17   | 1.5            | 194           | 0.31              | 0.096    | 0.001    | -3.000          | 0.207    | 0.003                 | -2.523         |
|                | 18   | 3.0            | 453           | 0.31              | 0.041    | 0.001    | -3.000          | 0.103    | 0.001                 | -3.000         |
|                | 19   | 3.0            | 402           | 2.00              | 0.299    | 0.004    | -2.398          | 0.667    | 0.010                 | -2.000         |
| MEAN           |      | 2.0            | 330           | 2.12              | 0.402    | 0.006    | -2.424          | 1.057    | 0.015                 | -2.049         |
| GEOMETRIC MEAN |      |                |               | 0.004             |          |          |                 |          |                       | 0.009          |

APPENDIX B (Continued).  
 INHALATION EXPOSURES OF WORKERS APPLYING BIFENTHRIN TO HOMES FOR TERMITES CONTROL

| TASK           | SITE | LBS<br>HANDLED | TIME<br>(min) | TOTAL<br>UG<br>FOUND | EXPOSURE |          |                 |          |             |                    |
|----------------|------|----------------|---------------|----------------------|----------|----------|-----------------|----------|-------------|--------------------|
|                |      |                |               |                      | UG/HR    | UG/KG/HR | LOG<br>UG/KG/HR | UG/LB AI | UG/KG/LB AI | LOG<br>UG/KG/LB AI |
| MIXER/HELPER:  | 2    | 2.3            | 432           | 4.30                 | 0.597    | 0.009    | -2.046          | 1.911    | 0.027       | -1.569             |
|                | 3    | 2.5            | 460           | 4.76                 | 0.621    | 0.009    | -2.046          | 1.904    | 0.027       | -1.569             |
|                | 4    | 1.5            | 316           | 0.07                 | 0.013    | 0.001    | -3.000          | 0.047    | 0.001       | -3.000             |
|                | 5    | 2.5            | 419           | 0.08                 | 0.011    | 0.001    | -3.000          | 0.032    | 0.001       | -3.000             |
|                | 6    | 2.5            | 290           | 1.23                 | 0.254    | 0.004    | -2.398          | 0.492    | 0.007       | -2.155             |
|                | 7    | 1.8            | 292           | 0.31                 | 0.064    | 0.001    | -3.000          | 0.177    | 0.003       | -2.523             |
|                | 8    | 2.0            | 162           | 0.31                 | 0.115    | 0.002    | -2.699          | 0.155    | 0.002       | -2.699             |
|                | 9    | 1.0            | 186           | 0.15                 | 0.048    | 0.001    | -3.000          | 0.150    | 0.002       | -2.699             |
|                | 10   | 1.5            | 301           | 3.05                 | 0.608    | 0.009    | -2.046          | 2.033    | 0.029       | -1.538             |
|                | 11   | 2.5            | 427           | 2.15                 | 0.302    | 0.004    | -2.398          | 0.860    | 0.012       | -1.921             |
|                | 12   | 1.5            | 310           | 0.15                 | 0.029    | 0.001    | -3.000          | 0.100    | 0.001       | -3.000             |
|                | 13   | 2.0            | 512           | 2.30                 | 0.270    | 0.004    | -2.398          | 1.150    | 0.016       | -1.796             |
|                | 14   | 1.5            | 240           | 1.53                 | 0.383    | 0.005    | -2.301          | 1.020    | 0.015       | -1.824             |
|                | 16   | 2.0            | 225           | 0.15                 | 0.040    | 0.001    | -3.000          | 0.075    | 0.001       | -3.000             |
|                | 17   | 1.5            | 195           | 0.08                 | 0.025    | 0.001    | -3.000          | 0.053    | 0.001       | -3.000             |
|                | 18   | 3.0            | 456           | 0.77                 | 0.101    | 0.001    | -3.000          | 0.257    | 0.004       | -2.398             |
|                | 19   | 3.0            | 388           | 0.61                 | 0.094    | 0.001    | -3.000          | 0.203    | 0.003       | -2.523             |
| MEAN           |      | 2.0            | 330           | 1.29                 | 0.210    | 0.003    | -2.523          | 0.625    | 0.009       | -2.046             |
| GEOMETRIC MEAN |      |                |               |                      |          |          | 0.003           |          |             | 0.009              |