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

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM 8 January 1985

SUBJECT: Exposure Assessment for Propoxur (Baygon).

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An assessment of human and canine exposure to propoxur has been completed. The estimated exposures to propoxur on an annual basis are as follows:

Estimated Annual Exposures to Propoxur

I. Pesticide Control Operators	
Domestic Indoor Use	180 mg/kg/yr
Domestic Outdoor Use	510 mg/kg/yr
→ Commercial Indoor Use	230 mg/kg/yr
→ Food Est. Indoor Use	300 mg/kg/yr
Residential Mosquito Control	120 mg/kg/yr
Aerial Mosquito Control (Pilot)	7.2 ug/kg/yr
Aerial Mosquito Control (Mixer/Loader)	120 ug/kg/yr
Lawn Application	6.9 mg/kg/yr
Kennel Worker-Pet Shampoo	2.3 mg/kg/yr

II. Home Owner Application

Pet Shampoo	30 ug/kg/yr
Flea Collars	2.3 ug/kg/yr
Aerosol Spray and Residue	44 ug/kg/yr

III. Non-Applicator Residue Exposure

Residential C&C Spray	460 ug/kg/yr
Commercial C&C Spray	0.98 ug/kg/yr
Residential Pest Strips	39 ug/kg/yr

IV. Canine

Shampoo	0.95 mg/kg/yr
Flea Collar	380 mg/kg/yr

V. Food Residue From Pest Strips 0.38 ppb

Information detailing the assumptions and calculations utilized to determine the exposure estimates are included in the enclosed attachments.

cc:Caroline Gordon
Judy Heckman

PROPOXUR USE BY PCO'S - DOMESTIC AND COMMERCIAL - INDOOR AND OUTDOOR USES.

Representative Label- Prentox Carbamate 1.5 EC
Contains 14.6% Propoxur
PCO restricted use only
Indoor Use Rate- 8 fl.oz./gal or 1.1% a.i.
Outdoor Use Rate- 8 fl.oz./qt or 4.5% a.i.

I. Surrogate Study

Wolfe,HR. et al. (1959) Evaluation of the Health Hazards Involved in House-Spraying With DDT. Bull. Wld. Hlth. Org. 20:1-14.

DDT at a 5% concentration made from mixing water and a 25% emulsifiable concentrate was applied to the walls and ceiling of a 2.4 m x 3.7 m x 1.8 m room. A 13 liter hand-operated, cylindrical, compressed air, hand sprayer was used. The dermal exposure for a worker wearing a short-sleeved, open-necked shirt, and no gloves was calculated to be 1755 mg/hr. Respiratory exposure was calculated to be 7.1 mg/hr.

II. Assumptions

a) Dermal absorption is 100% of the propoxur impinging on the skin.
b) Respiratory exposure is negligible compared to dermal exposure.
c) Applicators wear the same clothing defined in the surrogate study.
d) Dermal exposure to applicators (mg/hr) is independent of the type of facility sprayed (e.g. commercial, domestic).
e) PCO's spray indoor domestic establishments 330 hrs/yr, indoor commercial establishments (motel) 418 hrs/yr, indoor commercial food establishments 550 hrs/yr, and outdoors domestic 221 hrs/yr. The market penetration of propoxur is approximately 10% (BUD).

III. Indoor Use Dermal Exposure

Conversion Ratio = 1.1% propoxur/5% DDT = 0.22
Dermal Exposure = 1755 mg/hr x 0.22 = 390 mg/hr
390 mg/hr ÷ 70 kg = 5.5 mg/kg/hr

IV. Outdoor Use Dermal Exposure

Conversion Ratio = 4.5% propoxur/5% DDT = 0.90
Dermal Exposure = 1755 mg/hr x 0.90 = 1600 mg/hr
1600 mg/hr ÷ 70 kg = 23 mg/kg/hr

V. Annual Exposures

Indoor Domestic- 330 hrs/yr x 0.10 market penetration x
5.5 mg/kg/hr = 180 mg/kg/yr
Indoor Commercial - 418 hrs/yr x 0.10 market penetration x
5.5 mg/kg/hr = 230 mg/kg/yr
Indoor Food Est.- 550 hrs/yr x 0.10 market penetration x
5.5 mg/kg/hr = 300 mg/kg/yr
Outdoor Domestic- 221 hrs/yr x 0.10 market penetration x
23 mg/kg/hr = 510 mg/kg/yr

PROPOXUR USE BY PCO'S - RESIDENTIAL MOSQUITO CONTROL.

Representative Label- Baygon 70% WP Insecticide
Contains 70% propoxur
Maximum Application Concentration = 1.1% a.i.
Mosquito use applicable for outdoors only
Application by certified personnel only

I. Surrogate Study

Wolfe,HR. et al. (1959) Evaluation of the Health Hazards Involved in House-Spraying With DDT. Bull. Wld. Hlth. Org. 20:1-14.

DDT at a 5% concentration made from mixing water and a 25% emulsifiable concentrate was applied to the walls and ceiling of a 2.4 m x 3.7 m x 1.8 m room. A 13 liter hand-operated, cylindrical, compressed air, hand sprayer was used. The dermal exposure for a worker wearing a short-sleeved, open-necked shirt, and no gloves was calculated to be 1755 mg/hr. Respiratory exposure was calculated to be 7.1 mg/hr.

II. Assumptions

a) Dermal absorption is 100% of the propoxur impinging on the skin.
b) Respiratory exposure is negligible compared to dermal exposure.
c) The average PCO will spray for 1.7 hrs/day and 130 days/yr. Time spraying per year = 221 hours. The market penetration of propoxur is 10% so PCO's spray propoxur approximately 22.1 hrs/yr (BUD).
d) Applicators wear the same clothing defined in the surrogate study.

III. Dermal Exposure

Conversion Ratio = 1.1% propoxur/5% DDT = 0.22
Dermal Exposure = 1755 mg/hr x 0.22 = 390 mg/hr
390 mg/hr ÷ 70 kg = 5.5 mg/kg/hr

IV. Annual Exposure

5.5 mg/kg/hr x 22.1 hrs/yr = 120 mg/kg/yr

PROPOXUR USE BY PCO'S - AERIAL APPLICATION FOR MOSQUITO CONTROL

Representative Label- Prentox Carbamate 1.5 EC
Contains 14.6% propoxur
PCO restricted use only
Apply at 0.05 to 0.07 lbs a.i./acre
(0.825% concentration)
Load directly into aircraft spray tank

I. Surrogate Studies

Jegier,Z. (1964) Health Hazards in Insecticide Spraying of Crops. Arch. Environ. Health. 8:670-674.

Pilot exposure during aerial application of 7.1% endrin was measured. Dermal exposure was found to be 1.18 mg/hr. Respiratory exposure was found to be 0.08 mg/hr.

Everhart,LP and Holt,RF. (1982) Potential Benlate Fungicide Exposure During Mixer/Loader Operations, Crop Harvest, and Home Use. J. Agric. Food Chem. 30:222-227.

The dermal and respiratory exposure to mixer/loaders was measured. Eight mixer/loaders handled an average of 22 lbs. active ingredient in mixing one tank per person (9.4% conc.) for aerial application. Protective clothing was not worn. The average dermal exposure was determined to be 26 mg per operation (1.2 mg/lb a.i.) over an average exposure time of 3.5 minutes. Respiratory exposure was insignificant when compared to dermal exposure.

II. Assumptions

a) Flaggers are not used for mosquito control.
b) 100% of propoxur impinging on the skin is dermally absorbed.
c) A PCO will spray for mosquitos 64 times/yr. Each spray operation takes approximately one hour. The market penetration of propoxur is 5.66% for all types of mosquitos (BUD). Therefore propoxur use for mosquito control would be 64 x 0.0566 = 3.6 times per year.
d) The pilot does not mix and load the pesticide.

III. Pilot Exposure

Conversion ratio: 0.825% propoxur/7.1% endrin = 0.12
1.18 mg/hr x 0.12 = 0.14 mg/hr
140 ug/hr ÷ 70 kg = 2.0 ug/kg/hr

IV. Mixer/Loader Exposure

Conversion Ratio: 0.825% propoxur/9.4% benlate = 0.088
Dermal Exposure: 26 mg/operation ÷ 70 kg x 0.088 = 33 ug/kg/operation

V. Annual Exposure

Pilot = 2.0 ug/kg/hr x 3.6 hrs/yr = 7.2 ug/kg/yr
Mixer/Loader = 33 ug/kg/operation x 3.6 operations/yr = 120 ug/kg/yr

PROPOXUR USE BY PCO'S - LAWNS.

Representative Label- Prentox Carbamate 1.5 EC
Contains 14.6% Propoxur
Apply 11 fl.oz. in 10 to 15 gallons of water per 1000 ft^2
1.5 lbs a.i./gal of Prentox
Apply up to 3 times/month
First application in May or June
PCO use only

I. Surrogate Study

Daniel,WH, Freeborg,RP, and Konopinski,VJ. (1980) Evaluation of the Utilization of RPAR'd Pesticides Applied to Residential and Public Turf Sites and the Potential Exposure to Applicators. Unpublished report prepared for PIAP. 27 October 1980.

Diazinon AG500 liquid was applied by spray gun attached by hose to a 1200 gallon tank on a truck bed. Application rate was 5.5 lbs a.i./acre. Respiratory exposure was insignificant compared to dermal exposure. Dermal exposure was 2.2 mg/hr. Hand exposure was not included in the dermal exposure figures.

II. Assumptions

a) PCO's wear long pants and short sleeve shirts. Gloves are not worn.
b) 90% of total dermal exposure during hand spraying will occur to the hands. Therefore total dermal exposure from the surrogate study is assumed to be 22 mg/hr.
c) 100% of propoxur impinging on the skin is absorbed.
d) Average work day is 1.7 hours (BUD).
e) PCO sprays lawns 130 days/yr and the market penetration of propoxur is 10% (BUD).
f) PCO sprays propoxur 22.1 hrs/yr.

III. Dermal Exposure

Conversion Ratio: 11 fl.oz./1000 ft^2 x 43,550 ft^2/acre x 1 gal/128 fl.oz. x 1.5 lbs propoxur/gal = 5.6 lbs propoxur/acre

5.6 lbs propoxur/acre ÷ 5.5 lbs diazinon/acre = 1.02

Dermal Exposure = 22 mg/hr x 1.02 = 22 mg/hr

IV. Annual Exposure

22 mg/hr x 22.1 hrs/yr = 490 mg/yr
490 mg/yr ÷ 70 kg = 6.9 mg/kg/yr

PROPOXUR USE FOR PET SHAMPOO - HUMAN EXPOSURE

I. Assumptions

a) Concentrate (undiluted shampoo) comes in direct contact with shampooer's hands.
b) A total volume of 15 ml shampoo is used.
c) Contact time with undiluted shampoo is 5 seconds, then it is diluted during lathering by water on animal's hair. Assume the quantity of water on the animal is 250 ml and contact time with the diluted shampoo during lathering is 10 to 15 minutes (12.5 minute average).
d) There is no significant respiratory exposure to propoxur.
e) The shampoo is applied on an average of 4 times per year (BUD) at home. Figures could not be located for kennel workers shampooing dogs. EAB assumed 25 dogs/month or 300 dogs/year.
f) Shampoo is 0.125% propoxur.
g) 7 ml "just wet" hands.
h) 100% of propoxur that comes in contact with hands is absorbed.
i) Respiratory and dermal exposure to residues after rinsing and drying is insignificant.
j) Assume that propoxur has a specific gravity of 1 g/ml.

II. Dermal Exposure Calculations

15 ml shampoo = 15 ml x 0.125% = 19 mg propoxur
19 mg x 1/250 ml x 7 ml = 0.53 mg propoxur in contact with hands

III. Annual Exposure

Home- 0.53 mg/shampoo x 4 shampoos/yr = 2.1 mg/yr
= 2.1 mg/yr ÷ 70 kg = 30 ug/kg/yr

Kennel- 0.53 mg/shampoo x 300 shampoos/yr = 160 mg/yr
= 160 mg/yr ÷ 70 kg = 2.3 mg/kg/yr

PROPOXUR USE IN PET FLEA AND TICK COLLARS - HUMAN EXPOSURE.

Representative Label- Zoecon Dog Collar for Flea Control
Contains 9.4% propoxur
Collar weighs 1 oz.
Effective for up to 21 weeks

I. Surrogate Study

Jackson,MD and Lewis,RG. (1981) Insecticide Concentrations in Air After Application of Pest Control Strips. Bull Environ Contam Toxicol. 27:122-125.

Hercon Insectape containing 10% propoxur was applied in a 3x3.6x2.8 m room. Thirty-six of the 2.5x1.0 cm strips were placed in the room. Air samples were taken at 6 hours and at 1,2,3,4,7,15, and 30 days after placement of the strips. Ambient air concentrations of propoxur were as follows:

Time	PreTrt	6 HR	Day 1	Day 2	Day 3	Day 4	Day 7	Day 15	Day30
ug/m^3	0.005	0.4	0.39	0.79	0.58	0.11	0.33	0.74	0.70

II. Assumptions

a) Propoxur is released at a constant rate for the 21 week life of the flea collar.
b) Propoxur is incorporated into the collar, not on the surface; total dermal contact by human handling therefore is negligible.
c) Average breathing rate is 14.6 l/min. This assumes 1/3 light activity at a breathing rate of 29 l/min and 2/3 sedentary activity at a breathing rate of 7.4 l/min.
d) A person is exposed 24 hours/day and 365 days/year.
e) The flea collar is 45 cm x 1 cm.

III. Respiratory Exposure

36 Hercon strips = (1 cm x 2.5 cm) x 36 = 1 cm x 90 cm
Dog collar is 1 cm x 45 cm

Conversion Ratio: (45 cm/90 cm) x (9.4% a.i./10% a.i.) = 0.47

Average propoxur concentration in 30 m^3 room from surrogate study was 0.52 ug/m^3.
0.52 ug/m^3 x 0.47 = 0.24 ug/m^3

Conversion of room area to house area: 30 m^3/340 m^3 = 0.088
Average propoxur concentration in house: 0.24 ug/m^3 x 0.088 = 0.021 ug/m^3.

14.6 l/min x 1440 min/day x 1 m^3/1000 l x 0.021 ug/m^3 = 0.44 ug/day
0.44 ug/day ÷ 70 kg = 6.3 ng/kg/day

IV. Annual Respiratory Exposure

6.3 ng/kg/day x 365 days/year = 2.3 ug/kg/yr

PROPOXUR DOMESTIC INDOOR USE - HOUSEHOLD AEROSAL SPRAY.

Representative Label- Johnson Bolt Super Ant and Roach Killer
Contains 1% Propoxur
Spray surfaces until wet
Repeat as necessary

I. Surrogate Study

Staiff,DC. et al. (1975) Exposure to the Herbicide, Paraquat. Bull. Environm. Contam. Toxicol. 14(3):334.

Respiratory and dermal exposure for yard and garden application of 0.44% paraquat in pressurized hand containers was measured. A total of 15 volunteers were studied. Respiratory exposure was below the detection limit and was determined to be insignificant compared to dermal exposure. The dermal exposures ranged from 0.01 to 0.57 mg/hr with a mean of 0.29 mg/hr.

II. Assumptions

a) 100% of propoxur impinging on the skin is absorbed.
b) Average breathing volume is 14.6 l/min. This assumes 1/3 light activity at a breathing volume of 29 l/min and 2/3 sedentary activity at a breathing volume of 7.4 l/min.
c) Exposure to residues are for 24 hrs/day and 365 days/yr.
d) 5 - 8 oz (150 - 240 g assuming sp.g. = 1 g/ml) is used to spray a 340 m^3 house (BUD).
e) The spray is applied 4 times/yr with a spray time of 0.33 hrs/yr (BUD).
f) If the homeowner buys propoxur to use he will use the can for the four sprayings per year.

III. Dermal Exposure During Spraying

Conversion Ratio: 1.0% propoxur/0.44% paraquat = 2.3
0.29 mg/hr x 2.3 = 0.66 mg/hr
0.66 mg/hr ÷ 70 kg x 0.33 hr/yr = 3.1 ug/kg/yr

IV. Respiratory Exposure From Residues

Based on surrogate study-Miller,CW and Shafik,TM. (1974) Concentrations of Propoxur in Air Following Repeated Indoor Applications. Bull Wld Hlth Org. 51:41-44.

Propoxur was applied as a water dispersible powder at a dose of 2 g/m^2 every 35 days. The spray was applied in two 1 m swaths at the junction of the ceiling and walls. Air concentration of propoxur at day 1 was 7 ng/l, at day 7 was 2 ng/l, and at day 14 was not detectable.

Assume in a house with 2.8 m walls (340 m^3/2.8 m) 120 m^2 were sprayed.

$120\ m^2 \times 2\ g/m^2 = 240\ g$ propoxur

Conversion Ratio = 240 g/240 g = 1.0

Week 1- (7 ng/l + 2 ng/l)/2 = 3.5 ng/l x 1000 l/m^3 = 3.5 ug/m^3
3.5 ug/m^3 x 14.6 l/min x 10,080 min/wk ÷ 1000 l/m^3 =
550 ug/wk
Week 2- (2 ng/l + 0 ng/l)/2 = 1.0 ng/l x 1000 l/m^3 = 1.0 ug/m^3
1.0 ug/m^3 x 14.6 l/min x 10,080 min/wk ÷ 1000 l/m^3 =
160 ug/wk
Week 3 to Month 3- Propoxur not detectable

Residue Respiratory Exposure/3 Month Spray Period =
550 ug/week 1 + 160 ug/week 2 = 710 ug/3 months
710 ug/3 months x 4 sprays/year = 2840 ug/yr
2840 ug/yr ÷ 70kg = 41 ug/kg/yr

V. Total Annual Exposure

Residue + Dermal Spray = 41 ug/kg/yr + 3.1 ug/kg/yr = 44 ug/kg/yr

PROPOXUR USE FOR RESIDENTIAL CRACK AND CREVICE SPRAY - EXPOSURE TO RESIDUES.

Representative Label- Prentox Carbamate 1.5 EC
Contains 14.6% propoxur
Indoor Use Rate- 8 fl.oz./gal or 1.1% a.i.
May be repeated as necessary

I. Surrogate Study

Wright,CG, Leidy,RB, and Dupree,HE Jr. (1981) Insecticides in the Ambient Air of Rooms Following Their Application for Control of Pests. Bull. Environm. Contam. Toxicol. 26:548-553.

Propoxur was sprayed at cracks and crevices and at other surfaces likely to be infested with cockroaches in dormitory rooms at N.C. State University. An emulsifiable concentrate with a final spray concentration of 1.1% propoxur was sprayed into rooms averaging 61.2 m^3. An average of 3.8 g propoxur was applied to each of six rooms. Airborne concentrations were measured pre-treatment, immediately after treatment, and at 1, 2, and 3 days post treatment. The air was sampled for 4 hours at each sample interval. The pesticide was applied once weekly for four consecutive weeks using a 4 liter compressed air had sprayer. Average airborne concentrations of propoxur (ug/m^3) were as follows:

Day:	Pre-Trt	0	1	2	3
ug/m^3	N.D.	15.4	2.7	1.8	0.7

The windows in the rooms remained closed during the study.

II. Assumptions

a) Respiratory absorption is 100%.
b) Average breathing volume is 14.6 l/min. This assumes 1/3 light activity at a breathing volume of 29 l/min and 2/3 sedentary activity at a breathin rate of 7.4 l/min.
c) A person is exposed 24 hours/day and 365 days/year.
d) Dermal exposure to spray residue is negligible.
e) Rooms may be treated 0 to 10 times per month (NPCA). For a conservative worst-case estimate, propoxur is applied 10 times per month.
f) The air concentration of propoxur is negligible at time of repeat application.

III. Respiratory Exposure to Residue

Air volume inhaled per day =
14.6 l/min x 60 min/hr x 24 hr/day x 1 m^3/1000 l = 21 m^3/day

Day 0-1 = (15.4 ug/m^3 + 2.7 ug/m^3)/2 x 21 m^3/day = 190 ug/day
Day 1-2 = (2.7 ug/m^3 + 1.8 ug/m^3)/2 x 21 m^3/day = 47 ug/day
Day 2-3 = (1.8 ug/m^3 + 0.7 ug/m^3)/2 x 21 m^3/day = 26 ug/day

Average over 3 day period
(190 ug/day + 47 ug/day + 26 ug/day)/3 = 88 ug/day

IV. Annual Exposure

88 ug/day x 365 days/yr = 32 mg/yr
32 mg/yr ÷ 70 kg = 0.46 mg/kg/yr

PROPOXUR USE FOR COMMERCIAL ESTABLISHMENT CRACK AND CREVICE SPRAY - EXPOSURE TO RESIDUES.

Representative Label- Raid Residual Liquid
Contains 1% Propoxur
Apply as pin point spray in food areas
Crack and crevice treatment only

I. Surrogate Study

Wright,CG and Leidy,RB. (1980) Insecticide Residues in the Air of Buildings and Pest Control Vehicles. Bull. Environm. Contam. Toxicol. 24:582-589.

0.5% chlorpyrifos was applied as a pin point stream to cracks and crevices in the serving area of six resturants. Ambient chlorpyrifos levels in the air were taken over a 4 hour period immediately after sprayng and at 24 hours. 0 Hour ambient levels ranged from 20 to 1488 ng/m^3 (mean = 572 ng/m^3) 24 Hour levels ranged from 4 to 361 ng/m^3 (mean = 113 ng/m^3)

II. Assumptions

a) Dermal exposure to residual spray is insignificant.
b) The people most exposed will be employees. Assume 8 hours/day, 5 days/week, and 2080 hours/year.
c) Assume an average breathing volume of 29 l/min for light activity.
d) Assume dispersion of pesticide in the air follows first order kinetics and that the rate of pesticide volatilizing from residue and the rate of pesticide dispersing by air flow are represented by k. k shall be estimated from the surrogate as

$$C_{24}/C_o = e^{-kt} \quad \text{or} \quad 113/572 = e^{-k24}$$
$$k=0.068$$

e) Commercial establishments are sprayed up to 10 times/year (BUD). Therefore 365 days/year ÷ 10 times/year = 36.5 days will be assumed to elapse between sprayings. 36.5 days = 876 hours.
f) 100% of inhaled propoxur is absorbed.

III. Respiratory Exposure to Residues

Average ambient air concentration over 36.5 days is

$-C_o/876k \times (e^{-876k}-1) = -572/876(0.068) \times (e^{-876x0.068}-1) =$
$-572/60 \times (e^{-60}-1) = 9.5$ ng/m^3

If the establishment is sprayed every 36.5 days than 9.5 ng/m^3 may be taken as the yearly average concentration of propoxur in the air.

IV. Annual Exposure

9.5 ng/m^3 x 29 l/min x 60 min/hr x 2080 hr/yr ÷ 1000 l/m^3 = 34 ug/yr

34 ug/yr ÷ 70 kg = 490 ng/kg/yr

Since propoxur is applied as 1% a.i. compared to chlorpyrifos at 0.5%, annual respiratory exposure to propoxur residue is

68 ug/yr
980 ng/kg/yr

PROPOXUR DOMESTIC INDOOR USE - PEST STRIPS

Representative Label- Hercon Insectape 7% Propoxur
Contains 7% propoxur
Apply 36 tapes/kitchen or 18 in other rooms
Replace when effectiveness diminishes

I. Surrogate Study

Jackson,MD and Lewis,RG. (1981) I ɔecticide Concentrations in Air After Application of Pest Control Strips. Bull Environm Contam Toxicol. 27:122-125.

Thirty-six Hercon Insectapes containing 10% propoxur were placed in a 30 m^3 room according to label directions. Air concentrations of propoxur were measured at 6 hours and 1,2,3, 4,7,15, and 30 days after placement of the tapes. Ambient propoxur concentrations were as follows:

Time	PreTrt	6 Hr	Day 1	Day 2	Day 3	Day 4	Day 7	Day 15	Day 30
ug/m^3	0.005	0.4	0.39	0.79	0.58	0.11	0.33	0.74	0.70

II. Assumptions

a) Dermal exposure is negligible.
b) Average breathing volume is 14.6 l/min. This assumes 1/3 light activity at a breathing volume of 29 l/min and 2/3 sedentary activity at a breathing volume of 7.4 l/min.
c) A person is exposed 24 hours/day and 365 days/year.
d) The tapes are replaced when efficiency diminishes which will be assumed to keep the average ambient concentration of propoxur in the home constant.
e) Ambient propoxur levels are similar in all rooms of the house.
f) 100% of propoxur inhaled is absorbed.

III. Respiratory Exposure

Conversion Ratio: Average propoxur concentration was 0.52 ug/m^3
7% a.i./10% a.i. = 0.7
0.52 ug/m^3 x 0.7 = 0.36 ug/m^3

0.36 ug/m^3 x 1440 min/day x 1 m^3/1000 l x 14.6 l/m^3 = 7.6 ug/day
7.6 ug/day ÷ 70 kg = 0.11 ug/kg/day

IV. Annual Respiratory Exposure

0.11 ug/kg/day x 365 days/yr = 39 ug/kg/yr

V. Propoxur Residues in Food

a) Surrogate Study
Collins,RD and DeVries,DM. (1973) Air Concentrations and Food Residues From Use of Shell's No-Pest Insecticide Strip. Bull Environm Contam Toxicol. 9(1):227.

Shell No-Pest Strips were placed in the kitchen and dining room areas of 15 homes. Ambient air concentrations of DDVP were measured at 1,7,14,28,56, and 91 days. DDVP residues in food at breakfast and dinner on the sampling days were measured. The samples consisted of an adult portion including beverage that were left out during the period that the occupants consumed their meals. The meals at each sample period were sampled as a combined homogenate. The mean DDVP air concentration during the test between days 1 and 28 was 38 ug/m^3. DDVP residues in the food were as follows:

24/174 meals = 0.02 ppm
5/174 meals = 0.04 ppm
7/174 meals = 0.03 ppm
138/174 meals < 0.02 ppm

b) Assumptions
Assume that the relationship between DDVP air concentrations and food residue levels is representative for propoxur.

c) Calculations
Conversion Ratio: 0.36 ug/m^3 propoxur/38 ug/m^3 DDVP = 0.0096

Maximum propoxur food residue level = 0.04 ppm x 0.0096 = 0.38 ppb

PROPOXUR USE FOR PET SHAMPOO - DOG EXPOSURE

I. Assumptions

a) Concentrate contact with the skin is insignificant compared to diluted shampoo contact with the skin.
b) Per washing, a total volume of 15 ml shampoo is used. Shampoo contains 0.125% propoxur (label 11556-51). Assuming that the sp.g. = 1.0 g/ml, this is 19 mg of propoxur.
c) The quantity of water on the animal is 250 ml.
d) Contact time with the lathered shampoo is 12.5 minutes (BUD).
e) The shampoo is applied on the average of 4 times per year (BUD).
f) Respiratory exposure is insignificant compared to dermal exposure.
g) Exposure to residue after rinsing and drying is insignificant.
h) The average dog (beagle) weighs 16 kg (The Lab Facts Book, Ralston Purina Company).
i) The average surface area of a dog is 5800 cm^2 (Casarett,LJ and Doull,J. (1975) Toxicology-The Basic Science of Poisons. pg 22). Based on assumption that 7 ml covers the 820 cm^2 of the human hands, 5800 cm^2 will be covered by 50 ml.
j) 100% of the propoxur in contact with the skin is absorbed.

II. Dermal Exposure Calculations

19 mg x 1/250 ml x 50 ml = 3.8 mg propoxur in contact with the dog per shampoo.

III. Annual Exposure

3.8 mg/shampoo x 4 shampoos/year = 15 mg/yr
= 15 mg/yr ÷ 16 kg = 0.95 mg/kg/yr

PROPOXUR USE IN PET FLEA AND TICK COLLARS - DOG EXPOSURE.

Representative Label- Zoecon Dog Collar for Flea Control
Contains 9.4% propoxur
Collar weighs 1 oz.
Effective up to 21 weeks

I. Assumptions

a) Propoxur is released at a constant rate for 21 weeks.
b) All the propoxur in the collar that does not volatilize into the air is available for dermal absorption.
c) 100% of the available propoxur is dermally absorbed.
d) The average dog (beagle) weighs 16 kg. The breathing volume of the dog is 30 l/hr based on an oxygen consumption rate of 0.36 ml/gm/hr and 19% oxygen concentration (The Lab Facts Book, Ralston Purina Company).
e) A dog is exposed 24 hours/day and 365 days/year.

II. Respiratory Exposure

Based on the human respiratory exposure assessment for flea collars, a 340 m^3 house has an ambient concentration of 0.021 ug/m^3.

30 l/hr x 24 hr/day x 1 m^3/1000 l x 0.021 ug/m^3 = 15 ng/day
15 ng/day ÷ 16 kg = 0.94 ng/kg/day
0.94 ng/kg/day x 365 days/year = 340 ng/kg/yr

III. Dermal Exposure

Jackson and Lewis (1981) determined an ambient propoxur concentration of 0.40 ug/m^3 in a 30 m^3 room with 9 air changes/hr at 6 hours.

0.40 ug/m^3 in a 30 m^3 room is equivalent to 12 ug of propoxur.

Assuming for this particular instance that the 0.40 ug/m^3 at 6 hours was the average air concentration and resulted from an initial volatilization of propoxur with no furthur release of propoxur during the 6 hours, than the following equation will estimate the quantity of propoxur initially volatilized (C_o):

$$C_o = -Ckt/e^{-kt}-1$$

where C is the 12 ug of propoxur in the room at t = 6 hours and k is the air exchange rate of 9 exchanges/hour.

$$C_o = -12(9)(6)/e^{-9(6)}-1 = 650 \text{ ug}$$

The 650 ug will be taken to estimate the quantity of propoxur volatilized during 6 hours from the Hercon strips.
Using the conversion ratio determined in the human exposure estimate the flea collar is estimated to lose 650 ug x 0.47 = 300 ug of propoxur every 6 hours.

300 ug/6 hours = 1.2 mg/day
1.2 mg/day x 147 days/21 weeks = 180 mg/21 weeks
The flea collar originally contained 28 g x 9.4% propoxur = 2.6 g
2.6 g - 0.18 g = 2.4 g propoxur available for dermal absorption during the life of the collar.

One collar is used for 21 weeks, therefore 2.5 collars are used per year.
2.4 g/collar x 2.5 collars/year = 6.0 g/year
6.0 g/year ÷ 16 kg = 380 mg/kg/yr

IV. Annual Exposure

Respiratory = 340 ng/kg/yr
Dermal = 380 mg/kg/yr
Total = 380 mg/kg/yr