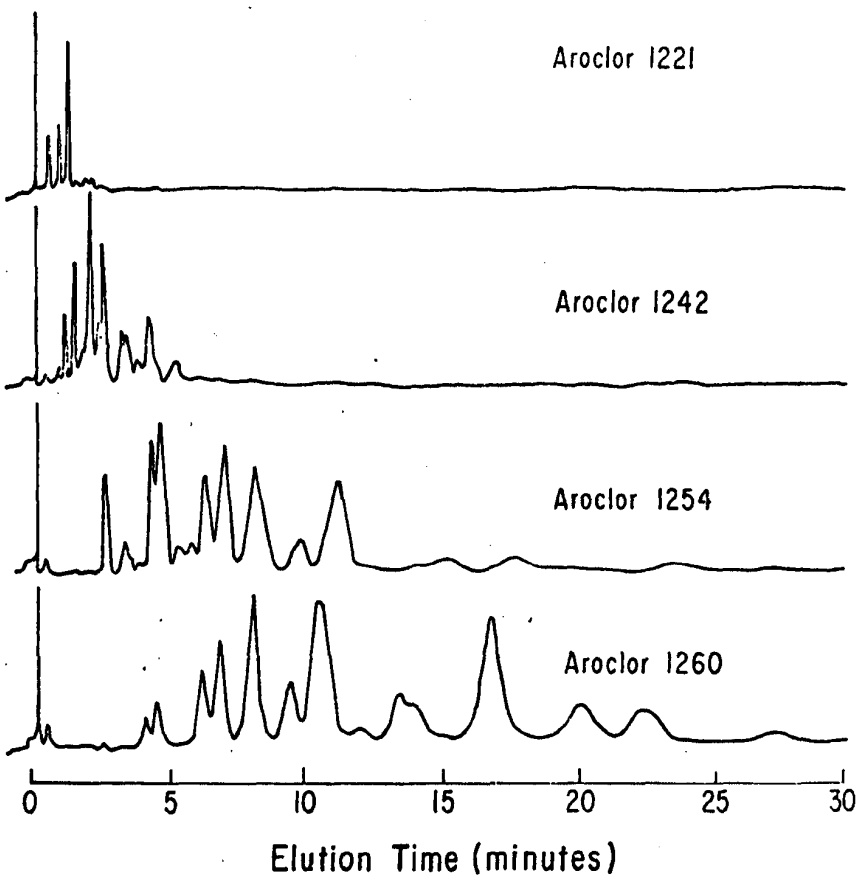
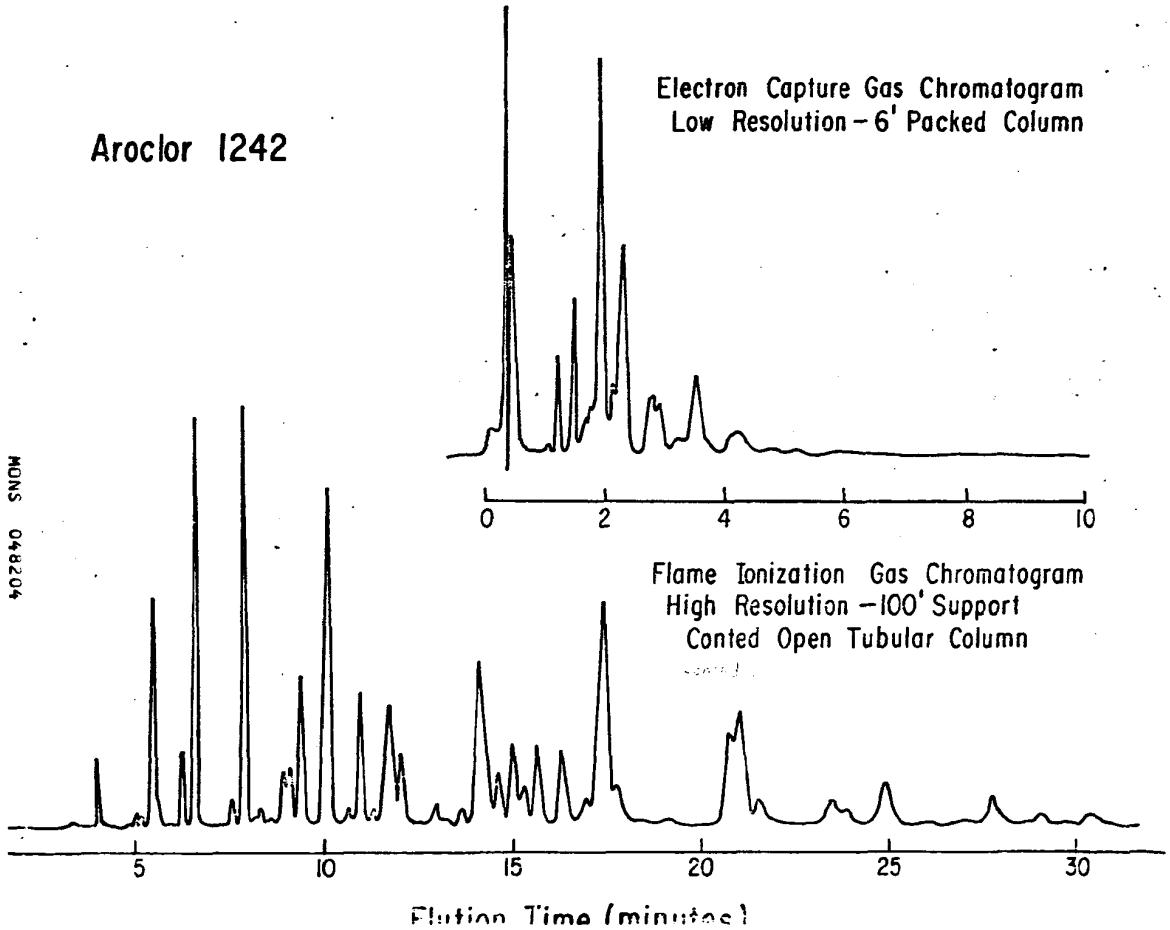
ASSESSMENT OF THE PERSISTENCE OF POLYCHLORINATED BIPHENYLS IN BIOLOGICAL SYSTEMS

MONS 048202

Electron Capture Gas Chromatograms



MONS 048203


Aroclor 1242
Electron Capture Gas Chromatogram
Low Resolution – 6' Packed Column
0
2
4
6
8
10
Flame Ionization Gas Chromatogram
High Resolution – 100' Support
Conted Open Tubular Column
5
10
15
20
25
30
Elution Time (minutes)
MONS 040204

PRIMARY BACTERIAL DEGRADATION STUDIES

- SEMI-CONTINUOUS ACTIVATED SLUDGE DEGRADATION

RESIDUE ACCUMULATION STUDIES

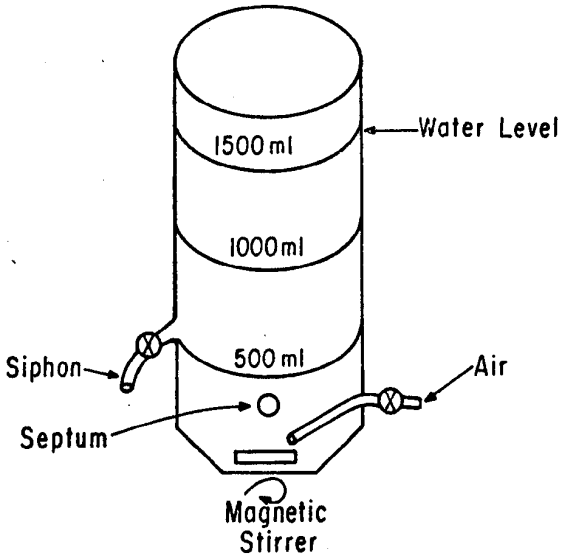
- FISH - CATFISH AND BLUEGILLS
- BIRDS - WHITE LEGHORN CHICKENS
- MAMMALS - ALBINO RATS AND BEAGLE DOGS

AROCLOR SEMI-CONTINUOUS ACTIVATED SLUDGE PRIMARY DEGRADATION STUDIES

MONS 048206

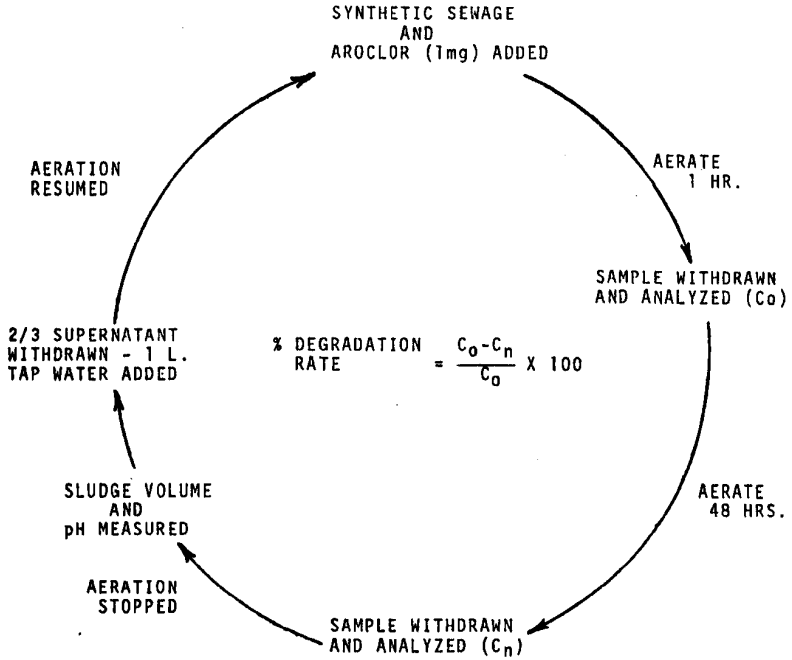
Activated

Semi-Continuous Activited Sludge Test Unit

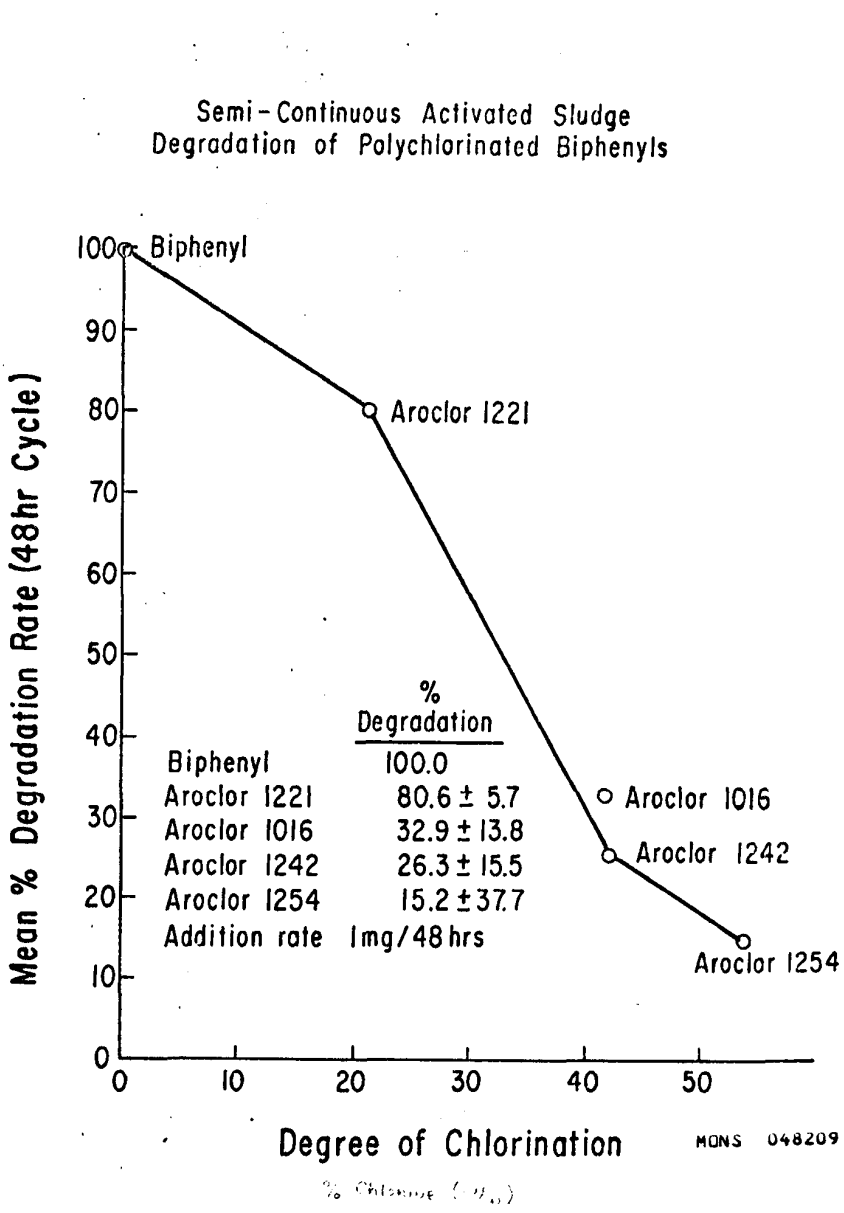


MONS 048207

MECHANICAL CYCLE

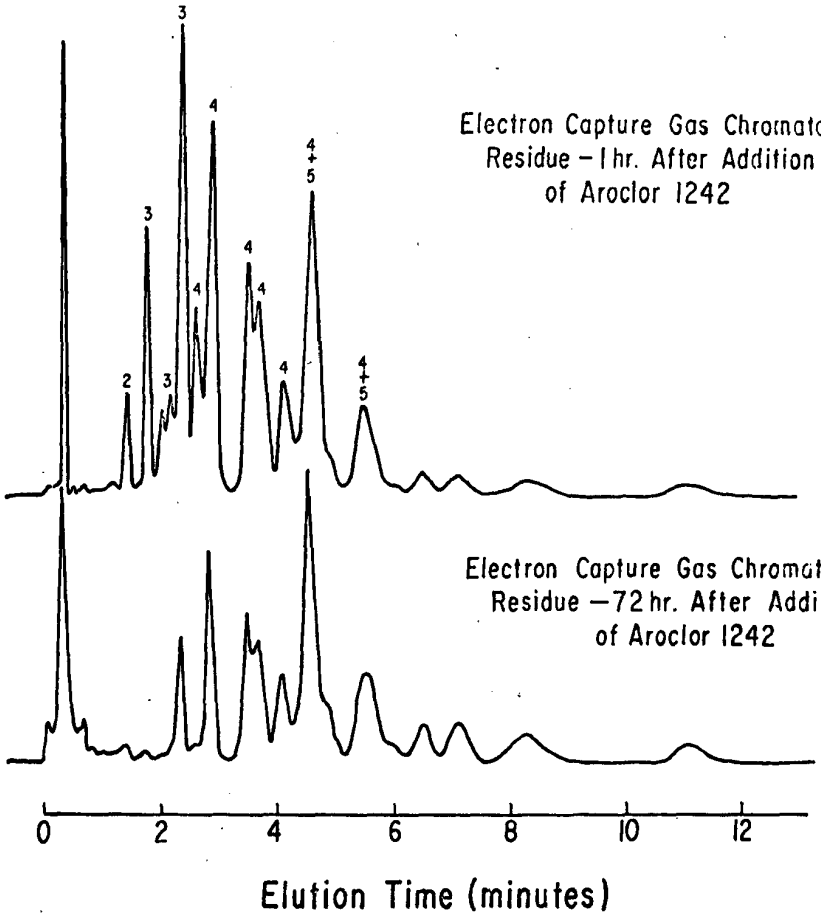


MONS 048208


Semi-Continuous Activated Sludge
Degradation of Polychlorinated Biphenyls
Mean % Degradation Rate (48hr Cycle)
100
90
80
70
60
50
40
30
20
10
0
Biphenyl
Aroclor 1221
Aroclor 1016
Aroclor 1242
Aroclor 1254
% Degradation
Biphenyl 100.0
Aroclor 1221 80.6 ± 5.7
Aroclor 1016 32.9 ± 13.8
Aroclor 1242 26.3 ± 15.5
Aroclor 1254 15.2 ± 37.7
Addition rate 1mg/48 hrs
0
10
20
30
40
50
Degree of Chlorination
% Chlorine (Wt.)
MONS 048209

Activated

Semi-Continuous Activitated Sludge Degradation of Aroclor 1242



MONS 048210

- BIPHENYL, MONO-, DI-, TRI-, AND TETRACHLORO BIPHENYL HOMOLOGS CAN UNDERGO PRIMARY BACTERIAL DEGRADATION

- RATE OF PRIMARY DEGRADATION DECREASES AS THE DEGREE OF CHLORINATION OF THE AROCLOR PRODUCT IS INCREASED

BIPHENYL>AROCLOR 1221>>AROCLOR 1016>AROCLOR 1242>AROCLOR 1254

AROCLOR RESIDUE STUDIES

MONS 048212

RESIDUE STUDIES* - CATFISH AND BLUEGILL FINGERLINGS

	21 DAY DYNAMIC
PRODUCTS STUDIED	AROCLOR 1016 AROCLOR 1242
NUMBER OF FISH	270
NUMBER OF SAMPLES WHOLE FISH	24
NUMBER OF SAMPLES ANALYZED WHOLE FISH	24

*BIONOMICS, INC.
WAREHAM, MASSACHUSETTS

RESIDUE STUDIES* - WHITE LEGHORN CHICKENS

PRODUCTS STUDIED		CHICKENS REPRODUCTION RESIDUE AROCLOR 1242 AROCLOR 1254 AROCLOR 1260	AROCLOR 1242
NUMBER OF CHICKENS	FEMALE	200	80
	MALE	40	16
NUMBER OF SAMPLES	MUSCLE	40	8
	LIVER	40	8
	FAT	40	8
	EGGS	~250	~60
	CHICKS	30	10
NUMBER OF SAMPLES ANALYZED	MUSCLE	14	5
	LIVER	12	4
	FAT	18	5
	EGGS	25	8
	CHICKS	11	10
TOTAL SAMPLES COLLECTED		400	121
TOTAL ANALYZED		80	32

*INDUSTRIAL BIO-TEST LABORATORIES, INC.
NORTHBROOK, ILLINOIS

RESIDUE STUDIES* - ALBINO RATS

PRODUCTS STUDIED		30 DAY ORAL AROCLOR 1242 AROCLOR 1254 AROCLOR 1260	2 YEAR CHRONIC ORAL AROCLOR 1242 AROCLOR 1254 AROCLOR 1260	3 GENERATION RAT REPRODUCTION AROCLOR 1242 AROCLOR 1254 AROCLOR 1260	90 DAY SUBACUTE ORAL AROCLOR 1221
NUMBER OF RATS	FEMALE	115	500	~20	60
	MALE	115	500	~20	60
NUMBER OF SAMPLES	MUSCLE	18	33	-	7
	KIDNEY	18	-	-	-
	LIVER	18	33	-	7
	FAT	18	33	-	7
	PUPS	-	-	10	-
NUMBER OF SAMPLES ANALYZED	MUSCLE	18	33	-	7
	KIDNEY	18	-	-	-
	LIVER	18	33	-	7
	FAT	18	33	-	7
	PUPS	-	-	10	-
TOTAL SAMPLES COLLECTED		144	198	20	42
TOTAL ANALYZED		72	99	10	21

*INDUSTRIAL BIO-TEST LABORATORIES, INC.
NORTHBROOK, ILLINOIS

RESIDUE STUDIES* - BEAGLE DOGS

PRODUCTS STUDIED		2 YEAR CHRONIC ORAL AROCLOR 1242 AROCLOR 1254 AROCLOR 1260	90 DAY SUBACUTE ORAL AROCLOR 1221
NUMBER OF DOGS)	FEMALE	40	14
	MALE	40	14
NUMBER OF SAMPLES)	MUSCLE	54	7
	LIVER	54	7
	FAT	54	7
TOTAL SAMPLES COLLECTED		242	21
NUMBER OF SAMPLES ANALYZED)	MUSCLE	42	7
	LIVER	40	7
	FAT	43	7
TOTAL ANALYZED		125	21

*INDUSTRIAL BIO-TEST LABORATORIES, INC.
NORTHBROOK, ILLINOIS

TWO YEAR CHRONIC ORAL EXPOSURE RESIDUE STUDY OF AROCLOR 1242, AROCLOR 1254, AND AROCLOR 1260 IN BEAGLE DOGS

RESIDUE STUDY OF AROCLOR 1242 IN BEAGLE DOGS

TWO YEAR CHRONIC ORAL EXPOSURE

ORAL EXPOSURE LEVEL	PPM PCBs			HOMOLOG DISTRIBUTION									
	1	10	100	1	2	3	4	5	6	7	8	9	10
*RESIDUE, IF TOTAL FED RETAINED	519	5186	51865	-	(2)	(3)	(4)	(5)	6	-	-	-	-
*RESIDUE, 2 YEAR EXPOSURE	2	6	12	-	-	(3)	(4)	5	6	(7)	(8)	-	-
*RESIDUE, 30 DAY RECOVERY	1	4	10	-	-	-	-	5	(6)	(7)	(8)	-	-
*RESIDUE, 60 DAY RECOVERY	0.8	3	6	-	-	-	-	5	6	(7)	(8)	-	-

*AVERAGE PPM IN LIPID - ALL TISSUES

( )ELECTRON CAPTURE PEAKS GREATER THAN 5% OF TOTAL

MONS 048218

RESIDUE STUDY OF AROCLOR 1254 IN BEAGLE DOGS

TWO YEAR CHRONIC ORAL EXPOSURE

	PPM PCBs			HOMOLOG DISTRIBUTION									
				1	2	3	4	5	6	7	8	9	10
ORAL EXPOSURE LEVEL	1	10	100										
*RESIDUE, IF TOTAL FED RETAINED	519	5186	51865	-	-	3	(4)	(5)	(6)	7	-	-	-
*RESIDUE, 2 YEAR EXPOSURE	7	30	132	-	-	-	-	(5)	(6)	(7)	8	-	-
*RESIDUE, 30 DAY RECOVERY	5	24	109	-	-	-	-	5	(6)	(7)	8	-	-
*RESIDUE, 60 DAY RECOVERY	4	20	88	-	-	-	-	5	(6)	(7)	(8)	-	-

*AVERAGE PPM IN LIPID - ALL TISSUES

( )ELECTRON CAPTURE PEAKS GREATER THAN 5% OF TOTAL

MONS 048219

RESIDUE STUDY OF AROCLOR 1260 IN BEAGLE DOGS

TWO YEAR CHRONIC ORAL EXPOSURE

	PPM PCBs			HOMOLOG DISTRIBUTION									
				1	2	3	4	5	6	7	8	9	10
ORAL EXPOSURE LEVEL	1	10	100										
*RESIDUE, IF TOTAL FED RETAINED	519	5186	51865	-	-	-	-	(5)	(6)	(7)	8	-	-
*RESIDUE, 2 YEAR EXPOSURE	8	63	388	-	-	-	-	-	(6)	7	(8)	-	-
*RESIDUE, 30 DAY RECOVERY	7	60	363	-	-	-	-	-	(6)	(7)	(8)	-	-
*RESIDUE, 60 DAY RECOVERY	7	55	337	-	-	-	-	-	6	(7)	(8)	-	-

*AVERAGE PPM IN LIPID - ALL TISSUES

( )ELECTRON CAPTURE PEAKS GREATER THAN 5% OF TOTAL

MONS 048220

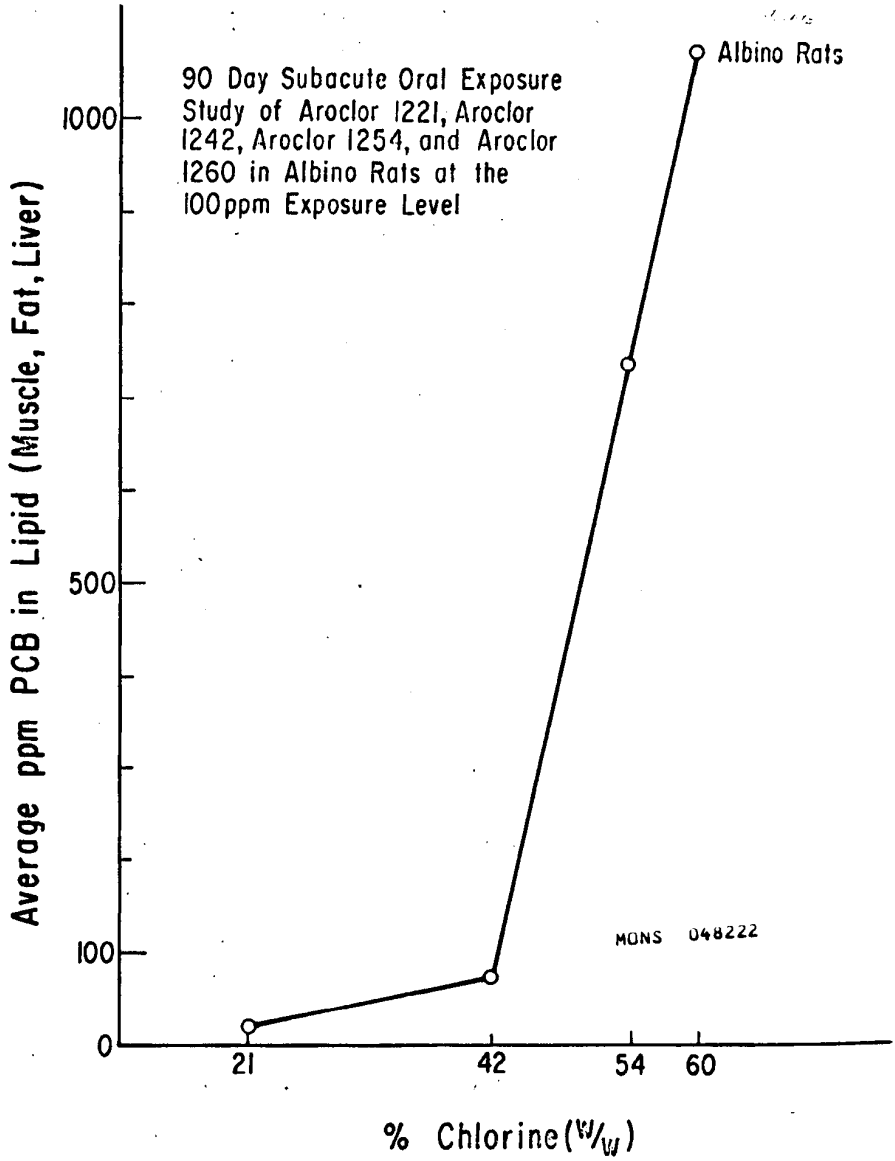
GENERAL CONCLUSIONS

I. RESIDUE BUILDUP RATE

- INCREASED AS THE EXPOSURE LEVEL INCREASED
- INCREASED AS THE EXPOSURE PERIOD INCREASED
- DECREASED EXPONENTIALLY AS THE DEGREE OF CHLORINATION OF THE PRODUCT FED DECREASED
- AROCLOR 1260>AROCLOR 1254>>AROCLOR 1242 >AROCLOR 1221
- FISH>>>>>>CHICKENS>RATS>DOGS
- CHICKENS (LIPID): FAT = MUSCLE>LIVER

  RATS (LIPID): LIVER>FAT = MUSCLE>KIDNEY

  DOGS (LIPID): LIVER>FAT = MUSCLE


90 Day Subacute Oral Exposure Study of Aroclor 1221, Aroclor 1242, Aroclor 1254, and Aroclor 1260 in Albino Rats at the 100ppm Exposure Level
Albino Rats
Average ppm PCB in Lipid (Muscle, Fat, Liver)
1000
500
100
0
21
42
54
60
% Chlorine (W/W)
MONS 048222

GENERAL CONCLUSIONS

I. RESIDUE BUILDUP RATE

- INCREASED AS THE EXPOSURE LEVEL INCREASED
- INCREASED AS THE EXPOSURE PERIOD INCREASED
- DECREASED EXPONENTIALLY AS THE DEGREE OF CHLORINATION OF THE PRODUCT FED DECREASED
- AROCLOR 1260>AROCLOR 1254>>AROCLOR 1242 >AROCLOR 1221
- FISH>>>>>>CHICKENS>RATS>DOGS
- CHICKENS (LIPID): FAT = MUSCLE>LIVER

  RATS (LIPID): LIVER>FAT = MUSCLE>KIDNEY

  DOGS (LIPID): LIVER>FAT = MUSCLE

	EXPOSURE LEVEL (PPM)	EXPOSURE PERIOD	CONCENTRATION FACTOR*
BLUEGILLS	0.1 (WATER)	21 DAYS	400,000
CATFISH	0.1 (WATER)	21 DAYS	320,000
WHITE LEGHORN CHICKENS	1.0 (FEED)	12 WEEKS	20
ALBINO RATS	1.0 (FEED)	2 YEARS	9
BEAGLE DOGS	1.0 (FEED)	2 YEARS	2

*CONCENTRATION FACTORS DO NOT TAKE INTO ACCOUNT EXPOSURE PERIODS

GENERAL CONCLUSIONS

I. RESIDUE BUILDUP RATE

- INCREASED AS THE EXPOSURE LEVEL INCREASED
- INCREASED AS THE EXPOSURE PERIOD INCREASED
- DECREASED EXPONENTIALLY AS THE DEGREE OF CHLORINATION OF THE PRODUCT FED DECREASED
- AROCLOR 1260>AROCLOR 1254>>AROCLOR 1242 >AROCLOR 1221
- FISH>>>>>>CHICKENS>RATS>DOGS
- CHICKENS (LIPID): FAT = MUSCLE>LIVER

  RATS (LIPID): LIVER>FAT = MUSCLE>KIDNEY

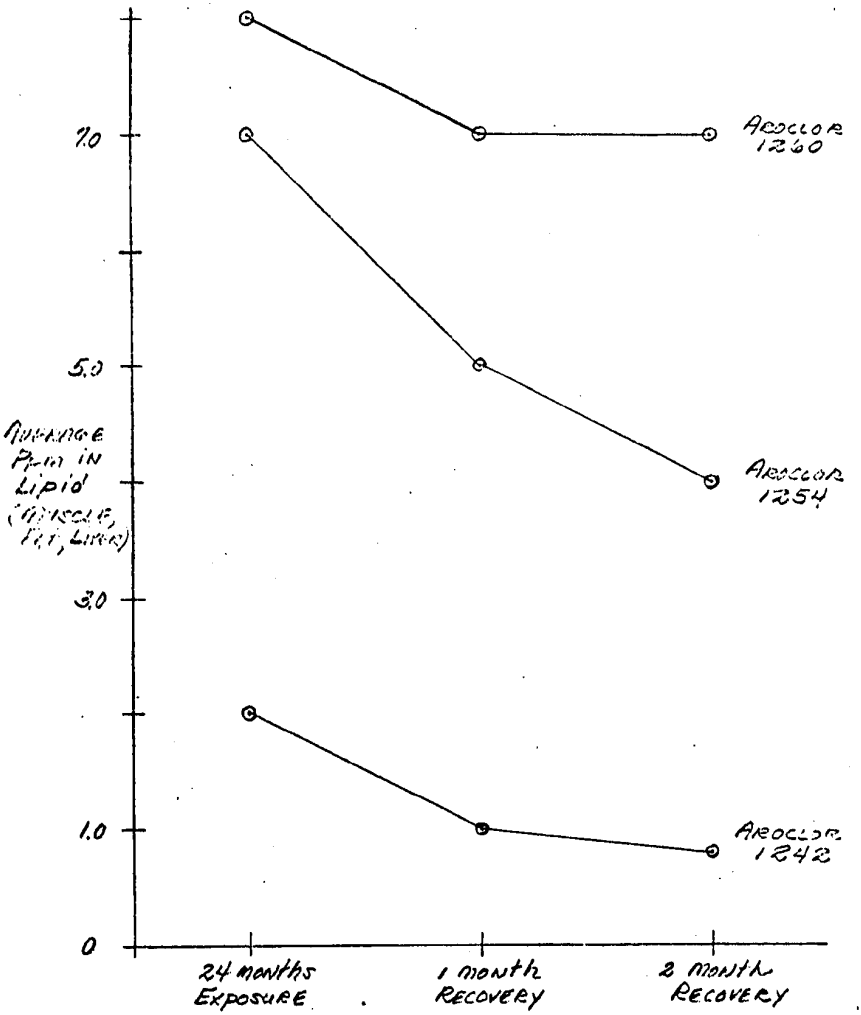
  DOGS (LIPID): LIVER>FAT = MUSCLE

GENERAL CONCLUSIONS

II. RESIDUE FALL OFF RATE

- INCREASED AS THE EXPOSURE LEVEL DECREASED
- INCREASED AS THE DEGREE OF CHLORINATION OF THE PRODUCT FED DECREASED
- AROCLOR 1242>AROCLOR 1254>AROCLOR 1260
- INCREASED AS RECOVERY PERIOD INCREASED
- DOGS>CHICKENS

TWO YEAR CHRONIC ORAL EXPOSURE IN BEAGLE DOGS AT THE 1 PPM LEVEL



MONS 048227

GENERAL CONCLUSIONS

II. RESIDUE FALL OFF RATE

- INCREASED AS THE EXPOSURE LEVEL DECREASED
- INCREASED AS THE DEGREE OF CHLORINATION OF THE PRODUCT FED DECREASED
- AROCLOR 1242>AROCLOR 1254>AROCLOR 1260
- INCREASED AS RECOVERY PERIOD INCREASED
- DOGS>CHICKENS

GENERAL CONCLUSIONS

III. ALTERATION OF THE HOMOLOG DISTRIBUTION OF PRODUCTS FED

- INDEPENDENT OF EXPOSURE LEVEL
- INDEPENDENT OF EXPOSURE PERIOD
- HIGHER CHLORINATED HOMOLOGS DOMINANTLY RETAINED (PENTA-, HEXA-, HEPTA-, OCTA-CHLORO BIPHENYLS)
- DOGS>RATS>CHICKENS>>>>>FISH*
- INCREASED AS DEGREE OF CHLORINATION OF PRODUCT FED DECREASED

  AROCLOR 1221>AROCLOR 1242>AROCLOR 1254 >AROCLOR 1260

*DISTRIBUTION UNALTERED BY FISH