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DATA EVALUATION RECORD

STUDY 3

CHEM 118202 Hexaflumuron §163-1

FORMULATION--00--ACTIVE INGREDIENT

STUDY ID 42648527-A
Yon, D., and G. Morrison. 1988. The leaching characteristics of hexaflumuron. Laboratory Project Study ID: GHE-P-1863. Unpublished study performed by Dow Chemical Company Limited, Wantage, Oxon, United Kingdom.

STUDY ID 42648527-B
Yon, D., and R.K. Grant. 1989. The aged desorption characteristics of Dowco 473. Laboratory Project Study ID: GHE-P-1892. Unpublished study performed by Dow Chemical Company Limited, Wantage, Oxon, United Kingdom.

STUDY ID 42648527-C
Racke, K.D. 1993b. Leaching and adsorption/desorption of hexaflumuron. Laboratory Study ID: GH-C 2969. Unpublished summary of GHE-P-1863 and GHE-P-1892 prepared and submitted by DowElanco, Indianapolis, IN.

DIRECT REVIEW TIME = 61

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CONCLUSIONS:

Mobility - Column Leaching (unaged hexaflumuron)

1. This portion of the study can be used towards the fulfillment of data requirements.
2. Based on column leaching experiments, hexaflumuron [1-(3,5-dichloro-4-(1,1,2,2-tetrafluoroethoxy)phenyl)-3-(2,6-difluorobenzoyl)urea] was immobile in columns of US silt loam and sandy loam soils and in columns of

UK sandy loam and clay loam soils. No [¹⁴C]residues were present in the leachate following the application of 20 in of water to 30-cm soil columns; all radioactivity was found in the top 6 cm of the columns.

3. This portion of the study is acceptable and partially fulfills EPA Data Requirements for Registering Pesticides by providing information on the mobility (column leaching) of unaged aniline and benzoyl ring-labeled [¹⁴C]hexaflumuron in silt loam, clay loam, and two sandy loam soils.
4. No additional information on the mobility of unaged hexaflumuron in soil columns is required at this time. However, in the future it may be necessary to generate fully acceptable K_d s to support any changes in use patterns.

Mobility - Adsorption/Desorption (aged hexaflumuron residues)

1. This portion of the study cannot be used towards the fulfillment of data requirements.
2. These data are of uncertain value and should not be used to predict the behavior of hexaflumuron and its degradates in the environment.
3. This portion of the study is unacceptable for the following reasons:

the experimental design and data manipulation by the study authors was atypical and severely limited the interpretation of the results. Batch equilibrium experiments are not appropriate for determining the adsorption and desorption of individual compounds from mixtures of degradates and parent as were present in the hexaflumuron-treated, aerobically aged soil used in this study.

4. Since adsorption-desorption batch equilibrium experiments are not appropriate for mixtures of degradates and parent as were present in the aerobically aged soil used in this study, this study cannot be upgraded with the submission of additional data. In order to accurately determine the mobility-adsorption/desorption of the parent and each degradate identified at 10% of the applied or higher in the aerobic soil metabolism study, standard batch equilibrium experiments must be conducted using four soils and at least four different concentrations of each compound so that valid Freundlich K values can be calculated.

This study does provide supplemental information on the mobility of hexaflumuron and its degradates.

Based on qualitative estimates of K_{des} for hexaflumuron and its degradates determined in this report (" K_d "s), it can be inferred that hexaflumuron and its phenylamine and phenylurea degradates are not easily desorbed in the soils tested; the benzoic acid degradate would be considered easily desorbed. No inferences can be made concerning K_{ads} of the degradates, since adsorption of the degradates could not be separated from other processes occurring during metabolism in the soil. However, because of the marginal validity of the reported " K_d "s, these numbers should not be used in risk assessments based on computer models that require these numbers as inputs to those models.

METHODOLOGY:

Mobility of unaged hexaflumuron: Air-dried, sieved (2 mm) US and UK soils (Hanford sandy loam soil, Catlin silt loam soil, Alconbury clay loam soil, or Castle Rising sandy loam soil; Table A) were packed in duplicate segmented aluminum columns (5-cm id x 30 cm). The soil columns were saturated with 0.1 N calcium chloride, then treated at a concentration equivalent to 150 g ai/ha with either uniformly aniline or benzoyl ring-labeled [¹⁴C]hexaflumuron [1-(3,5-dichloro-4-(1,1,2,2-tetrafluoroethoxy)phenyl)-3-(2,6-difluorobenzoyl)urea; radiochemical purities >99%, specific activities 802.9 and 932.4 KBq/mg, respectively; DowElanco] dissolved in acetone. After treatment, the soil surface was covered with a glass wool pad, and the columns were leached with 1 L (approximately 50.8 cm) of 0.1 N calcium chloride solution (leaching period unspecified). The leachates from the Hanford sandy loam soil column were collected in 30-50 mL fractions; the leachates from the other columns were collected in 500-1000 mL glass bottles. After leaching, each soil column was divided into ten equal segments.

Triplicate aliquots of the leachates were analyzed by LSC; subsamples of each soil segment were analyzed by LSC following combustion. Additional subsamples of the upper two segments of each soil column were extracted twice by shaking with acetone. The samples were centrifuged, the supernatants were decanted, and aliquots were analyzed by LSC. Aliquots (20 mL) of the first acetone extract were evaporated under a stream of nitrogen, then redissolved in methylene chloride; recoveries of radioactivity after evaporation and redissolving was >95%. Aliquots of the methylene chloride solutions were analyzed by one-dimensional TLC (plates not described) developed in toluene:isopropanol:acetic acid (9:1:1, v:v:v) or trimethylpentane:ethyl acetate (2:1, v:v). Unlabeled reference standards were cochromatographed with the soil extracts. In order to confirm the identity of hexaflumuron, aliquots of the soil extracts were concentrated to dryness under nitrogen. The resulting [¹⁴C]residues were redissolved in acetonitrile:water (2:1, v:v), and aliquots of the solution were analyzed by HPLC using an ODS-2 column eluted with acetonitrile:water (65:35, v:v); the column was equipped with radioactive flow and UV detection. Subsamples of the extracted soils were analyzed by LSC following combustion.

Mobility of aged hexaflumuron residues: Portions (50 g dry weight) of the same soils used in the column leaching studies described above were weighed into biometer flasks, moistened to 75% of 0.33 bar, and treated at a concentration equivalent to 150 g ai/ha with either uniformly aniline or benzoyl ring-labeled [¹⁴C]hexaflumuron [1-(3,5-dichloro-4-(1,1,2,2-tetrafluoroethoxy)phenyl)-3-(2,6-difluorobenzoyl)urea; radiochemical purities >99%, specific activities 802.9 and 932.4 KBq/mg, respectively; DowElanco] dissolved in acetone. The treated flasks were incubated under aerobic conditions (under a slight positive pressure of oxygen) for 30 days in the dark at 25°C. Volatiles were trapped in a sodium hydroxide (0.2 N) solution added to the sidearm of each flask. The sodium hydroxide trapping solutions were replaced after 14 and 30 days of aerobic incubation.

Following the aerobic incubation, each aged soil was transferred to a glass jar, mixed with a pesticide-free 0.1 M calcium chloride solution

(50 g:100 mL), and extracted by shaking for 1 hour (Hanford and Catlin) or 8 hours (Alconbury and Castle Rising). Following extraction, the slurries were centrifuged and the supernatants decanted. The soils were extracted two additional times; the second and third extractions for all soils were for 1 hour. Aliquots of individual supernatants were analyzed by LSC. The three supernatants for each soil sample were combined and acidified, then extracted three times by shaking with methylene chloride. The methylene chloride extracts were combined and aliquots were analyzed by LSC. The methylene chloride-extracted calcium chloride solutions from the benzoyl ring-labeled [¹⁴C]hexaflumuron-treated samples only were further extracted three times with diethyl ether after "addition of sufficient salt to saturate the water"; the extracts were combined and aliquots were analyzed by LSC. The methylene chloride and ether extracts were evaporated to dryness under a nitrogen stream; resulting [¹⁴C]residues were redissolved in methylene chloride. Aliquots of the solutions were analyzed by one-dimensional TLC (plates not described) developed in either toluene:isopropanol:acetic acid (9:1:1, v:v:v), trimethylpentane:ethyl acetate (2:1, v:v), or chloroform:methanol (95:5, v:v). Unlabeled reference standards were cochromatographed with the extracts; [¹⁴C]residues on the plates were located and quantified by radioscanning.

The calcium chloride-extracted soil was sequentially extracted three times by shaking with acetone (50 mL) for 30 minutes per extraction, once by shaking with 0.5 M sodium hydroxide (50 ml) for 2 hours, and once by heating (80°C) with 0.05 M sodium hydroxide (100 mL) for 3 hours. After each extraction, the samples were centrifuged, the supernatants were decanted, and aliquots of the extracts were analyzed by LSC. The acetone extracts were combined, and aliquots (10 mL) of the combined extracts were concentrated, acidified with 2 N sulfuric acid, and extracted three times with methylene chloride; the methylene chloride extracts were combined and aliquots were analyzed by LSC. Aliquots (10 mL) of each of the two sodium hydroxide extracts for each sample were combined, acidified with hydrochloric acid, saturated with salt, and partitioned three times with ether; the ether extracts were combined and aliquots were analyzed by LSC. The remainder of each extract was evaporated to dryness under a nitrogen stream; the resulting [¹⁴C]residues were redissolved in methylene chloride and analyzed by TLC as previously described. The identification of hexaflumuron was confirmed by HPLC of the acetone extracts using a Spherisorb ODS column eluted with acetonitrile:water (40:60, v:v); the column was equipped with UV detection. Subsamples of the extracted soil were analyzed by LSC following combustion.

The biometer flasks were rinsed with acetone, and aliquots of the acetone washings were analyzed by LSC. Aliquots of the sodium hydroxide trapping solutions were analyzed by LSC.

DATA SUMMARY:

Mobility of unaged hexaflumuron: [¹⁴C]Hexaflumuron was immobile in columns of silt loam, clay loam, and two sandy loam soils that were treated with uniformly aniline or benzoyl ring-labeled [¹⁴C]hexaflumuron [1-(3,5-dichloro-4-(1,1,2,2-tetrafluoroethoxy)-phenyl)-3-(2,6-difluorobenzoyl)urea; radiochemical purities >99%] at 150 g ai/ha and leached with approximately

50.8 cm of 0.1 N calcium chloride solution. [¹⁴C]Residues remained concentrated in the upper 6 cm of each column; the topmost soil segment (upper 3 cm) contained 96-101% of the applied radioactivity in the Hanford sandy loam soil columns, 89-95% in the silt loam soil columns, 69-82% in the clay loam soil columns, and 92% in the Castle Rising sandy loam soil columns (Tables 2A-5A). Parent hexaflumuron was the only [¹⁴C]compound detected in the soil extracts. No [¹⁴C]residues were detected in the soil below the 6-cm depth or in the leachate from any column. The material balances for all columns ranged from 93.9% to 100.8% (Table 8A).

Mobility of aged hexaflumuron residues: Based on sequential extraction of aerobically-aged (30 days) [¹⁴C]hexaflumuron-treated soils with 0.1 M calcium chloride, hexaflumuron residues appeared to be relatively immobile in silt loam, clay loam, and two sandy loam soils; only 1.1 to 3.4% of the total applied radioactivity was found in the combined calcium chloride extracts (Tables 2B-5B).

In the soil treated with aniline ring-labeled [¹⁴C]hexaflumuron, calcium chloride-extractable parent hexaflumuron was 0.48% of the applied in the silt loam soil, 0.47% in the Hanford sandy loam soil, 0.16% in the clay loam soil, and 0.76% in the Castle Rising sandy loam soil (Tables 6B-9B). In the soil treated with benzoyl ring-labeled [¹⁴C]hexaflumuron, calcium chloride-extractable parent hexaflumuron was 0.82% of the applied in the silt loam soil, 1.34% in the Hanford sandy loam soil, 0.57% in the clay loam soil, and 0.46% in the Castle Rising sandy loam soil (Tables 6B-9B).

Two degradates were identified in the calcium chloride extracts of the soil treated with aniline ring-labeled [¹⁴C]hexaflumuron:

3,5-dichloro-4-(1,1,2,2-tetrafluoroethoxy)phenylamine

was 0.03% of the applied in the silt loam soil, 0.12% in the Hanford sandy loam soil, 0.33% in the clay loam soil, and not detected in the Castle Rising sandy loam soil;

3,5-dichloro-4-(1,1,2,2-tetrafluoroethoxy)phenylurea

was 0.62% in the silt loam soil, 2.77% in the Hanford sandy loam soil, 1.28% in the clay loam soil, and 0.31% in the Castle Rising sandy loam soil (Tables 6B-9B).

One degradate was identified in the desorption solutions and the soil extracts of the soil treated with benzoyl ring-labeled [¹⁴C]hexaflumuron;

2,6-difluorobenzoic acid

was 0.63% of the applied in the silt loam soil, 1.56% in the Hanford sandy loam soil, 1.07% in the clay loam soil, and 1.39% in the Castle Rising sandy loam soil (Table 13B).

Although the registrant reported " K_d "s for hexaflumuron and its degradates, the experimental design and data manipulation by the study authors are atypical and severely limit the interpretation of the reported values. The reported " K_d " values can at best be considered to be qualitative estimates

of K_{des} for hexaflumuron and its degradates. On that basis, these marginal estimates would infer that hexaflumuron and its phenylamine and phenylurea degradates are not easily desorbed in the soils tested; the benzoic acid degradate would be considered easily desorbed (Tables 10B-13B). No inferences can be made concerning K_{ads} of the degradates, since adsorption of the degradates could not be separated from other processes occurring during metabolism in the soil.

For all soils treated with aniline ring-labeled and benzoyl ring-labeled [^{14}C]hexaflumuron, $\leq 0.4\%$ and 17.4-38.9% of the applied, respectively, was evolved as $^{14}CO_2$ during aging (Tables 2B-5B). Uncharacterized radioactivity in the acetone extracts was 4.41-8.49% of the applied for the soils treated with aniline ring-labeled [^{14}C]hexaflumuron (reviewer-calculated from Tables 2B-9B). Unextracted radioactivity comprised 6.3-18.6% of the applied (Tables 2B-5B).

The material balances for the aniline ring-labeled and the benzoyl ring-labeled [^{14}C]hexaflumuron solutions were 91.0-99.1% and 87.5-102.5% of the applied, respectively.

COMMENTS:

1. The soil columns in the unaged hexaflumuron leaching experiment were leached with a 0.1 N calcium chloride solution; the soils in the aged mobility experiment were extracted with a 0.1 M calcium chloride solution. Subdivision N guidelines state that a batch equilibrium experiment is to be conducted in a 0.01 N calcium ion solution; it is recommended in the SEP for column leaching studies that soil columns be eluted with 0.01-0.02 N calcium chloride solution.
2. None of the soils used in the unaged and aged hexaflumuron experiments had a organic matter of $<1\%$.

Aged mobility

1. The experimental design and data manipulation by the study authors are atypical and severely limit the interpretation of the results of the aged mobility study. In standard batch equilibrium experiments, pesticide-free soil is equilibrated with solutions containing individual degradates or parent to determine the amount of material adsorbed from the solution onto the soil. The soil containing the adsorbed compound of interest is then equilibrated with pesticide-free solution to determine the amount released from the soil to the solution (desorbed). In the aged mobility experiment described in this study, [^{14}C]hexaflumuron was incubated in four soils under aerobic conditions for 30 days; the [^{14}C]residues were then extracted from the soils by shaking three times with pesticide-free calcium chloride solution. The study authors assumed that during aging the hexaflumuron had adsorbed to the soil, and referred to all three equilibrations as "desorption." The soils were then further extracted with acetone and sodium hydroxide to determine the amount "adsorbed" to the soil. The registrant then calculated " K_d " values by dividing the amounts of hexaflumuron and each degradate remaining on the soils after the calcium chloride extractions by the amounts of hexaflumuron and each degradate

found in the combined calcium chloride extracts. The reported " K_d " values can at best be considered to be qualitative estimates of K_{des} for hexaflumuron and its degradates. On that basis, these marginal estimates would infer that hexaflumuron and its phenylamine and phenylurea degradates are not easily desorbed in the soils tested; the benzoic acid degradate would be considered easily desorbed. No inferences can be made concerning K_{ads} of the degradates, since adsorption of the degradates could not be separated from other processes occurring during metabolism in the soil.

Because of the marginal validity of the reported " K_d "s, these numbers were not discussed in this report. In addition, these values should not be used in risk assessments based on computer models that require these numbers as inputs to those models.

2. In general, the soils were extracted for only 1 hour. No evidence was provided that equilibration had been reached during that short period.
3. The aged hexaflumuron experiment was performed using only one concentration of hexaflumuron. In order to calculate accurate Freundlich K values, data for at least four concentrations of the test substance must be available.
4. Radioactivity present in the acetone extracts of the aged soil treated with aniline ring-labeled [^{14}C]hexaflumuron at up to 8.49% of the applied was uncharacterized. Several unidentified peaks were observed in the chromatograms; however, the study author did not address this observation.

HEXAFLUMURON

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Pages 8 through 35 are not included.

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