098301

A N

Date Out EFB: APR 8 1981

To: Product Manager 12- Ellenberger
TS-767

From: Dr. Willa Garner
Chief, Review Section No.1
Environmental Fate Branch

Attached please find the environmental fate review of:

Reg./File No.: 264 - 330 and 331

Chemical Aldicarb

Type Product: Insecticide-Nematicide

Product Name: Temik

Company Name: Union Carbide

Submission Purpose: Review the 1980 groundwater monitoring data with Corrections

ZBB Code: Other

Date in: 1/23/81

Date Completed: APR 8 1981

Deferrals To:

_____ Ecological Effects Branch

_____ Residue Chemistry Branch

X Toxicology Branch See last pg - 9.2

ACTION CODE: 731

EFB # 743

TAIS (Level II)	Days
60	18

1.0 INTRODUCTION

1.1 Purpose

Union Carbide subsmitted the 1980 report, for review, which dealt with monitoring and modeling aldicarb residues in soil and groundwater. The original report, received Jan. 19, 1981, was followed by two other reports, both of which were received on 3/11/81. Thus giving, a total of 600 pages of data, not including the 1979 or the EUP data.

Data generated during the 1980 were in compliance with the October 2, 1979 research protocol that was initiated by the EPA and the May 15, 1980 National Monitoring Program for Aldicarb, for the purpose of determining the levels of aldicarb residues and to asses the extent of aldicarb contamination in drinking water.

1.2 Previous Reviews

81 - Tx - 08	2/3/81
264 - EUP - 58	12/2/80
264 - EUP - 2	8/7/80
National Monitoring Program for Aldicarb	5/15/80
Aldicarb well water contamination	10/18/79

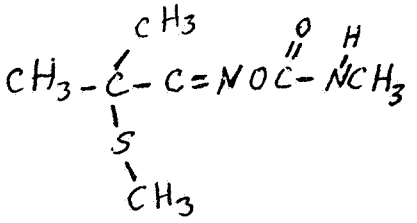
1.3 Chemical

Common name: Aldicarb

Trade Name: Temik

Chemical formula: 2-Methyl-2 - (methylthio) propionaldehyde O- (methylcarbomoyl) oxime - 10% and 15%G.

Structural formula:



Type: Insecticide/Nematicide

1.4 Registered Uses

Registration of aldicarb 10 G (264-331) under section 3 (c)(7) A, and 15 G (264 - 330) were amended on 1/22/81 to include use to the following sites for insects, mites and nematodes control:

Peanuts	at a maximum dosage of	5*	Lb ai/A
Potatoes	at a maximum dosage of	6	Lb ai/A
Sugarbeets	at a maximum dosage of	5	Lb ai/A
Sugarcane	at a maximum dosage of	3	Lb ai/A
Oranges	at a maximum dosage of	20	Lb ai/A
Dry Beans	at a maximum dosage of	2.2	Lb ai/A
Cotton	at a maximum dosage of	5	Lb ai/A
Sweet potatoes	at a maximum dosage of	3	Lb ai/A

*Dosages are additives assuming that the dosage for nematodes control was followed by a dosage for insect control.

1.5 Environmental Chemistry Data Gaps Aaccording to EPA letters of 10/19/77 and 11/2/77, EC data gaps are:

1. Fish accumulation study, employing both the flow and static systems.
2. Crop rotation study.
3. Photodegradation in soil.
4. Photodegradation in water.
5. Effects of Aldicarb on microorganisms.

1.6 Environmental Fate Profile

(a) were summarized in EFB review of 6/28/78 [File No. 1016-69 and 78; pp 6F 1829] pages 48-56.

(b) Information Pertinent to Groundwater Monitoring are:

Solibility at 25°C = 0.6%

P_{vap} at 25°C = 1.0×10^{-4}

$K = 4.2 \times 10^{-9} \frac{atm\text{-}M^3}{mole}$

Q value: Aldicarb 10, Sulfoxide 1, Sulfone 2

K_d of sulfoxide in clay = 3.3, in silt loam =0.34

Hydrolysis: Stable at pH 5-7

T-1/2 in soil = 14 d; sulfoxide 70 days.

2.0 Simulated Modeling of Aldicarb

Bob Carsel of EFB, now in Athens, Georgia; presented an excellent summary on this subject which he discussed before the SAP meeting on 3/25/81. This summary, it was felt, should be included here in this section for further references and updating the simulated modeling both in Athens and EFB in the EPA Headquarter:

<<Aldicarb is a highly toxic oxime-carbamate insecticide. It is sold for agricultural use on an inert carrier under the trade name Temik. Aldicarb was used on essentially all potato fields in estern Suffolk County, Long Island, New York, from 1976 through 1979. Aldicarb and its toxic sulfoxide and sulfone degradation products are soluble in water, but it was thought that total aldicarb (aldicarb + aldicarb sulfoxide + aldicarb sulfone) would degrade before reaching any such source of potable water as an underlying ground-water body.

In August, 1979, the presence of total aldicarb in Long Island ground water was reported to the EPA. INTERA was asked to make mathematical models simulating the movement of total aldicarb in soil and groundwater and to use them to evaluate future behavior of the pesticide. To validate the mathematical models and evaluate certain of their parameters, a field data collection program was undertaken.

Field data were collected at the [redacted] near Cutchogue on the South shore of the North Fork. Six soil zone cores were taken in December, 1979, and the total aldicarb contents of six-inch segments from the surface to the water table were measured. Results ranged from below detection to 120 ugms total aldicarb per kg. of core material. These data were used to validate the unsaturated zone mathematical model. Groundwater samples from depth of about 2, 6 and 10 feet below the water table were also collected in December, 1979, at nine locations in and adjacent to the study field. When analyses showed that the plume bottom had not been reached, additional samples were collected at depths of about 15 and 20 feet below the water table in May and June, 1980, at five of the original nine locations. Groundwater total aldicarb concentrations ranged from below detection to 70 ugms per liter (ppb) in both the December and May/June collections.

Three parameters of importance to solute transport were evaluated from the Wickham Farm field core sample and groundwater data: the distribution coefficient, the chemical decomposition rate, and the fraction of surface-applied total aldicarb which enters the unsaturated zone and groundwater systems from the root zones.

A distribution coefficient (K_d) value of 0.16 ml/gm best reproduced the positions of total aldicarb peak concentrations in both the

unsaturated and saturated zones. The mass of total aldicarb present in the unsaturated and saturated zones at any time depends on both the decomposition rate and the amount of total aldicarb which leaves the root zone.

Best agreement between simulated groundwater concentrations and those measured in both May, 1980 and December, 1979 is achieved using a low or zero decmposition rate (T1/2 = ∞) in the unsaturated and saturated zone. With zero decmposition, the mass of total adlicarb present in the saturated zone required that 20 percent of the total aldicarb applied to the study field enter the unsaturated and, subsequently the saturated zones. A similar source fraction (13 percent) accounts for the total aldicarb present in several of the unsaturated zone cores.

The behavior of aldicarb in a regional setting was simulated for a 2.4 mile cross-section in the vicinity of the village of Water Mill near the south shore of the South Fork.

This modeling provides insight into the fate of aldicarb in the groundwater system of Long Island. Convection of the contaminant out of the system is a relatively slow process. Aldicarb applied to the upper reaches of the simulated cross-section will take on the order of 100 years to exit the system. The reduction of total aldicarb concentrations due to dispersion and dilution is much more substantial, but more than 20 years will be required to reach currently acceptable levels. This estimate is based on the assumption that plant uptake and biochemical decay in the unsaturated zone will account for an 80 percent reduction in the mass total of aldicarb entering the groundwater. This estimate also assumes that no further degradation occurs in the groundwater. Even if some decay does occur in the saturated zone, the time required to obtain acceptable levels will be significant. A simulation performed asuming 15 percent removal, equal rates of degradation in both saturated and unsaturated zones, and a half-life of five years required approximately 20 years to reach acceptable levels.

These conclusions have been drawn based upon model calibration with measured field data. As such, they are subject to the accuracy of the laboratory and field collection procedures. It is recommended that additional data be collected at future intervals to substantiate the conclusions reached in the study>>.

3.0 DISCUSSION OF DATA

Data submitted were contained in a large volume (598 pages), entitled: "Monitoring Aldicarb Residues in Soil and Water, 1980", filed under accession no. 244091, dated 1/19/81. The report was arranged in 10 sections (A to J) which are reviewed in the same order:

3.1 [A] Introduction: History and Basis for the 1980 Program

The potential for aldicarb to leach to groundwater was first confirmed in eastern Long Island in August of 1979. This was reported to EPA and initiated an expanding program of private and municipal well water analyses. By the end of 1979, a total of 80 municipal water wells and 70 private wells in eastern Suffolk County had been sampled one or more times. The municipal wells were deeper than private wells, and usually did not show residues, whereas 5 to 10 percent of private wells contained measurable amounts of aldicarb residues.

Immediately following the discovery of residues in Long Island wells, Union Carbide identified high Temik use areas around the United States and obtained several well water samples from each. This initial search disclosed no residues at any of the use sites tested in Alabama, California, Idaho, Michigan, Mississippi, North Carolina, and Texas. Similar sampling by EPA Region II in Florida, Georgia, Alabama, and Mississippi showed negative results.

Other aspects of investigation included residue characterization, carbon filtration, and well monitoring. The analytical method determines the sum of aldicarb and its two major metabolites, aldicarb sulfoxide and aldicarb sulfone. Sensitivity is 1 ppb in water and 5 ppb in soils. Studies of the character of the residue in water from wells in eastern Long Island have confirmed that these are a 50:50 ratio of the two metabolites. This is significant in toxicological considerations. Carbon filtration was proven effective in removing aldicarb residues in a series of laboratory tests, and activated carbon filtration units were evaluated and found to be successful in removing residues under practical conditions in eastern Long Island. Monitoring of several higher residue wells in that area was continued monthly throughout 1979, and showed varying results, but no downward trend in magnitude, the acidity of the water, 53°F temperature, and apparent lack of microbial activity appear to retard residue degradation.

During late 1979, EPA contracted with the Medical University of South Carolina to conduct an epidemiological study to

determine if long-term exposure to low levels of aldicarb could result in symptoms in people. Different groups were selected who were exposed to no residues, to low level residues, and to residues in the highest potential exposure area. No differences were found among the 1,035 residents interviewed in the three situations.

During the last quarter of 1979, EPA contracted for a more extensive nationwide water sampling program. Sites were selected on demographic as well as on an agricultural crop acreage and aldicarb use basis. Water samples were composited from several adjacent sites. Midwest Research Institute reported that 249 samples, from 574 sites, 62 counties, and 21 states, showed no aldicarb residues at the level of method sensitivity, which was 1 part per billion.

EPA also contracted for a study of modeling aldicarb movement in soil. This was carried at Cutchogue, on the North Fork of Long Island, and showed that the 1979 season residues were apparently most concentrated at the 2 to 3 foot soil depth level, concluding that the residues in groundwater at 8 feet were probably from the 1978 applications.

In a summary report to EPA in December, 1979, Union Carbide, reviewed the registration history of aldicarb on Long Island, the events to date, and the synergistic conditions which were thought to have contributed to movement of aldicarb to groundwater in that locale. Product toxicology was carefully reviewed, and the estimate was made that an allowable residue of up to 200 parts per billion could be tolerated without adverse effects on public health. Residue findings were reviewed and corrective actions proposed. The latter included reduced use rates and delayed application as alternatives, also the use of bottled water or carbon filters where residents were concerned about residues.

The fact that most aldicarb is applied only once annually, during March through June, provided time to consider alternatives for 1980. By Februay 1, time was growing short. Farmers on Long Island had been wholly reliant on aldicarb for golden nematode and Colorado potato beetle control, and almost all of the potato acreage there was treated. Possible loss of aldicarb was of serious concern.

New York State set an allowable guideline of 7 ppb for aldicarb residues in drinking water during the latter part of 1979. A subpanel of EPA's Scientific Advisory Panel met on February 1, 1980, to hear testimony on the entire situation. This group did not address allowable residue levels in water, but did recommend lowering the aldicarb Acceptable Daily Intake. Weighing the benefits of use against government attitudes on allowable residues led Union Carbide to withdraw Temik products from the Long Island market on February 1. EPA promptly accepted revised labeling to this effect.

March 7, New York issued an action which forbade the distribution, purchase, or possession of aldicarb for use on potatoes in Nassau and Suffolk Counties.

Soil and water residues were further investigated by MRI, under contract with EPA, in Florida, Mississippi, and Texas. These samples were taken about 10 months after aldicarb application. No residues were found in water samples in Marathon, Washington County, in the Mississippi Delta; or at sites in Hadalgo, Cameron, or Willacy Counties in Texas' Lower Rio Grande Valley. Residues were found, however, not in surface soil, but at the 5 to 8 foot strata and in the water table surface, in a citrus grove in Hillsborough County, Florida. These last data, available in March, 1980, were significant factors in designing the 1980 program.

At a meeting on March 27 with the Agency, Union Carbide agreed to carry out certain research in 1980. This included (1) a full review of product toxicology, ADI derivation, and recommendations of allowable residue levels in water, (2) soil and water residue studies in key areas of mutual interest, (3) an Experimental Use Permit to study alternative application methods on Long Island, (4) initiation of laboratory studies on modeling the soil movement and degradation of aldicarb, and (5) continuation of sampling and other monitoring activities in Suffolk County. Details of the studies were subsequently agreed to by EPA and UCC as programs were developed. Results to date on points (2), (3), (4), and (5) are addressed in this Program Report. The toxicological work (1) was reported to EPA on September 17, and is a matter of continuing consideration.

In additional actions with states, the Agency granted an EUP for testing of aldicarb on hops to Washington, with provisions for monitoring soil and water residues. This work has Union Carbide support and is progressing, but not to the report stage and is not included here. The Agency denied a request for specific exemption but granted an EUP renewal to use aldicarb on grapefruit by Texas, again with monitoring requirements. The EUP was approved too late to allow 1980 applications, but the results of soil and water testing by Union Carbide, in response to this decision, are included in this report.

3.2 [B] Analytical Methodology

(1) Determination of Aldicarb Residues in Water

Aldicarb residues in water consisted of aldicarb, aldicarb sulfoxide and aldicarb sulfone. The residues were oxidized to aldicarb sulfone by peracetic acid and then extracted from the water sample with methylene chloride. The residue was then quantified by gas chromatography utilizing a flame photometric detector equipped with a sulfur filter.

The validity of the method was tested by determining recovery of residues from water fortified with aldicarb sulfoxide and aldicarb sulfone. The average recovery was 108%. Based on instrumental conditions which allowed detection of a 0.05 ug/ml aldicarb sulfone standard, a final sample dilution of 2 ml allowed a sensitivity of 1 ppb for aldicarb alone.

(2) Determination of Aldicarb Residues in Soil

The method described was found to be applicable to the determination of aldicarb and its cholinestrase inhibiting metabolites, aldicarb sulfoxide and aldicarb sulfone, in a broad spectrum of soil types including greenhouse mixes. In this method, the pesticide residues were extracted from the soil with acetone: water (1:1) solvent, and oxidized to aldicarb sulfone with peracetic acid. Liquid-Liquid partitioning was then utilized for selective cleanup of the sample.

The total toxic residue, injected in the form of aldicarb sulfone, was detected as a single peak by gas chromatography utilizing a Melpar flame-photometric detector with a 394 mu filter specific for sulfur-containing compounds. Quantitation was made by direct comparison of the recorder peak height with a calibration curve derived from the injection of aldicarb sulfone standards. The sensitivity of the method was about 10 ppb for total aldicarb residues, or 5 ppb for aldicarb alone.

(3) Characterization of Aldicarb Residues in Water

Preliminary analysis were performed to show the validity of the analytical methodology and characterization of aldicarb residues in well water.

The precision and reproducibility of the aldicarb residue methodology was performed on duplicate 734 well-water samples from Suffolk County in 1980. The program's accuracy was checked by 66 blind spiked samples. Test results showed low standard deviation of 1.27 ppb, and that the blind spiked samples were within the experimental error, however, the averages of the determinations were found to be about 11% below the spiked level.

The analytical method determined the sum of aldicarb (A) and its two major metabolites; aldicarb sulfoxide (ASO), and aldicarb sulfone (ASO_2). Tables 1 and 2 show the characterization of aldicarb residues, expressed in percentage and ppm, as found in well-water on Eastern Long Island.

3.3 [C] Long Island Projects

1. Analysis of 7,650 Private Home Wells

Early in March, 1980, Suffolk County and Union Carbide agreed to analyze all private wells within 2,500 feet of fields which had been treated with aldicarb.

Sample collection began in April and was concluded June 8. The precision of the aldicarb residue methodology was monitored by performing duplicate analysis of 734 samples. Accuracy was checked by 122 analyses of 66 blind spiked samples included with the collected water samples.

Results are summarized in Table 3. In summary, after deletion of blanks, spikes, and duplicates, 7,650 wells had been analyzed. Of these, 5583 or about 73% showed no residues. The 7 ppb guideline set by the state of New York was exceeded in 1042 wells equivalent to 13.6% of the samples. It was shown that aldicarb residues reached 51 ppb in well water. Table 4 shows residue levels from 0 to 51, their frequencies, cumulative frequency, percentage, and cumulative percentage.

As results were received by Suffolk County, homeowners were advised by letter of the analysis of their wells. These letters provided advice on water use depending on the magnitude of residues found.

2. The Long Island Filter Installation Program

On June 23, 1980, an agreement was reached by Union Carbide Corporation and the Suffolk County Department of Health Services with respect to the occurrence of aldicarb residues in the groundwater in Eastern Suffolk County. This agreement stipulated that Union Carbide would offer activiated carbon filtration systems to all residents whose well water exceeded the New York State guideline of 7 parts per billion maximum aldicarb concentration. As of September 19, 1980, a total of 1,113 filter offers had been sent by Union Carbide to qualifying residents, 1,005 signed and returned for installation, and 976 either installed by Union Carbide or delivered for installation by the homeowner. All orders generated from the original well sampling program conducted during the first half of this year are expected to be completed in early October, 1980. An additional set of well samples is presently being collected for analysis beginning in November and is expected to generate an estimated 150 additional installations in 1981. Cost of the filter installation program is estimated at $400M in 1980, and $60M in 1981.

Table-1-

CHARACTERIZATION OF ALDICARB RESIDUES IN WELL WATER ON EASTERN LONG ISLAND[1]

Place	Map Coord.	Sample No.	Total Aldicarb Residues, ppb	Percent of Residues Present as		
				Parent Aldicarb	Aldicarb Sulfoxide	Aldicarb Sulfone
Remsenburg	28P13	W2947	69	0	49	51
Calverton	28K02	W3316	115	0	53	47
Aquebogue	32L05	W5934	109	0	73	27
Jamesport	34L19	W7483	188	0	68	32
Laurel	35L10	W5902	225	0	54	46
Jamesport	35L12	W7688	148	0	54	46
Jamesport	35L14	W7694	176	0	54	46
Laurel	36K06	W6079	138	0	55	45
Mattituck	37J14	W5233	260	0	59	41
Cutchogue	38K03	W5522	108	0	53	47
Cutchogue	39J01	W6757	149	0	66	34
Southold	42J07	W4355	123	0	67	33
Greenport	44G06	W7862	181	0	49	51
Orient	47E19	W1133	335	0	72	28
Southampton	40P11	W6438	79	0	39	61
Watermill	41Q05	W2739	104	0	50	50
Watermill	42P17	W7058	119	0	49	51
Watermill	43O21	W1635	95	0	58	42
Bridgehampton	44O12	W0510	86	0	55	45
Wainscott	46P01	W1755	131	0	45	55

[1] As reported by Karin Mede, August 5, 1980.

R. C. Rack
8/5/80

Table 2. Character of Aldicarb Residues in Drinking Water

Well Location & Date Sampled		Parts per Billion			Percent of Residue	
		A	ASO	ASO_2	A+ASO	ASO_2
Wainscott Tennis Ct.	8/27	ND	20	22	48	52
	9/25	ND	16	17	48	52
	10/15	ND	16	20	44	56
Wainscott [redacted]	9/25	ND	19	5	79	21
	10/15	ND	92	28	77	23
Watermill [redacted]	9/25	ND	17	8	68	32
	10/15	ND	11	6	65	35
Southold [redacted]	8/27	ND	32	42	43	57
	9/25	ND	32	41	44	56
	10/15	ND	32	42	43	57
Southold [redacted]	8/27	ND	24	30	44	56
	10/15	ND	30	40	43	57
Southold [redacted]	8/27	10	52	26	70	30
	9/25	12	72	22	79	21
	10/15	6	60	20	77	23
Southold [redacted]	8/27	40	250	80	78	22
	9/25	18	237	75	77	23
	10/15	12	129	66	68	32
Riverhead [redacted]	9/25	ND	6	11	35	65
	10/15	ND	6	10	38	62
Orient [redacted]	9/25	ND	12	11	52	48

PRIVACY ACT EXEMPTION

R. C. Back
12/7/79

Table-3-
FREQUENCY AND MAGNITUDE OF RESIDUES BY COMMUNITY, LONG ISLAND.
ALDICARB RESIDUES IN PPB, PRIVATE WELLS, COMPUTER PRINT, JULY 8, 1980.

Community	ND	1-7	8-30	31-75	>75	Total
North - East to West						
Orient	293	28	6	9	3	339
E. Marion-Greenport	204	4	5	0	0	213
Southold	349	65	29	10	2	455
Bayview	132	33	10	9	11	195
Peconic-E. Cutchogue	283	38	17	12	3	353
Cutchogue	591	112	55	45	31	834
Mattituck	452	66	27	28	13	586
Laurel	146	44	39	24	11	264
Jamesport	276	91	67	49	57	540
Northv-Aquebogue	264	57	21	18	5	365
Riverhead	211	22	10	4	3	250
Roanoke-Centerv.	117	43	17	0	1	178
Baiting Hollow	43	18	2	0	0	63
Wading River	317	57	22	2	0	398
Shoreham-Calverton	59	15	13	6	4	97
Manow-Brookhaven	184	12	0	2	0	198
South - West to East						
Moriches-Hmptn Bays	148	23	17	12	0	200
Reservation	45	10	9	11	1	76
Southampton	424	61	34	19	5	543
Deerfield-Watermill	241	51	38	12	5	347
Scuttle-Mecox	167	39	29	13	4	252
Bridgehampton	180	50	18	10	3	261
Sagaponack	103	27	28	24	2	184
Wainscott	224	53	30	11	3	321
E. Hampton	130	6	1	1	0	138
TOTAL	5,583	1,025	544	331	167	7,650

R. C. Back
10/21/80

4

Table-4-

ALDICARB LONG ISLAND WATER ANALYSIS — 10:54 TUESDAY, JULY 8, 1980 — 1

FREQUENCY OF RESIDUE LEVELS
BLANKS DELETED
SPIKES AND DUPLICATES DELETED

PPB	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
.	5423	5423	69.357	69.357
0	325	5748	4.157	73.513
1	500	6248	6.395	79.908
2	166	6414	2.123	82.031
3	127	6541	1.624	83.655
4	82	6623	1.049	84.704
5	66	6689	0.844	85.548
6	46	6735	0.588	86.136
7	51	6786	0.652	86.789
8	53	6839	0.678	87.466
9	44	6883	0.563	88.029
10	31	6914	0.396	88.426
11	36	6950	0.460	88.886
12	31	6981	0.396	89.283
13	25	7006	0.320	89.602
14	25	7031	0.320	89.922
15	24	7055	0.307	90.229
16	16	7071	0.205	90.434
17	21	7092	0.269	90.702
18	22	7114	0.281	90.984
19	18	7132	0.230	91.214
20	20	7152	0.256	91.469
21	18	7170	0.230	91.700
22	24	7194	0.307	92.007
23	19	7213	0.243	92.250
24	22	7235	0.281	92.531
25	13	7248	0.166	92.697
26	18	7266	0.230	92.927
27	13	7279	0.166	93.094
28	10	7289	0.128	93.222
29	16	7305	0.205	93.426
30	15	7320	0.192	93.618
31	17	7337	0.217	93.836
32	13	7350	0.166	94.002
33	16	7366	0.205	94.206
34	14	7380	0.179	94.385
35	7	7387	0.090	94.475
36	13	7400	0.166	94.641
37	16	7416	0.205	94.846
38	8	7424	0.102	94.948
39	10	7434	0.128	95.076
40	6	7440	0.077	95.153
41	6	7446	0.077	95.230
42	6	7452	0.077	95.306
43	8	7460	0.102	95.409
44	7	7467	0.090	95.498
45	10	7477	0.128	95.626
46	8	7485	0.102	95.728
47	8	7493	0.102	95.831
48	8	7501	0.102	95.933
49	9	7510	0.115	96.048
50	7	7517	0.090	96.138
51	11	7527	0.141	96.266

(9)

10-13, not
on this disk.

According to Union Carbide, overall reaction to the program by homeowners and the press was favorable throughout. No major or unresolved incidents occurred with any of the filter recipients. They added that the program will continue to be provided in 1981.

According to a latest report by Union Carbide, summarized by Dr. P.A. Scheib on 2/25/81, which was received by EFB on 3/11/81; the carbon filters appear to be functioning normally. In one sample, 76 million gallon containing 21 ppb aldicarb, however, after filtration aldicarb residues were below the detectable level of 1 ppb. In another sample, the filter was used for a period of 236 hours where water contained 54 ppb before filtration but none was detected after filtration.

3. The Experimental Use Permit

At the suggestion of Cornell University scientists and area farmers who were concerned about groundwater contamination with aldicarb, Union Carbide applied for and was granted an experimental use permit on 3/28/80. It was thought that several procedures might reduce or eliminate aldicarb movement to groundwater under the special conditions on the East End of Long Island. These are:

(a) Reduce the maximum use rate from 7 to 3 lbs ai/A/y.

(b) Delay application until the potato plants had begun root development and were sprouting.

(c) Avoid early season cold rainy weather, allow soil to warm, and perhaps increase soil microbial activity.

Test sites chosen were at Orient on the North Fork, at Sagaponack Lake on the South Fork, and at Cutchogue.

On June 28, 1980, Union Carbide submitted the first quarterly report. These data were not reviewed, however, a "No adverse comments" statement was made on the EFB cover sheet dated 8/7/80. The fate of the data is unknown.

Similarly, on September 28, 1980, Union Carbide submitted the second quarterly report. Again, the data were not reviewed and the reviewer wrote: "Without the benefit of discussion of all test results, it is rather difficult to reach a sound conclusion that would elucidate the fate of aldicarb under the conditions of this program. Hence, EFB concludes that adequate review of the reported results can not be accomplished at this time. It is anticipated that the final results of EPA's own modeling effort on the transport and fate of aldicarb in Long Island groundwater is forthcoming ca. Jan. 1981, (Per conversation with Bob Carsel)".

In my opinion field date should have been given a thorough review and that modeling, when perfected, should only serve as a guide for predicting the transport and fate of chemicals in the environment. Note that "expectation" and "observation" are two different events. Expectations are the results of modeling, whereas, observations are actual field and/or laboratory data.

3.4 [D] Soil and Water Sampling and Analyses in Areas of Special Interest

In planning the 1980 aldicarb groundwater monitoring program, certain special interest areas were selected for consideration because of similarity to Long Island. According to Union Carbide, all of these are areas where aldicarb is used, and all have sandy soils. All except Virginia had been previously sampled in a preliminary way, and were areas where a recognized potential for aldicarb movement to groundwater existed.

1. Wisconsin

The following is a general description, as provided by Union Carbide, of the Wisconsin central sands area, its topography, weather, crops, aldicarb use history, and factors affecting the downward transport of aldicarb residues: The Central Sands area of Wisconsin primarily includes portions of Portage, Waushara and Adams Counties. This area is fairly level to gently undulating land composed of loamy sand, fine to coarse sands and gravel. Bedrock is usually found at 10 to 60 feet. Rapid permeability and low water holding capacity typify these soils, with groundwater generally found at 10 to 20 feet, or as little as 3 to 5 feet in wet periods. The major waterway is the Wisconsin River on which numerous dams reduce the potential for flooding.

The weather is humid, temperate, and being midcontinental, subject to rapid change. Winters are cold and snowy, summers warm and sometimes hot and humid. Average rainfall is about 30 inches, with 60% falling during the May through September growing season, an average of 130 to 140 days. All of the potato acreage is irrigated. Irrigation varies with natural rainfall, but averages 10 to 20 inches per season. Irrigated acreage is rapidly expanding in Central Wisconsin and has caused increased attention to groundwater characteristics.

Harvested crops grown in the area include corn, small grains, alfalfa, hay and beans. Potatoes are the largest specialty crop and are grown on about 20 percent of the harvested acreage. About half of Portage County's 22,000 areas of potatoes are treated at planting in-furrow with Temik 15

Granular Pesticide, 18 to 20 pounds per acre, or 3 pounds active ingredient per acre. Adjacent Waushara County reports 1,300 of 2,000 acres similarly treated. Only one application is made, and practically all planting is done in April.

Five potato fields with two to five years of TEMIK use as an in-furrow at-planting application were selected for the sampling program as indicated by the following pages. The [redacted] field was treated with TEMIK at three pounds active ingredient per acre in 1976, 1978 and 1980. The [redacted] Field had TEMIK applications in 1979 and 1980 of 3 pounds and 2.7 pounds of active ingredient per acre. Both the [redacted] and [redacted] Fields were sampled on July 1 and September 2, 1980.

The [redacted] Field had been treated on at least half of the field for the last five years with TEMIK at the rates of 2.4 to 2.7 pounds of active ingredient per acre. TEMIK at 2.7 pounds of active ingredient was applied in both 1978 and 1980 on the [redacted] Field. The [redacted] Field had 3.0 pounds of active ingredient per acre applied in 1979 and 1980. The [redacted] and [redacted] Locations were sampled on July 2 and September 3, 1980.

Factors promoting the downward transport of aldicarb residues include the rapid permeability of the sandy soils and the proximity of the groundwater which is normally 10 to 20 feet below the surface. The acidic soil pH prevents chemical decomposition of the residues. The factors promoting the degradation of aldicarb residues include the marginal rainfall received during the season and the carefully controlled irrigation which is used to supplement the water requirements of the crop. These two factors enable the grower to control water infiltration. The use rate of 2 to 3 pounds of aldicarb per acre is moderate.

The results of the Wisconsin sampling are shown in Tables 5, 6, and 7.

Table 5 shows aldicarb residues in soil and water samples collected on 7/1 and 7/2, 1980 and analyzed by the International Research and Development Corporation (IRD), the table contains a wealth of information that are self explanatory. It should be noted, however, that aldicarb was detected in all wells at concentrations of up to 11 ppb. Similarly, soil samples, showed high aldicarb concentrations of up to 11 ppb, 8' deep and of up to 38 ppb, 5' deep.

Table 6 shows aldicarb residues in Wisconsin, single analysis. Sapmles were collected July/September and recorded October, 1980. The objective of the September sampling were to determine whether any downward movement of aldicarb was taking place. It was suspected that the heavy rains in August 1980 might have contributed

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Table-5--
TEMIK NATIONAL MONITORING PROGRAM
WISCONSIN SOIL AND WATER SAMPLES
SAMPLED 7/1 AND 7/2/80, ANALYZED BY IRD

Grower, County, Legal Description	Crop.	Acreage, Treatment Dates	Lbs ai/A	Soil pH and Type, Water Table	Soil Residues in parts per billion Depth	Site I	Site II	Site III	Water Residues in parts per billion ppb	Source	Well Depth	Distance to Treated Field	Irrigation
[redacted] Waushara Co. [redacted]	potatoes	38 acres 4/79	3	pH Unk. Coarse to fine sand WT-5'		SW 526	Cent. 178	NE 759	ND	East House	20'	1,320'	1 rev/week
	potatoes	4/80	3		Top ft.	137	ND	36	1	South House	25'	300'	514 gal/ac.
					1-2'	22	8	ND	8	Center Pivot	50'	0'	Weekly
					2-4'	-	-	ND					
					4-6'								
				(Groundwater and rock at 4-6')									
[redacted] Waushara Co. [redacted]	potatoes	140 acres 3/78	3.7	pH Unk. Fine to coarse sand WT-6-8' or 13'		SW 30	Cent. 298	NE 779	ND	House Well	Unk.	750'	0.8" every 3 days
	potatoes	4/80	3.7		Top ft.	45	56	50	7	Center Pivot	80'	0	514 gal/ac.
					1-2'	121	294	46					
					2-4'	21	42	9					
					4-6'	ND	14	-					
					6-7'								
				(Groundwater at 6', rock at 7')									
[redacted] Portage Co. [redacted]	potatoes	75 acres 1976	3	pH 6.2 Friendship sandy loam WT-12'		NW 139	Cent. 100	SE 463	3	[redacted] House	30'	99'	1" every 5-7 days
	potatoes	1978	3		Top ft.	127	8	ND	2	House	20'	100'	16M gal/ac/app.
	potatoes	4/80	3		1-2'	13	ND	ND	3	[redacted] House	20'	170'	
					2-4'	ND	ND	ND	2	NW Irrigation Well	72'	0	
					4-6'	ND	ND	ND	2	Center Pivot	120'	0	
					6-8'								
[redacted] Portage Co. [redacted]		130 acres 1976 1977 1978 1979 4/80		pH 6.0 Plainfield sand WT-12'		NE 289	Cent. 695	SW 1,382	1	Garden Well	15'	300'	15M gal/ac/app.
					Top ft.	165	280	33	2	House Well	25'	300'	
					1-2'	105	134	53	9	Center Pivot	80'	0	
					2-4'	14	12	80					
					4-6'	11	ND	11					
					6-8'								
				(Groundwater at 8')									
[redacted] Portage Co. [redacted]	potatoes	130 acres 1979	3	pH 6.3 Plainfield sand WT-10'		NE 149	Cent. 1,115	SW 433	ND	NE House	Unk.	900'	15M gal/ac/app.
	potatoes	4/80	2.7		Top ft.	203	267	175	11	Center Pivot	80'	0	
					1-2'	54	ND	ND					
					2-4'	30	38	13					
					4-5'								
				(Groundwater at 5', rock at 5-6')									

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Total Rainfall, Whiting Wisconsin (in) and Hancock*

1975 –	92.7	27.8*	78 –	38.5	35.7 Wisconsin
76 –	85.4	19.1	79 –	38.76	32.0
77 –	83.5	37.8	80 –	22.87	—

Table-6-

ALDICARB RESIDUES IN WISCONSIN SOILS:
SINGLE ANALYSIS, METHOD SENSITIVITY 5 ppb.
SEPTEMBER SAMPLES REPORTED OCTOBER 20, 1980.

Farm and Site	Soil Depth in Feet from Surface and Sampling Time							
	Surface-1 ft		1-2 foot		2-4 foot		4-6 foot	
	July	Sept	July	Sept	July	Sept	July	Sept
H I	139	N	127	29	13	N	N	N
II	100	39	8	128	N	38	N	24
III	463	239	N	73	N	13	N	31
H AVG	234	93	45	77	4	17	0	18
PA I	289	24	165	12	105	42	14	16
II	695	99	280	153	134	140	12	54
III	1382	32	33	24	53	9	80	21
PA AVG	789	52	159	63	97	64	35	30
B I	149	8	203	14	54	N	30	41
II	1115	24	267	11	N	43	38	24
III	433	364	175	131	N	57	13	W
B AVG	566	112	215	52	18	33	27	33
PO I	30	25	45	20	121	40	21	32
II	298	123	56	62	294	N	42	9
III	779	68	50	ND	46	84	9	W
PO AVG	369	72	50	27	154	41	24	21(W)
M I	526	38	137	52	22	122	W	W
II	178	10	N	19	8	22	W	W
III	759	12	36	10	N	27	N	13
M AVG	488	20	58	27	10	57	W	13(W)
5 FARM AVG	489	70	105	49	57	42	17	23
% LOSS	85		53		26		Gain	

N = Non-detect = 0.
W = Groundwater prevented sampling.

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10/21/80

Table-7-

ALDICARB RESIDUES IN WELL WATER, PPB
SUMMARY OF 1980 WISCONSIN SAMPLES

Farm & GW Flow	Well Type	Depth in feet	Distance to Treated Area, ft.	Sampled 7/1-2/80 IRD	Sampled 7/1-2/80 UCC	Sampled 9/2-3/80 IRD	Sampled 9/2-3/80 UCC
1 to NE	House	30	99 NE	3	2	2	3
	House	20	100 SW	2	2	4	ND
	House	20	170 NW	3	4	3	2
	Irrigation	68	100 NW	2	2	2	2
	Irrigation	72	0	2	3	1	1
2 to SW	Garden	15	300 SE	1	ND	1	ND
	House	25	300 SE	2	ND	ND	ND
	Irrigation	80	0	9	10	3	ND
	Shop	Unk	300 SW	NA	NA	2	ND
3 to SW	House	Unk	900 NE	ND	ND	1	1
	Irrigation	80	0	11	3	1	2
4 to SW	House	Unk	750 SE	ND	1	12	ND
	Irrigation	80	0	7	8	6	6
5 to SW	House	20	1320 SE	ND	ND	6	ND
	House	25	300 S	1	ND	ND	ND
	Irrigation	50	0	8	12	3	ND

NA=not analyzed, ND=non detectable at Method Sensitivity 1 ppb.
Unk=unknown.

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to aldicarb leaching. Table 6 shows an 85, 53 and 26% reduction in the amount of aldicarb residues present in the surface-1 foot, 1-2 feet, and 2-4 feet respectively. According to Union Carbide, biological and chemical degradation, especially in the top two increments of soil. Some downward transport of the aldicarb residues might have taken place in the two months between samplings as indicated by the slight gain in residues detected at the 4-6 feet level.

Finally table 7 is a summary of aldicarb residues in well water tested during 1980 in Wisconsin. Late sampling in September and early sampling taken in July, mentioned in Table 5 above. It is obvious from the table that the two methods of analysis, the International Department Corporation (IRD) and the validated method by Union Carbide Corporation (UCC), were in agreement in 25 of the sample pairs and differed in only 7 sample pairs. As with IRD analysis, UCC analysis showed aldicarb residues of up to 12 ppb in the July samples and up to 6 ppb in the September samples.

2. Florida

The following is a summary on the topography of the mid-peninsula of Florida, weather, crops, soil characteristics, aldicarb use history, and factors affecting the transport of aldicarb in these areas (source: Union Carbide): In early June and September, 1980, Union Carbide sample soil and water from 5 treated citrus groves located in mid-peninsula Florida. This section introduces the field description of sampling locations, which follows the EPA report on 1979 samplings.

St. Lucie, Indian River, Polk and Hillsborough Counties are located about half way down the Floida peninsula and include the highest orange-producing counties in the State. St. Lucie and Indian River Counties are located on the east coast and are composed of primarily flatwoods and marshy lands. The elevations are quite low, no more than 15 to 30 feet. Polk County is located approximately in the middle of the peninsula and overall consists of gently rolling land climaxing to elevations of bout 200 feet on the central ridge. Hillsborough County includes Tampa and the eastern shore of Tampa Bay in west central Florida. The western and southern portions are in the coastal lowlands of nearly level plains. The eastern part enters to central Florida highlands; gently rolling to elevations of 100 feet. Many permanent lakes and intermittent ponds are found in the north central and northwestern parts.

Most soils in St. Lucie and Indian River Counties are loamy sands, nearly level poorly drained and slowly permeable. In the Winder series the water table is within 10 inches of the surface for 2 to 4 months and no more than 40 inches deep the rest of the year. Extensive use of raised beds are used to make this soil more usable for cropland. Except for the area under the drip line of the trees,

these groves are usually sodded. The Polk County soils are primarily loamy sands which are level, fairly well drained and moderately permeable. Many of the groves are limed to bring the soil pH up to the 6.8 and 7.0 range. Sod cover in groves in Polk County is not usual. In Hillsborough, common soils include Blanton and Lakeland fine sands which are readily permeable, rapidly drained and are naturally strongly acid although through liming the pH is adjusted upward.

The counties studied have subtropical climates with long, warm and humid summers and mild winters. The annual mean temperature is about 75° F and the annual rainfall amounts to approximately 50 to 60 inches. The groundwater temperature is approximately 74° F.

In the four counties, 257, 029 acres are planted to orange groves. Of the total acreage of oranges grown, one percent is treated with TEMIK 15G at spring flush which usually occurs from mid-February to mid-March. The labeled use rate is 33 to 67 pounds of Temik 15G, or 5 to 10 pounds active ingredient per acre.

The five locations or groves studied in the 1980 program were each sampled twice during the growing season according to the procedure outlined in the project protocol. The first set of samples were obtained June 4 and 5, the second set September 9 and 10 1980. The September soil samples were taken on the same tree, different side than the June sampling so that close correlation of the analytical results could be facilitated. A set of ten water samples were taken on October 31, 1980 as a means of checking results by IRD on samples taken on September 9 and 10. The ten water samples were taken before the UCC lab analyses were performed on the September 9 and 10 water samples.

The two groves owned by [redacted] received an application of TEMIK 15G on April 1, 1980 as their only treatment with this material. Orange-Co Grove I received a total of 67 pounds per acre of TEMIK 15G in both 1979 and 1980. A total of 67 pounds of TEMIK 15G had been applied to Orange-Co Grove II in 1980 only. In late February, 1979, 65 pounds per acre of TEMIK 15G was appied and 67 pounds were appied on March 15, 1980.

Factor promoting the transport of aldicarb in these areas of Florida include the higher rate of 10 pounds of active ingredient aldicarb on groves which, in many cases, have a water table of ten feet or less. These soils tend to be acid in nature in the uper portion of the soil profile but are often limed to pH of 6.8 to 7.0. The soils tend to be acid in nature in the upper portion of the soil profile but are often limed to a pH of 6.8 to 7.0. The soils vary in permeablilty but all receive a high amount of rainfall and hence high water infiltration.

Factors promoting the degradation or decomposition of aldicarb residues include the shallow granule placement in the zone of high microorganism activity and established root systems at the time of

treatment. The potential evapotranspiration rate is approximately 45 inches per year. In some cases, a slow to moderate soil permeability rate and low to moderate amount of water infiltration is present. An alkaline condition in the lower strata of soil often exists which would promote chemical degradation of the aldicarb residues.

The groundwater temperature, as mentioned earlier, is about 74° F which is conducive to fairly rapid breakdown of aldicarb residues. As a rule, the shallow wells which exist in some areas are not used for drinking. Drinking water is obtained from wells which pump water from an aquifer which is protected from the more shallow layer of groundwater by a layer of limestone.

The average 1980 rainfall for three locatins in Florida was recorded as follows (inches):

Month	Fort Pierce	Indian River Co.	Lake Alfred Co.
1	3.7	-	-
2	6.5	-	-
3	8.2	-	2.3
4	11.7	3.5	2.6
5	14.6	3.0	1.7
6	18.7	4.1	8.0
7	28.1	9.5	5.6
8	30.4	2.2	2.8
9	35.8	5.4	2.0
10	39.6	-	-

Test Results

Test results are shown in Tables 8 and 9. Table 8 lists the June 4 and 5, 1980 sampling from five orange groves. The table is self explanatory. Notice, however, that aldicarb was detected in soil layers 8' deep at 65 ppb. Overall averages of all samples, taken 2 months after application, were calculated at 363 ppb at 1-2 feet, 257 ppb at 2-4 feet, 131 ppb 4-6 feet,, and 39 ppb at 6-8 feet.

Aldicarb residues in water samples (100-500 feet deep) were below the detectable level. Table 9 lists the September 9 and 10, 1980 sampling from the same five sites listed in Table 8. Aldicarb was detected in soil layers 8' feet deep at 109 ppb. Overall averages of all samples taken 5 months after application were calculated at 53 ppb at 1-2 feet, 53 ppb at 2-4 feet, 33 ppb at 4-6 feet, and 36 ppb at 6-8 feet.

Aldicarb residues in water were not detected by the UCC method. However,

Table-8-

ALDICARB RESIDUES FROM SOIL AND WATER SURVEY

FLORIDA SAMPLES TAKEN JUNE 4 AND 5, 1980

Field and Treatment History	Water Residues in ppb Source	Depth	Residue IRD	Residue UCC	Soil Depth	Soil Residues/Site in ppb Site I	Site II	Site III	X
[redacted]	Canal		ND	ND	Top 1'	2,954	345	537	1279
	Irrig. well	100	ND	ND	1-2'	178	140	79	132
10 lb ai/A on oranges in 1980					2-4'	217	11	ND	76
					4-6'	148	10	ND	53
					6-8'	ND	GW	13	6
[redacted]	Canal		ND	ND	Top 1'	ND	33	586	206
	GW Site I		ND	ND	1-2'	ND	16	22	13
10 lb ai/A on oranges in 1980	Irrig. well	UK	ND	ND	2-4'	ND	ND	33	11
					4-6'	ND	ND	ND	0
					6-6½'	GW	GW	GW	GW
[redacted]	Swamp		ND	ND	Top 1'	7	16	60	28
10 lb ai/A on oranges in 1979 and 1980	Irrig. well	400-500'	ND	ND	1-2'	ND	ND	245	82
	Barn well	400-500'	2	ND	2-4'	ND	ND	6	2
					4-6'	ND	ND	8	3
					6-8'	ND	ND	ND	0
[redacted]	Store well	400-500'	ND	ND	Top 1'	98	105	107	103
10 lb ai/A on oranges in 1980					1-2'	42	25	70	46
					2-4'	114	280	62	152
					4-6'	ND	98	60	53
					6-8'	23	11	65	33
[redacted]	Lake		ND	ND	Top 1'	676	233	18	309
10 lb ai/A on oranges in 1980	Outside well	150'	ND	ND	1-2'	244	26	ND	90
	House tap	150'	2	ND	2-4'	6	14	29	16
9.5 Lb ai/A on Oranges in 1979					4-6'	ND	ND	67	22
					6-8'	ND	ND	ND	0

ND = Less than 5 ppb in soil and 1 ppb in water.
GW = Groundwater encountered.

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Table--9-

ALDICARB RESIDUES FROM SOIL AND WATER SURVEY

FLORIDA SAMPLES TAKEN SEPTEMBER 9 AND 10, 1980

Field and Treatment History	Water Residues in ppb Source	Depth	Residue IRD	Residue UCC	Soil Depth	Soil Residues/Site in ppb Site I	Site II	Site III	X
[redacted] 10 lb ai/A on oranges in 1980	Canal	100'	6	ND	Top 1'	565	72	16	218
	Irrig. well	-	ND	ND	1-2'	270	83	102	152
					2-4'	198	11	127	112
					4-6'	63	25	6	31
					6-8'	33	GW	9	21
[redacted] 10 lb ai/A on oranges in 1980	Canal	-	ND	ND	Top 1'	ND	46	92	46
	GW Site I	-	NA	NA	1-2'	8	18	40	22
	Irrig. well	UK	ND	ND	2-4'	33	11	33	26
					4-6'	GW	8	ND	4
					6-6½'	GW	20	GW	20
[redacted] 10 lb ai/A on oranges in 1979 and 1980	Swamp	-	5	ND	Top 1'	16	7	128	50
	Irrig. well	400-500'	1	ND	1-2'	13	13	17	14
	Barn well	400-500'	ND	ND	2-4'	ND	18	8	9
					4-6'	ND	ND	ND	0
					6-8'	13	17	ND	10
[redacted] 10 lb ai/A on oranges in 1980	Store well	400-500'	10	ND	Top 1'	39	11	29	26
					1-2'	41	ND	20	20
					2-4'	56	ND	133	63
					4-6'	28	ND	30	19
					6-8'	14	ND	32	15
[redacted] 10 lb ai/A on oranges in 1980	Lake	-	5	ND	Top 1'	27	31	43	35
	Outside well	150'	ND	ND	1-2'	28	27	116	57
	House tap	150'	8	ND	2-4'	48	22	98	56
					4-6'	77	47	212	112
					6-8'	109	122	GW	115

ND = Less than 5 ppb in soil and 1 ppb in water.
NA = Not available
GW= Groundwater encountered.

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the IRD measurement detected 6 ppb in an irrigation canal, 5 ppb in a swamp and a lake, 8 ppb in a house top, and 10 ppb in a store well.

The differences between June, and September sampling was that in September, residues were reduced by 81% in the surface foot, by 27% at the 1-2 feet level. However, a 4% increase was shown at the 2-4 feet level, 27% at the 4-6 feet level, and an increase of 260% at the 6-8 feet level.

Few additional samples were analyzed to provide, according to Union Carbide, OPP a tool for decisionmaking. Soil and water samples were taken from Washington County, Mississippi and Hillsboro County, Florida. In Mississippi three cotton fields were sampled where aldicarb had been applied for 8-10 years at approximately 0.4 -0.5 lbs ai/A/y. Soils are loamy in texture and water table is 3-8 feet deep. In Florida, one citrus grove was sampled where aldicarb was applied the year before sampling at 10 lbs ai/A. Soils are generally sandy in texture.

Results showed no aldicarb in Misissippi soils down to 8 feet deep. Similarly, 6 water well samples and one surface sample were all negative. In Florida, however, aldicarb was deffected only at lower depths, approaching the water table. Aldicarb concentrations were: 8, 20, 80, and 70 ppb in the 5, 6, 7, and 8th foot respectively. On the other hand, three water samples did not show delectable levels of aldicarb.

3. Virginia

The following is a general description, as provided by Union Carbide, of the Virginia area, its topography, weather, crops, aldicarb use history and factors affecting the downward transport of aldicarb residues: Sampling on the Delmarva Peninsula was undertaken because it is, like Long Island, a coastal area of agricultural importance. Three farms were selected for study in Accomack County, Virginia.

Accomack is on Virginia's eastern shore, lying between Chesapeake Bay and the Atlantic Ocean. It is part of the Delmarva peninsula, about 10 miles wide and 35 miles long, running southwesterly from the Maryland boundary on the northeast to Northampton County on the southeast. This is all part of the Coastal Plain; the central drainage divide in Accomack is about 10 feet above sea level.

The soils are sand and silt, underlain by a coarser sand subsoil at about 3 feet. Sassafras sandy loam is a brown silty sand at the surface with a reddish brown, heavy loam to a depth of 30 to 36 inches. It is the predominant soil, accounting for 40 percent of the County cropland. Elkton sandy loams are frequently heavy and poorly drained; this and the Keyport series make up 25 percent of the area. Tidal marshes and coastal beaches occupy the remaining County land.

Long, warm summers and mild winters show the moderating influence of the sea. The growing season runs about 215 days from early April to early November. Mean annual temperature is 58° F, annual precipitation is about 42 inches. The groundwater temperature is approximately 60° F. It should be noted that 1980 was a particularly dry growing season. Through June, precipitation was less than 4 inches of normal and virtually no rain fell in July. The 1980 potato yield was down from 130 to 100 cwt per acre, due to the dry weather, according to the Virginia Crop Reporting Service.

In 1974, 97M, or 32 percent, of the County's 305M acres were in farms and of that, 70M acres were in harvested crops. Statistics at that time were 34M acres soybeans, 20M acres corn and small grains, 13 M acres potatoes, and 10M in other commercial vegetables. Present data, obtained locally and which may also include Northampton County, are 60M acres soybeans, 22M acres potatoes, with cucumbers, snap-beans, and tomatoes as other commercial vegetables.

TEMIK is applied to an estimated 25% of the potato crop. It is effective against Colorado potato beetle to within 3 or 4 weeks of season end. Performance is good enough to expect some expansion of use. A small percentage of soybeans were treated in 1980. Yield increases where used were significant, so a rise in this market is predicted. In all, and estimated 110M pounds of Temik 15G were applied in 1980.

The three fields selected for sampling have had potatoes growing in them for a number of years. These fields represent three geographic sections of the Delmarva Peninsula. The Seaside Field is located on the Atlantic portion of the area. The Home Field is near the ridge or high point on the peninsula. The Groton Field area is influenced by the Chesapeake Bay. all three fields had received TEMIK at 2.25 pounds active ingredient per acre as an in-furrow at-planting time treatment the last two years. The application dates were March 10, 1979 and April 10, 1980 for all three fields.

Factors prompting transport of aldicarb residues to drinking water in this area include the four to six inch placement of the granules at application time when the plant is in the seed stage and the rapid permeability of these soils, coupled with a water table of less than ten feet may also contribute to downward movement of residues. The soil pH of Accomack County is in the range of 4.5 to 6.0 which will not break down aldicarb as quickly as soils with a higher pH range. The potential evaporation rate is approximately 32 inches per year. Among the factors promoting the degradation of the residues before reaching drinking water are the moderate rate of TEMIK which is applied to crops in the area and the relatively warm weather present from planting time through the season.

Test results from Virginia are shown in Table 10. It could be seen from the table that soil samples showed no residues above method sensitivity. Note that groundwater table during 1980 was very high, approaching 4-5 feet in all areas tested. For this reason, water samples were not tested in one field. In two other fields, however, groundwater from a depth of 60-270 feet, showed no aldicarb residues.

4. Washington-Oregon

The following is a general description, as provided by Union Carbide, at the Washington-Oregon area, its topography, weather, crops, aldicarb use history, and factors affecting the downward transport of aldicarb residues: This study area is the largest inland basin between the Cascade and Rocky Mountain ranges, which contains the Columbia River and the lower valleys of its major tributaries, the Yakima and Snake. It is of interest because of large acreages of irrigated potatoes on which Temik is used and the specialty crop, hops, where use has been proposed. Soil and water samples were taken from potato farms in Grant and Franklin Counties, Washington, and in Umatilla County, Oregon.

The climate of the area is temperate and semiarid. Summers are hot and dry, winters cold and moist. Rainfall varies greatly with elevation; averageing 7-9 inches per year in most areas but with 12 to 14 inches in higher altitudes to the East.

Most cropland rangs from level bottomlands to low terraces and gently sloping fields at elevations of 300 1000 feet rising to a high of 4000 feet. The soils range greatly but most are deep, very premeable, and neutral to alkaline. Types include silt loams, loams, sands, and some clays, from alluvium, loess, and lake sediments. These are commonly underlain by basaltic bedrock at 5 feet or much deeper.

Rainfall, as mentioned is low and the area is semiarid. Irrigation is by surface water from dams and reservoirs which feed canal systems. Ground-water is usually more than 20 feet deep, and has a temperature of 52 to 54° F. Wells are common and those sampled near treated fields in this study were 59, 65, and 120 feet deep.

The agriculture of the area can be depicted by the following statistics for the counties of interest (Cens. Agr. 1974).

Table-10-

ALDICARB RESIDUES FOR SOIL AND WATER SURVEY
ACCOMACK COUNTY, VIRGINIA, SAMPLED JULY 17, 1980

Field & Treatment History	Crop	Water Residues, PPB Source	Depth	Residue IRD	UCC	Soil Depth	Soil Residues/Site, PPB Site I	II	III
[redacted]	potatoes	-- None -- Available Core terminated due to groundwater				Top 1 ft	120	50	143
						1-2 ft	38	8	12
						2-4 ft	7	17	19
2.2 lb ai/A '79 & '80						4-6 ft	ND	26	ND
						6-8 ft	ND		7
						8-9 ft			ND
							GW 7'	GW 4.5'	GW 9'
[redacted]	potatoes	Housewell	60'	ND	ND	Top 1 ft	16	8	ND
		Shop Well	270'	ND	ND	1-2 ft	ND	ND	ND
						2-4 ft	ND	ND	ND
2.2 lb ai/A '79 & '80						4-5 ft	ND	ND	ND
							GW 5'	GW 5'	GW 4.5'
[redacted]	potatoes	Bailey Well	100' (Est.)	2	ND	Top 1 ft	150	202	266
						1-2 ft	ND	ND	44
						2-4 ft	ND	ND	ND
2.2 lb ai/A '79 & '80						4-5 ft	ND	11	ND
							GW 5.5'	GW 5'	GW 5'

ND = Sensitivity for water = 1 ppb, for soil = 5 ppb

PRIVACY ACT EXEMPTION

Thousands of Acres

County	Area	Farms	Harvested	Irrigated	Potatoes	Wheat	Veg.
Grant	1712	1081	451	293	40	244	12
Adams	1212	1147	461	106	9	406	2
Franklin	802	601	271	146	12	169	4
Benton	1102	721	249	90	19	185	4
Umatilla	2065	1389	433	94	11	320	40

On potatoes, Temik 15G is applied at 3 pounds active ingredient per acre. The 1979 use statistics show major consuming Counties to be Umatilla, Grant, and Benton in that order. A total of 123, 000 pounds of active aldicarb were used in the area in 1979. This decline to 108,000 in 1980. This would treat 35,000 to 45,000 acres at 3 pounds per acre, or about one-third to one-half the total potato acreage.

PRIVACY ACT EXEMPTION

All three sampling locations in the 1980 program, has had TEMIK at three pounds active ingredient per acre applied to potatoes in two of the last five years. Two of the locations received a TEMIK treatment as a side-dress application after planting time in 1980. The [redacted] potato field was treated when the plants were 70% emerged in 1978 ahd 1980; the [redacted] field was treated about May 5 in both 1977 and 1980. Soil and water sampling was done on July 7 and 8, 1980 on [redacted] and [redacted] respectively.

The [redacted] location was in winter wheat when soil and water samples were taken on July 9, 1980. The field had been in potatoes in 1978 and 1979 and had been treated with 3 pounds active ingredient per acre of TEMIK at layby, about June 1, both years.

The downward movement of aldicarb in the soil profile in this area would be limited by the application of a moderate rate of TEMIK, the marginal rainfall received during the growing season and the moderate evapo-transpiration rate of 24 to 36 inches per year. Aldicarb degradation due to relatively high soil temperature, promoting biological activity from the time of aplication through the rest of the growing seasons and the alkaline pH of the soil would, along with the controled application of irrigation water to control the rapid soil permeability, decompose the residues before reaching groundwater which is normally found 20 feet or more below the surface.

Test results are shown in Table 11. It could be seen from the Table that aldicarb residues are detected in soil profile 8 feet deep at 12 ppb.

Table-11--

ALDICARB RESIDUES FOR SOIL AND WATER SURVEY
OREGON AND WASHINGTON SAMPLED JULY 7-9, 1980

Field & Treatment History	Crop	Water Residues, PPB Source	Depth	IRD	UCC	Soil Depth	Soil Residues/Site, PPB Site I	II	III
[redacted] Umatilla Co 3 lb ai/A SD to pot '78 & '80	potatoes	Shop	65'	1	ND	Top 1 ft	586	608	483
						1-2 ft	ND	10	ND
						2-4 ft	6	12	9
						4-6 ft	ND	ND	ND
						6-8 ft	ND	12	ND
[redacted] Franklin Co 3 lbs ai/A at Layby '78 & '79	potatoes	Canal		ND	ND	Top 1 ft	ND	ND	ND
		Drain Pond		1	ND	1-2 ft	ND	ND	ND
		Well	59'	ND	ND	2-4 ft	10	ND	ND
						4-6 ft	6	ND	ND
						6-8 ft	ND	ND	ND
[redacted] Grant Co 3 lb ai/A at Layby '77 & '80	potatoes	Shop Well	120'	2	ND	Top 1 ft	7	771	1200
		Drain Ditch		9	14	1-2 ft	ND	9	13
						2-4 ft	ND	7	ND
						Bedrock at 4 ft.			

ND = Non-detectable. Method sensitivity: 1 ppb in duplicate water samples, 5 ppb in single soil samples.

PRIVACY ACT EXEMPTION

On the other hand, none of the groundwater samples contained detectable levels of aldicarb residues. In only one sample, however, water specimen was collected from a drainage ditch. The ditch is located at the end of a field being irrigated. The field had been treated with aldicarb at 3 lbs ai/A. 45 days prior to sampling. IRD analysis showed aldicarb residues at 9 ppb, whereas, UCC analysis showed aldicarb at 14 ppb.

5. CALIFORNIA

The fllowing is a general decription, as provided by Union Carbide, of the California area, its topgraphy, weather, crops, aldicarb use history, and factors affecting the downward transport of aldicarb:

Kings County is located centrally in the San Joaquin Valley of California, surrounded by Fresno, Tulare, and Kern Counties. These and other counties in central and southern California constitute the larges Temik consuming area in the United States. It is, therefore of major interest with respect to the transport and fate of aldicarb residues in soil and groundwater.

The 1980 soil and water sampling on two Kings County farms had been preceded by three other studies, all proving negative for aldicarb residues in groundwater, but was initiated to look at soil residues and to provide additional evidence of residue behavior. The prior studies included an initial survey by Union Carbide of well water from several sites near treated fields in both the Shafter and Davis areas, the EPA survey of 47 composite samples from eleven counties, and the CDFA sampling of twelve wells in the BakersfieldRosedale area of Kern County and sites along the lower Salinas River between Chualar and San Lucas in Monterey County. These were all negative at method sensitivity of 1 ppb.

The San Joaquin Valley climate and soils are highly variable, but in general may be characterized at semi-arid with deep, moderately permeable, fairly well drained soils derived from alluvial fans and flood plains. Subsoils tend to be alkaline; the total profile may range from 7.2 to 9.4. In some areas, calcareous hard-pans are present and sometimes broken as an agricultural practice. Sandy loam and sandy clay soils were encountered on the farms sampled.

The San Joaquin Valley water supply is partially from rainfall but mainly from the Sierra Nevadas to the east. Water for crops comes from the mountains via aqueducts, reservoirs, and canals. Water is also widely supplied by deep wells. Irrigation is required to supplement the 10-inch annual average rainfall of the central valley. Furrow, sprinkler, and drip irrigation are all practiced, and because water is in short supply, its use and infiltrtion is carefully controlled. No rain falls in the summer months. The water

table varies, occasionally only 5 to 15 feet where irrigated, but generally very deep. Most wells range from 120 to over 700 feet in depth.

The mean annual temperature is 62°; shallow groundwater ranges from 62° to 72°. Potential evapotranspiration water loss from soil surface is 36 to 48 inches per year.

Kings County comprises 893M acres, of which 735M, or 82 percent, is in farms. Harvested crops are taken from 453M acres, and in 1979, over 300M acres of cotton were harvested. Small grains account for over 100M acres.

The major Temik use is on cotton where it is applied at the rates of 0.5 to 2.2 pounds active aldicarb per acre, the former at planting and the latter, the major use, sidedressed at squaring. Two cotton fields, located in the high Temik use area and treated the past two years. were treated for sampling. The [redacted] site received 0.6 lb ai/A at planting only; the [redacted] location received the same at panting treatment plus a 2.2 lb ai/A application at squaring. Approximate data are April 10 for planting, June 10 for sidedress, and soil and water sampling was done July 11.

Based on available information, one would expect the downward movement of aldicarb in the soil profile to be limited by the relatively low dosage per acre, the split application, absence of unpredictable rainfall, and the careful use of controlled irrigation. Although the soil is moderately permeable, product degradation due to relatively high soil temperature and alkalinity is to be expected. The depth of the water table allows for product degradation before it is encountered; pH and temperature would continue the trend should residues ever reach the groundwater.

Tests results are summarized in Table 12. It could be seen from the Table that aldicarb residues were detected in soil profile 8' at 8 and 15 ppb. On the other hand, well water sampled at depth of 175 and 295 feet as well as surface water from irrigation canals, all of which contained no detectable levels of aldicarb residues.

6. THE LOWER RIO GRANDE VALLEY OF TEXAS

The following is a general description, as provided by Union Carbide, of the Lower Rio Grande Valley, its topography, weather, crops, aldicarb use history, and factors affecting the downward transport of aldicarb:

Sampling in the lower Rio Grande Valley of Texas was undertaken because of concern on the part of the Environmental Protection Agency that aldicarb may leave treated citrus groves and be transported via drainage systems.

Table-12-

ALDICARB RESIDUES FOR SOIL AND WATER SURVEY
KINGS COUNTY, CALIFORNIA, SAMPLED JULY 11, 1980

Field & Treatment History	Water Residues, PPB Source	Depth	IRD	UCC	Soil Depth	Soil Residues/Site, PPB Site I	II	III
[redacted]	Canal	Surface	ND	ND	Top 1 ft	22	9	40
	Shop	175'	ND	ND	1-2 ft	59	8	5
9.5 lbs ai/A	Well				2-4 ft	7	6	8
IFAP Cot					4-6 ft	ND	ND	ND
'79 + '80					6-8 ft	hardpan	15	hardpan
[redacted]	Canal	Surface	ND	ND	Top 1 ft	34	22	403
	Irrig	295'	ND	ND	1-2 ft	10	13	305
0.5 lb ai/A	Well				2-4 ft	7	ND	ND
IFAP +					4-6 ft	ND	ND	ND
2.2 lb ai/A					6-8 ft	8	ND	11
SD Cotton								
'79 & '80								

ND= non detectable. Method Sensitivity: 1 ppb in duplicate water samples, 5 ppb in single soil samples.

PRIVACY ACT EXEMPTION

The concern is that the aldicarb would travel some 50 miles or more from the major citrus producing areas in Cameron and Hidalgo Counties to the Laguna Madre and endanger the shrimp industry there.

This area is the southeastern tip of Texas bounded on the east by the Gulf and on the south by Mexico. It includes Hidalgo, Cameron, and Willacy Counties. The northern part of Hidalgo is an undulating sandy plain; the rest of the area is a smooth, flat plain sloping toward the east. The flood plain of the Rio Grande contains minor depressions and old river channels. Elevation ranges from sea level to an average 45 feet in Cameron and 70 to 150 in Hidalgo.

The favored agricultural soils of the area are fine sandy loams to silty clay loams constituting dark-colored calcareous topsils underlain by calcareous clays and sands. Hidalgo and Victoria fine sandy loams account for 23 percent of Hidalgo's 1010M acres; Harlingen clay soils, calcareous alluvials with poor drainage, cover about 10 percent of the County; Willacy fine sandy loams are also important. In Cameron, Laredo and Olmito silty clay account for 23 percent of the County. These soils range from moderately to very slowly permeable and are uniformly alkaline, with 7.9 to 8.4 average pH.

The climate is semitropical with dry winters and hot humid summers. Prevailing southesterly winds from the Gulf temper the heat. Annual precipitation is 23 inches, falling in an irregular pattern which requires irrigation. The irrigated acreage is 477M, or 51 percent of the crop acreage included in this survey. The frostfree season is from early February to early December, averaging 303 days; a mean annual temperature of 74F ranges from 60F monthly. Occasional freezes occurs in winter. The groundwater temperature is approximately 74° F.

The main source of irrigation water is drawn from the Rio Grande upstream, fed into reservoirs, and distributed by canals and pipelines. In irrigated fields, the water table may be at 3 to 10 feet. Drinking water is from the Rio Grande as well, and virtually all of the population is served by municipal systems. There are few shallow wells, and these are (generally) unacceptable for drinking purposes.

The lower Rio Grande Valley is one of the most intensively farmed areas in the nation. Intensified and specialized, the major crops include cotton, sorghum, citrus, and many vegetables. Area citrus totals 77M acres, and Hidalgo has the major share with 64M acres.

Temik has been registered for use on oranges for aphid, mites, and nematode control at 5 to 10 pounds ai/A since 1978. Application for registration on grapefruit is pending. Temik use on oranges occurs once annually, toward the close of the fresh market season. Sales records

show a use of about 500M pounds of TEMIK 15G on oranges in 1980. This equivalent to 90M pounds ai. The average use rate is 5 pounds ai/A, so an estimated 18M, or almost 65 percent, of the 28M acre crop receive TEMIK. Grower acceptance of TEMIK is the result of its excellent control of nematodes and other pests, therefore successfully substituting for DBCP. Product use would expand upon acceptance by EPA for use on grapefruit.

A water sampling series was taken on July 10, 1980 to test for the presence of aldicarb residues in 11 locations on the major waterways upstream from their discharge into either the Laguna Madre or the Gulf of Mexico.

Three groves with a previous TEMIK use history were studied in the 1980 soil and water sampling program. All three groves had received 5 pounds active ingredient each time they were treated. The [redacted] grove had received three years consecutive treatment with TEMIK applied about May 10 each year. The Texas A. and I. location at Weslaco received a TEMIK application on May 31, 1979 and May 12, 1980, and the [redacted] grove was treated on April 1 in both 1979 and 1980.

The soil water sampling program was conducted on these three locations on September 23-24, 1980.

According to available data, the downward movement of altricarb residues would be limited by a number of factors. Although a high rate of TEMIK is used on oranges, the application placement is relatively shallow and the trees to which the material is applied have extensive root systems for the uptake of much of the aldicarb. The warm soil temperature and alkaline soil pH would promote both biological and chemical breakdown of groundwater is usually less than 15 feet; the soil, however, is slow to moderately permable and the amount of water infiltration is moderate. The potential evaportranspiration rate is about 54 inches per year and, along with moderate organic matter plus low rainfall, contributes to an overall situation which, for the most part, opposes the movement of aldicarb to groundwater. The above factors tend to keep the aldicarb in a zone where it would be absorbed by the plants or broken down by physical or biological means.

Average monthly rainfall from 1973-1980 for the Weslaco, Texas area, as recorede by Texas A & I University Citrus Center is summarized in Table 13.

Water samples were taken at suitable sites on the major waterwasy immediately upstream from their discharge into either the Laguna Madre or the Gulf of Mexico. The sampling was conducted on July 10, 1980 and on September 23, 24, 1980. Table 14 summarises the results of the July sampling.

Table-13-

Texas A&I University Citrus Center, Weslaco, Texas
South Research Farm
Rainfall Record, In Inches

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1973	4.35	5.60	0.08	0.38	2.64	7.44	1.68	5.24	4.17	2.95	2.25	0.16	36.94
1974	1.81	-0-	1.77	2.79	0.95	1.14	2.33	0.08	7.29	6.37	0.10	0.48	25.11
1975	1.14	0.53	0.07	-0-	1.23	0.91	7.26	3.01	7.02	0.82	-0-	1.63	23.62
1976	0.64	-	0.39	3.82	1.78	0.87	8.95	1.54	7.35	4.90	3.10	0.98	34.32
1977	1.71	1.20	0.07	1.84	0.71	6.93	0.11	0.25	3.77	2.07	1.55	-0-	20.21
1978	2.07	0.78	-0-	0.83	0.10	1.20	0.21	6.09	7.34	4.13	0.23	0.71	23.69
1979	0.53	0.46	.05	1.18	1.32	3.29	.47	4.03	3.26	.57	0.40	2.45	18.01
1980	.24	3.90	.34	1.30	8.03	-0-	1.18	17.95					32.94
1981													
1982													
1983													
1984													
1985													

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Table 14. Aldicarb Residues for Soil, and Water Survey Lower Rio Grande Valley, Sampled July 10, 1980:

Site No.	Sample	Location Description	Aldicarb PPb
1.	A	Raymondville drain on FM Road	ND
	B	Raymondville drain on FM Road	ND
2.	A	North Floodway on FM Road	ND
	B	North Floodway on FM Road	ND
3.	A	Arroyo Colorado at Arroyo City	ND
	B	Arroyo Colorado at Arroyo city	ND
4.	A	Drain at Laguna Atascosa	ND
	B	Drain at Laguna Atascosa	ND
5.	A	Brownsville Ship Channel	ND
	B	Brownsville Ship Channel	ND
6.	A	Rio Grande River below Brownville	ND
	B	Rio Grande River below Brownville	ND
7.	A	Arroyo Colorado at U. S. Highway 77	ND
	B	Arroyo Colorado at U. S. Highway 77	ND
8.	A	Existing small ditch	ND
	B	Existing small ditch	1
9.	#1	Llano Grande Lake	ND
	#2	Llano Grande Lake (1 m down stream)	ND
10.		Resaca, North of Los Fresnos	ND

Table 15 summarizes the September sampling. It could be seen from the table that measurable amounts of aldicarb residues, 8-14 ppb, were detected in soil profile 8 feet deep.

Water samples from all sources, including wells 50, 51 and 60 feet deep; contained detectable amounts of aldicarb residues of 2-6 ppb when the IRD method of analysis was used. No residues, however, were detected when the UCC method of analysis was employed.

3.5. [E] Additional Water Sampling in High-Use Counties

This phase of the 1980 program was not part of the agreement reached between EPA and Union Carbide on March 27, 1979. The plan was devised in June by Union Carbide wth the intent that it would add to the available knowledge on Counties where significant amounts of Temik 15G were being applied. The objective was to locate worst case situations and to sample wells known to be adjacent to treated fields in about 2% high-use counties. Each of these counties consumes 100,000 pounds of product, equivalent to 15,000 pounds of the active ingredients. In total, these study areas and the high-interest areas consume over two-thirds of all the aldicarb used in the United States.

The samples and field data were obtained from Local Union Carbide representatives. Sample containers and instructions were provded by the Registration Chemistry Section of R&D, and analysis were performed by IRD and by UCC. In same Cases, state-derived data were used where the states had established their own program.

The following Counties were studied:

1. Aroostook County, Maine

The topygraphy, soil characteristic, weather water table aldicarb use history, and fctors affecting the downward transport of aldicarb residues were provided by Union Carbide as follows:

Aroostook is Maine's northernmost county. It is called the Potato Empire and raises 127M acres of potatoes on about 50 percent of the County's cropland. The most specialized potato area is 50 miles north of the County Seat of Houlton in the vicinity of Presque Isle, Caribou, and Fort Fairfield.

The major improtant arable soils include gravelly to silty loams over glacial tills underlain by calcareous shale bedrock at 25 to 75 feet. These soils are moderately to slowly permeable, and moderately to strongly acid. Caribou, conant, and Mapleton soils are all deep, with the area water table ranging from 10 to 30 feet.

Table-15-

ALDICARB RESIDUES FOR SOIL AND WATER SURVEY
LOWER RIO GRANDE VALLEY, SAMPLED SEPT. 23, 24, 1980

Field, County & History	Water Residues, PPB Source	Depth	IRD	UCC	Soil Depth	Soil Residues/Site, PPB Site I	II	III
[redacted]	Pond	Surface	ND	ND	Top 1 ft	9	10	17
Hidalgo	Ditch	Surface	6	ND	1-2 ft	ND	ND	ND
5 lb ai/A	Irrig	60'	4	ND	2-4 ft	ND	ND	ND
'78,'79,'80 Oranges	Well Irrig Well	51'	3	ND	4-6 ft	16	ND	9
					6-8 ft	ND	ND	9
TX.A&I Exp.Sta.	Ditch	Surface	3	ND	Top 1 ft	ND	ND	12
Weslaco, Hidalgo	Shop	est. 50'	2	ND	1-2 ft	ND	ND	ND
5 lbs ai/A	Well				2-4 ft	ND	ND	ND
'79 & '80					4-6 ft	13	ND	ND
Oranges					6-8 ft	14	8	ND
[redacted]					Top 1 ft	ND	9	12
Cameron	Ditch	Surface	2	ND	1-2 ft	ND	ND	ND
5 lbs ai/A					2-4 ft	ND	ND	ND
'79 & '80					4-6 ft	ND	GW	ND
Oranges								

ND= non detectable. Method Sensitivity = 1 ppb in duplicate water samples, 5 ppb in single soil samples.

Warm summers and cold winters result in a daily mean of 41°F, ranging from 31F to 52F. Annual precipitation is 37 inches fairly evenly spread, with a monthly mean of 2.5 to 3.8 inches. The growing season averages 123 days. Supplemental irrigation is not used. Most drinking water is taken from 50 to 250-foot wells.

In 1974, about 10 percent of the land of Aroostook was in farms, harvesting some 240M acres. About 50 percent of the crop acreage, or 127M, is in potatoes. Other major crops are small grains, forages, and vegetables. Potatoes are planted beginning about May 15, and most farmers rotate to grains every third year.

Aroostook uses 250M pounds of Temik 15G annually. This is applied at 2 to 3 pounds ai/A in the planting furrow. An estimated 10 to 15 percent of the crop is treated, or about 12 to 18M acres.

Table 16 summarizes, well depth location to nearest town, distance from treated field, treated crops, acreage treated, dosage, use history, and results in ppb. Of the four wells sampled near Caribou and Fort Fairfield, one proved positive for aldicarb residues. It is a 50-foot well within 10 feet of a 200-acre field treated with aldicarb for the past 4 to 5 years. This well analyzed 20 ppb from an 8/18 sample, and 23 ppb when re-sampled 10/20. According to Union Carbide, the owner had been notified and is taking corrective actions.

2. Southhampton County, Virginia

The topography, soil characteristics, weather, aldicarb use history water table, and factors affecting the downward transport of aldicarb residues were provided by Union Carbide as follows: Southampton County lies in the coastal plain in southeastern Virginia on the North Carolina border. Courtland, the county seat, is roughly 60 miles south of Richmond and located on the Nottoway River, which bisects the County. The Blackwater and Meherrian Rivers form the County's east and west boarders. The area is characterized by slightly rolling lands and broad, level plains. Elevation ranges from 15 feet above sea level in the east to 130 feet in the west.

The soils in the western part of the County are alluvial deposits from the Meherrin and Nottoway Rivers. Eastern soils are derived from marine deposits. Norfolk and Ruston soil association are well drained, and Norfolk fine sandy loam is a preferred agricultural soil. Climate is influenced by the ocean, the winters being mild with long, hot summers. Annual precipitation averages 49 inches; average annual termperature is 58 F.

Water for irrigation is taken from the rivers; groundwater is found at 15 to 40 feet. Many shallow wells are used for domestic supply, but many farms also have one deep well of 200 feet more for household uses.

PRIVACY ACT EXEMPTION

Table-16--

SUMMARY OF WATER SAMPLE ANALYSES

Aroostook COUNTY, Maine

NAME: [redacted] TOWN:	Caribou	Ft. Fair-field	Ft. Fair-field-1	Ft. Fair-field-2
SOURCE:	Private Well	Private Well	Private Well	Private Well
USE:	Domestic	Domestic	Cooking & Bathing Only	Domestic
WELL DEPTH, FT:	50	50	40	100
WT DEPTH, FT:	40	?	30	70
FT TO TRTD FIELD:	1,200	10	150	1,000
CROP:	Potatoes	Potatoes	Potatoes	Potatoes
ACREAGE TRTD:	210	200	100	125
TRTMT HISTORY:	3 lb ai/A for 4 yrs.	3 lb ai/A for 4-5 yrs.	3 lb ai/A for 4 yrs.	3 lb ai/A for 4 yrs.
PPB FOUND:	ND	20 23 - resampled 10/20-21	ND	2

October 10, 1980

In 1974, 219M of the County's 388M acres, or 57 percent of the land was in farms. Peanuts at 33M acres, soybeans at 15M, and corn at 40M are major crops among the 93M total harvested acres.

Estimated acreage treated with Temik is 85 percent of the peanuts and 5 percent of the soybean crop. At average use rates, this calculates to a total of 195M pounds of Temik 15G applied each year. Area sales, which would include adjacent Northampton County, North Carolina, have averaged about 300M pounds of Temik 15G annually.

Table 17, summarizes, well depth, location to nearest town, distance from treated fields, treated crops, acreage treated, dosage, aldicarb use history, and results in ppb. None of the four wells sampled showed detectable levels of aldicarb residues.

3. Northampton County, North Carolina

The topography, soil characteristics, weather, aldicarb use history, water table, and factors affecting the downward transport of aldicarb residues were provided by Union Carbide as follows:

Northampon is a northeastern border county, just south of Southampton County, Virginia. It is bounded on the south by the Roanoke River, Roanoke Rapids lying just over the county line on the west. Most of the County is in the coastal plain of fairly level land sloping toward the east. The western point of the County lies in the rolling hills of the Piedmont. Elevation ranges from 50 feet at Margaretsville to 350 feet at Vultare.

Soils are well drained; sandy loams, sandy silts, and silt loams are the preferred agricultural soils. Average annual rainfall is 48 inches; 1980 has been much drier than average.

The water table varies from 3 to 20 feet below land surface. Most dwellings are served by shallow wells drilled to about 30 feet. All irrigation comes from ponds, swamps or rivers. Town and city municipal water systems are served by deep wells of over 100 feet.

The County size is 345M acres of which 63 percent is in farms. Harvested cros are taken from 97M acres; leading crops include corn 31M acres, peanuts 29M, soybeans 24M, and cotton 7M.

Temik-treated acreage is estimated at 95 percent of the peanuts, 95 percent of the cotton, and 5 percent of the soybeans. At average use rates, this calculates out to approximately 234M pounds of Temik 15G. Area sales records, including adjacent counties, have averaged around 300M pounds of Temik 15G in recent years.

PRIVACY ACT EXEMPTION

able-17-

SUMMARY OF WATER SAMPLE ANALYSES

Southampton COUNTY, Virginia

AME: [redacted]				
OWN:	Courtland	Courtland	Courtland	Capron
OURCE:	Private Well	Private Well	Private Well	Private Well
SE:	Domestic	Livestock Only	Domestic	Domestic
ELL DEPTH, FT:	360	20	30	33
DEPTH, FT:	50	18	18	15
FT TO TRTD FIELD:	120	60	90	45
CROP:	Peanuts	Peanuts	Peanuts	Peanuts
ACREAGE TRTD:	35	25	80	16
TRTMT HISTORY:	1 lb ai/A for 5 yrs.	1 lb ai/A for 5 yrs.	1 lb ai/A for 5 yrs.	1.5 lb ai/A for 2+ yrs.
PPB FOUND:	ND	ND	ND	ND

October 10, 1980

Table 18 sumarizes, well depth, location to the nearest town, distance from treated fields, treated crops, acreage treated, dosage, aldicarb use history, and results in ppb. Three of the four wells studied showed no detectable levels of aldicarb residues. One well, however, adjacent to a peanut and cotton field, showed aldicarb residues of 1 ppb. The field received 1 lb ai/A for the past 5-6 years.

4. Hampton County, South Carolina

The topagraphy, soil characteristics, weather, aldicarb use history, water table, and factors affecting the downward transport of aldicarb residues were provided by Union Carbide as follows: Hampton is a southwestern border county about 60 miles west of Charleston and 40 miles north of Savannah. It is bounded on the east by the Salkehatchie River, bisected by the Coosawatchie, which drains most of the County, and bounded on the west by the Savannah River and Georgia. The area lies within the Coastal Plain and is gently rolling land sloping generally southeastward. Average elevation is about 100 feet. There are numerous ditches, swamps, rivers, and low marshy areas.

There are three distinct soil types: upland or sedimentary, terrance or old alluvial, and recent alluvial. The upland soils range from coarse to fine sands, silt, and to clays. They are low in organic matter and acid. Predominant associations are sandy loams: Norfolk, Coxville, susquehanna, and Portsmouth.

The climate is mild, with an 8-month growing season and an average annual temperature of 65 F. Summer months produce higher rainfall; the annual precipitation is 49 inches.

The water table in the area sampled ranges from 20 to 25 feet. Water for domestic use is obtained from 40 to 50 foot sand point wells or from deep wells of 100 to 200 feet.

At present, 144M acres are in farmland, or 40 percent of the total County area of 360M acres. Harvested crops include 76M acres. Major crops are soybeans, 65M acres, and corn, 27M acres. About half of the cropland is rotated yearly. Cotton, vegetables, and peanuts are of lesser importance and much less acreage.

An estimated 100M to 125M pounds of Temik 15G are applied annually in Hampton County. About 18M acres, or almost 30 percent of the soybean crop receives Temik 15G in the seed furrow at planting at 6 to 10 pounds of formulation per acre. Some peanuts are treated at planting at 7 pounds per acre.

Table 19 summarizes, well depth, location to nearest town,

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Table-18--
SUMMARY OF WATER SAMPLE ANALYSES

Northampton COUNTY, North Carolina

NAME: [redacted]				
TOWN:	Jackson	Jackson	Garysburg	Jackson
SOURCE:	Private Well	Private Well	Private Well	Private Well, Serving 30
USE:	Drinking & Spray Prep.	Domestic	Domestic	Domestic
WELL DEPTH, FT:	20	32	25	20
[illegible] DEPTH, FT:	10	20	8	12
FT TO TRTD FIELD:	30-45	90	90	40
CROP:	Cotton, Peanuts	Peanuts	Cotton, Peanuts	Peanuts, Cotton
ACREAGE TRTD:	50+	20	25	180
TRTMT HISTORY:	0.5-1 lb ai/A for 7 yrs.	3 lb ai/A for 1 yr.	1.2 lb ai/A peanuts, 0.5 lb ai/A cotton for 10 yrs.	1 lb ai/A for 5-6 yrs.
PPB FOUND:	ND	ND	ND	1

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distance from treated fields treated crops, acreage treated, dosage, aldicarb use history, and results in ppb. Four farm wells near Estill, Brunston, and Luray were tested for aldicarb residues, and all showed non detectable levels of residues (less than 1 ppb).

5. Baldwin County, Alabama

The topography, soil characteristics, weather, aldicarb use history, water table, and factors affecting the downward transport of aldicarb residues were provided by Union Carbide as follows:

Baldwin is in southwestern Alabama, bounded on the west by the Alabama River and Mobile Bay, on the south by the Gulf, and on the east by the Florida panhandle. Located in the Gulf Coastal Plain, low hills in the north give way to broad, flat lowlands in the south elevation ranges from sea level to 200 feet.

Most soils have a sandy surface layer and are underlain by silt and clay deposits deposited on nearly level, undulating river flood plains and terraces. Soils are very low in organic matter and strongly acid. Marlboro very fine sandy loam types occur in 18 percent of the County; Norfolk sandy loam about 7 percent.

Climate is humid and nearly subtropical. There is no dry season; annual rainfall is 65 inches, ranging from 3 to 8 inches per month. Average temperature is 68F; forst-free dates from early March to late November provide a 250-day growing season.

Water is abundant. Streams are fed in by springs and seep areas and flow year round. Most water comes from drilled wells 25 to 65 feet deep. The water table at Foley is about 6 feet; land elevation is about 40 feet.

In 1959, 321M acres were in farms and of this, 135M acres were in timber. At that time, major crops were 75M acres soybeans, 28M corn, 17M small grains, and 9M potatoes. In the lower third of the County, there are 67M pecan trees. Potatoes are all fresh market. More recently, soybeans have expanded to 200M acres. Some irrigation is practiced; an estimate is 85 center pivot systems applying 5 to 6 inches per year.

An estimated 150M pounds of Temik 15G are applied annually in Baldwin County. Potatoes are planted in January or February, and Temik 15G is applied at 14 to 20 pounds in-furrow at planting. Of the total 4, 500 acres, 65 percent, or 3,000 acres, are treated. Soybeans are planted in April or May, and Temik 15G is used infurrow at 5 to 10 pounds per acre. Of the 200M acres, 10 percent, or 20M acres are treated. Both potatoes and soybeans are rotated, so the likelihood of repeated annual aplications of Temik is low.

Table-19-

SUMMARY OF WATER SAMPLE ANALYSES

Hampton COUNTY, South Carolina

[redacted]	Estill	Estill	Brunson	Luray
OWN:				
OURCE:	Private Well	Private Well	Private Well	Private Well
SE:	Drinking & Farm Use	Domestic	Domestic	Domestic
ELL DEPTH, FT:	180	100+	125	40
T DEPTH, FT:	25	25	25	20
FT TO TRTD FIELD:	300	150	300	300
CROP:	Soybeans	Soybeans	Soybeans	Soybeans
ACREAGE TRTD:	75	55	50	100
TRTMT HISTORY:	1 lb ai/A for 2 yrs.	1 lb ai/A for 2 yrs.	1 lb ai/A for 2 yrs.	1 lb ai/A for 2 yrs.
PPB FOUND:	ND	ND	ND	ND

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Table 20 summarizes well depth, location to nearest town, distance from treated fields, treated crops, acreage treated, dosage, aldicarb use history, and results in ppb. Four farm wells near Foley and Loxley were analyzed and showed no delectable residues of aldicarb and metabolites.

6. Montcalm County, Michigan

Union Carbide provided the following information on the County's topography, soil characteristics, weather, aldicarb use history, water table, and factors affecting the downward transport of aldicarb resudes:

Montcalm is located in the west-central part of the Lower Peninsula; the County seat of Stanton is 35 miles northeast grand Rapids and 45 miles northwest of Lansing. This is an area of rolling to level open fields and wood lots with many streams and lakes. Elevation is around 700 feet above sea level.

Loamy sands and sandy loams predominate. Organic matter approximates 2 percent. The McBride and Montcalm series are especially suited for potatoes. These are well to moderately well drained soils and may have an accumulation of clay in the lower profile. Organic or bog soils are found on 12 percent of the County.

Summers are mild with only a few extremely hot days; winter is moderately long, cold, and snowy. Average annual temperature is 48 F. The growing season varies but averages 148 days from mid-May to early October. Average annual precipitation is 30 inches. This may be supplemented by an inch of irrigation per week on potatoes and peas.

Groundwater ranges from 10 to 85 feet below land surface. Most domestic wells are 10 to 85 feet deep, with irrigation wells drilled to 85 to 135 feet.

Agriculture is the most important enterprise of Montcalm County. Of the County's 455M acres, 52 percent, or 240M acres, were in farms in 1974. Harvested cropland now totals 170M acres. Heavy dairy influence accounts for 70M acres of corn and 30M acres of hay crops. There are 25M acres of dry beans; and potatoes, a major cash crop, are grown on 12M acres. These crops are rotated.

An estimatd 360M pounds of Temik 15G are applied annually in Montcalm County. This is used on 11M acres, or about 90 percent of the potatoes, where it is applied at 20 pounds of Temik 15G per acre, and on dry beans where 12M of the 25M acres are treated at 7 pounds 15G per acre. These planting applications are made in May and June.

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Table-20-

SUMMARY OF WATER SAMPLE ANALYSES

BALDWIN COUNTY, ALABAMA

NAME: TOWN:	Loxley	Foley	Foley	Foley
SOURCE:	Private Well	Private Well	Private Well	Pond
USE:	Domestic	Domestic	Domestic	Fishing
WELL DEPTH, FT:	45	60	40	NA
DEPTH, FT:	20	20	20	0
FT TO TRTD FIELD:	150	150	100	25
CROP:	Potatoes, Soybeans	Potatoes, Soybeans	Potatoes	Potatoes
ACREAGE TRTD:	1,000	200	750	750
TRTMT HISTORY:	1.5 lb ai for 5 yrs	1.2 lb ai for 5 yrs	1.5 lb ai for 6 yrs	1.5 lb ai for 6 yrs
PPB FOUND:	ND	ND	ND	ND

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In addition to 6 locations in Montcalm County, one in Monroe County was sampled. Monroe county is the most southeasterly County in the state, north of Toledo, Ohio, and bordered on the east by Lake Erie.

Table 21 Summarizes, well depth, location to nearest town, distance from treated fields, treated crops, acreage treated, dosage, aldicrb use history, and results in ppb. It could be seen from the table that no aldicarb residues were detected in any of the seven wells studies.

7. Dunklin County, Missouri

Union Carbide provided the follwing information on the County's topography soil characteristic, weather, adlicarb use history, water table, and factors affecting the downward transport of aldacarb residues:

This study area includes the northeast corner of Arkansas and the southeast, or bootheel, of Missouri. New Madrid and Dunklin counties in Missouri, and Craighead in Arkansas, combine to consume over 100M pounds of Temik 15G. In these and neighboring Mississippi Valley counties, Temik is applied at planting at one pound active ingredient per acre for insect and nematode control on cotton and soybeans. The area is predominantly agricultural with fairly level terrain composed of alluvial deposits from the Mississippi and Ohio River systems. Elevation rangs from 200 to 500 feet.

The land includes flood plains, broad natural levels and terraces. The soils are fertile, deep, well to poorly drained, and range from sands to loams, silts, and clays. Most contain moderate to high amounts of plant nutrients, and silty loams and silty clay loams predominate. Soil pH is neutral to slightly acid.

Climate is midcontinental and temperate with a growing season from early April to November. Precipitation is relatively high, 47 to 49 inches annually with sufficient summer rain to be adequate for all crops. Temperatures average 60F for the year, with monthly ranges of 48 to 71F. Water is plentiful with most domestic wells running 75 to 150 feet deep. Groundwater in most areas is 20 feet or more below surface, but in bottomlands when wet it would be closer to land surface.

At least 80 percent of the land is in farms in this area. The three study counties total almost 900M harvested acres, according to the 1974 Census of Agriculture. Soybeans, cotton, and small grains are predominant crops. soybeans total over 500M acres and cotton over 250M. At the

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Table-2-

SUMMARY OF WATER SAMPLE ANALYSES

Montcalm County, Michigan

NAME: [redacted]						
TOWN:	Coral	Stanton	Stanton	Stanton	Stanton	Stanton	Petersburg
SOURCE:	Private Well	Private Well	Private Well	Private Well	Private Well	Private Well	Private Well
USE:	Irrigation	Irrigation	Irrigation	Irrigation	Drinking, Cooking, Bathing	Irrigation	Drinking, Cooking, Bathing
WELL DEPTH, FT:	121	30-40	50	100	10	60	15
WT DEPTH, FT:	NA	25	30	30	10	30	NA
FT TO TRTD FIELD:	In Field	In Field	In Field	In Field	300	In Field	100
CROP:	Potatoes	Potatoes	Potatoes	Potatoes	Dry Beans	Potatoes	Potatoes
ACREAGE TRTD:	106	14	20	160	35	160	190
TRTMT HISTORY:	3 lb ai/A for 3 yrs.	3 lb ai/A for 2 yrs.	3 lb ai/A for 3 yrs.	3 lb ai/A for 4 yrs.	1 lb ai/A for 1 yr.	3 lb ai/A for 3 yrs.	2.25-3 lb ai/A for 1+ yrs.
PPB FOUND:	ND	ND	ND	ND	ND	ND	ND

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Tamik use rate of 1 pound ai/A, less than 10 percent of this total crop acreage is treated.

Table 22 summarizes, well depth, location nearest town, distance from treated fields, treated crops, acreage treated, aldicarb dosage, aldicarb use history, and results in ppb. It could be seen from the table that six of the wells studied showed no detectable levels of aldicarb residues. However, in one well, aldicarb residues were determined at 26 ppb when analyzed by IRD, and 31 ppb when re-sampled and tested by UCC method of analysis.

8. Wayne County New York

The following is a description, as provided by Union Carbide, of the topography soil characteristics, weather, aldicarb use history, water table, and factors affecting the downward transport of aldicarb residues:

Wayne County is located in northcentral New York between Rochester and Syracuse, bonded on the north by Lake Ontario, and roughly 34 miles wide east to west, by 20 miles north to south. The relatively flat northern third is old lakebed, which gives way to drumlin hills of glacial till in more southern parts. Elevation ranges 250 to 681 feet.

The Ontario-Hilton soils cover 37 percent of the County. This Association is derived from sandstone and limestone, is well drained, moderately permeable, and ranging from acid to alkaline in reaction. Sedimentay bedrock underlies these glacial deposits at about 40 feet. Pockets of organic soils occur in the southern parts, and 85 percent of the 5,000 acre potato crop is found on this specialized soil types.

Average snowfall of 88 inches and growing season rains of 18 inches provide a total annual precipitation of 34 inches. Climate is moderate for the northeastern United States. The growing season is April through September, or about 180 days.

Water is available from springs and streams. Drainage is to the Lake on the north and to the barage canal which runs east-west through the southern part of the County. Wells are dug or drilled, the latter usually penetrating into bedrock. The water table ranges from 10 to 40 feet.

Of the County's 388M acres, 53 percent is farmland, of which 114M are harvested cropland. Wayne ranks second in agricultural income in New York. Forage and pasture account for 30M acres; corn, small grains and other fields crops 50M; fruit 26M; potatoes 5M; vegetables about 2M.

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Table-22-

SUMMARY OF WATER SAMPLE ANALYSES

Dunklin County, Missouri, Area

NAME: TOWN:	New Madrid	New Madrid	Dunklin	Weiner	Jonesboro	Lake City	Lake City
SOURCE:	Private Well	Private Well	Private Well	Private Well	Private Well	Private Well	Private Well
USE:	Irrigation Only	Domestic	Irrigation	Domestic	Irrigation	Shop Well for spray mix and equipment	Domestic
WELL DEPTH, FT:	90	80	100	150	100	100	100
WT DEPTH, FT:	30	30	60	80	70	80	80
FT TO TRTD FIELD: CROP:	In Field Cotton & Soybeans	30 Cotton	In Field Cotton	150 Soybeans	600 Soybeans	40 Cotton	70 Cotton
ACREAGE TRTD:	140	120	30	80	10	40	50
TRTMT HISTORY:	1 lb ai/A First yr.	1 lb ai/A 2 years	1 lb ai/A 1 year	1.2 lb ai/A 1 year	1 lb ai/A 1 year	1 lb ai/A 6 years	1 lb ai/A 6 years
PPB FOUND:	ND	ND	ND	ND	ND	26 IRDC Resampled 31 UCC	ND

About 90,000 pounds of Temik 15G are applied to 4,500 of the 5,000 acres in potatoes. Orangic muck soils account for 85 percent of this crop. Temik is applied at planting, April 20 to May 20, in furrow with the seed piece at 20 pounds Temik 15G, or 3 pounds ai/A.

Table 23 summarizes, well depth, location to nearest town, distance from treated fields, treated crops, acreage treated, aldicarb dosage, aldicarb use history, and results in ppb. It could be seen from the table that none of the four wells studied showed detectable levels of aldicarb residues.

9. Parmer and Castro Counties, Texas

The following is a description, as provided by Union Carbide, of the topography, soil characteristic, weather, aldicarb use history, dosages, water table, and factors affecting the downward transport of aldicarb residues:

The irrigated high plains of the Texas Panhandle have been high users of Temik Aldicarb Pesticide beginning with its registration on cotton in 1970. In its 1979 survey, the EPA contractor selected 55 sites in 10 of the counties in this area, finding no detectable aldicarb residues in any samples of water from 35 private and 20 community or municipal potable water wells. The relation of these wells to Temik-treated areas is not know, however.

In selecting 20 high-use Temik counties for mointoring in 1980, Union Carbide included two adjacent counties in this area. Parmer County is NW of Amarillo on the west boundary adjacent to New Mexico; Castro County is immediately east of Parmer. The two comprise over 1100M acres, of which over 70 percent is harvested cropland. Agriculture, crop processing, and cattle feeding are major industries. Major crops are corn, cotton, and milo, with over 90 percent of the acreage irrigated.

These counties lie in the smooth tableland of the Great Plains and have fine textured soils formed by outwash from the Rockies. The topography is level, elevation sloping from 4400 feet in the West to 400 feet in the East. Major soils include Olton and Pullman associations. Olton is a slowly permeable clay loam with a high water capacity and pH of 7.4 to 8.4. Pullman is a very slowly permeable surface loam underlain by clays and loams similar to Olton in water capacity and pH.

The area climate shows an annual rainfall of about 17 inches, with 80 percent during the growing season. The average temperature is 71 F. The growing season is from mid-April to Mid-October, averaging over 180 days. Potential evapotranspiration in this area is 3 to 33 inches per year, creating a soil moisture deficit. Area water is obtained from the Ogallala Formation of coarse, gravelly material. Wells of 300 to over 400 feet are used to reach this water at 200 to over 300 feet below land surface.

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Table-23--

SUMMARY OF WATER SAMPLE ANALYSES

Wayne COUNTY, New York

NAME: [redacted] TOWN:	Port Byron	Savannah	Savannah	Savannah
SOURCE:	Private Well	Private Well	Private Well	Private Well
USE:	Washing potatoes before packing - non-drinking	Washing potatoes before packing - non-drinking	Washing potatoes and drinking	Drinking
WELL DEPTH, FT:	23	75	20	20
JT DEPTH, FT:	15	40	10	18
FT TO TRTD FIELD:	100	500	100	1,000
CROP:	Potatoes	Potatoes	Potatoes	Potatoes
ACREAGE TRTD:	175	400	75	70
TRTMT HISTORY:	2 yrs. at 3 lb ai/A; 3 yrs. at 4.2 lb ai/A	3 lb ai/A for 2 yrs.	3 lb ai/A for 3 yrs.	3 lb ai/A for 3 yrs.
PPB FOUND:	ND	ND	ND	ND

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The main Temik use is on cotton; an estimated 110M of the 160M acres are treated at planting in May with 0.5 lb ai aldicarb/A, mainly for thrips control. Cotton, like other crops, is irrigated from deep wells with about 12 inches applied per season from this source. Crops are rotated on a 2-year scheme.

Table 24 summarizes, well depth, location to nearest town, distance from treated crops, acreage treated, aldicarb dosage, aldicarb use history, and results in ppb. It could be seen from the table that none of the four wells studied showed detectable levels of aldicarb residues.

10. Weld County Colorado

The following is a description, as provided by Union Carbide, of the topography, soil characteristics, weather, aldicarb use history, aldicarb dosage, water table, and factors affecting the downward transport of aldicarb residues:

Weld County is located in Northeastern Colorado just east of the Rockies and bordering on Wyoming and Nebraska. The Western Great Plains in this area slope gradually eastward. Greely, the county seat, is at 4,600 feet elevation. Important waterways are the Cache La Poudre and Big Thompson, which flow eastward from the mountains to the South Platte.

Important soils are Cloroado fine sandy loam, Billings loam, and Laurel sandy loam. Some contain fair amounts of organic matter, and most are free from alkali. The undulating uplands drop to level valleys.

The climate is semiarid, and the growing season is about 5 months, from May through September. Average precipitation is 12 to 15 inches, which accounts for irrigation of most of the cropland. Average annual temperature is 47 F.

Water for irrigation is obtained from rivers, reservoirs, and from irrigation wells generally 50 to 100 feet deep. The water table varies from 30 feet to 65 feet, and may be closer to the surface in some areas. Water for homes and livestock is usually from community or municipal systems.

Weld County covers 2,560M acres, of which 92 percent is in farms. In 1974, 363M of the 590M harvested acres received irrigation. Winter wheat and corn account for most cropland. Sugar beets are grown on 35M acres and potatoes on 3,500.

An estimated 200M to 250 M of Temik 15G are applied annually, at planting time, mostly to sugar beets. Common rate is 1.5 to 5 pounds active

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Table-24-

SUMMARY OF WATER SAMPLE ANALYSES

Texas

	PARMER COUNTY		CASTRO COUNTY	
NAME:	[redacted]			
TOWN:	Farwell	Farwell		
SOURCE:	Private	Private	Private	Private
USE:	Irrigation	Irrigation	Irrigation	Domestic & Irrigation
WELL DEPTH, FT:	480	486	350	350
[illegible]T DEPTH, FT:	300	320	220	220
FT TO TRTD FIELD:	200	900	300	90
CROP:	Cotton	Cotton	Cotton	Cotton
ACREAGE TRTD:	560	400	200	60
TRTMT HISTORY:	4 yrs at 0.5 lb ai/A AP	4 yrs at 0.5 lb ai/A AP	8 yrs at 0.5 lb ai/A AP	5 yrs at 0.5 lb ai/A AP
PPB FOUND:	ND	ND	ND	ND

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ingredient per acre, band-incorporated. An estimated third of the sugar beet crop is treated.

Table 25 summarizes, well depth, location to nearest town, distance from treated fields, treated crops, acreage treated, aldicarb dosage, aldicarb use history, and results in ppb. Four farm wells situated in sugar beet fields were analyzed and found to contain no aldicarb residues. These wells range from 43 to 95 feet deep where the water table is at 30 to 65 feet. Aldicarb had been used 5 to 8 years at these sites.

11. Maricopa and Yuma Counties, Arizona

The following is a description, as provided by Union Carbide, of the topography, soil characteristics, weather, aldicarb use history, aldicarb dosage, water table, and factors affecting the downward transport of aldicarb residues:

Maricopa and Yuma Counties are adjacent and located in southwestern Arizona. Yuma is bordered on the west by California and on the south by Mexico. Both Counties raise large acreages of irrigated cotton on which Temik is used. The desert floor elevation ranges from the Colorado Valley on the western border of Yuma County to 1,400 feet in the Phoenix area. Agriculture is intensive; irrigated crops are grown on flat valleys, plains, and low stream terraces.

The soils are loams, sandy loams, and clay loams, which are moderately permeable, moderate to strongly alkaline, deep, and well drained.

Irrigation in Maricopa is from surface water from reservoirs of the Aqua Fria, Salt and Verde Rivers. Groundwater from deep wells is also used, but the water table is dropping. Annual rainfall averages 3 to 7 inches. Average temperature is 70 to 72F.

Cotton and alfalfa are major crops, but many others are grown including small grains, citrus, greens, and truck crops. Among the latter are potatoes. The long season allows double cropping. Total cotton acreage for two counties is about 340,000.

Temik 15G used in this area was estimated at 18 truckloads, equivalent to 100M pounds active ingredient. Its widespread use on cotton led to inclusion of the area in the 1980 water sampling program. Common usage is as a sidedress at squaring using 14 to 20 pounds 15G per acre.

Table 26 summarises, well depth, location to nearest town, distance from treated fields, treated crops, acreage treated, aldicarb dosage, aldicarb use history and results in ppb. It could be seen from the table that three of the four wells studied, sowed no detectable residues. In one well, however, aldicarb residues were detected at 6 ppb.

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Table-25-

SUMMARY OF WATER SAMPLE ANALYSES

Weld COUNTY, Colorado

NAME: [redacted]
TOWN:

SOURCE:	Private Well	Private Well	Private Well	Private Well
USE:	Irrigation	Irrigation	Irrigation	Irrigation
WELL DEPTH, FT:	95	45	43	65
WT DEPTH, FT:	30	45	43	65
FT TO TRTD FIELD:	Immediate	Immediate	Immediate	Immediate
CROP:	Sugar beet	Sugar beet	Sugar beet	Sugar beet
ACREAGE TRTD:	44	49	40	105
TRTMT HISTORY:	4.3 lb ai/A for 8 yrs.	4.8 lb ai/A for 6 yrs.	4.5 lb ai/A for 5 yrs.	3 lb ai/A for 8 yrs.
PPB FOUND:	ND	ND	ND	ND

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Table-26-

SUMMARY OF WATER SAMPLE ANALYSES

Maricopa & Yuma COUNTY, Arizona

	[redacted]			
NAME: TOWN:	Poston	Poston	Buckeye	Buckeye
SOURCE:	Private Well	Private Well	Private Well	Private Well
USE:	All but Drinking & Cooking	All but Drinking & Cooking	Domestic	Irrigation
WELL DEPTH, FT:	18	20	375	450
WT DEPTH, FT:	4	4	100+	180
FT TO TRTD FIELD:	8	200	300	50
CROP:	Cotton	Cotton	Cotton	Cotton
ACREAGE TRTD:	700	160	20	320
TRTMT HISTORY:	2.2 lb ai/A for 10 yrs.	2.2 lb ai/A for 10 yrs.	1 lb ai/A for 4 yrs.	1+ lb ai/A for 3 yrs.
PPB FOUND:	6 10/15/80	ND 10/15/80	ND 9/8/80	ND 9/8/80

NOTE: Four other samples are noted from the [redacted] area. See map and report forms for location. All of these showed ND residues as reported 10/21/80.

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3.6 [F] Factors Affecting the Potential for Aldicarb Residues in Groundwater

To obtain a quicker estimate of the likelihood of aldicarb residues in drinking water, a semiquantitative rating system has been developed by Union Carbide and used to rate the areas and counties studied in 1980. According to Union Carbide, development of a mathematical model to predict aldicarb movement and degradation, and possible occurrence of residues in groundwater, requires many laboratory analyses. Such a project was begun by union Carbide in 1980, and will require at least two years for completion.

The rating system developed by Union Carbide is shown in the next 4 pages. Of the many factors influencing the movement and degradation of aldicarb residues, Union Carbide listed 15 major factor, each was then assigned to one of for categories: (1) application factors, (2) transport factors (3) degradation and decomposition factors, and (4) groundwater and drinking water factors. Each factor was given an appropriate rating, and the final rating is the product of the sum of the four categories. Accordingly, the maximum rating would by a factor of 54.

Table 27 is an example showing the maximum and actual score for the likelihood of aldicarb residues to contaminate groundwater in Suffolk County, New York. On a scale of 0-54, the county was given a rating of 27; i.e., a 50% chance to appear in groundwater.

Table 28 shows the rting of all 22 localities studied in 1980. Of all the 22 localities, Parmer and Castro Counties, Texas, were given a rating of Zero; whereas, Suffolk County, New York was the highest.

3.7 [G] Model Development and Soil Study

Union Carbide is currently searching for those field, laboratory and literature data that best be utilized as parameters in a simulated model that would predict adlicarb residues at a given point and time. According to Union Carbide it will take at least two years to generate additional field and laboratory data, which in addition to the literature data, should serve as the data base for a reliable mathematical model. One model is being used is called the Hydrological simulation program-fortran. It was developed for the EPA in Athens, Georgia by Hydrocomp, Inc of California. According to Union Carbide, three different levels of mathematical models will be developed as the work progresses. The first will use aldicarb data available in published literature. The second will be an updated

THE SCORING OF KEY FACTORS IN CALCULATING THE LIKELIHOOD OF ALDICARB RESIDUES IN DRINKING WATER

The Application, Transport, and Degradation of Temik, and Potable Water Sources are the key factors. Each of the first three Key Factors can be assigned up to 3.0 points, and the fourth is assigned 2.0 points. The subdivision of each Key Factor and the scoring of these subdivisions is provided. The final rating is the product of the scores of the key factors.

Score	Factor	
3.0	1.0	Application Factors concern the entry of TEMIK into the environment; both the amount and timing influence chances for migration. This section may accumulate a score of up to 3.0, comprised of the following subdivisions.
1.0	1.1	Labeled rates range from 0.3 to 10.0 lb ai/A. The lower rates, up to and including 2 lb ai/A, have shown much less tendency to leach in practice, compared to the higher rates of 3 to 10 lb ai/A. Scoring was assigned on a direct relationship: pounds applied divided by 10. A rate of 0.5 lb ai/A is scored as .05; 5 lb ai/A is scored at .5.
1.0	1.2	Percent of harvested cropland treated. The greater percent of cropland treated, the greater chance for consistent appearance of residues in groundwater.

Scoring:

0- 5%	-	0
5- 15%	-	.2
15- 25%	-	.4
25- 40%	-	.6
40- 70%	-	.8
70-100%	-	1.0

0.1	1.3	Crop stage influences leaching by the fact that established growing plants will absorb more Temik from soil than germinating seeds. If Temik is applied with the seed, score 0.10; to a young growing plant such as a side dress to cotton, score 0.05; if applied to the root zone of an established plant, such as an orange tree at spring flush score 0.01 The tree will absorb higher percentage of Temik than the seed.
0.5	1.4	Rotation of Temik and non-Temik treated crops. If not rotated, the maximum chance of leaching is encountered; score 0.50. If treatment is deleted by rotation or use of alternate materials, scoring is reduced because data suggest less chance for leaching. If treated twice in 3 years, score 0.35; once in 2 years, score 0.25; once in 3 years, score 0.10.

Score Factor

0.2 1.5 Two applications per season may be made, splitting the full seasonal rate and applying half early and half later. Several small quantitites of Temik appear to degrade more completely than use of the total quantity at one time. Score 0.2 if one application per season; 0.1 if 2 applications of split rate are made.

0.2 1.6 Years of Temik use in the county or area appear to influence potential groundwater residues. Repeated annual use may result in repeated surges of residue leaching, providing an additive effect to past years' groundwater residues unless these are depleted by recharge or chemical decomposition. Score 0.02 points per year for the number of years of use in the county.

NOTE: The influence of placement of Temik granules was considered, thinking that granules placed close to the surface of the soil might exhibit less tendency to leach than material placed 6 to 8 inches deep. After discussion, placement was not considered significant enough to rank with the foregoing application factors.

3.0 2.0 Temik transport factors include water infiltration from rainfall and irrigation, downward movement through the soil profile as influenced by permeability, and the reverse effect of potential evapotranspiration. Sorption to soil, an important factor with many pesticides, was intentionally deleted because neither aldicarb not its carbamate decomposition products sorb strongly to soil.

1.0 2.1 Annual rainfall plus irrigation.

2.1.1 Rainfall is an uncontrolled factor directly related to downward movement of Temik through the soil. Heavy thunderstorms or rainfall above average within two months after application may be expected to further accentuate leaching. Scoring is based on inches of rainfall per year and influenced by that expected within the months immediately following application.

Scoring: <10" - 0.0
10-25" - 0.2
26-40" - 0.6
>40" - 1.0

Score	Factor
0.5	2.1.2 Irrigation is the controlled application of water. The type of irrigation is considered more influential than the amount or timing. Furrow irrigation would have less tendency to cause downward leaching than sprinkler irrigation because Temik would normally be applied above the water surface in the furrow. Increased awareness of water conservation is tending to restrict overirrigation.

Scoring: Drip or None - 0.0
Furrow - 0.2
Sprinkler - 0.3
Flood - 0.5

1.0	2.2 Soil type and permeability are interrelated and directly affect the rate at which Temik is moved through the soil profile. All soil strata from surface to groundwater should be considered. Scoring is based on permeability measured in inches/hour.

Scoring:

0.06	Clay	- 0.0
> 0.06-0.2	Silty clay	- 0.1
> 0.2-0.6	Clay loam	- 0.2
> 0.6-2.0	Loam	- 0.4
> 2.0-6.0	Sandy Loam	- 0.6
> 6.0-20	Loamy sand	- 0.8
> 20	Sand	- 1.0

0.5	2.3 Potential evapotranspiration affects the time during which water containing dissolved aldicarb is held at a given soil depth. High PE would hold Temik in surface strate where biodegradation is most active; it could even move residues to soil surface where volatilization and photochemical losses may occur. Local data on PE are not usually available, and reliance in scoring has based on the Geraghty & Miller Water Atlas, Plate 13.

Scoring: PE, inches/year.

≤ 24	- 0.50
24-36	- 0.25
37-48	- 0.10
> 48	- 0.0

3.0	3.0 Temik degradation and decomposition factors of major importance include pH, temperature of soil and groundwater, and biological decomposition. The former are generally on record; soil biota and organic matter are generally not available or ill defined. For this reason, scoring of biological decomposition is given fewer points, and it may prove to be more important than now credited in the future.

Score Factor

1.0 3.1 Reaction of soil and shallow groundwater, recognizing the relationship of soil pH to cation exchange capacity. The strong influence of pH on biodegradation and hydrolysis of aldicarb has been observed in the field.

Scoring:

Strongly acid	< 5.5	1.0
Moderately acid	5.5-6.5	0.8
Neutral	6.6-7.3	0.5
Moderately alkaline	7.4-8.4	0.1
Strongly alkaline	> 8.4	0.0

1.0 3.2 Soil and groundwater temperature have a significant effect on biological activity and on chemical reaction rates for aldicarb decomposition. Soil temperature is derived from annual mean air temperature and from occasional localized research. Reliance has been placed on the Geraghty & Miller Water Atlas, Plate 30, on average temperature of shallow groundwater.

Scoring: 2.0 minus 1/40 times avg. T °F.

1.0 3.3 Bioactivity.

3.3.1 Soil biota count will generally decrease with soil depth resulting in less biodegradation as Temik moves down through the soil profile. A properly fertilized soil is required to provide sufficient nutrients for active biological growth.

Scoring: No assigned score because definitive data are absent in almost all cases.

1.0 3.3.2 Organic matter. A very low value would have a low bioactivity due to inability to support soil biota, while low or medium values would be expected to support biota and degrade aldicarb residues. High organic matter content would indicate low pH, relatively high stability, but low transport of aldicarb residues.

Scoring: Percentage by weight organic matter.

Very low	< 0.5	1.0
Low	0.5-2.0	0.5
Medium	2.1-20	0.1
High	> 20	0.0

RATING THE POTENTIAL FOR ALDICARB RESIDUES IN POTABLE GROUNDWATER IN

LOCATION Suffolk County, New York

FACTOR		(MAXIMUM)	SCORE	COMMENTS
1.0 Temik Application Factors				
	1.1 Rate	1.0	0.5	5 lb AI/A is maximum used (could be 7).
	1.2 Cropland Percentage	1.0	1.0	>90% of cropland acres potatoes; >90% NYS of Unit.
	1.3 Crop State	.1	0.1	High score because applied with seed
	1.4 Crop Rotation	.5	0.5	Max score - all applied at one time; applied per acre
	1.5 No. of Applications per Season	.2	0.2	one, one appl./season in most areas
	1.6 Years in Use	.2	0.10	5 years at 0.02 points per year
	Subtotal	3.0		2.4
2.0 Temik Transport Factors				
	2.1.1 Rainfall	1.0	1.0	>40" = full score
	2.1.2 Irrigation	.5	0.3	Sprinkle irrigation supplement rainfall
	2.2 Soil Type	1.0	0.8	soil is a loamy sand to sand
	2.3 Evapotranspiration	.5	0.25	potential evapotranspiration = 24-36"/year
	Subtotal	3.0		2.35
3.0 Temik Degradation and Decomposition Factors				
	3.1 pH	1.0	1.0	strongly acid pH ratio max score (<5.5)
	3.2 Temperature	1.0	0.65	20 - (1/40 × 53° - 1.15) = 6.5
	3.3 Bioactivity	1.0	1.0	Very low biological activity = full score
	Subtotal	3.0		2.65
4.0 Ground Water				
	4.1 Depth to Ground Water	1.0	1.0	groundwater is generally ≤15' deep
	4.2 Depth to Potable Water	1.0	0.8	potable water is at 15-30'
	Subtotal	2.0		1.8

LOCATION RATING = (2.4) x (2.4) x (2.6) x (1.8) = 26.9 ≈ 27.0

12/9/00

Table-28-

SCORING LIKELIHOOD OF ALDICARB RESIDUES IN DRINKING WATER
PRELIMINARY CALCULATIONS BASED ON DATA AVAILABLE DECEMBER 1, 1980.

COUNTY, STATE	SUM OF FACTORS IN EACH CATEGORY				PRELIMINARY RATING: PRODUCT OF CATEGORIES
	APPL.	TRANS.	DEG.	WATER	
HIGH INTEREST AREAS					
Suffolk Co., NY	2.40	2.35	2.65	1.80	26.9
Wisconsin	1.20	2.15	2.15	1.80	10.0
Virginia (Delmarva)	1.33	2.05	1.80	1.50	7.4
Florida	1.90	2.20	1.35	1.00	5.6
Washington (Franklin)	0.90	1.40	1.78	1.00	2.2
Washington (Grant Co.)	0.90	1.20	1.68	1.00	1.8
Oregon (Umatilla)	0.95	0.80	1.98	1.00	1.5
California (Kings Co.)	1.23	1.10	0.95	1.10	1.4
Texas (Rio Grande)	1.42	1.00	0.50	1.00	0.7
HIGH USE COUNTIES					
Wayne Co., NY	1.36	1.20	2.33	1.80	6.8
Aroostook Co., ME	1.10	1.50	2.25	1.40	5.2
Southampton Co., VA	1.02	2.25	1.50	1.40	4.8
Northampton Co., NC	1.04	1.75	1.45	1.80	4.8
Baldwin Co., AL	0.90	1.65	1.63	1.80	4.4
Hampton Co., SC	1.15	1.70	1.63	1.30	4.1
Dunklin Area, MO	1.07	1.45	1.60	1.10	4.0
Montcalm Co., MI	1.00	1.45	1.43	1.60	3.3
Weld Co., CO	1.31	1.60	1.35	1.10	3.1
Minidoka Co., ID	1.06	1.05	1.93	0.80	1.7
Maricopa and Yuma Cos., AZ	1.00	0.80	1.30	1.00	1.0
Parmer and Castro Cos., TX	0.96	0.95	1.10	0.00	0.0

12/9/80

version using their own laboratory-generated data and probably site specific hydrological data. The third will be a further modified version, "fine-tuned" with additional laboratory data, if required.

It will be suggested that data presented in this sectin [G] should be reviewed by Dr. Carl Einfield and Bob Carsel in Athens, Georgia for calibrating and updating the aldicarb simulated model. However, because of the valuable wealth of these data, it was felt that detailed information of this section should be included in our review for possible development of a simulated model in the EPA Headquarter (EFB).

3.7.1 Data Analysis

The monitoring study in the seven states were used to calculate half-lives for the dissappearance of carbamate residues from the sampled layers of soil. The half-lives were used to both assess the leaching potential at each site and determine which soil characteristics contribute to carbamate residue decomposition. Data were summarized in Tables 29-35 as follows:

Table 29: Mechanical soil analysis
Table 30: 1980 crop and aldicarb use history.
Table 31: Geometric mean total carbamate residue concntration (ppb).
Table 32: Environmental data
Table 33: Carbamate residue concentrations in water samples.
Table 34: Calculated total residues from actual residues found.
Table 35: Calculated half-lives, (days).

Analyses

The residue concentration data from Table 31 were used to estimate the total residues in the sampled layers of soil. A soil bulk density of 1.5 was wed to calculate the total weight of an-acre-foot of soil. The total residues (1 lb ai/A) were calculated by assuming the concentrations to be uniform in the respective sampled layers. Data in Table 34 were used to estimate T-1/2 of aldicarb and its residues. The rate constants associated with these half-lives are not degradation rate constants, but represent a disappearance rate which is the sum of the rates of processes associated with degradation, leaching, plant uptake, and volatilization. The degradation rate for aldicarb or:

$K = K^{o} + K_b + K_h$, where: K = chemical soil catalyz-oxidation rate constant.
K_b = biological oxidation rate constant.
K_h = hydrolysis rate constant.

Percent sand accounted for most of the variation in the data when calculating K value. No other variables such as % cla, pH, etc, was statistically significant. Contour plots of these models appear in figures 1 and 2.

The available data were also used in a regression analysis to determine if any soil or environmental parameters correlated with the dissapearance rates observed in the fields. The three variable which correlated the strongest with the disappearance T-1/2 were: pH, %OM, and CEC for the one foot level. The pH and CEC correlated (r = 0.66). The best equation from the available data was developed as follows:

$$\text{Log}_e \text{ (disappearance T-1/2)} = 5.09 - 0.362 \text{ pH} + 0.963\% \text{ OM}$$

where N = 18 and $R^2 = 62$

This relationship states that as pH increases, the dissappearance rate rises.

3.7.2 Soil Degradation Studies

Four soil types were chosen (30 samples) representing all four spectrum of agricultural soil types these are sand, clay, loam, silt-loam, and clay. A fractional factorial design of 5 variables in 16 experiments was used to study the 5 variables: pH moisture content (% of field capacity),temperature, soil depth and aerobic/nonaerobic conditions. Seven sample aliquots per experiment were prepared in August, 1980. The samples were first acclimated and then dosed with 10 ppm aldicarb between September 10 and 16, 1980. The samples for time intervals through 56 days have been analyzed. The final analyses will be completed in 1981, then the data will be used to estimate the degradation rate constants.

3.7.3 Hydrolysis Studies

Tests to determine hydrolysis constants for aldicarb, aldicarb sulfoxide and aldicarb sulfone in water at pH levels of 5.5, 7.5, and 8.5 at both 5°C and 15°C were initiated on August 28, 1980. Analysis are complete through 83 days of hydrolysis.

Preliminary data showed that all three carbamate degrade very slowly at pH 5.5 at both 5°C and 15°C. The stability to hydrolysis at higher pH and temperature is relative in the order: Aldicarb> sulfoxide> sulfone. There is an inverse relation between stability and increase in pH and temperature. Briefly, sulfone hydrolyzed fastest and did so more rapidly at higher pH and temperature levels.

TABLE 29

Mechanical Soil Analysis

State	Farm	Top 1 Foot pH	% O.M.[a]	% Sand[b]	% Clay	% Silt	CEC[c]	4-6 Foot pH	% O.M.	% Sand	% Clay	% Silt	CEC
Wisconsin	[redacted]	6.30	1.8	81	12	7	2.8	7.35	.2	92	6	2	.1
		6.15	.7	90	6	4	5.9	5.60	.1	92	6	2	1.6
		5.84	1.6	77	12	11	4.9	6.78	.3	72	14	14	4.3
		5.15	.6	84	12	4	3.3	6.50	.1	91	6	3	1.5
		7.62	1.7	79	10	11	4.2	6.75	.6	79	13	8	2.2
Florida		5.75	1.4	93	2	5	5.4	4.85	.1	98	2	0	.5
		7.65	.8	90	6	4	2.4	7.54	.1	92	6	2	.4
		5.30	.8	94	4	2	.3	4.15	.8	94	4	2	1.2
		5.85	.1	94	4	2	2.8	8.2	.2	83	14	3	18.
		5.5	1.1	92	4	4	2.8	7.65	.1	83	14	3	23.
California		8.10	.9	43	20	37	17.	8.40	.2	66	16	18	12.
								8.25	.1	65	19	16	11.
Oregon		5.60	1.	52	12	36	10.	7.75	.1	30	11	59	20.
Washington		8.25	.3	84	9	7	11.	8.60	.1	83	11	6	28.
		6.70	1.1	43	14	43	10.	8.15	.6	52	34	14	27.
Virginia		5.1	1.5	62	13	25	4.1	5.3	.1	83	12	15	3.6
		5.6	.6	62	15	23	4.0	7.2	.1	95	4	1	.8
		6.15	2.5	51	21	28	6.6	6.0	.3	84	14	2	.8
Texas		8.30	.6	74	17	9	13.	8.50	.3	70	22	8	26.
		8.25	1.0	66	21	13	13.	8.30	.5	47	32	21	26.
		6.60	1.2	65	24	11	12.	8.25	.3	70	23	7	26.
New York		4.5	.3	54	10	36	13.	5.57	.1	91	7	2	25.

(a) Organic matter, COD type oxidation (wet)
(b) Percentages are on a dry soil basis
(c) Cation Exchange Capacity, (meg/100 g)

TABLE 30

1980 Crop and TEMIK Application History

State	Farm	Crop	lb a.i./ acre	Application Date	Plant Stage	Soil Placement	Use History (a)
Wisconsin	[redacted]	Potato	3.0	April 21	Seed	In Furrow	2
		Potato	2.7	April 23	Seed	In Furrow	4
		Potato	2.7	April 25	Seed	In Furrow	1
		Potato	2.7	April 22	Seed	In Furrow	1
		Potato	3.0	April 21	Seed	In Furrow	1
Florida		Orange	10.	March 15	Mature	Band Incorporated	1
		Orange	6.75	March 15	Mature	Band Incorporated	1
			3.25	July 28	Mature	Band Incorporated	
		Orange	6.75	March 15	Mature	Band Incorporated	0
			3.25	July 28	Mature	Band Incorporated	
		Orange	10.	April 1	Mature	Band Incorporated	0
		Orange	10.	April 1	Mature	Band Incorporated	0
California		Cotton	.6	April 10	Seed	In Furrow	2
		Cotton	.6	April 10	Seed	In Furrow	2
			2.25	June 10	Sidedress	In Furrow	
Oregon		Potato	3.	June 1	70% Emergence	In Furrow	1
Washington		Potato	3.	-In 1978 and 1979-			2
		Potato	3.	May 5	70% Emergence	In Furrow	1
Virginia		Potato	2.25	April 10	Seed	In Furrow	1
		Potato	2.25	April 10	Seed	In Furrow	1
		Potato	2.25	April 10	Seed	In Furrow	1
Texas		Orange	4.95	May 10	Mature	Band Incorporated	2
		Orange	4.95	May 12	Mature	Band Incorporated	1
		Orange	4.95	April 1	Mature	Band Incorporated	1
New York		Potato	3.00	May 5	Seed	In Furrow	
		Potato	1.5	May 5	Seed	In Furrow	
			1.5	June 13	Sidedress	In Furrow	

(a) Number of years TEMIK applied, 1976-1979.

TABLE 31

Geometric Mean Total Carbamate Residue Concentration, (PPB)

State	Farm	First Sample Depth (Feet) Date	0-1	1-2	2-4	4-6	6-8	Second Sample Depth (Feet) Date	0-1	1-2	2-4	4-6	6-8
Wisconsin	[redacted]	July 1	186	10	2.4	0		Sept 3	97	97	22	27	10
		July 2	652	115	91	24	5	Sept 3	42	35	38	26	
		July 1	416	212	4	25		Sept 3	39	27	13	31	34
		July 2	191	50	118	20	4	Sept 3	60	11	15	16	25
		July 2	414	17	5.6	0		Sept 3	17	22	42	13	
Florida		June 5	396 (a)	80	9	0	0	Sept 10	34	44	50	71	115
		June 5	19	6.3 (b)	2	2	0	Sept 10	24	14	5	0	6
		June 5	103	42	126	18	21	Sept 10	23	10	20	10	8
		June 4	28	7	3	0		Sept 9	16	18	23	3	
		June 4	818	125	13	2	4	Sept 9	87	132	65	21	17
California		July 11	20	13	4	2.5							
		July 11	67	34	2	0							
Oregon		July 7	556	2	8	0	2						
Washington		July 7	0	0	2	2	0						
		July 8	190 (c)	5	2								
Virginia		July 17	200	4	0	2							
		July 17	95	15	18	3							
		July 17	5	0	0	0							
Texas		Sept 23	11.5	0	0	5	2						
		Sept 24	2.3	0	0	2.4	5						
		Sept 24	5	0	0	0							
New York		June 20	56	20	0 (d)								
		June 20	162	12	50								

(a) Only field locations I and II used.
(b) Geometric mean is 6.3, raw data is (ND, ND, 245).
(c) Geometric mean of locations II and III is (962, 11, 2.6).
(d) These data obtained from the Experiment Station on Long Island and are single analyses of a composite sample.

TABLE 32

Environmental Data

State	Farm	Average Groundwater Temperature, (°F) (a)	Rainfall, to Sample 1 (b)	Irrigation, to Sample 1 (b)	Rainfall, to Sample 2 (c)	Irrigation, to Sample 2 (c)
Wisconsin	[redacted]	46	9.6	3	10.5	1
		46	9.6	3	10.5	1
		46	9.6	3	10.5	1
		46	9.6	3	10.5	1
		46	9.6	3	10.5	1
Florida		75	5.5	0	18.6	0
		75	5.5	12	18.6	18
		75	5.5	0	18.6	0
		75	6.4	12	18.0	18
		75	6.4	12	18.0	18
California		65	0.0	24		
		65	0.0	24		
Oregon		53	0.0	10		
Washington		53	0.0	10		
		53	0.0	10		
Virginia		60	4.5	1.5		
		60	4.5	1.5		
		60	4.5	1.5		
Texas		75	27	18		
		75	27	18		
		75	27	18		
New York		58	2	0		

(a) Source Water Atlas from Geraghty and Miller

(b) Total moisture between application data and first sampling, (inches)

(c) Total moisture between first and second samplings, (inches)

PRIVACY ACT EXEMPTION

TABLE 33

Carbamate Residue Concentrations in Water Samples

State	Farm	Date	Well[a]	Surface[b]	Date	Well	Surface
Wisconsin	[redacted]	7/2/80	2, 3, 2, 2, 4 (c)		9/3/80	2, 1, 3, ND, 2	
		7/2/80	ND, ND, 10		9/3/80	ND, ND, ND, ND	
		7/1/80	ND, 3		9/4/80	1, 2	
		7/2/80	1, 8		9/3/80	ND, 6	
		7/1/80	ND, ND, 12		9/4/80	ND, ND, ND	
Florida		6/5/80	ND, ND	ND	6/10/80	ND, ND	ND
		6/5/80	ND, ND	ND	6/10/80	ND, ND	ND
		6/5/80	ND		6/10/80	ND	
		6/4/80	ND	ND, 1	6/9/80	ND	ND
		6/4/80	ND	ND	6/9/80	ND	ND
California		7/11/80	ND	ND			
		7/11/80	ND	ND			
Oregon		7/7/80	ND				
Washington		7/9/80	ND	ND, ND			
		7/8/80	ND	14			
Virginia		7/17/80	ND				
		7/17/80	ND, ND				
Texas		9/24/80	ND, ND	ND, ND			
		9/24/80	ND	ND			
		9/23/80		ND			
New York		6/20/80					
		6/20/80					

(a) Well refers to an irrigation, house, or shop wells located near treated fields.

(b) Surface refers to pond, lake, drainage ditch, or canal water near treated fields.

(For exact descriptions, see main report)

(c) ppb, method sensitivity 1 ppb, ND = None detected.

PRIVACY ACT EXEMPTION

TABLE 34

Calculated Total Residues From Actual Residues Found

(Pounds a.i./acre)

State	Farm	Sample 1			Sample 2		
		Days[a]	Amount	% Dose	Days[b]	Amount	% Dose
Wisconsin	[redacted]	70	.9	30	136	1.4	47
		71	4.3	100+	134	.9	33
		67	3.0	100+	131	1.0	32
		73	2.3	83	135	.8	30
		72	1.9	63	135	.7	22
Florida		82	2.2	22	179	2.8	28
		82	.2	2.2	179/44	.3	~~.03~~ 3.
		82	2.1	31	179/44	.5	5
		64	.2	2	161	.4	4
		64	4.3	43	161	1.9	19
California		92	.2	30			
		92/31	.5	22			
Oregon		36	2.5	83			
Washington		396	.03	1.1			
		64	.9	29			
Virginia		98	.9	40			
		98	.7	31			
		98	.02	1			
Texas		136	.11	2.2			
		135	.07	1.5			
		167	.02	.4			
New York		45	.3	10.			
		45/7	.9	31.			

(a) Days are the number of days between application and sampling.

(b) Days are the number of days between the two samplings.

TABLE 35

Calculated Half-Lives, (days)

State	Farm	Field[a] Sample 1	Field[a] Sample 2	Literature[b] Sulfoxide	Literature[b] Sulfone
Wisconsin	[redacted]	78	125	90	160
		--	44	120	200
		--	80	90	160
		277	76	100	180
		108	62	90	160
Florida		40	97	20	30
		15	10	20	30
		50	16	20	30
		11	35	20	30
		50	67	20	30
California		53			
		14		20	40
Oregon		137		44	80
Washington		60		60	110
		37			
Virginia		74		40	70
		58		40	70
		15		35	60
Texas		25		18	30
		22		18	30
		21		14	28
New York		14		35	60
		~10			

(a) Estimated disappearance half-life in sampled layer of soil.

(b) Estimated degradation half-life in surface layer using predictions derived from literature data.

FIGURE 2.
CONTOURS ARE SULFONE 1/2 LIFE(DAYS)

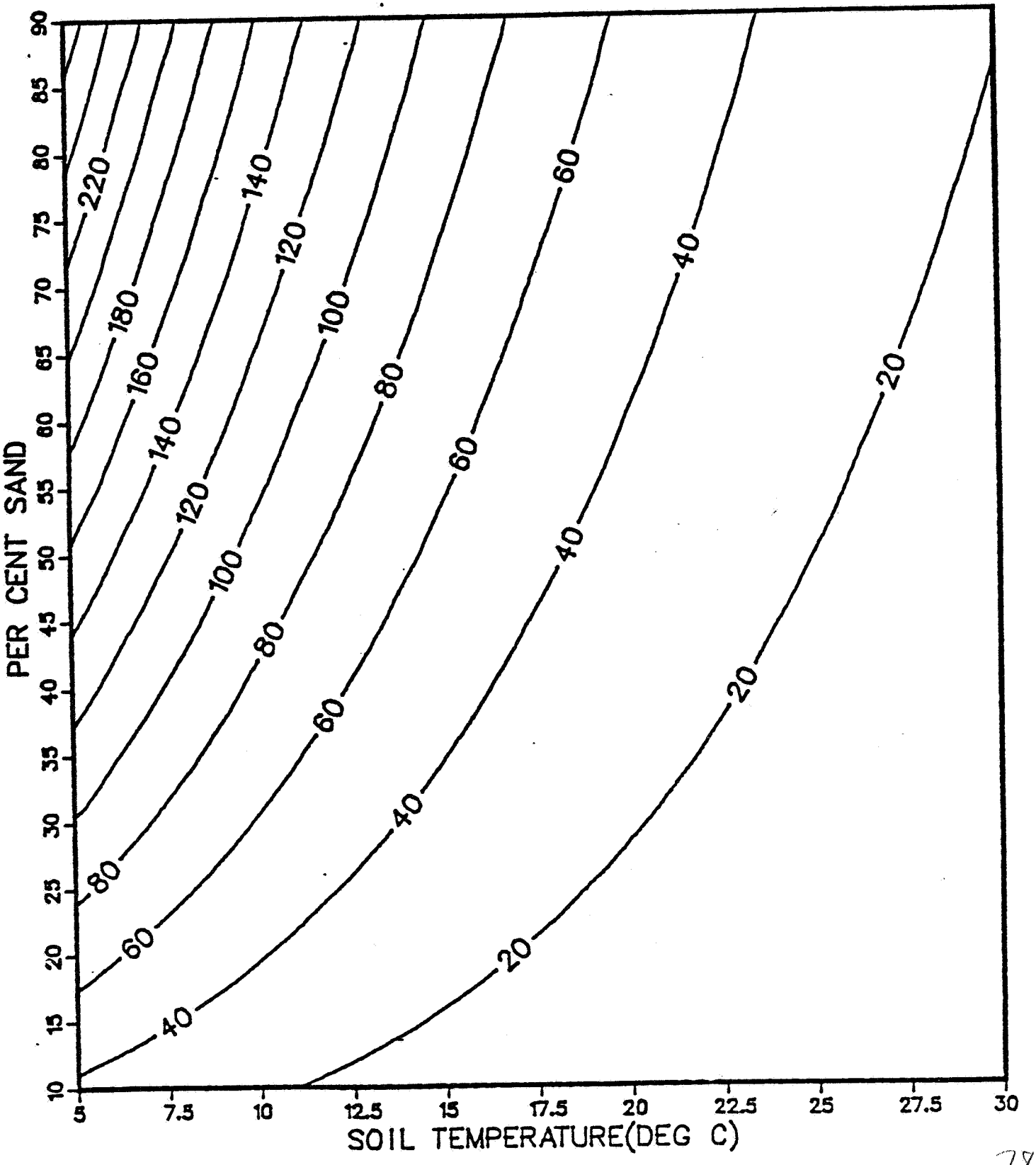
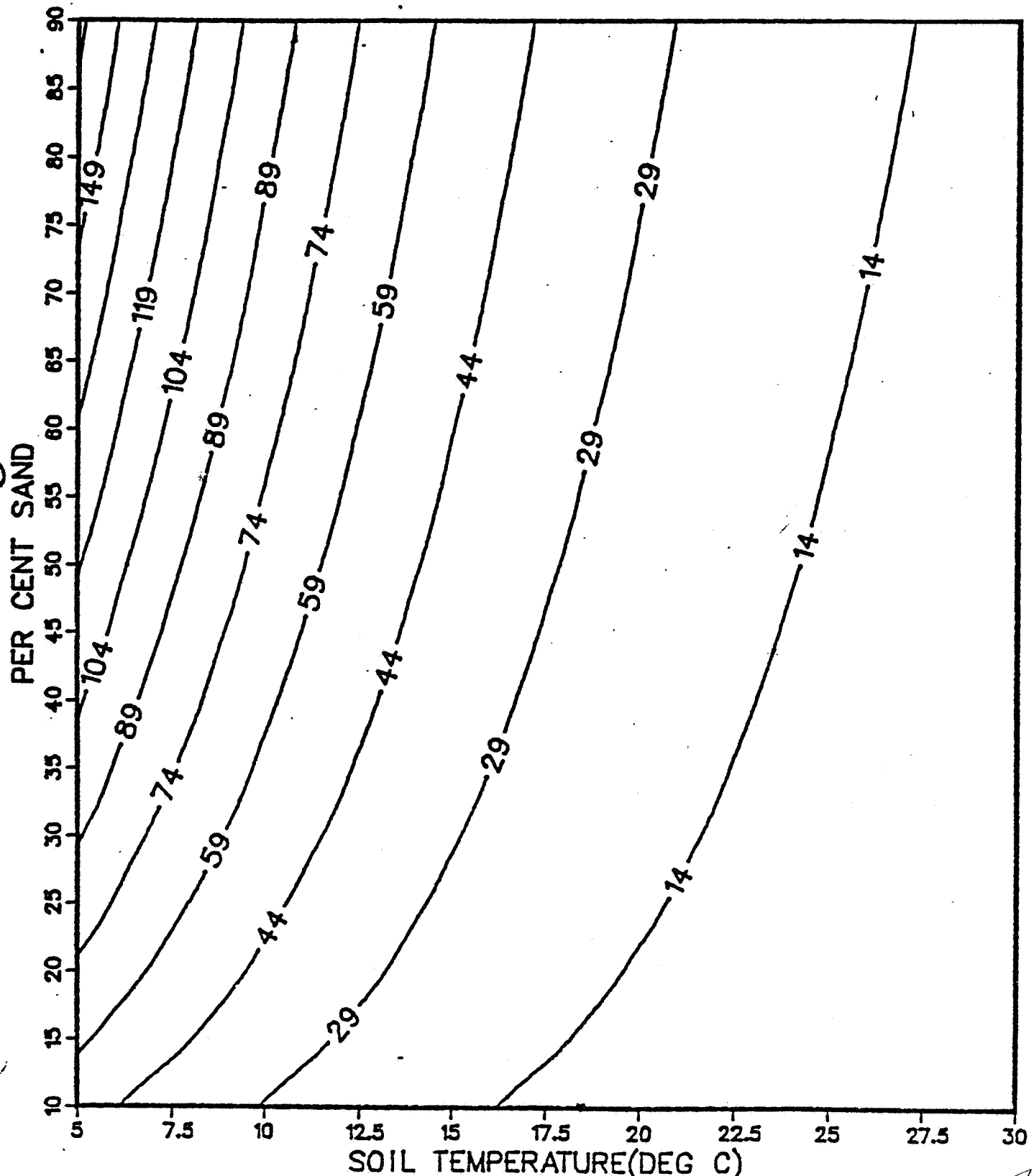


FIGURE I.

CONTOURS ARE SULFOXIDE 1/2 LIFE(DAYS)



3.7.4 Rough Mathematical Model: M. H. Spiegel

According to Dr. Spiegel of Union Carbide, a literature and laboratory studies are currently underway in an attempt to achieve a better understanding of the fate of aldicarb in the environment, and for the development of a mathematical model capable of predicting aldicarb concentrations in the ground at any given time and location. He emphasizes: (a) soil degradation study, (b) hydrolysis studies, (c) soil-catalyzed hydrolsis studies, and (d) soil sorption studies.

Dr. Spiegel of Union Carbide presented some data which, in his opinion, should be useful in initial modeling efforts. These include:

(a) Biodegradation: The biodegradation of aldicarb, aldicarb sulfoxide, and aldicarb sulfone in soil has been found to be described generally by first-order kinetics. Approximately 90-100% of the aldicarb is oxidized to sulfone. In addition to biodegradation, hydrolysis, chemical oxidation and volatilization are possible routes for reducing the concentration of the active carbamates (Figure 3).

(b) Aldicarb degrades fastest of the three
The degradation rate of aldicarb was correlated roughly with a combination of common soil parameters resulting in a curve indicating the conditions for a maximum degradation rate (Table 36 and Figure 4). The correlation uses pH and the percentages of sand, silt, clay, water, and organic matter in soil. The use of a log-log plot masks rate data for very low abscissa values. The effect is shown in Figutre 5 and may help put Figures 4, 6, and 7 in a different prespective. Use of the plot shows T-1/2 of 4.6 days to 43 days depending upon sil characteristics.

(c) Sulfoxide degradation rate

Sulfoxide degradation rates were correlated in a manner similar to that for aldicarb (Table 37, Figure 6). The resulting curve indicates a degradation rate of about one-tenth those of aldicarb. Use of the plot shows T-1/2 of 48 days to 1575 days depending on soil texture.

(d) Sulfone Degradation

The degradation rate constants obtained were about the same order of magnitude as those of sulfoxide (Table 37 and Figure 7). Use of the plot shows T-1/2 of 40 days and 1900 days for Norfolk sandy loam and a soil approximating that of [redacted] Cutchogue, N. Y., respectively.

(e) Hydrolysis is pH and Temperature Dependent

The limited quantity of data required estimating pH-rate profiles. The understanding of typical pH-rate profiles is very helpful in such a situation. A properly chosen coordinate system for plotting log K vs. pH will result in profiles consisting of horizontal and/or 45°C lines (figure 8).

(f) Aldicarb Hydrolysis

Calcuated data show that aldicarb hydrolyzes slowly at expected pH and temperature levels. At all temperatures, its T-1/2 seems to be a maximum at pH 6, decreasing on either side of that pH (Figure 9). At 15°C aldicarb has a T-1/2 of 30,000 days at pH 5 and 140,000 days at pH 7. Half-lives at other temperatures are shown in Figure 9. Known hydrolysis rate constant data and an estimated pH-rate profile data were available that were used for an Arrhenius plot (Figure 11).

(g) Sulfoxide Hydrolysis

Sulfoxide hydrolyzes much faster than aldicarb, having a T-1/2 at 15°C of 12,000 days at pH 5 and 3100 days at pH 7. Half-lives at other temperatures are shown in Figure 12. Known hydrolysis data and an estimated pH-rate profile are shown in Figure 13. The hydrolysis of sulfoxide to sulfoxide oxime and sulfoxide oxime and sulfoxide nitrile is known to be a major pathway for the degradation of sulfoxide. An Arrhenius plot is shown in Figure 14.

(h) Sulfone Hydrolysis

The rate of hydrolysis of sulfone increases steadily with increasing pH and does not go through a minimum value as estimated for aldicarb and sulfoxide. At 15°C, T-1/2 range from 69,00 to 700 days for pH levels of 5 and 7 respectively (Figure 15, 16 and 17). based on the hydrolysis mechanism, sulfone, along with sulfoxide and aldicarb, would degrade slowly since most soils tend to lie within the pH range of 5 t 7.

(i) Soil Sorption

The mobility of a chemical in a soil is limited to the extent by which it is sorbed by the soil. One mean of expressing the relative mobility of chemicals is by Q value (also written as Kom) which is defined as follows:

$$Q = \frac{\text{Chemical Concentrtion in Soil Organic matter}}{\text{Chemical concentration in soil water.}}$$

It was shown that Q for aldicarb, sufoxide, and sulfone to be 10, 1, and 2 respectively. The smaller the Q value, the greater the proportion of the chemical that is in the soil water and so the greater the potential mobility of chemical in soil. Other Q values: Mirex 20,000; DDT, 7000; and methomyl 5. It is herefore the Q value and not water solubility per se, that determines chemical mobility in soil.

Recent studies have indicated that the organic carbon content rather than organic matter results in a better correlation of the soil sorption of nonpolar organic, chemicals. An estimate of this ratio (Koc) may be obtained using the chemical's water solubility as follows:

$$\text{Log } K_{OC} = 3.655 - 0.556 \log W_S$$

where W_S = water solubility, ppm

This gives estimated K_{OC} values for aldicarb, sulfoxide and sulfone of 35, 4, and 30 respectively. To put these in perspective K_{OC} estimates for Dicamba, Lindane, and DDT are 0, 1300, and 240,000 respectively. Again, the lower number indicates greater mobility. Mobility classes were defined as follows:

0- 50	very high
50-150	high
150-500	medium
500-2000	low
2000-5000	slight
75000	inert

(j) Volatilization Losses

$$\text{Volatility index} = \frac{(V_p)\ (T\text{-}1/2)}{(S)\quad (K_{OC})}$$

V_p = vaporpressure at 25°C mm Hg
T-1/2 = soil degradation T-1/2, 25°c, days
S = water solubility, ppm
K_{OC}= soil sorption constant, organic carbon

A volatlity index was calculated for the three chemicals for both Norfolk Sandy loam and a sandy soil (Tables 38). These are:

	Norfolk Sandy Loam	[redacted] Type Sand
Aldicarb	2.2×10^{-9}	2.05×10^{-8}
Sulfoxide	2.8×10^{-9}	8.4×10^{-8}
Sulfone	2.6×10^{-8}	7.3×10^{-7}

A comparison of these values with other chemicals are shown in Table 39.

It could be seen that soils, having relatively shorter degradation half-lives for the active carbamates, are not conductive to a significant loss through volatility. Additionally, volatility losses are difficult to model.

(k) Photochemical Degradation

Limited data show that photochemical degradation in water solution at pH 5 was far more rapid than achieved by hydrolysis alone. The T-1/2 of aldicarb was 8-12 days and sulfoxide T-1/2 was about 480 days. It is expected that only a very small quantity of the carbamates would be exposed to photodegradation, and that the half-lives would not apply directly because much of the chemical would be in particulate solid form rather than in solution.

4.0 TOXICOLOGY ASPECTS

Three pages. Should be reviewed by Toxicology Branch.

5.0 PROGRAM COST

	Thousands of Dollars 1980	1981
Total product development*	850	365
Total research	290	340
Grand Total	1140	705

*Including §400 M in 1980 and an estimated § 105 in 1981 for the filter installation program alone.

6.0 LONG ISLAND, DEEP SOIL CORE (REPORT RECEIVED ON 3/11/81):

The core, 85 - foot deep, was taken from the Horticultural Research Farm, Long Island in 1980. It is believed that the field has been treated annually with aldicarb from 1975 through 1979. More information concerning this, detailed method of analysis, and other field information will be provided by Union Carbide as they become available. Test results are shown in Table 40. One could see that there is very little residue of significance and little variation throughout the entire 85-foot core. Residues fluctuated from the non delectable level (ND) to the minimum detectable level of 5 ppb beginning from 2 feet deep, to a maximum of 10 ppb detected at a depth of 70 feet. Water table was encountered at 80 feet where residues were determined at 6-8 ppb.

ALDICARB ENVIRONMENTAL FATE REVIEW dated 4-8-81

Page _____ is not included in this copy.

Pages 84 through 87 are not included in this copy.

The material not included contains the following type of information:

___ Identity of product inert ingredients

___ Identity of product impurities

___ Description of the product manufacturing process

___ Description of product quality control procedures

___ Identity of the source of product ingredients

___ Sales or other commercial/financial information

___ A draft product label

___ The product confidential statement of formula

___ Information about a pending registration action

X FIFRA registration data

___ The document is a duplicate of page(s) _____

___ The document is not responsive to the request

The information not included is generally considered confidential by product registrants. If you have any questions, please contact the individual who prepared the response to your request.

Table 40

ALDICARB RESIDUES IN DEEP CORE SOIL SAMPLES

FROM THE LONG ISLAND HORTICULTURAL RESEARCH STATION,

RIVERHEAD, NEW YORK

Description				
Union Carbide Code No.	Sampling Date	Research Station Code No.	Core Depth, Ft.	Aldicarb Residues, PPB
13158	11/12/80	# 1	1 - 2.5 ft.	ND
13159	"	# 2	2.5- 4.0	6
13160	"	# 3	4.0- 5.5	ND
13161	"	# 4	5.5- 7.0	ND
13162	"	# 5	7.0- 8.5	ND
13163	"	# 6	9.0-10.5	ND
13164	"	# 7	10.5-12.0	ND
13165	"	# 8	12.0-13.5	ND
13166	"	# 9	14.0-15.5	6
13167	"	#10	15.5-17.0	9
13168	"	#11	17.0-18.5	8
13169	"	#12	19.0-20.5	8
13170	"	#13	20.5-22.0	6
13171	"	#14	22.0-23.5	6
13172	"	#15	24.0-25.5	6
13173	"	#16	25.5-27.0	6
13174	"	#17	27.0-28.5	6
13175	"	#18	29.0-30.5	ND
13176	"	#19	30.5-32.0	6
13177	"	#20	32.0-33.5	ND
13178	"	#21	34.0-35.5	5
13179	"	#22	35.5-37.0	6
13180	"	#23	37.0-38.5	5
13181	11/13/80	#24	39.0-40.5	6
13182	"	#25	40.5-42.0	8
13183	"	#26	42.0-43.5	6
13184	"	#27	44.0-45.5	6
13185	"	#28	45.5-47.0	5
13186	"	#29	47.0-48.5	6
13187	"	#30	49.0-50.5	6
13188	"	#31	50.5-52.0	ND
13189	"	#32	52.0-53.5	5
13190	"	#33	54.0-55.5	7
13191	"	#34	55.5-57.0	8
13192	"	#35	57.0-58.5	8
13193	"	#36	59.0-60.5	6
13194	"	#37	60.5-62.0	6
13195	"	#38	62.0-63.5	7
13196	"	#39	64.0-65.5	6
13197	"	#40	65.5-67.0	6

Cont'd. Table -40--
Description

Union Carbide Code No.	Sampling Date	Research Station Code No.	Core Depth, Ft.	Aldicarb Residues, PPB
13198	"	#41	67.0-68.5	7
13199	"	#42	69.0-70.5	10
13200	"	#43	70.5-72.0	5
13201	"	#44	72.0-73.5	9
13202	"	#45	74.0-75.5	7
13203	"	#46	75.5-77.0	9
13204	"	#47	77.0-78.5	5
13205	"	#48	79.0-80.5	7
13206	11/14/80	#49	80.5-82.0	7*
13207	"	#50	82.0-83.5	8*
13208	"	#51	84.0-85.5	6*

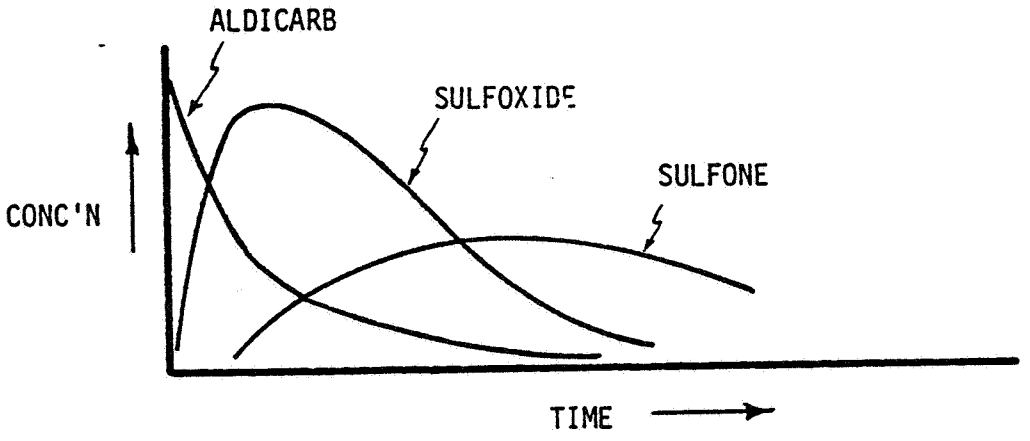
ND = None detected, less than 5 ppb method sensitivity.

* = Water table.

FIGURE 3

MEANS OF REDUCING THE CONCENTRATION OF ACTIVE CARBAMATES

A.



B.

$$\underset{\downarrow k_h}{\overset{k_p \uparrow k_v}{\text{ALDICARB}}} \xrightarrow[k_b]{k_o} \underset{\downarrow k_h}{\overset{k_p \uparrow k_v}{\text{SULFOXIDE}}} \xrightarrow[k_b]{k_o} \underset{\downarrow k_h}{\overset{k_p \uparrow k_v}{\text{SULFONE}}} \xrightarrow[k_b]{k_o}$$

WHERE: k_b = Biological
k_h = Hydrolysis
k_p = Photolysis
k_v = Volatilization
k_o = Chemical Oxidation

FIGURE 4

ALDICARB DEGRADATION RATE CORRELATION

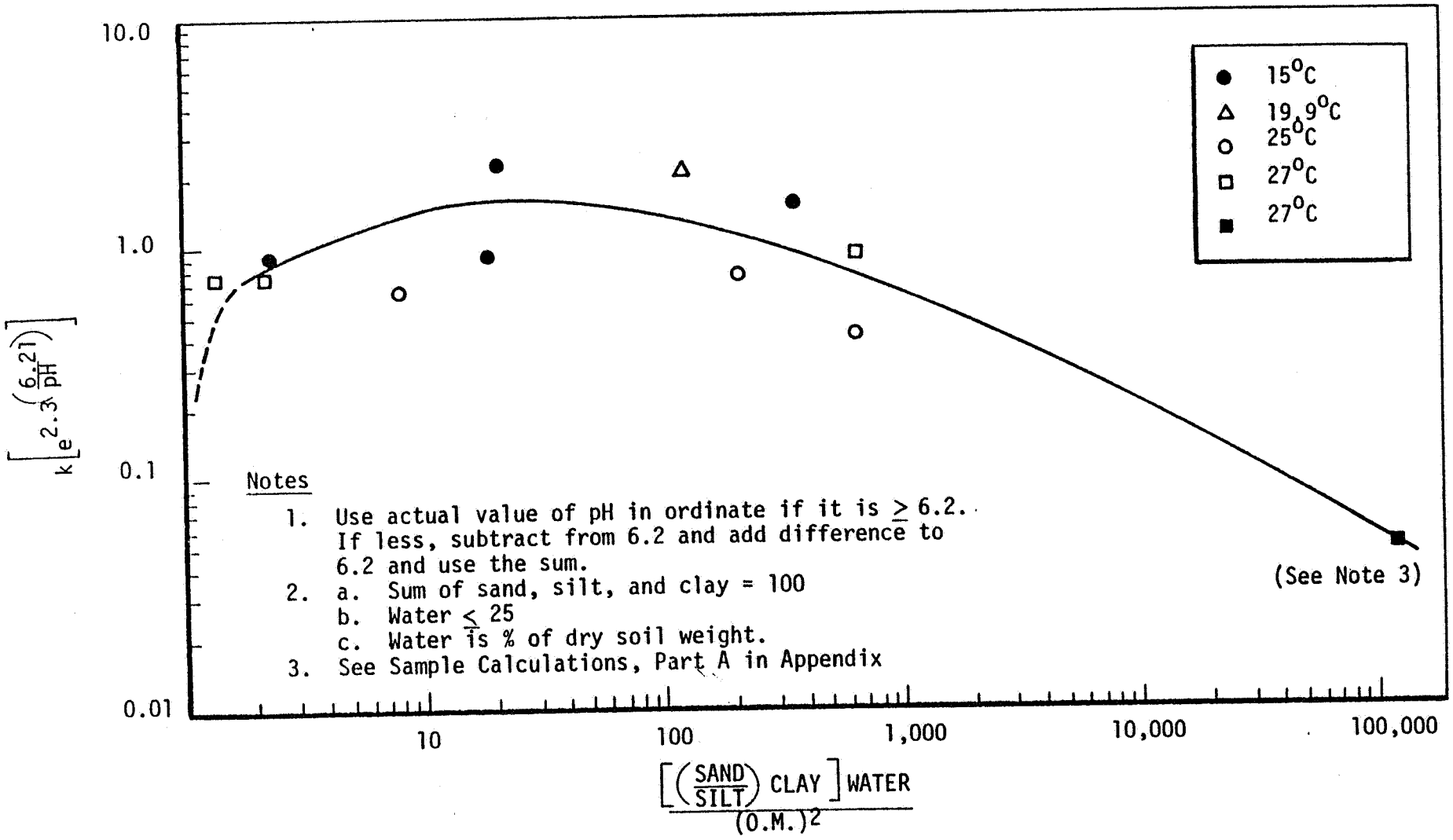


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FIGURE 5

ALDICARB DEGRADATION RATE CORRELATION

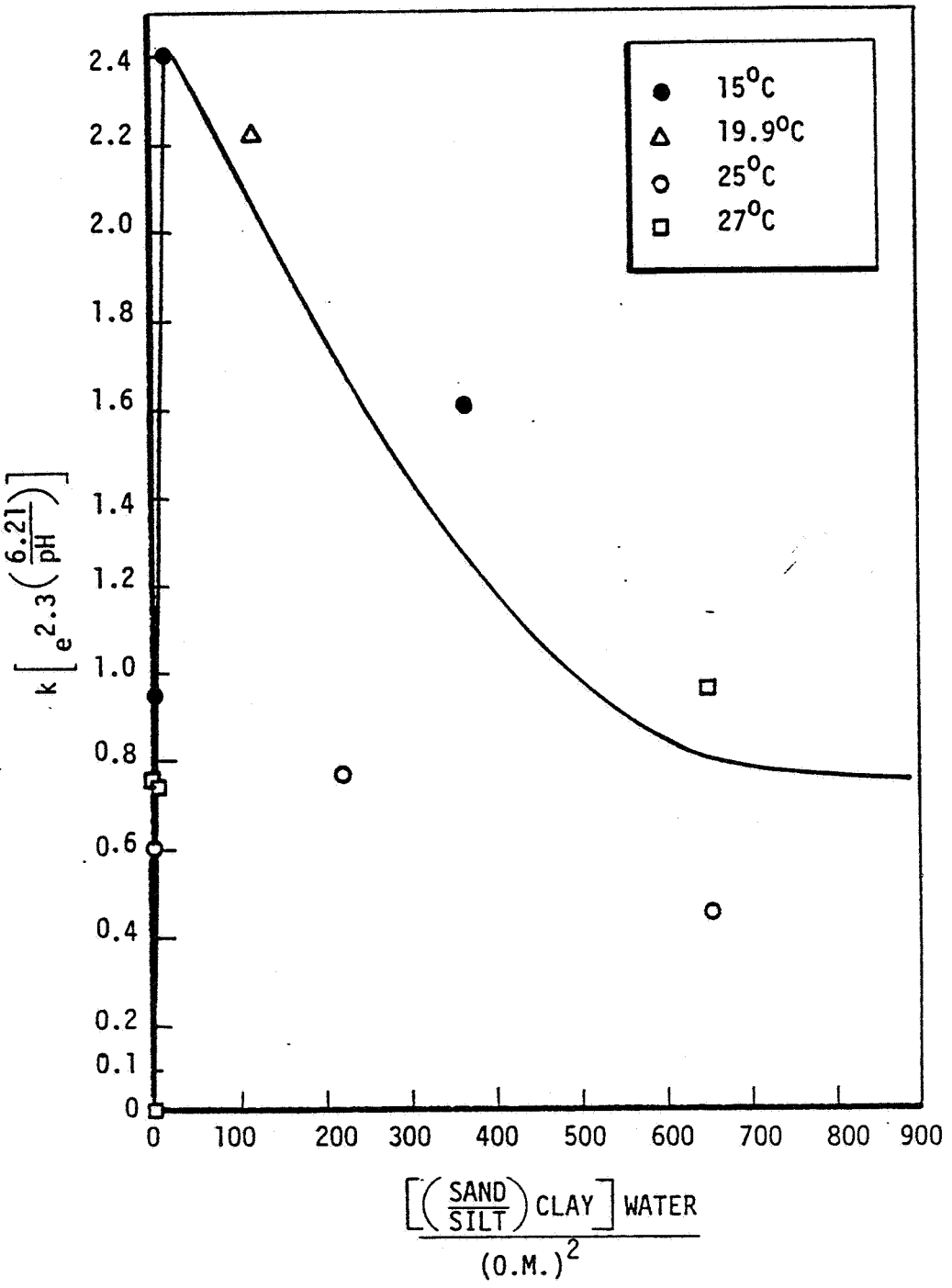

FIGURE 6

SULFOXIDE DEGRADATION RATE CORRELATION

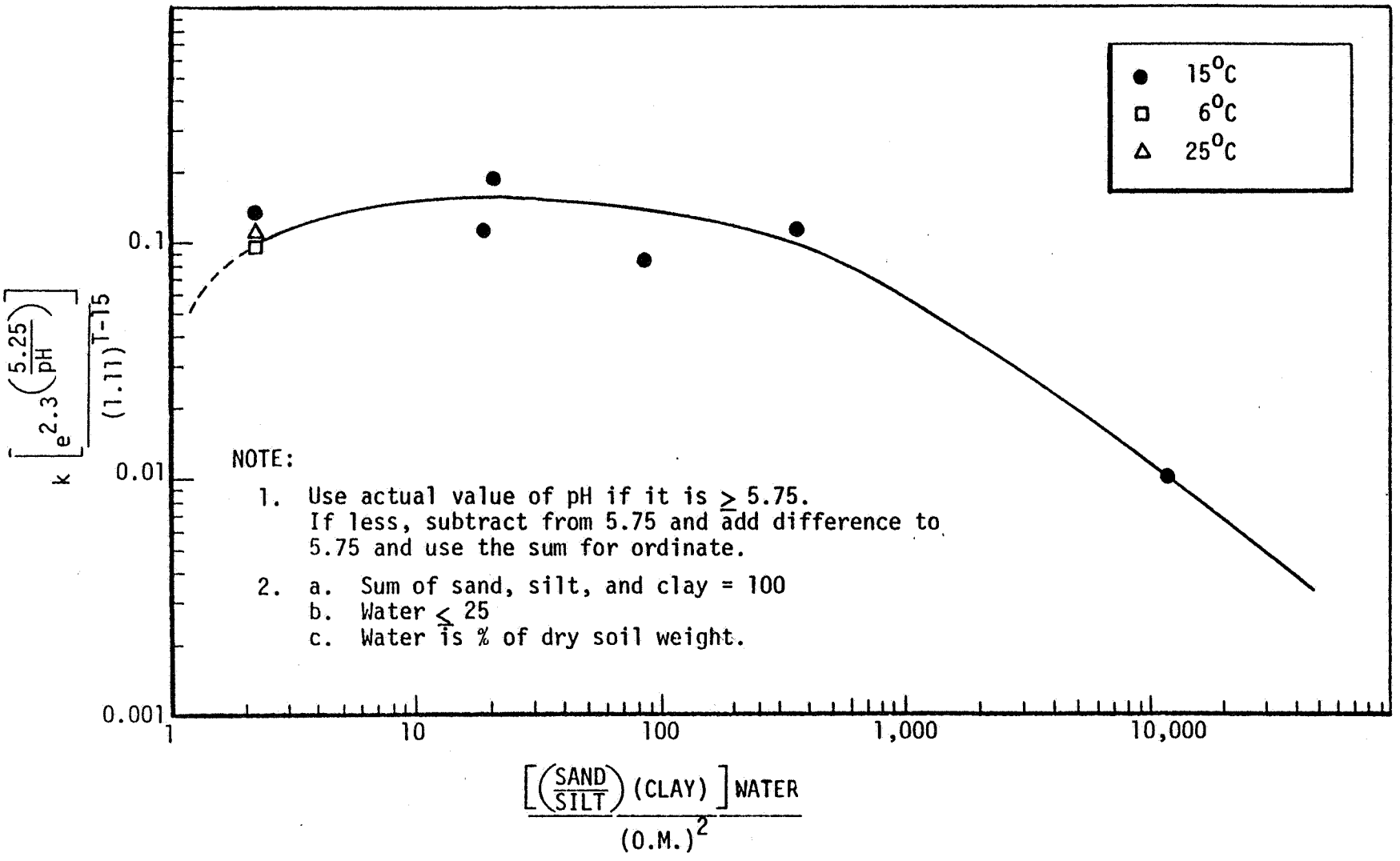

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FIGURE 7

SULFONE DEGRADATION RATE CORRELATION

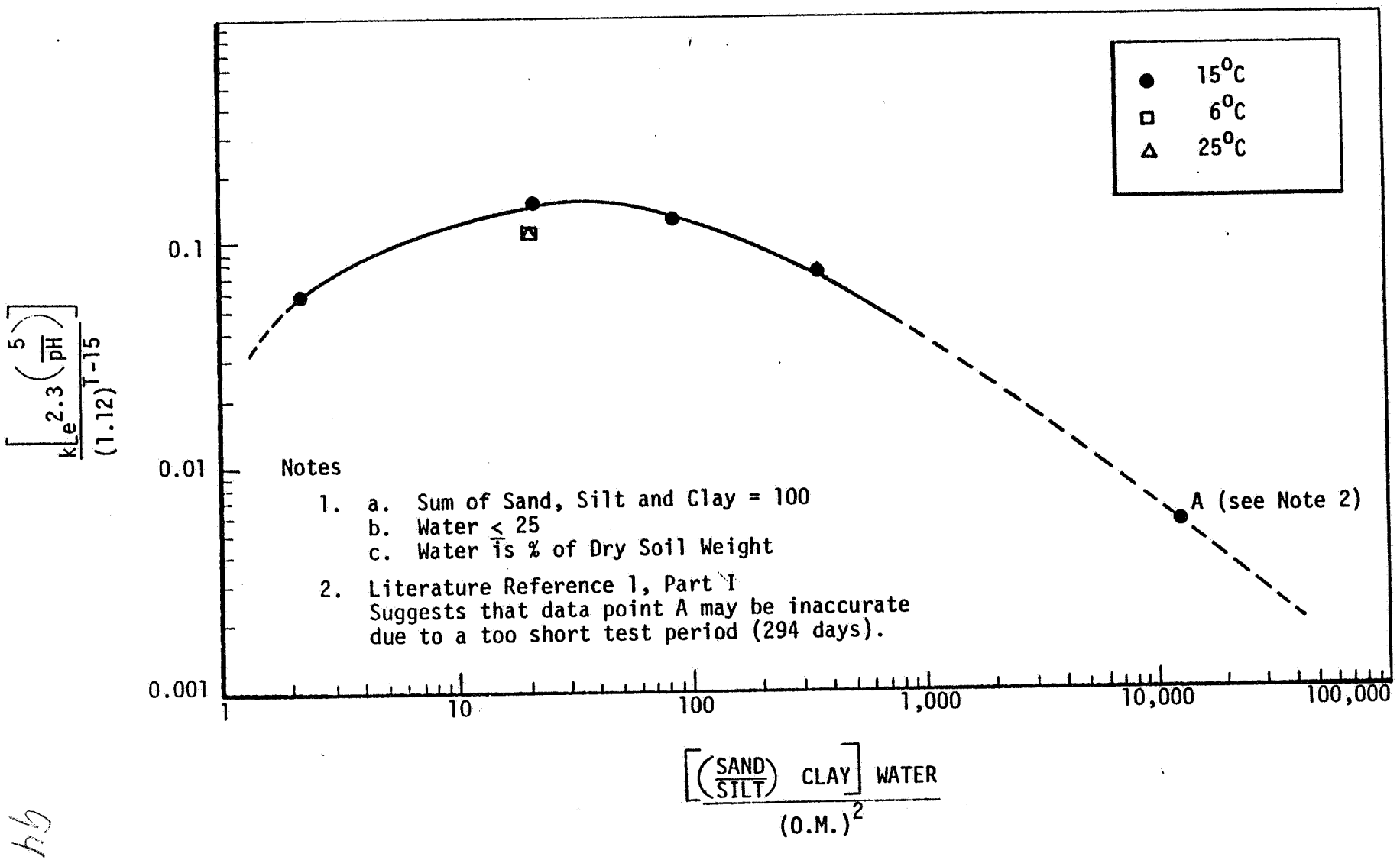


FIGURE 8

TYPICAL pH - RATE PROFILE
FOR HYDROLYSIS

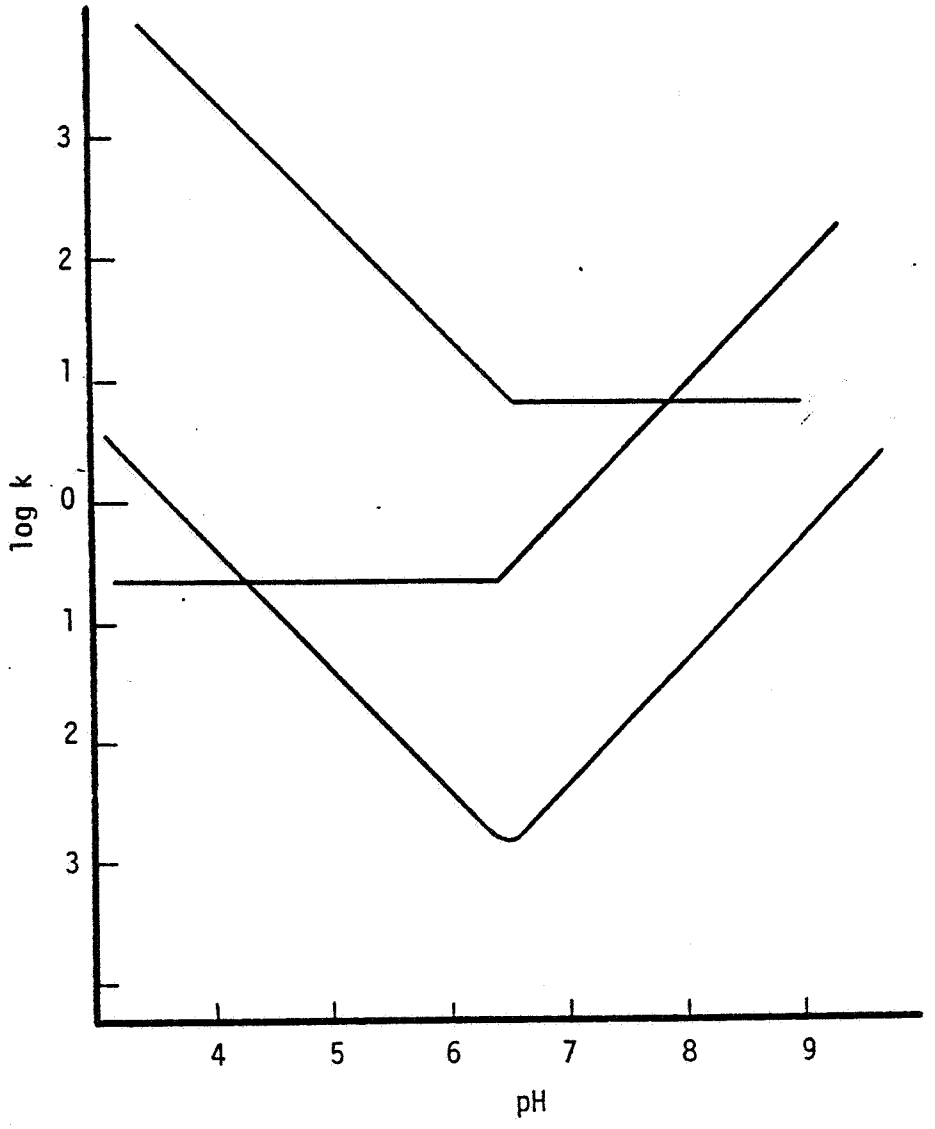


FIGURE 9

ALDICARB HYDROLYSIS
HALF-LIFE (DAYS) vs pH

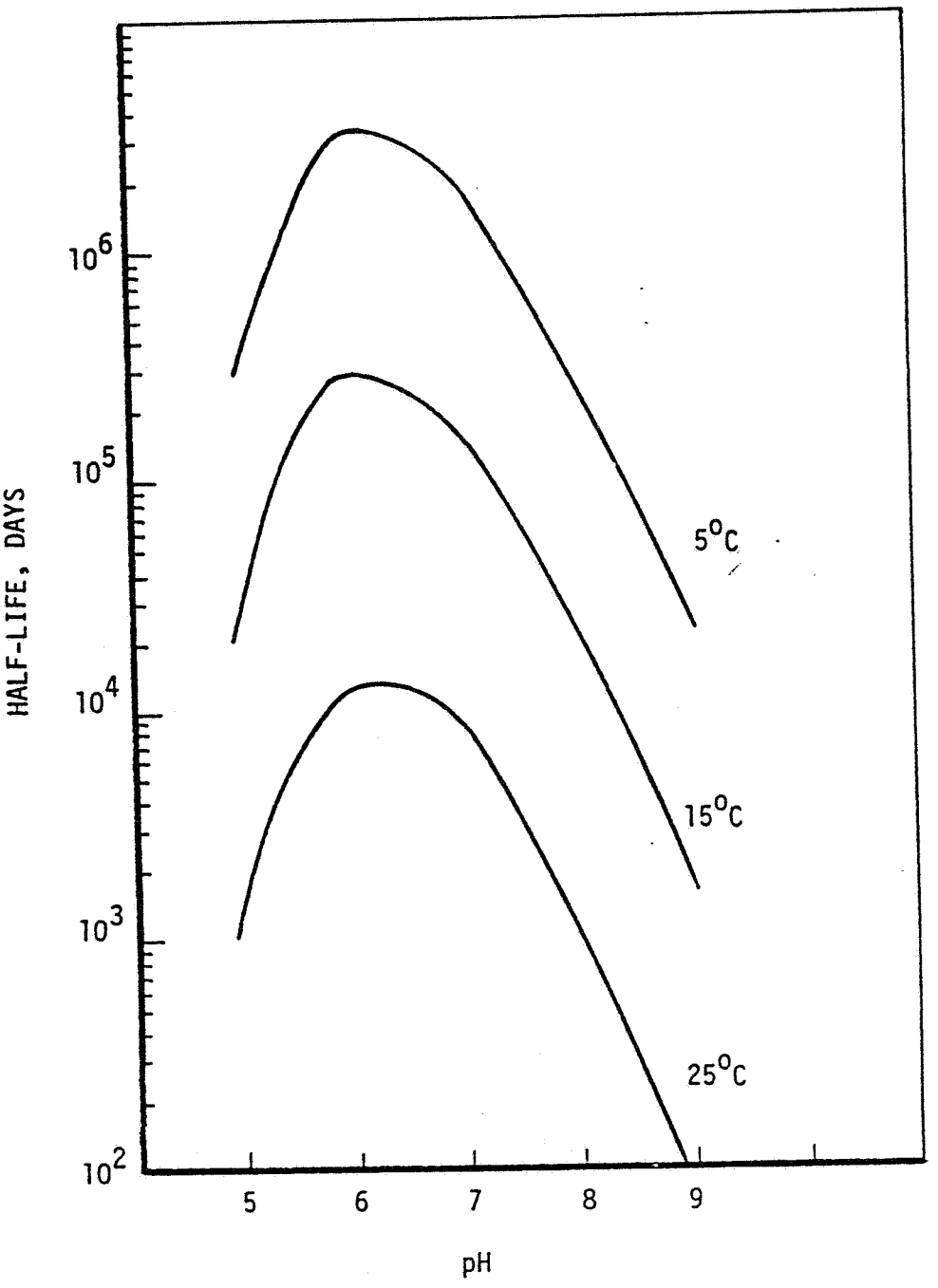


FIGURE 10

ALDICARB HYDROLYSIS

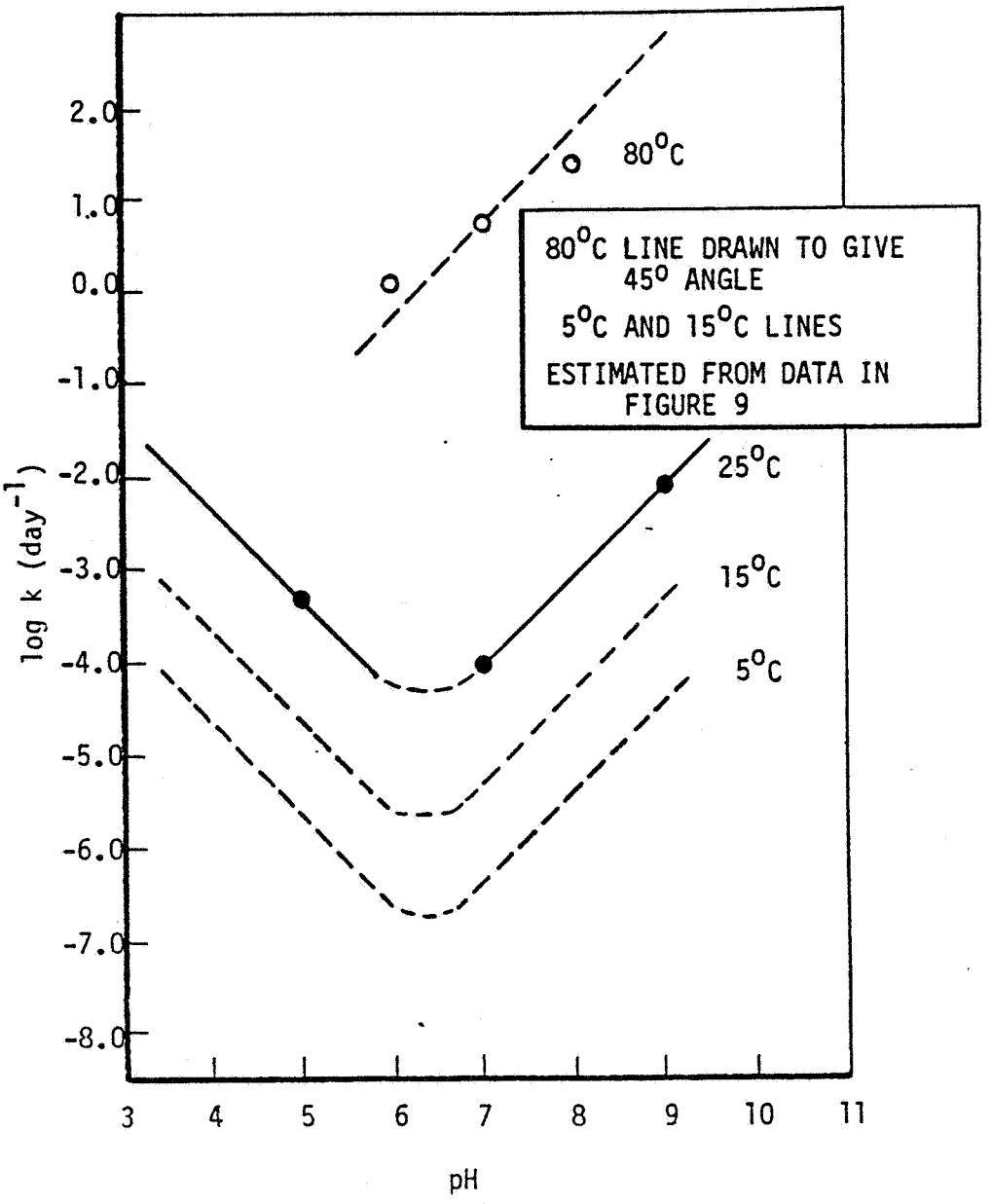


FIGURE 11

ALDICARB HYDROLYSIS

ARRHENIUS PLOT

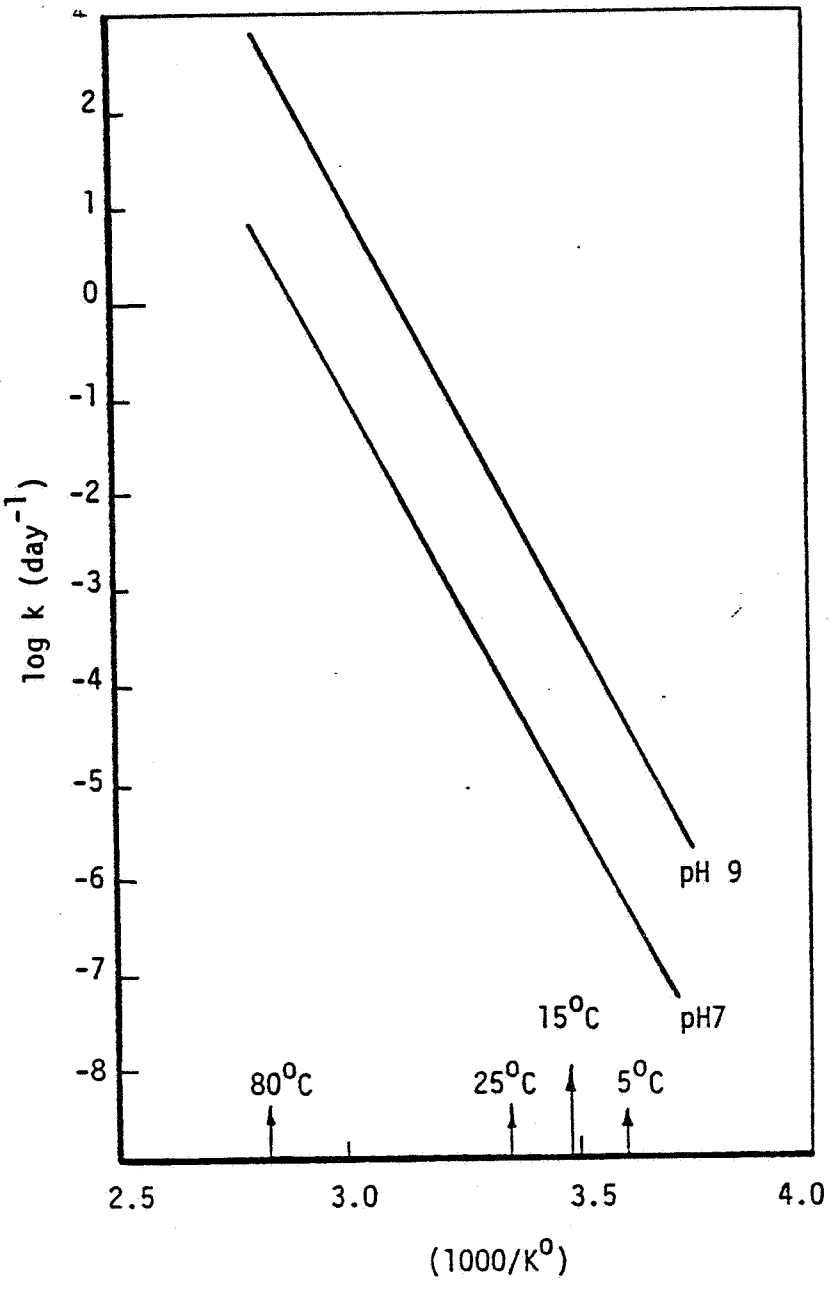


FIGURE 12

SULFOXIDE HYDROLYSIS

HALF-LIFE vs pH

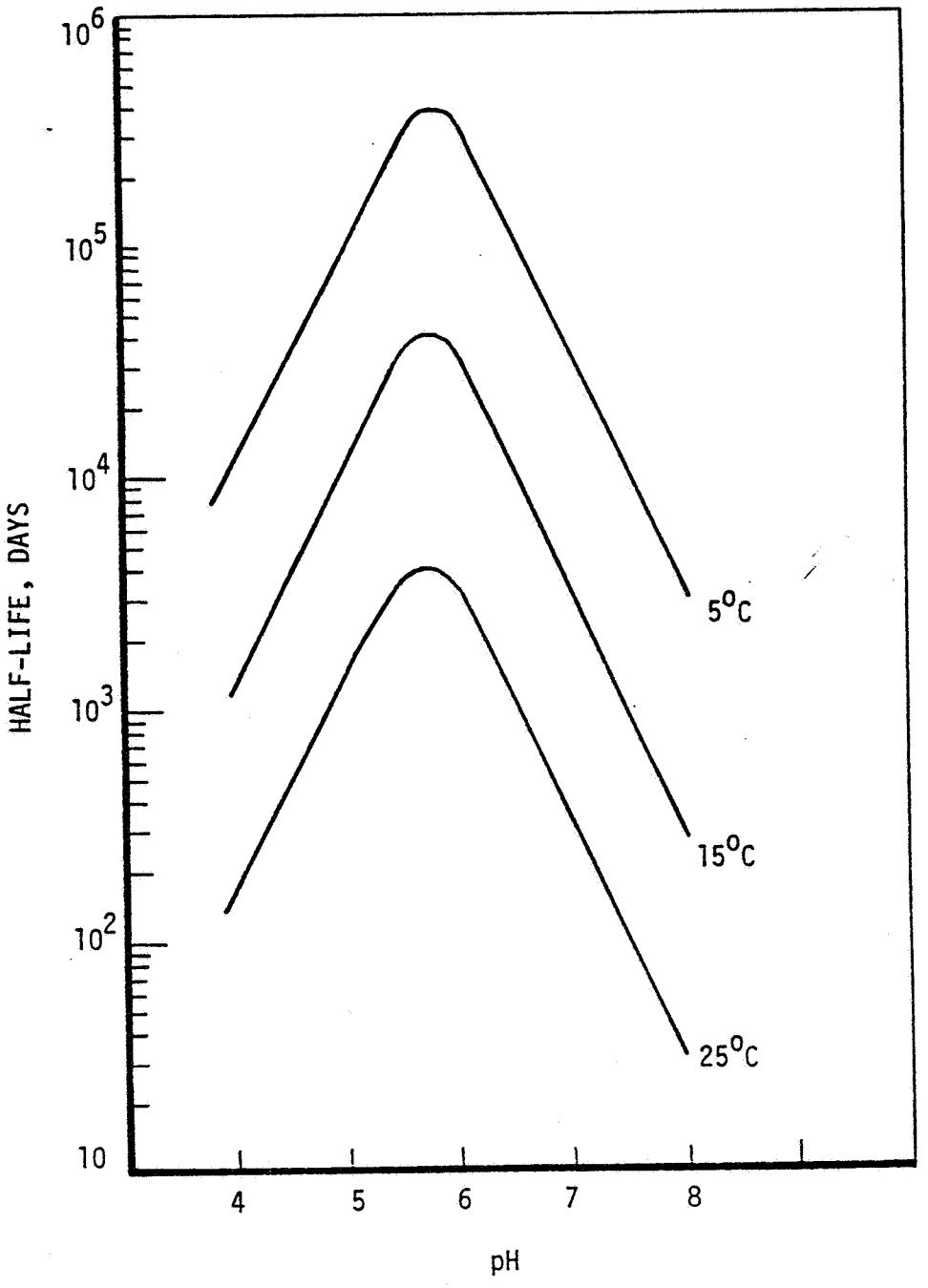


FIGURE 13

SULFOXIDE HYDROLYSIS

REACTION RATE CONSTANT vs pH

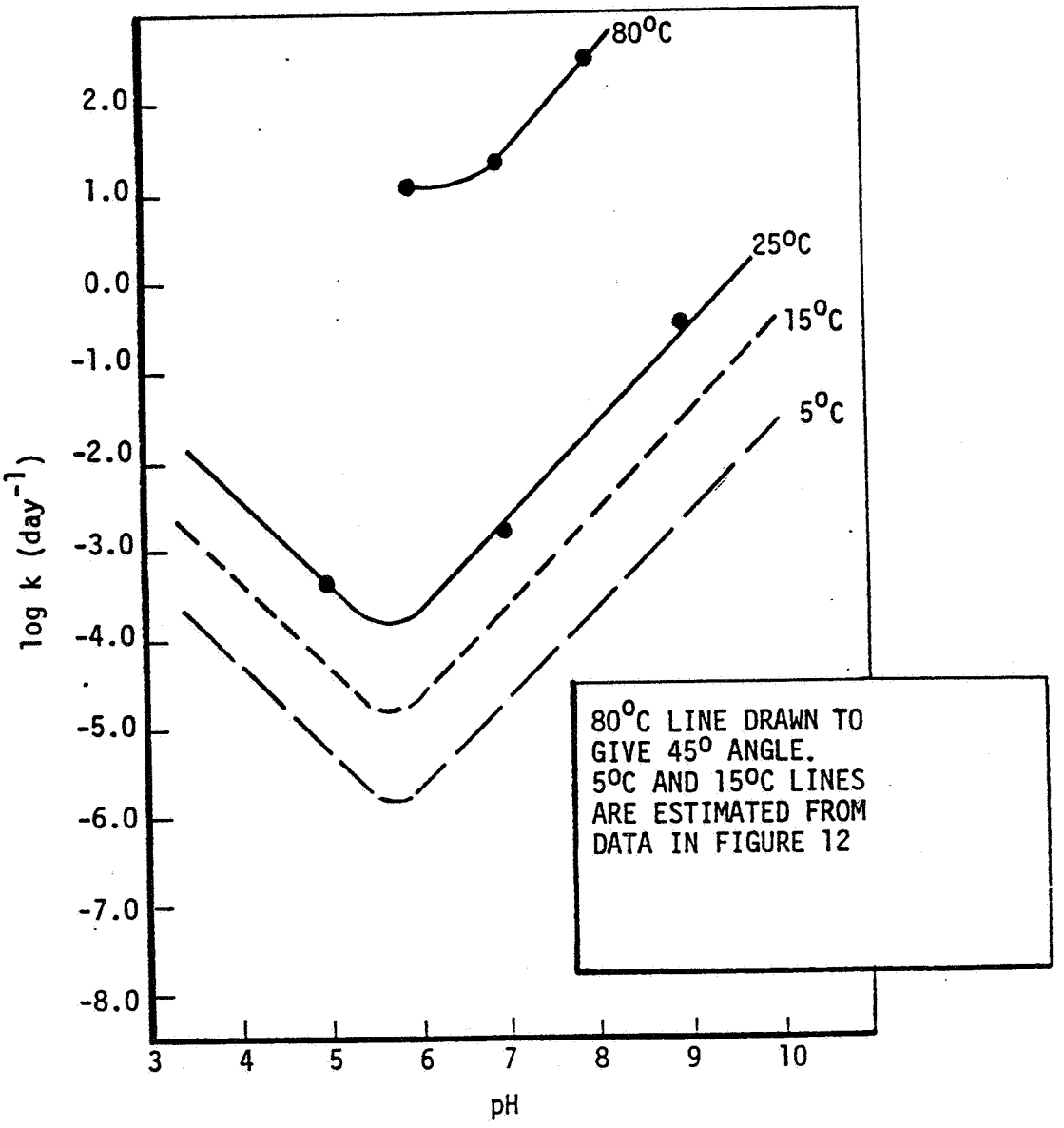


FIGURE 14

SULFOXIDE HYDROLYSIS
ARRHENIUS PLOT

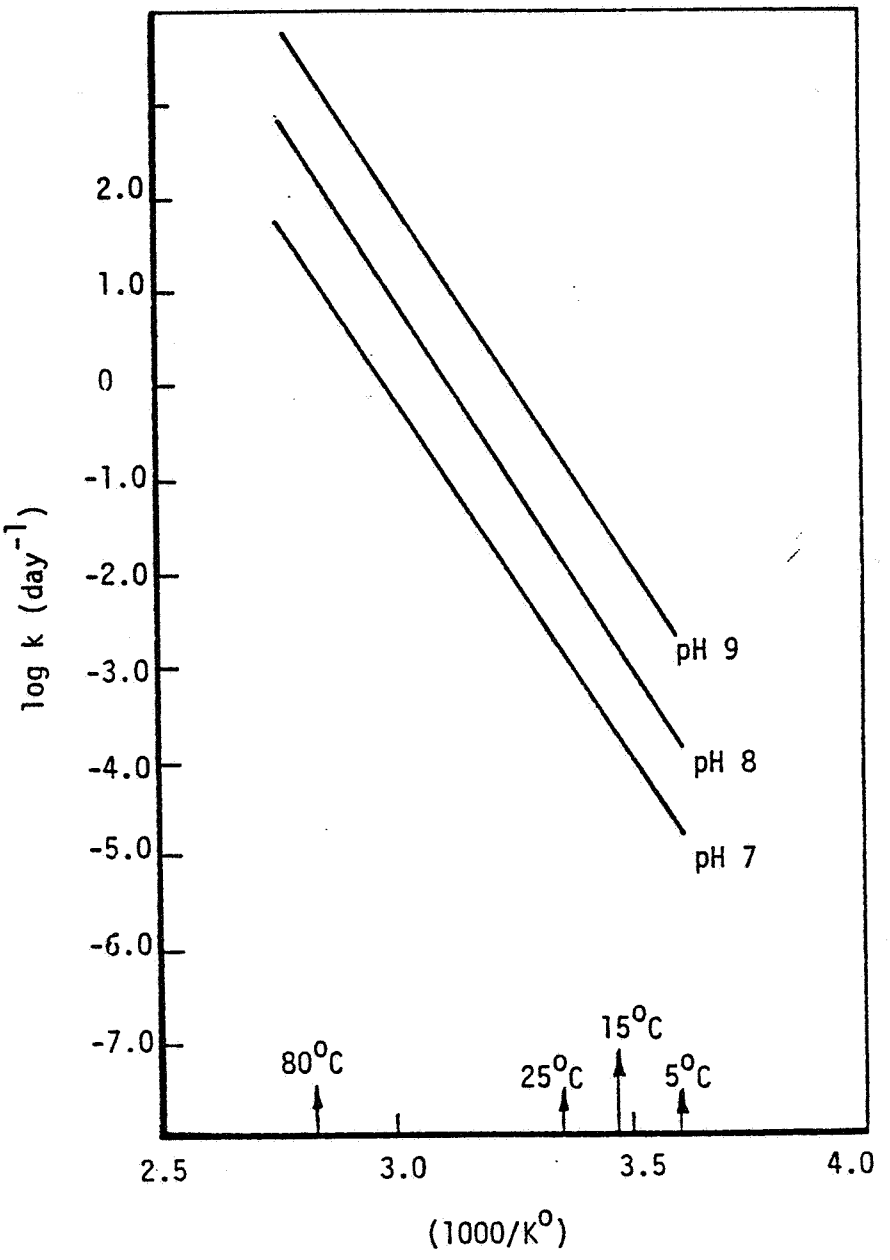


FIGURE 15

SULFONE HYDROLYSIS

HALF-LIFE vs pH

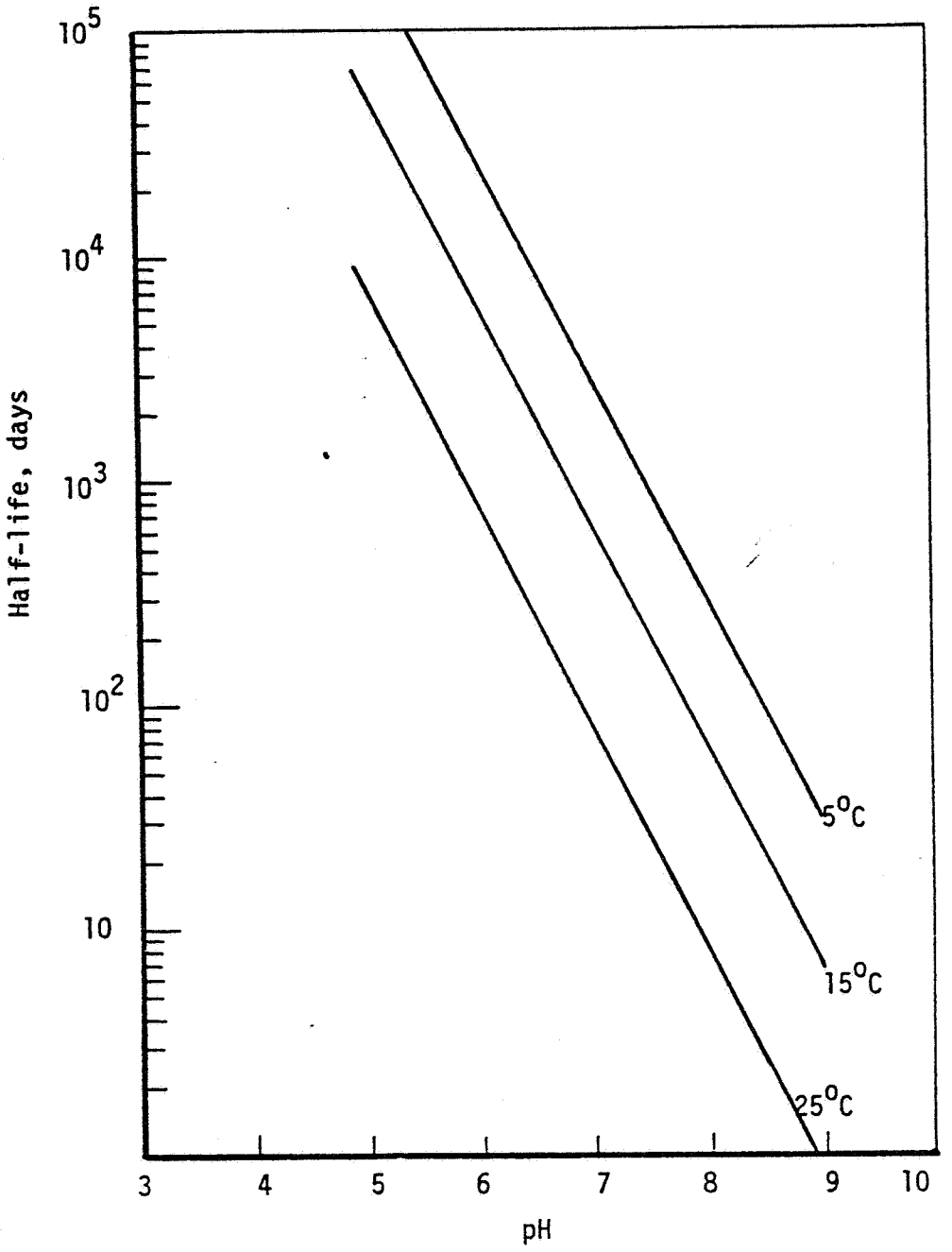


FIGURE 16

SULFONE HYDROLYSIS

REACTION RATE CONSTANT vs pH

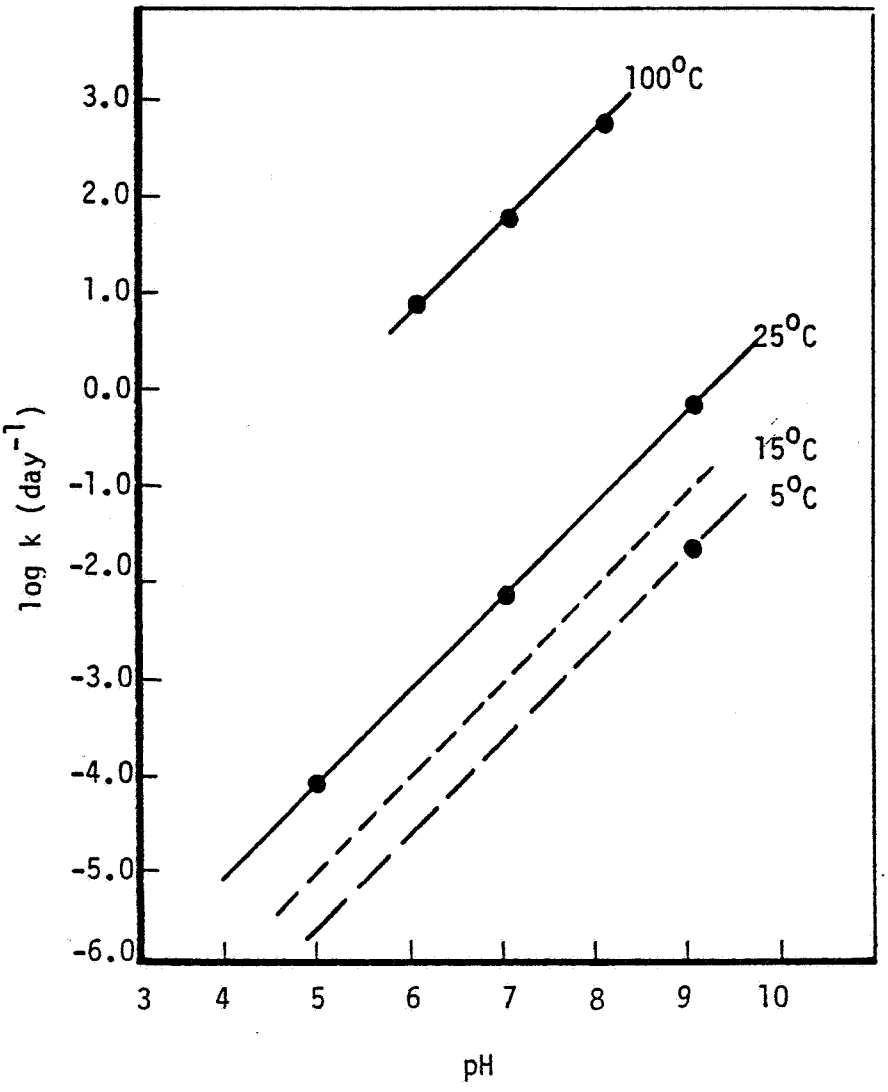
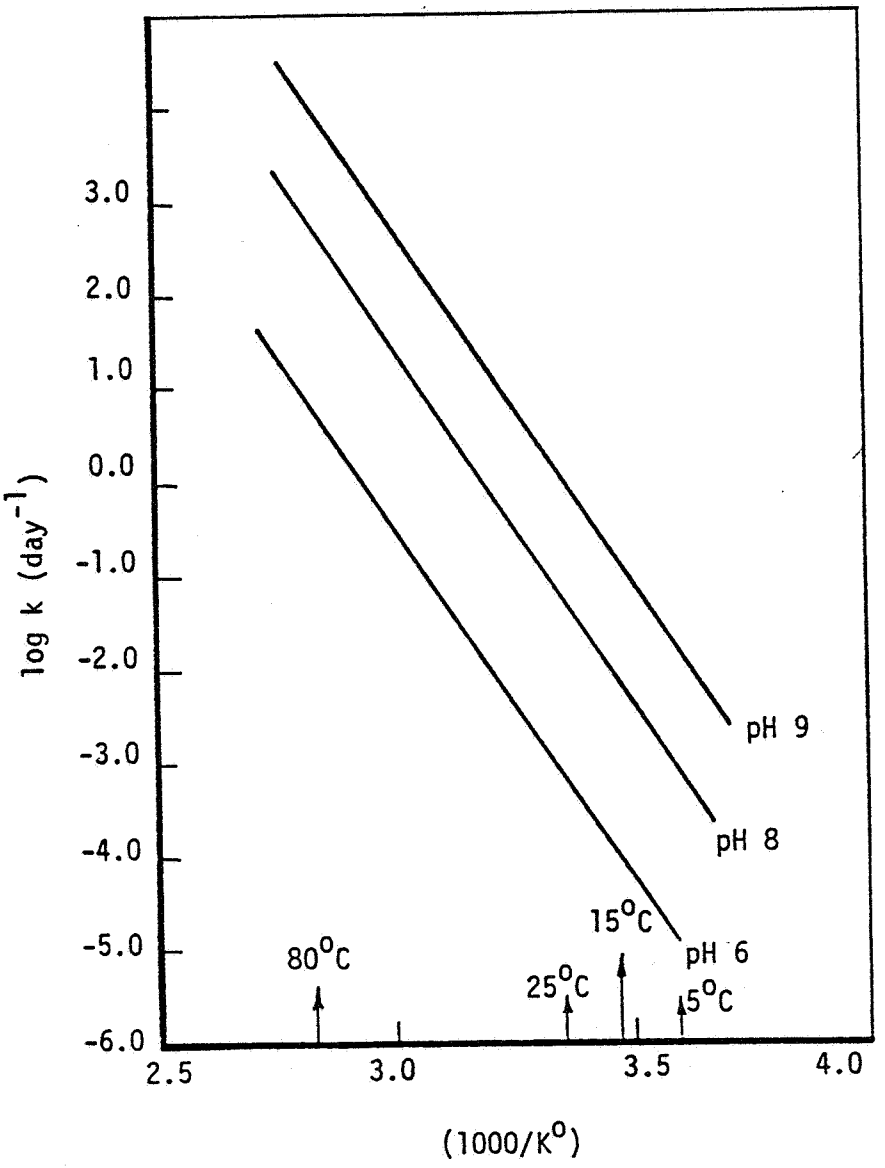


FIGURE 17

SULFONE HYDROLYSIS

ARRHENIUS PLOT



7.0 DATA SUMMARY

7.1 Monitoring Data

The analytical methods employed to monitor aldicarb residues in soil and/or water, determined the sum of aldicarb and its two major metabolites, aldicarb sulfoxide and aldicarb sulfone. Sensitivity is 1 ppb in water and 5 ppb in soils. Studies of the character of the residues in water from wells in eastern Long Island have confirmed that the two metabolites occur in a 50:50 ratio.

1. Long Island private home wells

Analysis of 7,650 private wells showed the followings:

(a) 73% of the wells had no residues.
(b) 13.4% had residues of 1-7 ppb.
(c) 7.4% had residues of 8-30 ppb.
(d) 4.3% had residues of 31-75 ppb.
(e) 2.1% had residues of >75 ppb.

Note that: (1) The 7 ppb guideline was set by the state of New York, however, it was not officially endorsed by the Science Advisory Panel (SAP); (2) The filter installation program installed at the expense of Union Carbide in Long Island, seems to be functioning satisfactory (last report came to our attention on 3/11/81); (3) An 85-foot deep soil core in Long Island showed residues fluctuating from none detected to residues of 10 ppb. Variations were evident throughout the entire core, that they may be due to sampling errors, if one considers the minimum detectable levels of residues in soils of 5 ppb (Last report came to our attention on 3/11/81); and (4) According to Union Carbide use of aldicarb products in Long Island had been discontinued.

2. Soil and Water Sampling in areas of Special Interest

These areas were: Wisconsin, Florida, Virginia, Washington-Oregon, California, and the lower Rio Grande Valley of Texas.

Aldicarb residues were detected in Wisconsin and Florida's ground-water at levels of up to 11 ppb in wells about 80-500 feet deep. In soils, aldicarb residues remained in the upper 1-2 feet of soil surface, with the exception of:

(a) Wisconsin: residues of 80 ppb were detected in soil layers 6 feet deep. Groundwater was encountered at 8 feet deep.

(b) Florida: residues of 122 ppb were detected in soil layers 8 feet deep. No sampling was taken below 8 feet

A note of interest here, in Wisconsin, two months soil sampling interval (June-September) showed losses of aldicarb residues in the upper 4 feet of soil and a slight gain in the 4-6 feet layer [85% loss in the surface, 1-foot, 53% loss in the 1-2 foot, and 26% loss in the 2-4 foot layer of soil]. Similarly, in Florida, a three months soil sampling interval (June-September), showed losses of aldicarb residues of 81% in the upper 1-foot, 27% in the 1-2 foot; 4% gain in the 2-4 foot, 27% gain in the 4-6 foot, and 260% gain in the 6-8 foot layer of soil.

3. Water sampling in high-use counties

Results of analyses of groundwater samples from 22 counties where aldicarb is known to be used in large quantities showed detectable residues in the fllowing counties:

(a) Aroostook County Main: residues of 20-23 ppb in a 50-foot deep well.
(b) Dunkin County, Missouri: residues of 26-31 ppb in a 100-foot deep well.
(c) Maricopa County, Arizona: residues of 6 ppb in an 18-foot deep well.

With the exception of the state of New York which was reported under 7.1 (2) above, all 18 other counties reported no residues in their groundwater.

7.2. Simulated Modeling

Union Carbide is currently searching for those field laboratory, and literature data that best be utilized as parametes in a simulated model that would perdict aldicarb residues of a given point and time. Presently, one model is being used, called the Hydrological Simulation Program-Fortran. It was developed for the EPA in Athens, Georgia by Hydrocomp, Inc., of California. (See 2·0).

The 1980 data collected from areas of special interest, were employed by Union Carbide to calculate half-lives for the disappearance of aldicarb and its residues. The disappearence rate was defined as the sum of the rates of processes associated with degradation, leaching, plant uptake, and volatilization.

According to Dr. Spiegel of Union Carbide, data base for the development of a "rough mathematical model" consists of, soil degradation study, hydrolysis studies, and soil sorption studies. A summary of these studies, accompanied with graphs and figures are included in the text. Some of these information will be made available to EPA personnel (C/o Dr. Einfield and Bob Carsel) in Athens, Georgia for calibrating and updating the aldicarb simulated model. It should be noted, however, that the soil degradation studies (3.7.2) and several other studies (3.7.4) needed for the mathematical model are in progress through, perhaps, 1982.

7.3 Science Advisory Panel's Opinion on Modeling [See also 2.0]

Prediction and evaluation of groundwater concentration by pesticides, were the topics of discussion by EPA personnel before the Science Advisory Panel (SAP) who convened an 3/25/81. After a lengthy presentation by Bob Carsel and Stuart Cohen of EPA, and Larry Balentine of Ciba-Geigy, the following points could be extrapolated:

(a) Simulated modeling to predict the fate of chemicals at anytime and at a given point still in its infancy. For a reliable model, there is a need for good field and laboratory data, coupled with literature data. For new chemical, the progress is very slow and the predictions are not very reliable.

(b) Bob Carsel stated that, at least at this stage, modeling should be used along with field data. For example, in five field studies on aldicarb monitoring, only two sets of data could be utilized for calibrating modeling parameters and that the remaining three were quite variable.

(c) Stuart Cohen stated that modeling should be used to predict if field testing should be done and where it could be done.

(c1) My personal opinion was revealed in the beginning of this review, long before I heard about SAP meeting which I wrote under 3.3(3): <<In my opinion, monitoring data should be given thorough considerations and that modeling, when perfected, should only serve as a guide for predicting the fate of chemicals in the environment noting that in statistical terms, expectations and observations are two differnt events where expectations are the results of modeling and observations are actual field and/or laboratory studies.>>

(e) SAP, finally gave their recommendations by encouraging EPA efforts in Athen, Georgia to continue on improving and

updating the mathematical model. They contended that modeling should not be expected to serve as a substitute for monitoring the fate of chemicals under field and laboratory conditions.

8.0 DATA GAPS

8.1 EUP Data

Personal communication with Union Carbide representatives, revealed that all EUP data performed during the latter part of 1979 and all throughout 1980, will be compiled and sent for our review. The permit was granted to study the fate of aldicarb in the environment and its hazards to groundwater under reduced rates and delayed timing of application [See details under 3.3(3)].

8.2 1981 Programs

Personal communication with Union Carbide representatives revealed that a program outline for 1981 had been submitted to Mr. Frank Sanders. A copy of this program was not routed for our review. However, the followings may be considered the highlight, for the 1981 program as we can best extrapolate them from this submission:

[A] Monitoring

Union Carbide intends to continue soil and groundwater monitoring in Wisconsin and Florida. In their Jan. 14, 1980 letter, they proposed program extension in these states beyond the 1980 to include a pre-treatment and at least two, perhaps three post-treatment soil and water residue series. A similar expansion of the Virginia location will be added, because the potential for groundwater residues may have been reduced by the extremely dry weather of 1980. These are:

1. Monitor the Delmarva sites to confirm the low probability of downward movement because of the very low 1980 rainfall.

2. Monitor a Wisconsin location to better define the degradation and transport phenomena in that area. Sufficient sampling will be done to establish a mass balance to determine the amount of carbamate residues which move to the groundwater. Do an analysis of the central sands hydrology to assess possible residue accumulation.

3. Do an analysis of the central Florida hydrolgy to further assess the probability of groundwater, contamination.

4. Carry on all programs agreed upon between EPA and Union Carbide in Suffolk County, New York.

[B] Modeling

1. The laboratory studies of factors affecting aldicarb movement and degradation in soils (3.7.2), applicaiton of these data to development of mathematical models, will be continued in 1981. Initial steady state and dynamic model development will be undertaken in 1981, with the intent of applying site-specific modeling at some location in 1982.

2. As a parallel to the mathematical modeling approach, Union Carbide, intends to refine the semi-quantitative rating system and test its applicability to some high use areas.

[C] Areas of Concern not considered by Union Carbide

These areas of concern where aldicarb residues were detected in significant amounts include: Aroostook County, Main; Dunklin County, Missouri; and Maricopa County, Arizona. We recommend that the 1981 program should include monitoring for aldicarb residues in soil and groundwater in these Counties.

9.0 RECOMMENDATIONS

9.1 Section [G] in Union Carbide's submission dealing with modeling aldicarb, was fully covered in our review. A copy of our review could be made available to Dr. Carl Einfield and Bob Carsel of the EPA in Athens, Georgia. However, in compliance with the 3/25/81 SAP recommendations, they may wish to review the entire section for calibrating and updating their aldicarb simulated modeling.

9.2 Section [H, 2 pages] in Union Carbide's submission should be reviewed by the Toxicology Branch.

9.3 In addition to the EUP data, data from the proposed 1981 test program; Union Carbide is asked to monitor aldicarb residues in soil and groundwater in Aroostook, Dunklin, and Maricopa Counties (See 8.0 above).

9.4 Union Carbide must comply with Environmental Chemistry data gaps listed under 1.5 in this review.

9.5 In the absence of the above data ~~gaps~~ (See 9.3 / See 1.5) we cannot concur ~~We recommend a full freeze~~ on ~~all~~ pending registration actions for aldicarb. Registered labels could be revised, or use could be curtailed depending on the outcome of future monitoring studies.

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Environmental Fate Branch
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