POLYCHLORINATED BIPHENYL BIODEGRADATION STUDIES

The threat of continued accumulation of polychlorinated biphenyl (PCB) residues in the environment is responsible for much of the apprehension about the future use of these materials. Examination of the data collected to date from both external and internal PCB residue monitoring programs has confirmed that at their previous rate of release some persistent PCB homologs have begun to accumulate in the eco-system. Conversely, it can also be stated that, with the exception of direct high level controllable contamination, PCB homologs with less than 5 chlorine atoms have not accumulated in the eco-system although they have been released in an unrestricted fashion for many years.

This observation indicates that at the previous rate of release an environmentally compatible PCB product would be one containing no PCB homologs with greater than four chlorines per molecule. As has been previously stated, it is not commercially feasible to produce a product completely free of the persistant homologs. However, it is technically feasible to produce an industrially useful PCB product, Aroclor 1016, which contains significantly (10 to 20 times) lower levels of these persistent homologs.

Two questions remain which must be answered, first to what degree is biological degradation responsible for the disappearance of the "non-persistent" PCB homologs, and secondly, with controlled and restricted usage, will Aroclor 1016 be environmentally compatible.

In an attempt to answer these questions, a number of comparative experimental laboratory studies of the Aroclor products have been carried out to determine the extent to which these materials are degraded by bacterial, avian, mammalian, and aquatic organisms.

Bacterial Degradation - Semi-Continuous Activated Sludge (SCAS) Degradation Studies of Polychlorinated Biphenyls

Introduction

The semi-continuous activated sludge (SCAS) test procedure used to study the primary bacterial degradation[2] of polychlorinated biphenyls is patterned after the test method recommended by the sub-committee on biodegradation test methods of the Soap and Detergent Association for the evaluation of surfactants[3]. This procedure employs sludge from a sewage treatment plant as the source of microorganisms. A specific amount of the material being studied and a synthetic sewage mixture[4] are fed, on a periodic basis to the activated sludge in a specially designed aeration chamber. Aliquots of the mixed liquor (sludge + water) are withdrawn from the chamber shortly after feeding and near the end of the aeration period and analyzed to determine the disappearance rate of the test compound. This cycle is continuously repeated until a steady state[5] is achieved and consistent biodegradation rates are obtained. Details of the procedure may be found in the attached Analytical Chemistry Method 71-32.

Summary and Conclusions

SCAS testing of Aroclor 1254, Aroclor 1242, Aroclor 1016, MCS 1043, and Aroclor 1221 were carried out over an eight-month period.

Disappearance rate data were obtained during two sampling periods for Aroclor 1254, Aroclor 1242, Aroclor 1016, and MCS 1043. For Aroclor 1221 only one sampling period was employed. In the initial testing of these matsrials, a feed rate of 1 mg per 24-hour cycle was used. Because the data obtained from the first sampling period for all PCBs studied, except Aroclor 1221, were extremely erratic with little apparent biodegradation, the exposure period between additions of the test material was extended to 48 hours for all materials except Aroclor 1221.

Mean disappearance rates and 95% confidence limits obtained via statistical analysis of the data from the last sampling period are shown in Table I.

TABLE I

Test Material	% Cl (w/w)	Exposure Period (Hrs)	Mean Per Cent Disappearance Rate (Uncorrected)
Aroclor 1221	21	24	64.0 ± 13.6
MCS 1043	30	48	56.2 ± 15.5
Aroclor 1016	41	48	32.9 ± 13.8
Aroclor 1242	42	48	26.3 ± 15.5
Aroclor 1254	54	48	15.2 ± 37.7

It is apparent from inspection of Table I that degradation decreases as the degree of chlorination increases and that because of the uncertainty in the data that it is not possible to differentiate between Aroclor 1242 and Aroclor 1016 with respect to degradability at the 95% confidence level. This is not surprising since Aroclor 1016 constitutes ~80% of Aroclor 1242 and the resolving power of the test procedure is comparable to this difference.

Subsequent SCAS testing of Aroclor 1221 at a feed level of 1 mg was carried out to establish the significance of volatility losses, the effect of exposure period, and the reproducibility of the test procedure. The results obtained are shown in Table II.

TABLE II
Aroclor 1221

Exposure Period (Hrs)	Aeration Rate (CFH)	Volatility Losses (%)	Mean Per Cent Disappearance Rate Uncorrected	Corrected
24	0.5	16.1	74.9 ± 7.7	58.8
24	0.1	4.5	69.9 ± 17.8	65.4
24	0.1	-	81.0 ± 18.6	-
48	0.1	-	80.6 ± 5.7	-

The data in Table II demonstrate that volatility losses can and do occur and that these losses are a function of the aeration rate and hence also the vapor pressure of the test material in question. It

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is, therefore, reasonable to assume that as the degree of chlorination increases that volatility losses would become insignificant.

The fact that the corrected disappearance rates do not vary with aeration rate also indicates that the volatile components of Aroclor 1221 are subject to degradation and that even if they were not lost in this manner they should not appreciably effect the observed degradation rate.

The mean uncorrected Aroclor 1221 disappearance rates for the 24-hour and 48-hour exposure periods were for all practical purposes equivalent, establishing that when dealing with complex mixtures, a simple linear extrapolation of disappearance rates as a function of exposure period is not valid.

Electron-capture gas chromatography analyses of samples taken at the end of the aeration cycle showed that the lower level of chlorination the greater the changes in the homolog distribution. For Aroclor 1221, the dominant monochloro- and dichlorobiphenyl homologs almost completely disappear after 24 hours of exposure to activated sludge. Similar changes in the ratio of the higher chlorinated homologs to lower ones were noted for the other PCBs studied with the exception of Aroclor 1254. For Aroclor 1254, no significant change in the homolog distribution was observed.

At the feed levels employed, no toxic effects toward the activated sludge were observed for any of the test compounds. Does this mean the bacteria were still active - that the sewage plant would not be rendered inoperable?

Results and Discussion

The sampling and analytical procedures employed in the disappearance rate determination of a test compound during a cycle were as follows: A 20-ml sample of the mixed liquor (activated sludge + liquor) was withdrawn one hour after feeding and at the end of the aeration period. The sample of mixed liquor was then extracted and the extract concentrated according to the procedure given in Analytical Chemistry Method 71-18. The concentration of test compounds was then determined either by an ultraviolet (UV) spectroscopic or electron-capture gas chromatographic (EC-GC) method. Details of the UV methods are given in Analytical Chemistry Method 71-17 and the EC-GC methods in Analytical Chemistry Method 71-35. The disappearance rate was calculated from the following equation:

$$\% \text{ Disappearance Rate} = \frac{C_o - C_n}{C_o} \times 100$$

Where C_o = level of test material present after feeding

C_n = level of test material present after n hours of exposure

Tests were carried out to determine if quantitative recovery of the various test materials from the mixed liquor was achieved by the extraction procedure. Details are given in Analytical Chemistry Method 71-17. Although complete recovery was not achieved in all cases, the recoveries were consistent and independent of concentration level. The calculated disappearance rates should, therefore, not be affected significantly.

Since the level of chlorination is the most significant factor in the relative biodegradability of the PCBs, the homolog distribution of the various test materials is given in Table III.

TABLE III

HOMOLOG DISTRIBUTION OF POLYCHLORINATED BIPHENYL PRODUCTS

Homolog No. of Cl Per Biphenyl Molecule	Aroclor 1254 (54% Cl)	Aroclor 1242 (42% Cl)	MCS 1016 (41% Cl)	MCS 1043 (30% Cl)	Aroclor 1221 (21% Cl)
0	0.05	0.01	0.02	0.11	19.00
1	0.06	0.70	1.00	23.4	54.10
2	0.32	15.50	19.70	71.3	20.40
3	0.78	49.40	57.30	5.2	3.90
4	22.99	24.80	21.20		2.30
5	47.38	8.70	0.80		0.25
6	19.75	0.85	0.05		
7	4.62				
8					
9	3.96				
10					

Feeding of the Aroclor 1254, Aroclor 1242, Aroclor 1016, and MCS 1043 units was started on 8-10-70 at a feed level of 1 mg per 24-hr cycle. These units were sampled for approximately one month starting with the first day of feeding. All analyses were carried out by electron-capture gas chromatography. The data obtained were extremely erratic. A statistical analysis of the data (Statistics Special Study 70-22) using the Student's t test indicated that at the 95% significance level, only MCS 1043 showed evidence of biodegradation. Both Aroclor 1016 and Aroclor 1242 showed some evidence of biodegradation, but neither was significant at the 95% level. Aroclor 1254 showed no evidence of biodegradation. In order to detect biodegradation at the 95% level of significance in 20 observations, about one-half of the test materials must be degraded in a cycle. The lack of significant biodegradation during the first sampling period was probably due in part to the need for an acclimation period by the bacterial sludge. Subsequent spot checks on the unit, however, indicated that the data obtained were still erratic. Because of the apparent slow rate of biodegradation of these materials, the cycle time was increased to 48 hours in the hope that larger differences would be observed between the before and after feeding samples.

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Feeding of the Aroclor 1221 unit was started on 10-27-70 at a feed level of 1 mg per 24 hours. Aroclor 1221, because of its higher rate of disappearance was maintained on the 24-hour cycle. Sampling of the unit was started 1-25-71 and completed 1-29-71. Analyses were carried out by electron-capture gas chromatography.

The final sampling period for the Aroclor 1254, Aroclor 1242, Aroclor 1016, and MCS 1043 units at a ~~feed rate~~ of 1 mg per 48-hour cycle was started 2-8-71 and completed 3-8-71. Both UV and EC-GC analyses were carried out; the UV data was used to determine the overall disappearance rate and the EC-GC to monitor the change in homolog distribution.

In Figures 1-1 to 4-2, the observed data from which the mean disappearance rates were calculated are shown for both sampling periods for Aroclor 1254, Aroclor 1242, Aroclor 1016, and MCS 1043. In Figure 5, similar data for Aroclor 1221 is shown for a single sampling period. In the top chart of each figure the total mg found in the unit at the beginning and end of each cycle is plotted versus the elapsed time in days after the start of the test. The after feeding sample is denoted by the solid circle; the before feeding sample by the arrowhead; the connecting line indicates the amount lost during each cycle. In the lower chart of each figure, the disappearance rate obtained is plotted versus elapsed time. In Table IV the mean disappearance rate and 95% confidence limits obtained for the test compound during the various sampling periods are given. Since the analyses for Aroclor 1221 were carried out by EC-GC, the disappearance rate does not include any decrease in the biphenyl component (see Table III for Aroclor 1221 composition).

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TABLE IV

SCAS MEAN DISAPPEARANCE RATES FOR POLYCHLORINATED BIPHENYL PRODUCTS*

Sampling Period/ Cycle Time	Mean Disappearance Rate ±95% Confidence Limits				
	Aroclor 1254	Aroclor 1242	MCS 1016	MCS 1043	Aroclor 1221
1/24 Hours	-29.0±58.7	11.0±19.5	3.6±19.0	4.7±22.0	
2/24 Hours					64.0±13.6
3/48 Hours	15.2±37.7	26.3±15.3	32.9±13.8	56.2±15.5	

*Identification of feed material in SCAS tests

Aroclor 1254	Lot AK-38
Aroclor 1242	Lot AK-255
Aroclor 1016	Sample No. 1, OR 158591
MCS 1043	Sample No. 2, OR 158591
Aroclor 1221	Lot AK-2

Can you get 11.0 ± 19.5 = |11.0 − 19.5| i.e. gain in PCBs 8.5% ???

In order to make certain that the observed disappearance rates were not due primarily to volatility losses, scrubbing experiments on the most volatile test material, Aroclor 1221, were carried out in which the off-gases from the units were passed through a series of three hexane scrubbers during a complete time cycle. Data were obtained at both 0.1 and 0.5 SCFH aeration rates. The data established that at the 0.5 SCFH air flow volatility losses were ∿16%, at an aeration rate of 0.1 SCFH the volatility losses were reduced to ∿5%, while the overall disappearance rate was essentially the same as that obtained at 0.5 SCFH. This means that the components lost by volatilization are for all practical purposes completely degradable and the disappearance rate (64.0%) obtained represents actual biodegradation.

Since the volatility of the PCBs decreases with increasing level of chlorination, the volatility losses should likewise decrease. From the volatility losses observed for Aroclor 1221, one would not expect such losses to be a significant factor in test disappearance rates for MCS 1043, Aroclor 1016, Aroclor 1242, and Aroclor 1254.

From the data in Table IV and Figures 1-1, 2-1, 3-1, 4-1, it is quite apparent that the disappearance rate data obtained for Aroclor 1254, Aroclor 1242, Aroclor 1016, and MCS 1043 during the first sampling period was very erratic. The data obtained during the last sampling period as shown in Table IV and in Figures 1-2, 2-2, 3-2, and 4-2 was a significant improvement. From the latter data, the following ranking in terms of biodegradability can be made:

Aroclor 1221>MCS 1043>Aroclor 1016≅
Aroclor 1242>Aroclor 1254

In Figure 6, the mean disappearance rate is plotted versus the per cent chlorine in the test compound. The mean per cent disappearance rate for biphenyl was obtained in a previous study (Statistics Special Study 71-2). It is apparent that the disappearance rate decreases with increasing levels of chlorination.

As was previously noted, selected samples from the last sampling period were analyzed by EC-GC to monitor changes in homolog and isomer distribution. In Figure 7, chromatograms for Aroclor 1221 are shown.

The top trace is a chromatogram of an Aroclor 1221 standard representative of the feed material. The center chromatogram is that of a sample taken at the end of the exposure period or aeration cycle. The bottom chromatogram is that of an Aroclor 1242 standard run under the same GC conditions as the other chromatograms. The numbers above each peak indicate the dominant homolog represented by that peak according to GC-mass spectroscopic determination.

It is important to note that the electron-capture detector does not have the same response for all components. The sensitivity of the detector generally increases as the degree of chlorination increases. From the chromatograms in Figure 7, it is apparent that the dominant monochlorobiphenyl and dichlorobiphenyl components of Aroclor 1221 have almost completely disappeared after a 24-hour cycle, while there is an apparent buildup of the minor higher chlorinated isomers. These minor components, because of the increase in detector sensitivity with chlorination level, are amplified in the chromatograms compared to their true weight per unit basis. Comparison of the extract chromatogram to that of the Aroclor 1242 standard shows that these minor components in Aroclor 1221, which are more resistant to degradation, comprise the major components of Aroclor 1242.

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In Figure 8, similar chromatograms are shown for MCS 1043. Comparison of the extract chromatogram to that of the standard again shows that the lower chlorinated isomers or homologs disappear more rapidly while a buildup of higher chlorinated components occurs.

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In Figures 9 and 10, chromatograms for Aroclor 1016 and Aroclor 1242 extracts and standards are shown. With these more highly chlorinated products, the change in homolog distribution are not as dramatic compared to the lower chlorinated products. The buildup of the more refractory penta- and hexachlorobiphenyl homologs is apparent.

For Aroclor 1254, chromatograms have not been included since no significant change in homolog or isomer distribution was observed during the testing period.

At the conclusion of the final sampling periods for Aroclor 1254, Aroclor 1242, Aroclor 1016, and MCS 1043, feeding of the test compound was stopped. The units were then monitored over a period of time to determine how rapidly the residues remaining from the various test compounds disappeared. In Table V, the mg of residue found at various time intervals after the last feeding are shown. As expected, the lower the level of chlorination the more rapidly the residue disappears. For Aroclor 1254, it is apparent that no significant decrease in the residue occurred over the period studied.

Δ mg appears same order of magnitude for both A.1254 + A.1242.

TABLE V

Days After Last Feeding of Test Compound	Mg of Residue			
	Aroclor 1254	Aroclor 1242	MCS 1016	MCS 1043
3	5.38 (Δ = 0.88)	2.62 (Δ = 0.33)	2.26	1.24
5	4.50 (Δ = 0.56)	2.29 (Δ = 0.82)	1.16	1.06
7	4.94	1.47	1.31	0.70
10	7.42 ??	1.76	1.17	0.75

Residue Studies for Polychlorinated Biphenyls (PCBs) in Fish, Birds and Mammals

Introduction

Early in 1969, after confirmation of Jensen's[6] identification of PCB residues in Swedish birds and fish, Monsanto began initiating a series of Aroclor toxicity-tissue residue studies. The general objective of these studies was to learn more about the environmental behavior and potential effects of PCBs.

As indicated by the title of this appendix, it will deal only with the results of the residue work. Appendix should be consulted for the results of the toxicity work.

The specific objectives of the tissue residue studies with fish, birds and mammals were to learn more about:

1. tissue storage levels as a function of exposure time and exposure level,

2. the character of the PCB residues retained from the various Aroclor products, and

3. the rate at which PCB residues disappear once exposure ceases.

To date, analyses of tissues collected from nine[7] toxicity-tissue residue studies have been completed. The tissue samples were collected, quick frozen, and shipped by the consultant laboratories to Monsanto Industrial Chemicals Company. Upon receipt, the tissues were analyzed for PCB residues by Monsanto personnel in accordance with Analytical Chemistry Method 71-35.

In the first two tissue collection studies all samples were analyzed. In the subsequent studies, a statistical approach was employed because of the large number of samples In this manner, both the elapsed time and manpower requirements were minimized with little real loss in either accuracy or precision. The approach involved analysis of a balanced sub-set (~25-30%) of the tissues collected. The data from the balanced sub-set of samples, the appropriate study variables (tissue, exposure period, exposure level, sex, and Aroclor fed), and the most probable variable interactions were then used to generate an interpolation equation via multiple regression analysis. The initial equation was then smoothed by deleting data more than two standard deviations from the predicted values and the variable interaction terms not significant at the 95% confidence level. The final equations were then used to calculate the PCB residue levels in the un-analyzed tissues.

The validity of each of the predicting equations was established in the following manner. The respective residual standard deviations of each equation was compared to those obtained for the equations developed for the two studies in which all samples were analyzed. The 95% confidence limits calculated for these studies from the log of the residual standard deviations indicated that in all studies the actual values determined by analyses would be ~0.5-2 times the predicted values.

Summary and Conclusions

The most significant conclusion which can be drawn from these residue studies is that it supports what has and is being observed via residue analysis of environmental samples. That is to say, that from a "residue viewpoint", the bulk of the PCB isomers which have been released to the environment (PCBs with less than 5 chlorines) are subject to degradation. Since degradation of these PCB isomers can and does occur at significant rates they in turn should not be a long term threat to the higher members of the food chain.

In Figure 11, the observed PCB residue levels for rats and dogs exposed to Aroclor 1221, Aroclor 1242, Aroclor 1254 and Aroclor 1260 for 90 days is plotted vs the degree of chlorination of the product fed. It graphically illustrates that PCB storage levels decrease exponentially as the degree of chlorination of the product decreases. This exponential decrease simply reflects the refractory PCB content of each product produced via direct chlorination.

Considerable differences were noted in concentration factors as judged by the ratio of the PCB level found in the extractable lipid to the exposure level. Fish were found to be most efficient PCB concentrators followed by chickens, rats and then dogs. The calculated concentration factors observed for Aroclor 1242 are shown in Table VI.

TABLE VI

	Exposure Level (PPM)	Exposure Period	Max. Observed PCB Level in Lipid	Concentration Factor* (ppm ?)
Blue Gills	0.1 in wtr.	21 Days	4.0%	400,000
Catfish	0.1 in wtr.	21 Days	3.2%	320,000
White Leghorn Chickens	1.0 in feed	12 Weeks	20 PPM	20
Albino Rats	1.0 in feed	2 Years	9 PPM	9
Beagle Dogs	1.0 in feed	2 Years	2 PPM	2

*NOTE: Factors do not take into account exposure periods

Calculation of concentration factors in this fashion for chickens, rats, and dogs can be misleading. For example, ratio of total PCBs retained to that orally ingested by chickens, rats and dogs is shown in Table VII.

TABLE VII
Test Material - Aroclor 1242

	Exposure Level		
	1 PPM	10 PPM	100 PPM
White Leghorn Chickens	0.11	0.11	0.11
Albino Rats	0.02	0.01	0.003
Beagle Dogs	0.005	0.001	0.0003

Does this mean that higher the feed level the less PCB is retained?

Inspection of the ratios illustrates that the higher members of the food chain are in fact inefficient PCB concentrators.

Decrease of PCB residues was noted with both chickens and dogs placed on PCB free recovery diets. The dogs remobilized the residues more rapidly than chickens. In both studies, the residue levels fell more rapidly the lower the degree of chlorination of the product fed.

Figure 12 illustrates this point. In it the % total PCBs accumulated in the lipid is plotted vs the recovery periods for the Two Year Beagle Dog Study with Aroclor 1242, Aroclor 1254, and Aroclor 1260.

Figures 13-22 are bar graphs constructed from electron capture gas chromatograms of the product fed and the isolated PCB residues. The bar graphs were constructed by normalization to a convenient peak present in each of the chromatograms being compared. The numbers above each bar indicate the dominant homolog or homologs as determined by mass spectrometry. In no case were the residue fingerprints observed to be a function of the exposure level.

Figures 13-15 compare the distributions observed for residues isolated from fish, chickens, rats and dogs exposed to Aroclor 1242, Aroclor 1254, and Aroclor 1260. Inspection of these figures demonstrates that fish absorbed Aroclor 1242 without altering the isomer distribution. Dogs were found to be most effective at selectively degrading the Aroclor products followed by rats and the chickens. The figures also indicate that, with minor exceptions, the lower chlorinated isomers present in each product are more easily degraded.

Figures 16-18 illustrate the make up of the residues isolated from dogs after 2 years of continuous exposure followed by 30 and 60 day recovery periods on PCB free diets. Inspection of these figures reveals that the bulk of the isomers observed in the dogs sacrificed after two years of continuous exposure rapidly degraded once exposure ceases.

Figures 19-21 illustrate the alterations observed when chickens exposed to these three Aroclor products for 12 weeks were placed on recovery diets for 30 days. Although the degradation was less extensive than observed with dogs, the same general trends were noted.

In Figure 22, the isomer distribution of Aroclor 1242 and the residues isolated from rats fed Aroclor 1242 and Aroclor 1016 for 90 days are shown. Although the difference in the total % chlorine in these products is negligible the isomer distribution of the residues are significantly different. This difference can be explained by the fact that the higher chlorinated biphenyl content of Aroclor 1016 relative to Aroclor 1242 has been reduced by a factor of twenty.

The actual residue levels as determined by analysis and interpolation are shown in Tables VIII - XXXII.

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4. Synthetic Sewage: 30g. dextrose, 20g. nutrient broth, and 13g. dipotassium hydrogen phosphate in one liter of water.

5. Swisher, R. D., Surfactant Biodegradation, Marcel Dekker, Inc., N.Y. (1970) pp 173, 175-186.

6. Jensen, S. (1966) "Report of a New Chemical Hazard", New Scientist (32) 612.

7. IBT B7009 30-Day Tissue Collection Study In Albino Rats with Aroclors

IBT B7298 Two-Year Chronic Oral Toxicity Study of Aroclor 1242, Aroclor 1254, Aroclor 1260 in Albino Rats

IBT P7297 Three-Generation Reproduction Study in Albino Rats with Aroclor 1242, Aroclor 1254, Aroclor 1260

IBT 9888C 9888D 90-Day Subacute Oral Toxicity Study of Aroclor 1016, Aroclor 1221 in Albino Rats

IBT C7299 Two-Year Chronic Oral Toxicity Study of Aroclor 1242, Aroclor 1254, Aroclor 1260 in Beagle Dogs

IBT 9887 9885 90-Day Subacute Oral Toxicity Study of Aroclor 1016, Aroclor 1221 in Beagle Dogs

7. Continued

IBT J7300 Toxicity, Reproduction and Residue Study of Aroclor 1242, Aroclor 1254, Aroclor 1260 in White Leghorn Chickens

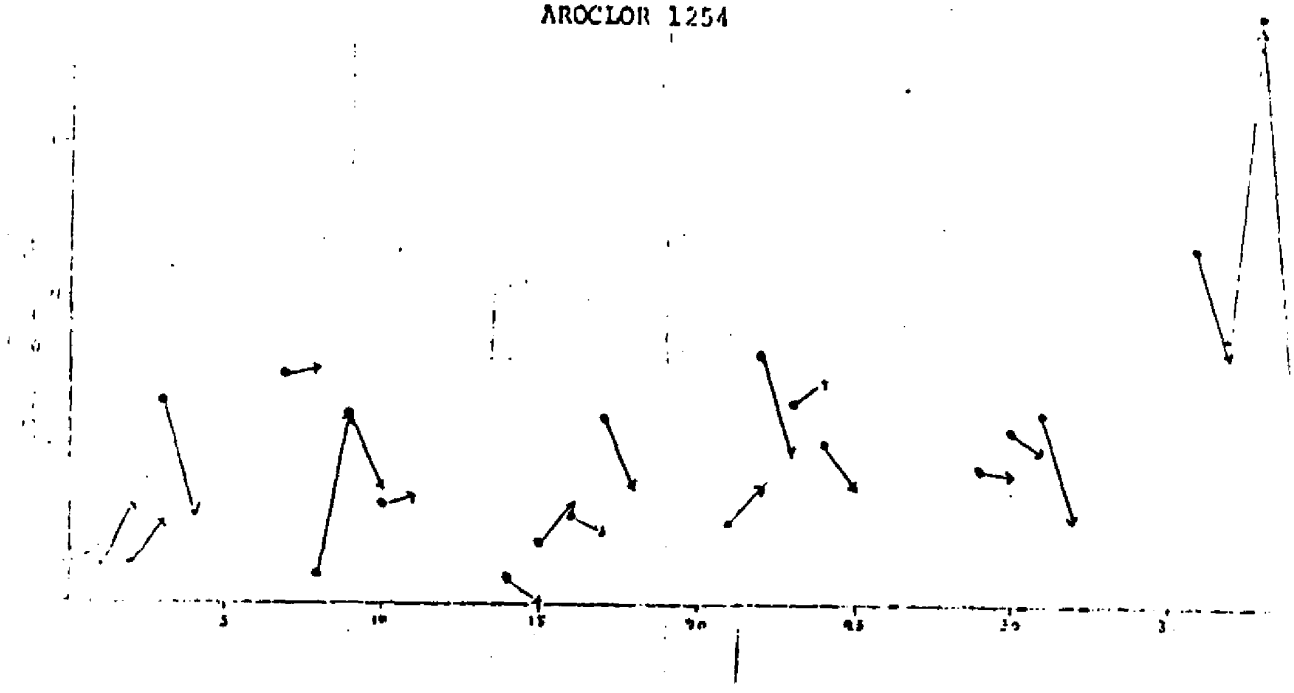
IBT 8746 Toxicity, Reproduction and Residue Study of Aroclor 1242, Lot #AK-255 in White Leghorn Chickens

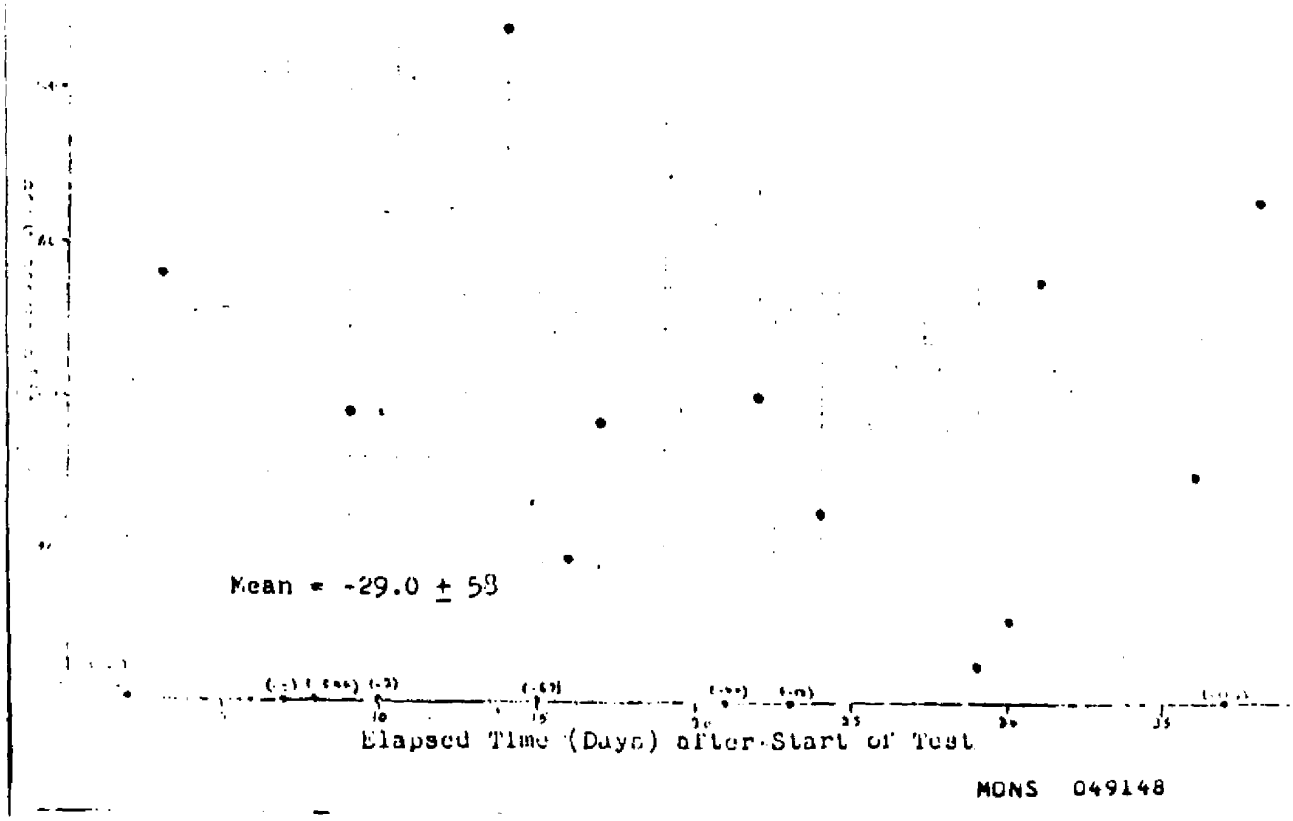
The following study was carried out at Bionomics, Inc. of Wareham, Massachusetts.

Acute Toxicity of Aroclor 1016, Aroclor 1242, and DDT to Bluegill and Channel Catfish During 21 Days Continuous Exposure to the Chemicals in Water.

SCAS BIODEGRADATION DATA

AROCLOR 1254





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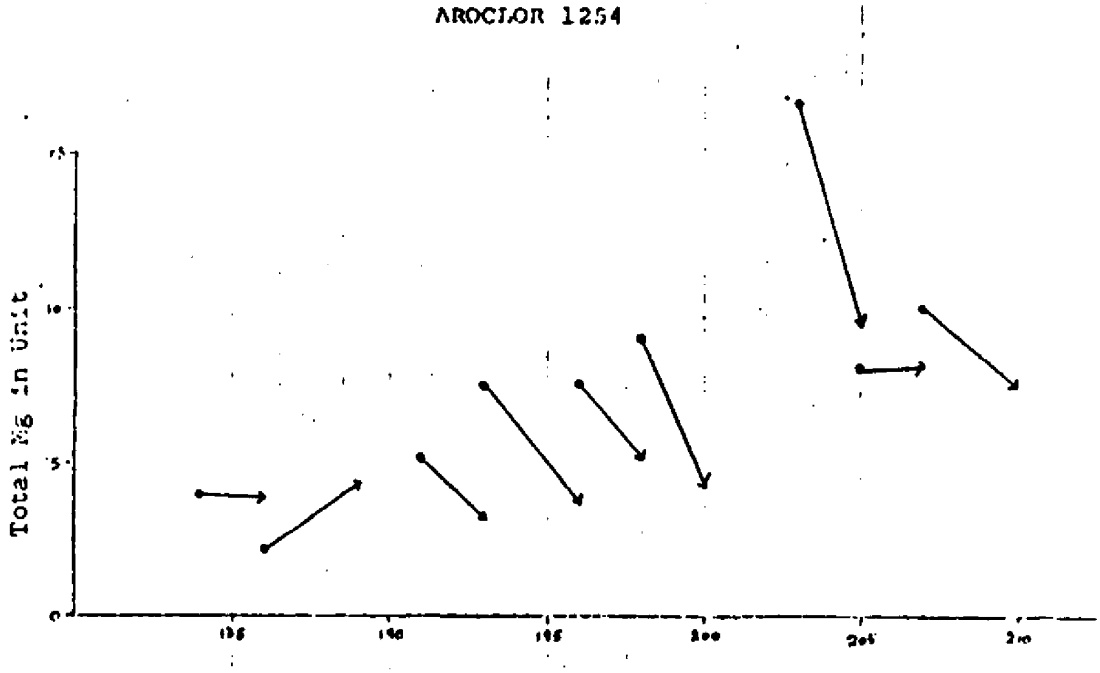
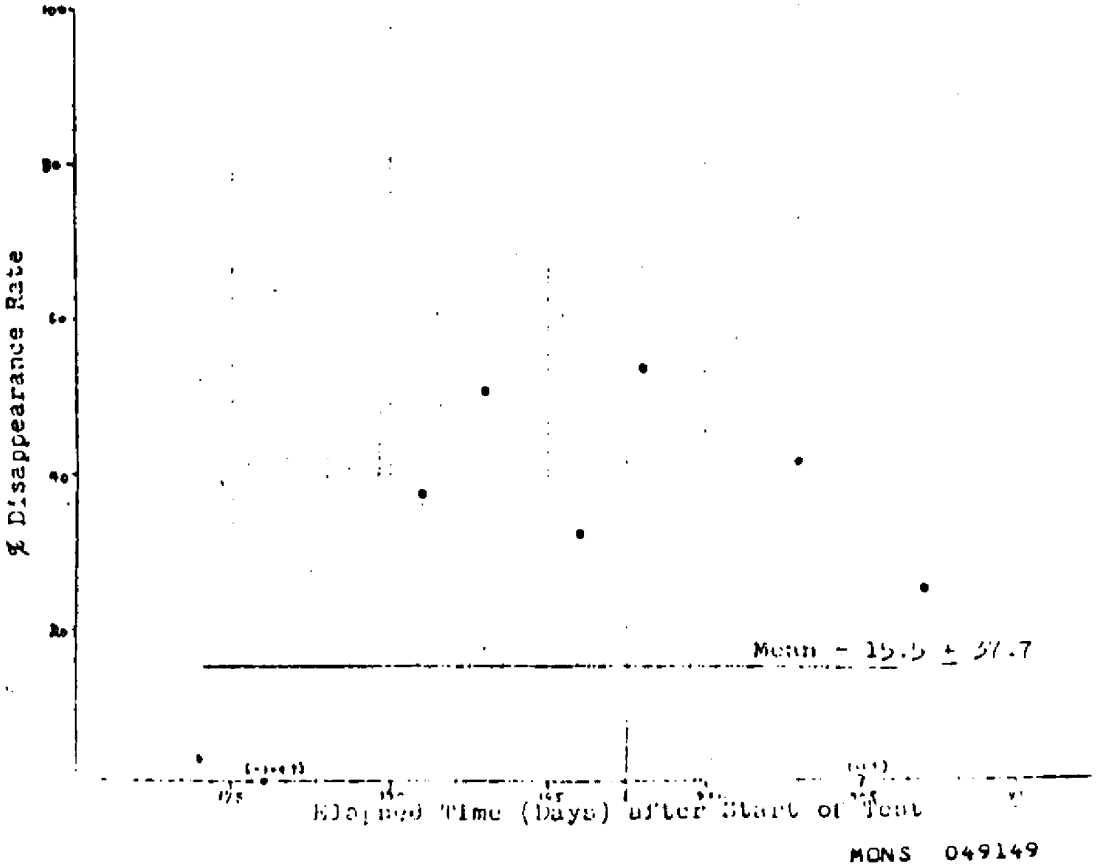
SCAS BIODEGRADATION DATA

AROCLOR 1254





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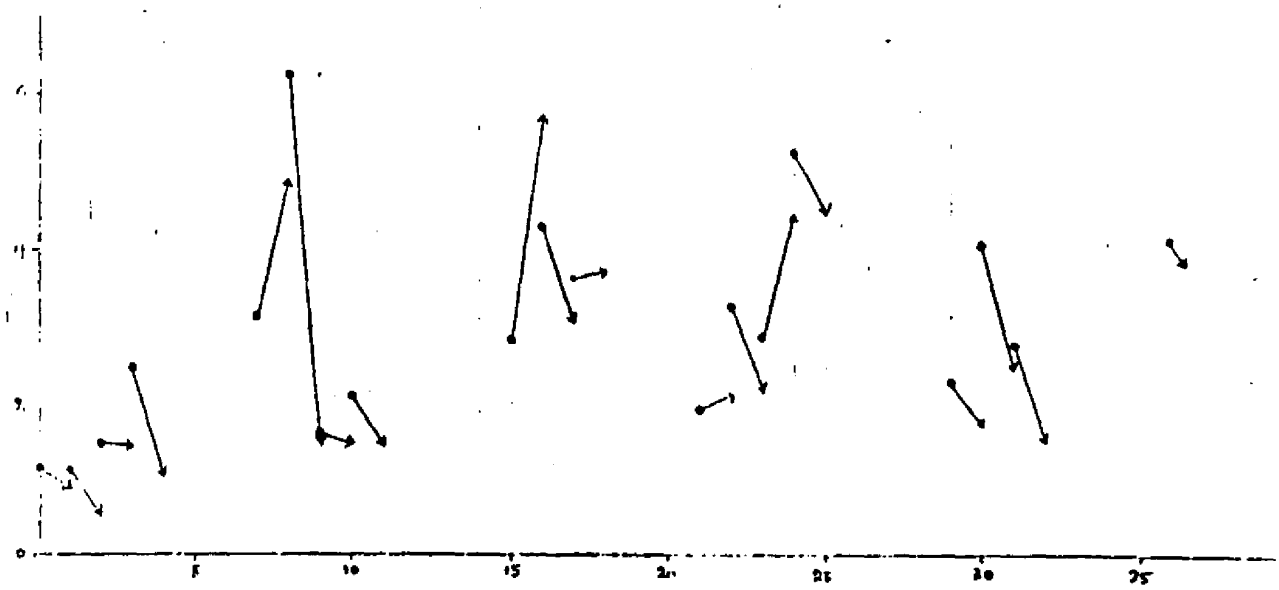

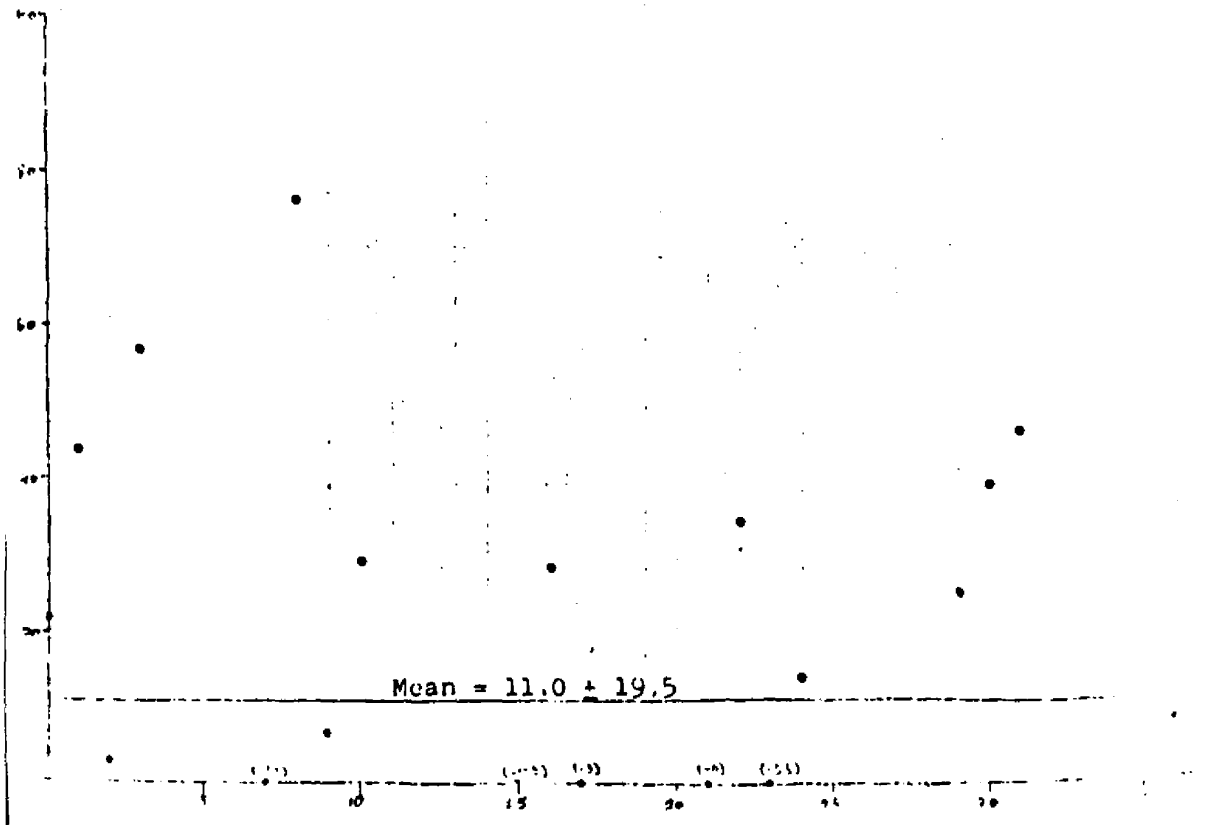

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SCAS BIODEGRADATION DATA

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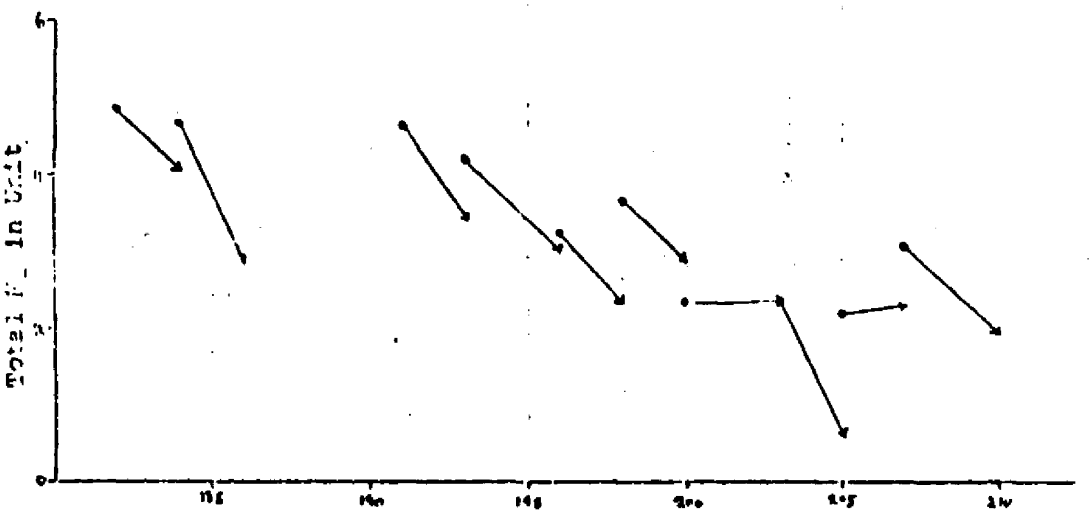
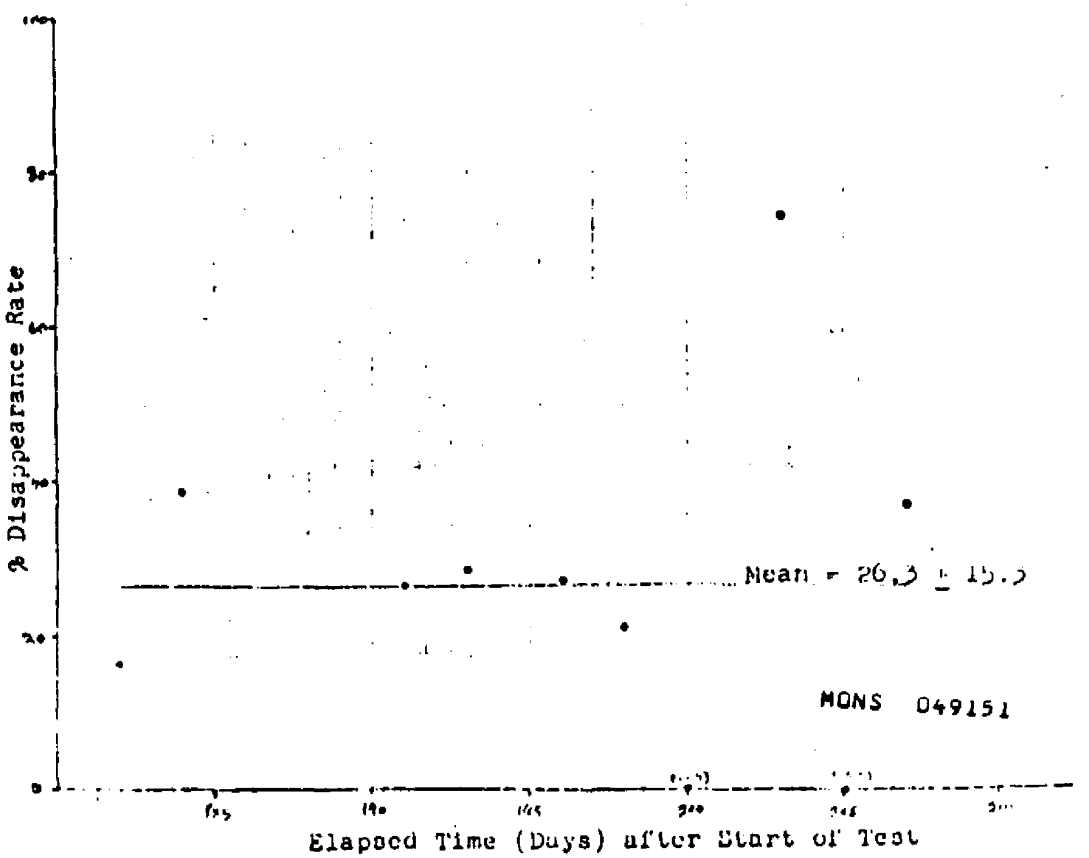
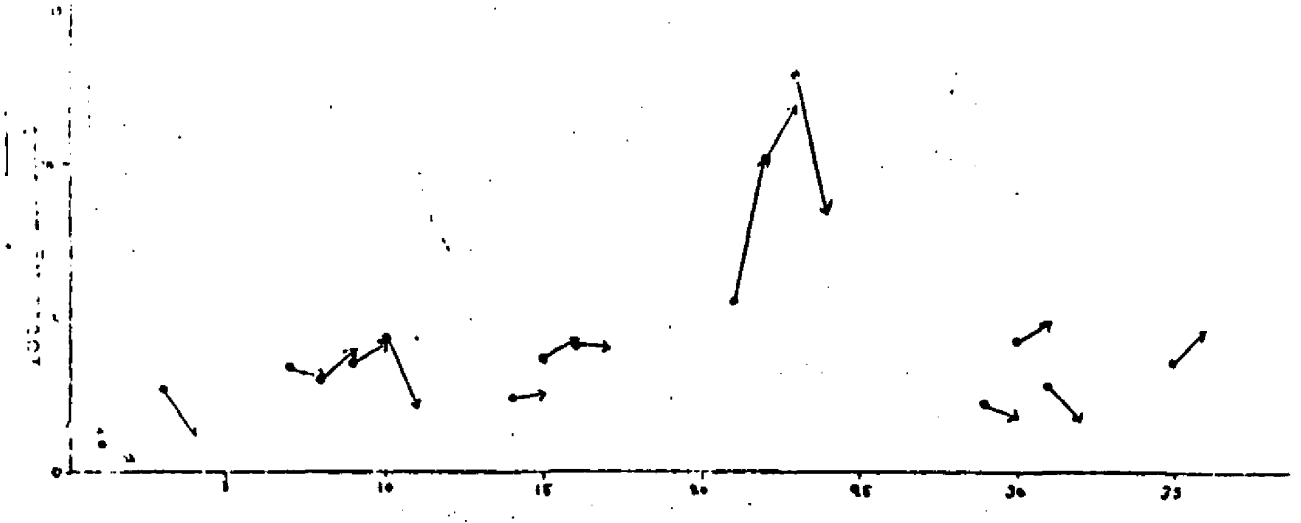
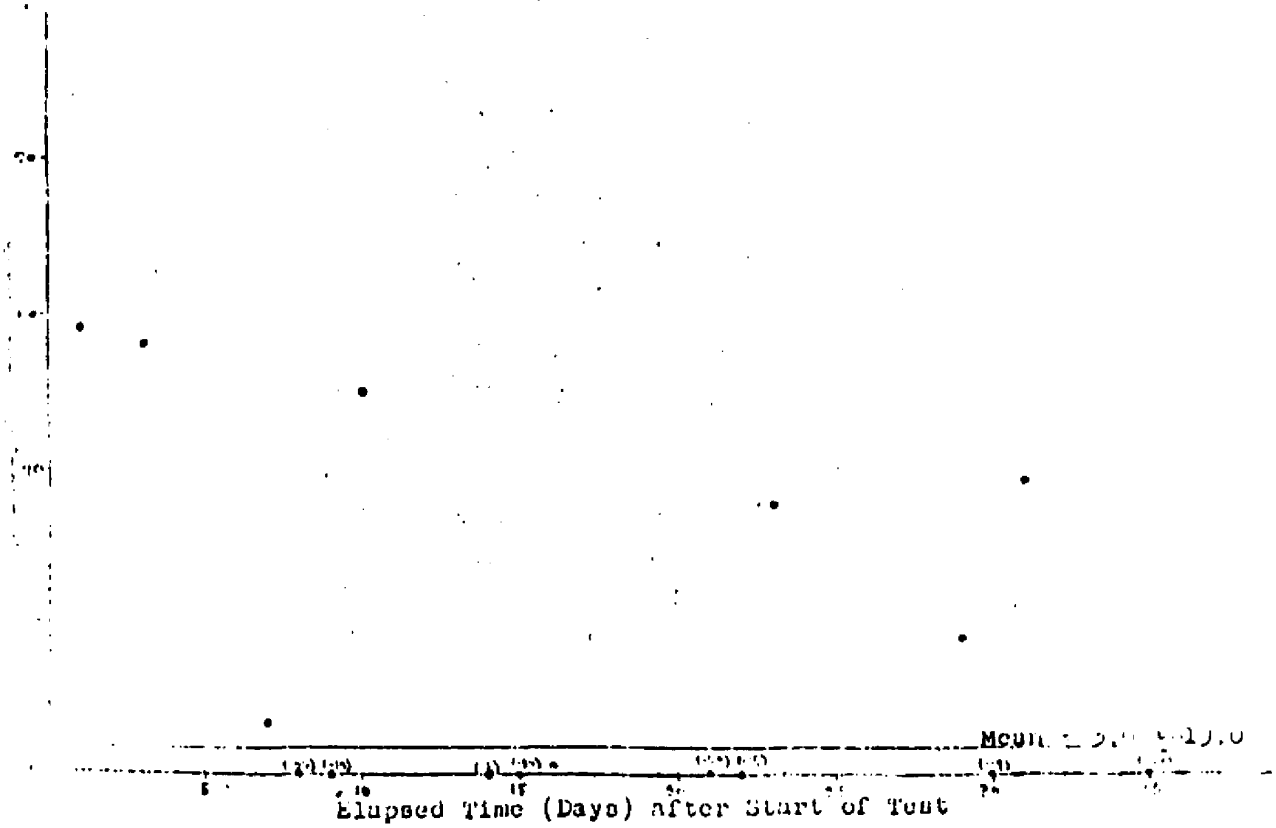




SCAS BIODEGRADATION DATA

MCS 1016



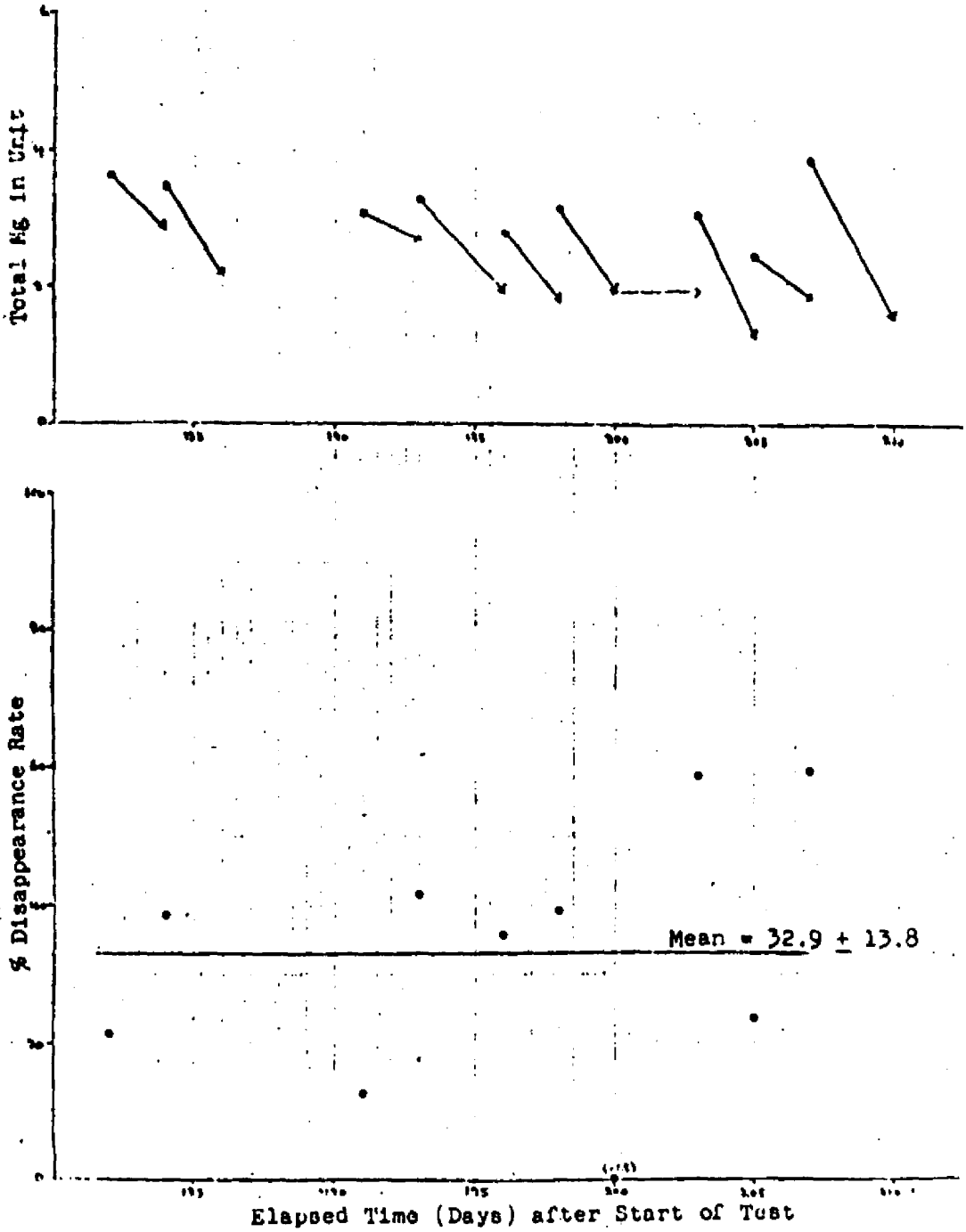


Elapsed Time (Days) after Start of Test

MONS 049152

SCAS BIODEGRADATION DATA

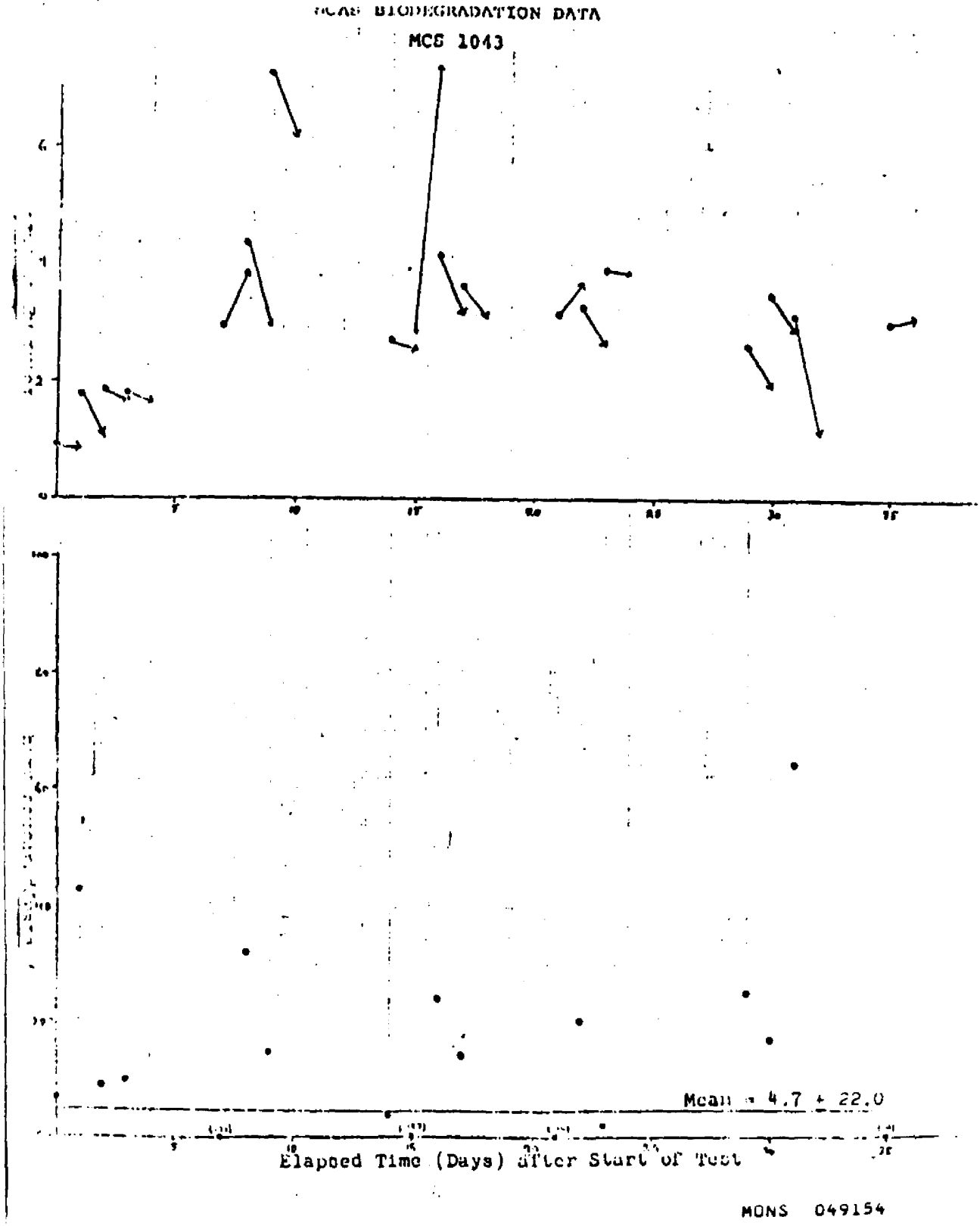
MCS 1016



MONS 049153

SCAS BIODEGRADATION DATA

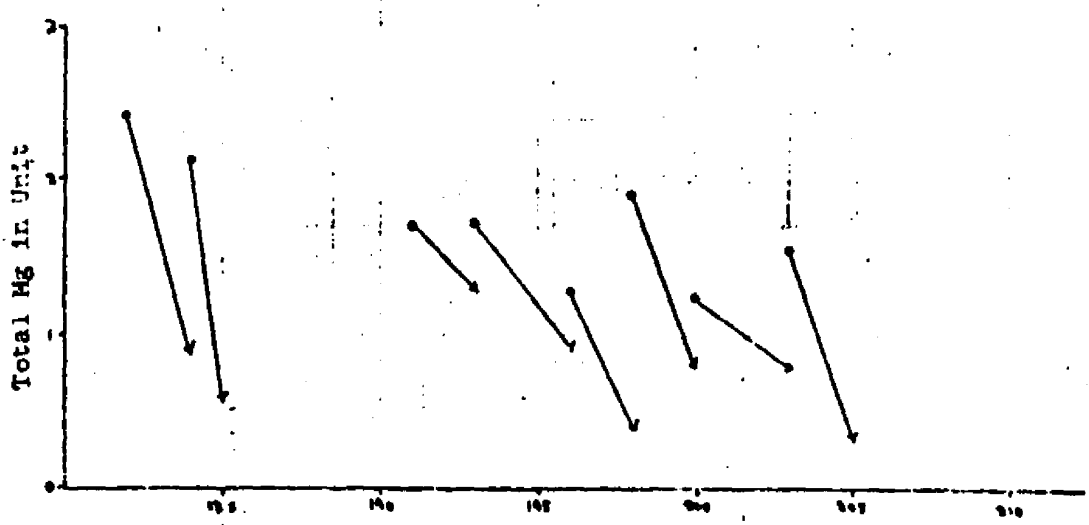
MCS 1043

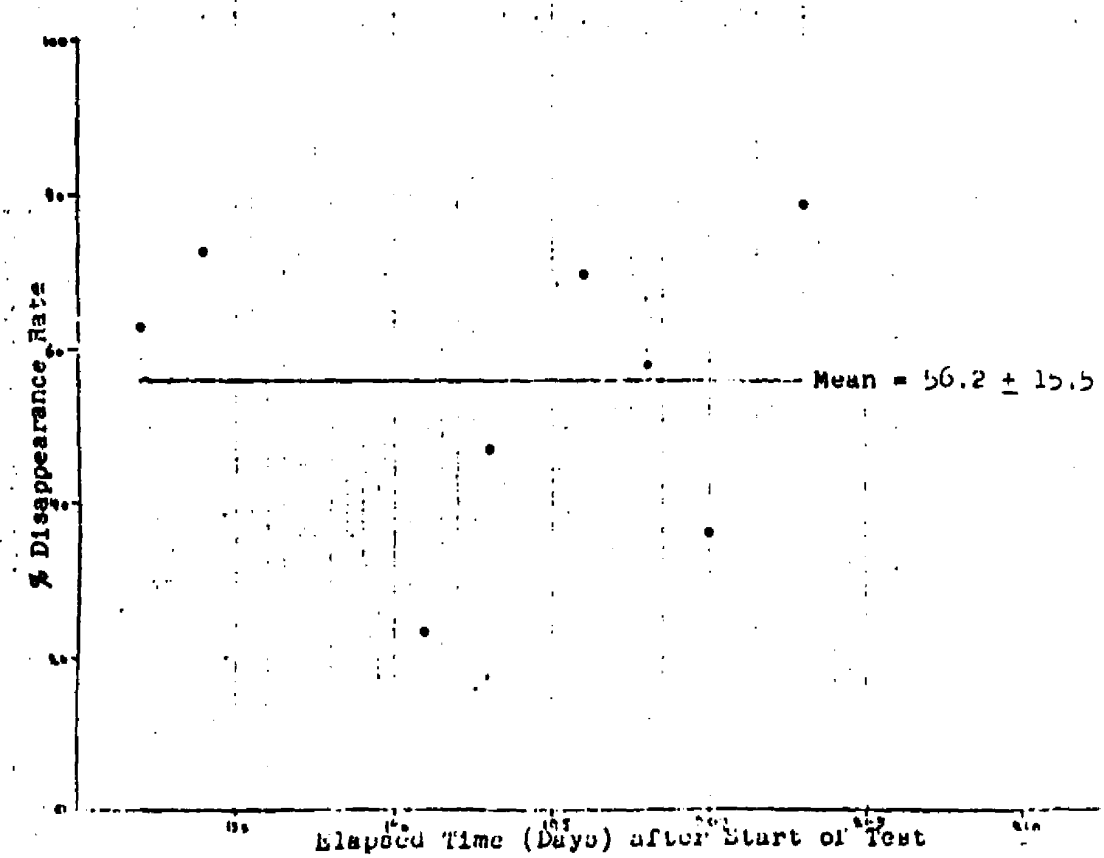


MONS 049154

SCAS BIODEGRADATION DATA

MCS 1043

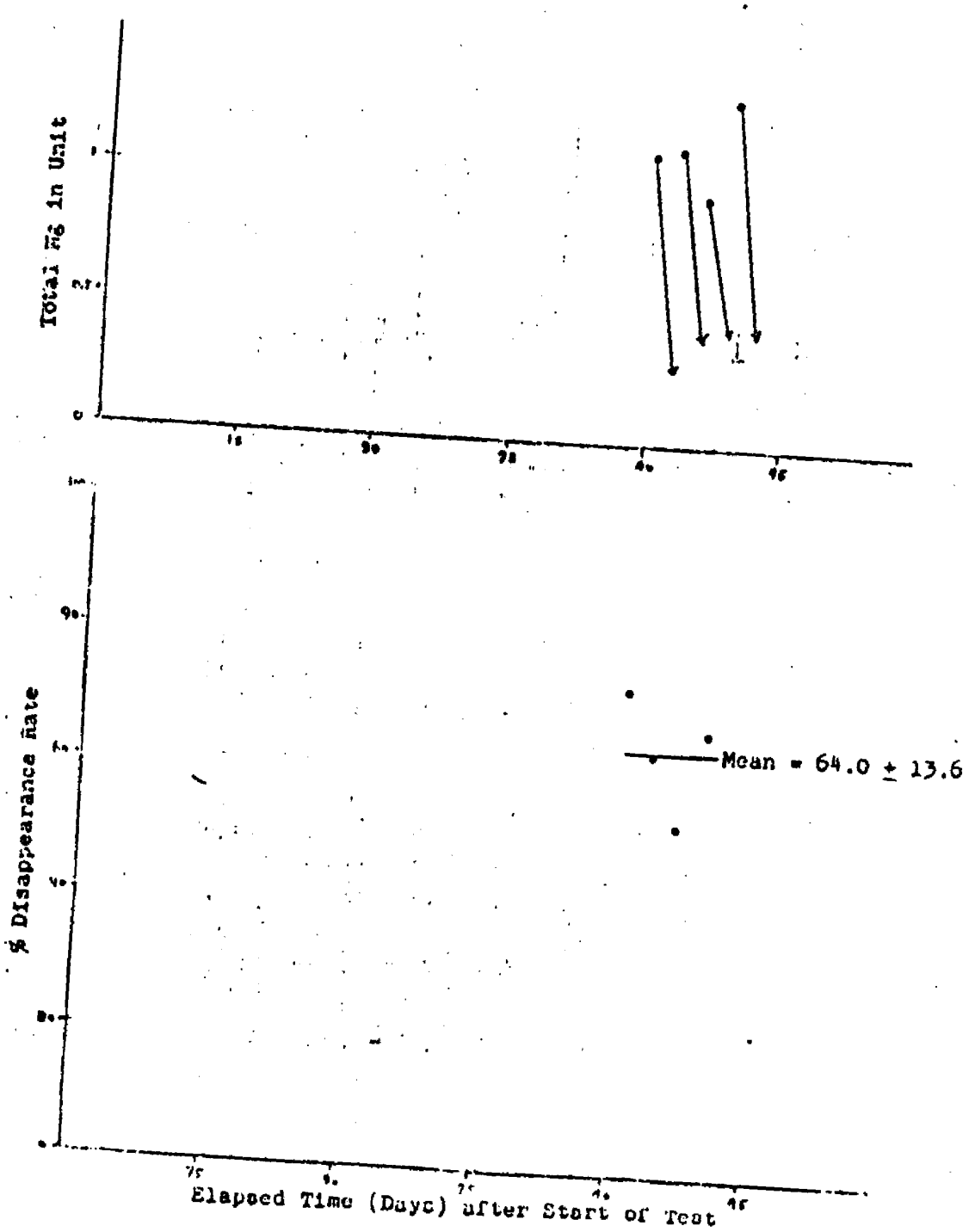




MONS 049155

BCAS BIODEGRADATION DATA

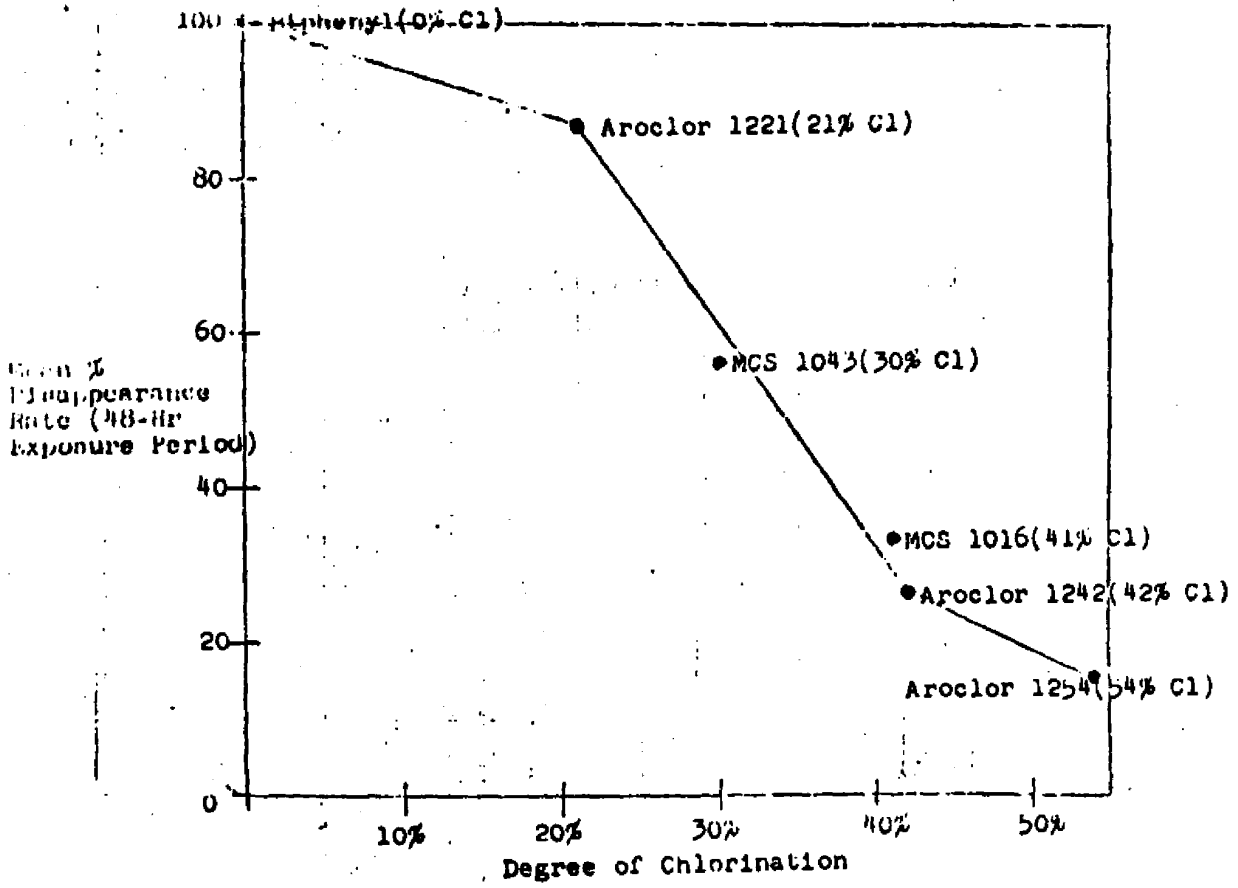
AROCLOR 1221

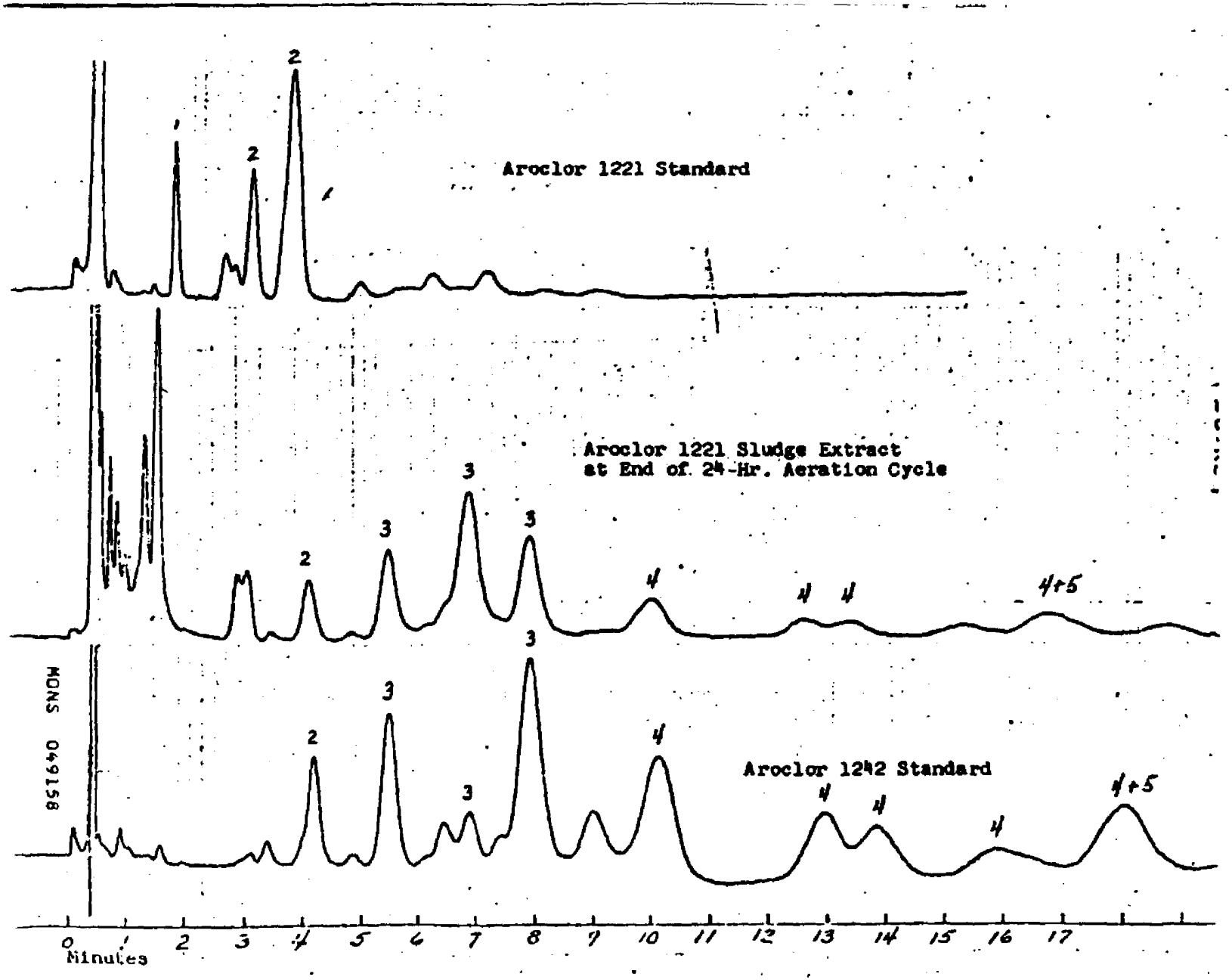


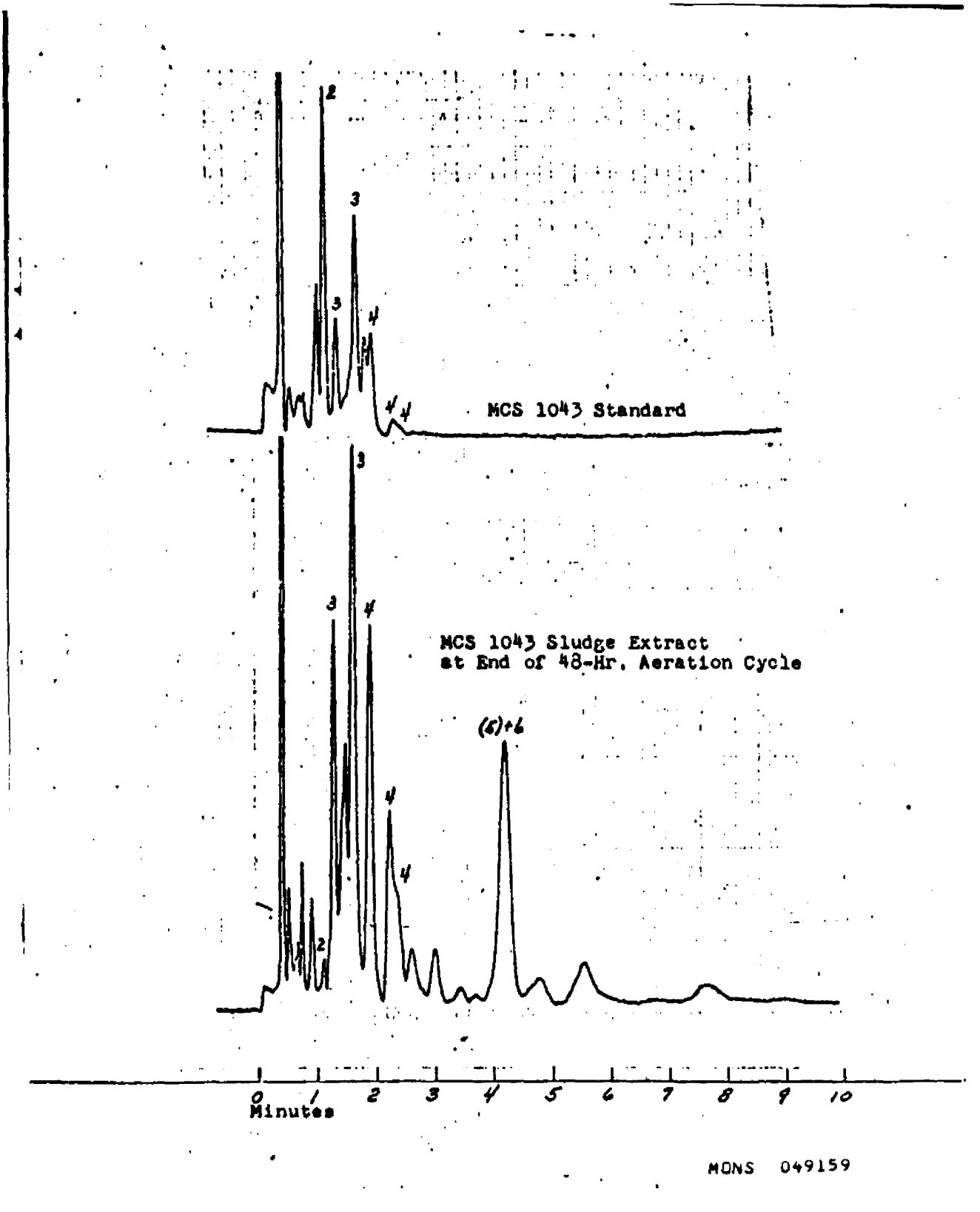
MONS 049156

FIGURE 6

SEMI-CONTINUOUS ACTIVATED SLUDGE (SCAS)
DEGRADATION OF POLYCHLORINATED BIPHENYLS




Aroclor 1221 Standard
Aroclor 1221 Sludge Extract
at End of 24-Hr. Aeration Cycle
Aroclor 1242 Standard
MONS 049158
Minutes
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17


MCS 1043 Standard
MCS 1043 Sludge Extract
at End of 48-Hr. Aeration Cycle
(6)+6
0
1
2
3
4
5
6
7
8
9
10
Minutes

MONS 049159

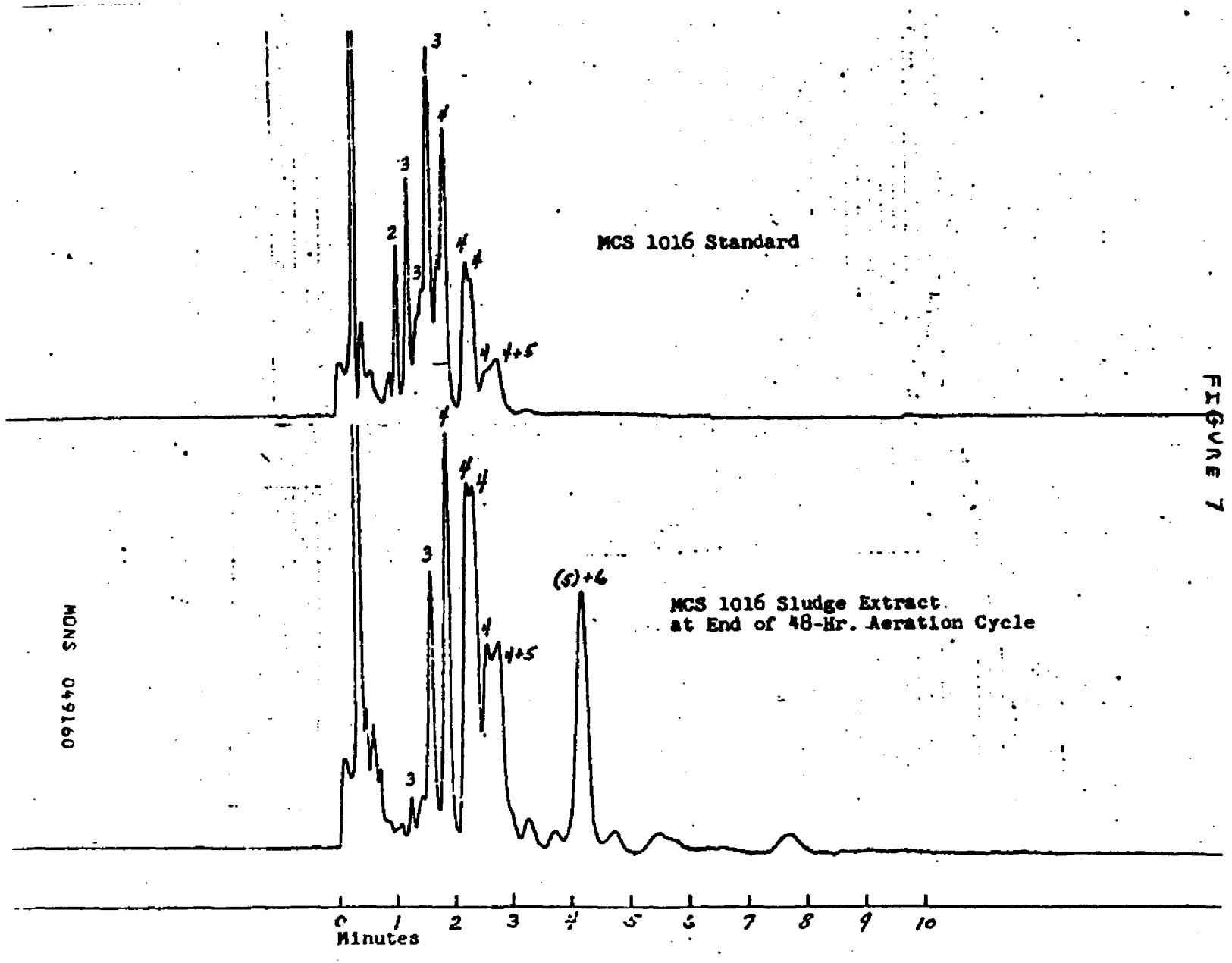

MCS 1016 Standard
MCS 1016 Sludge Extract
at End of 48-Hr. Aeration Cycle
(5)+6
4+5
Minutes
0 1 2 3 4 5 6 7 8 9 10
MONS 091660

FIGURE 7

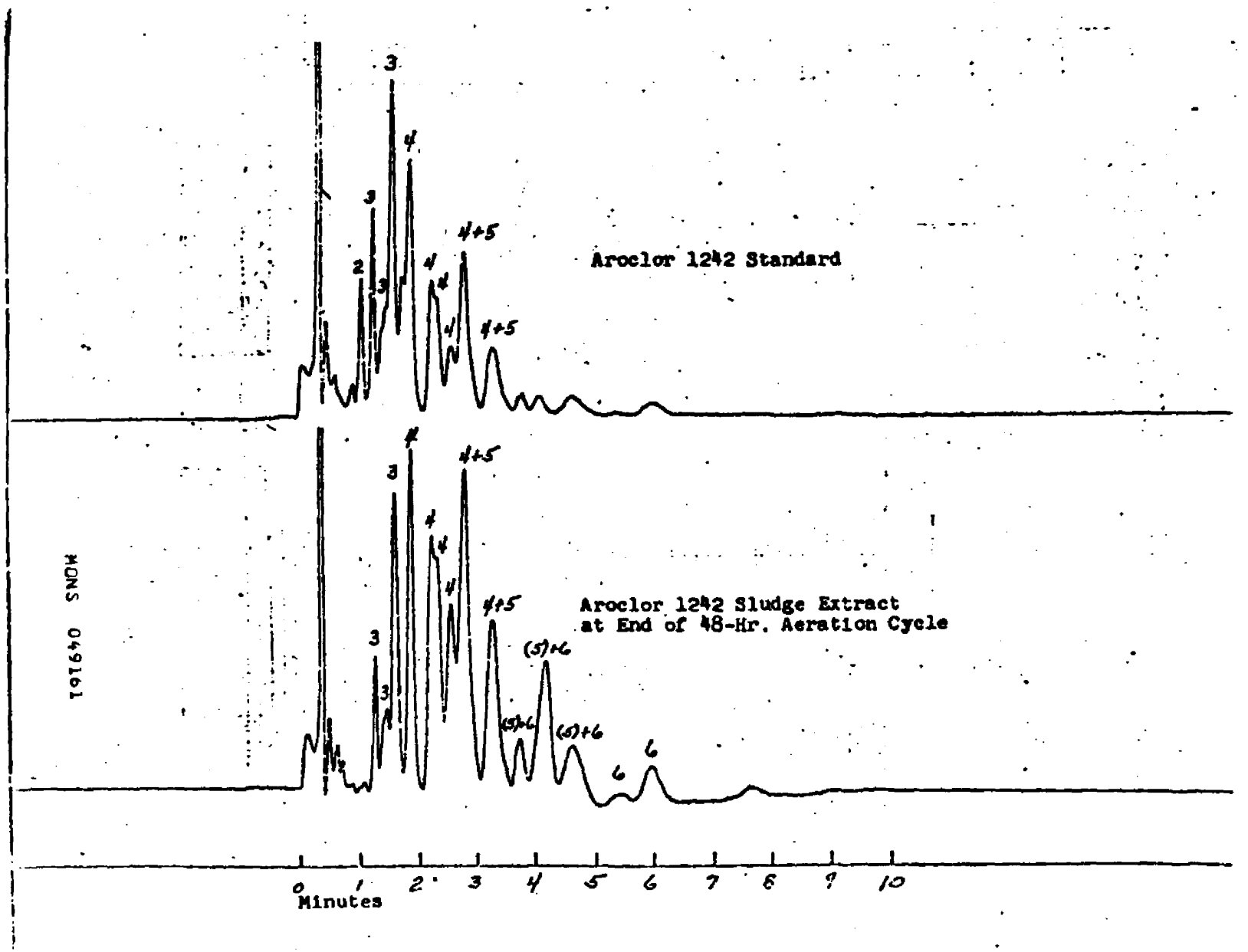
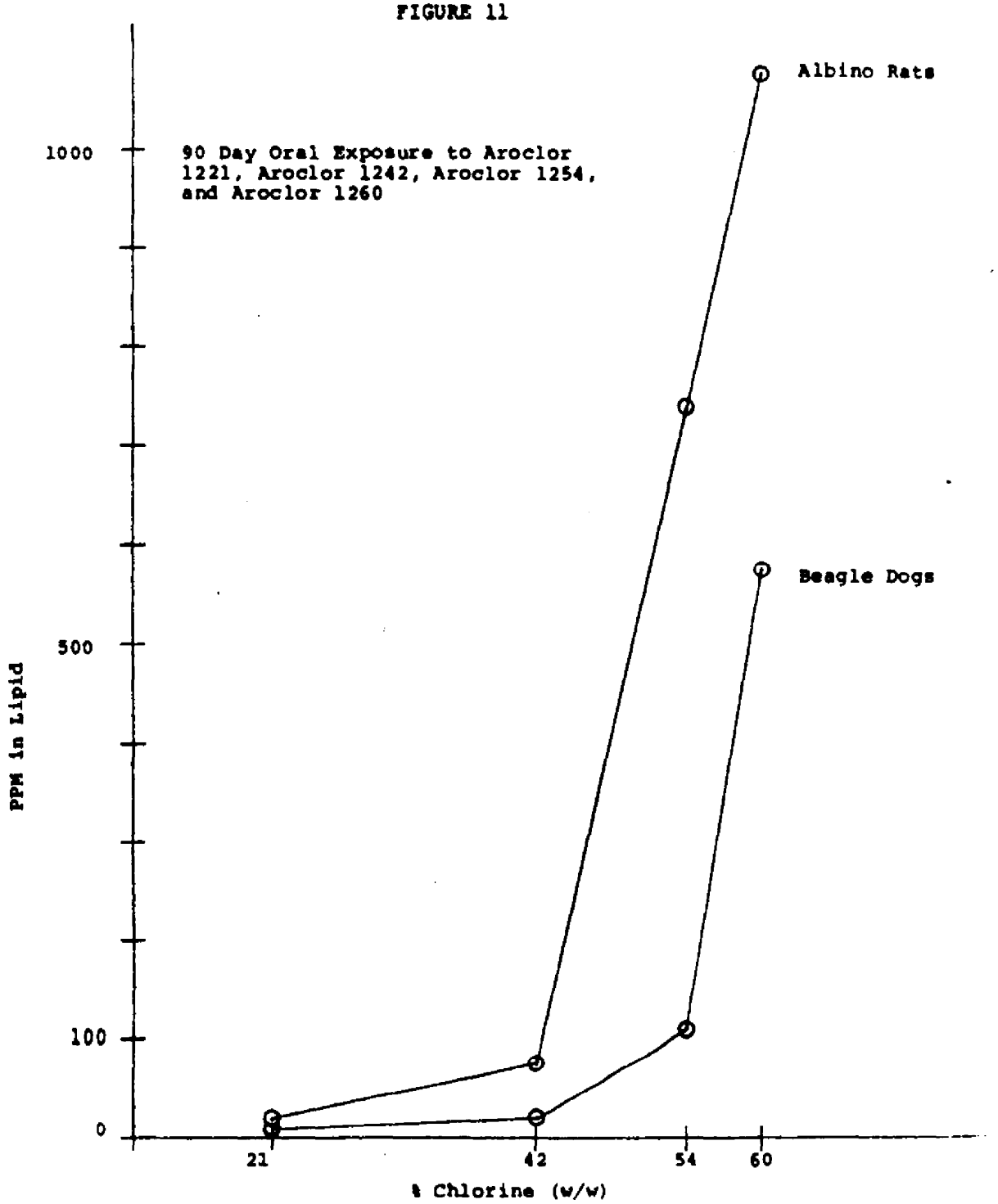

Aroclor 1242 Standard
Aroclor 1242 Sludge Extract
at End of 48-Hr. Aeration Cycle
Minutes
0
1
2
3
4
5
6
7
8
9
10

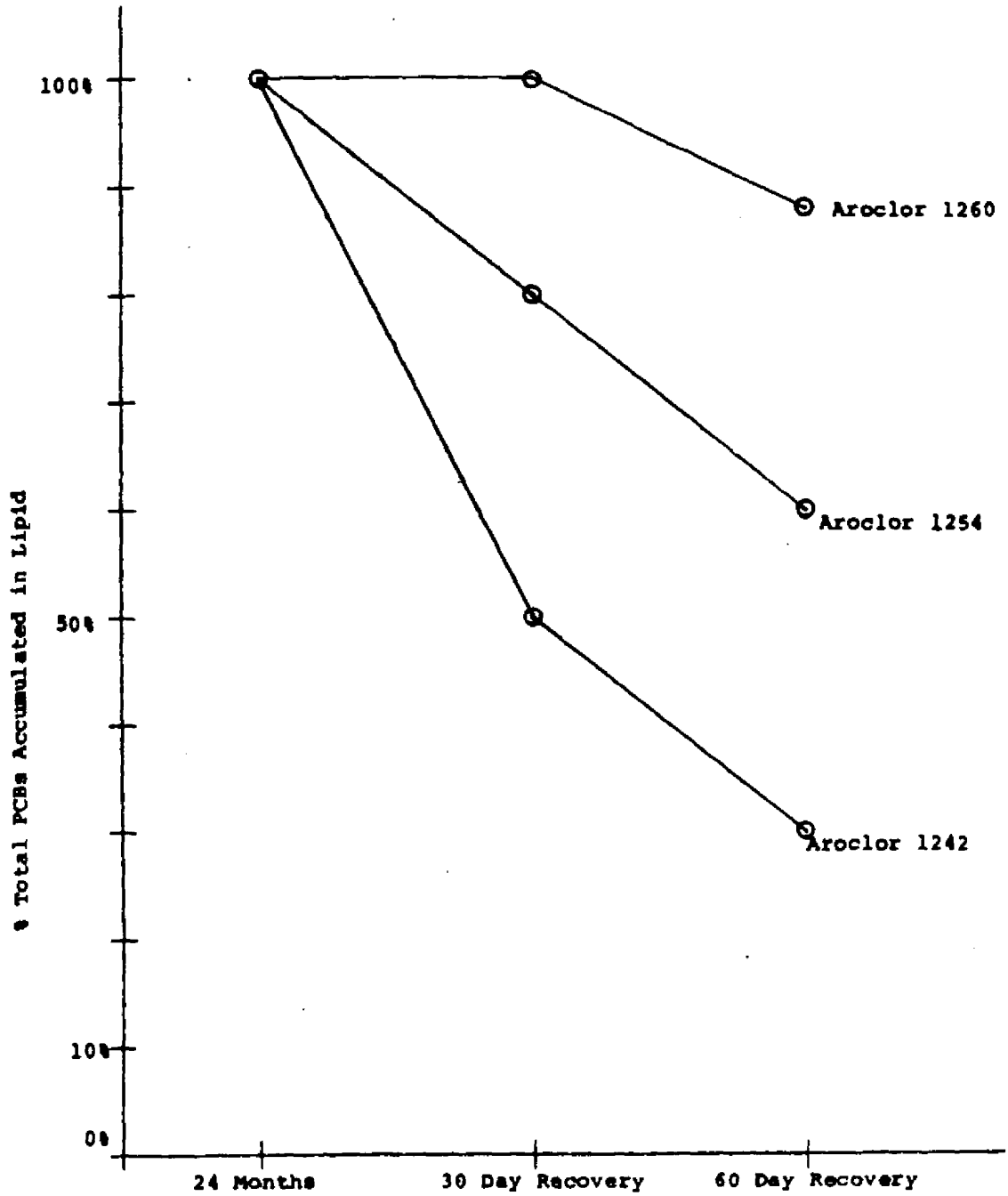
FIGURE 11



MONS 049162

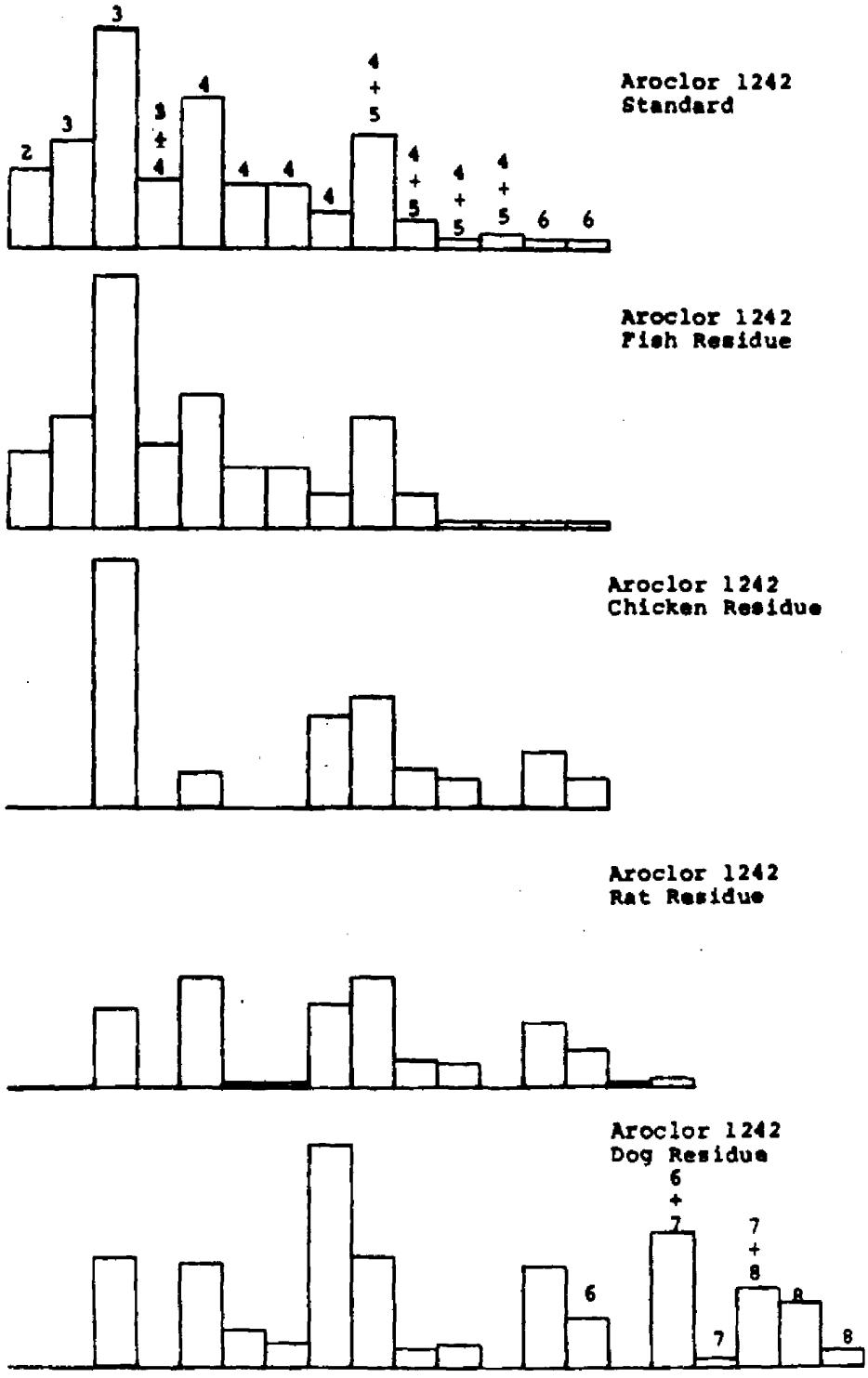
FIGURE 12

Two Year Chronic Oral Toxicity Study of Aroclor 1242, Aroclor 1254 and Aroclor 1260 with Beagle Dogs



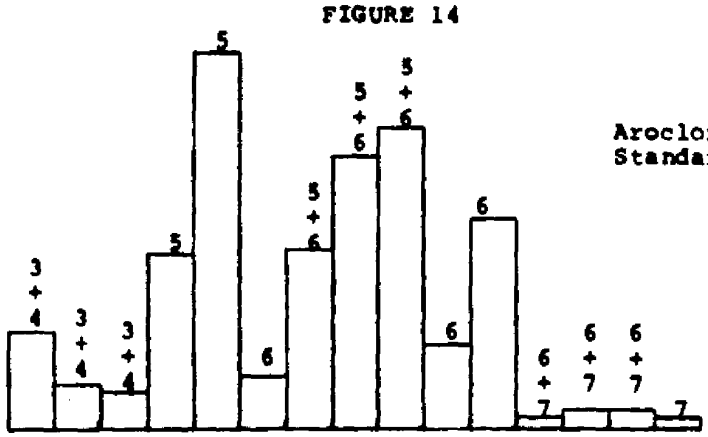
MONS 049163

FIGURE 13

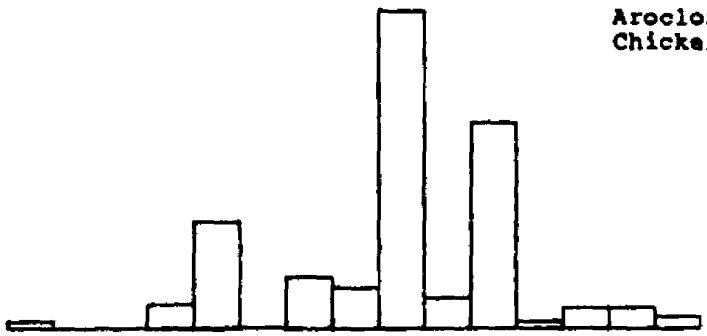


MUNS 049164

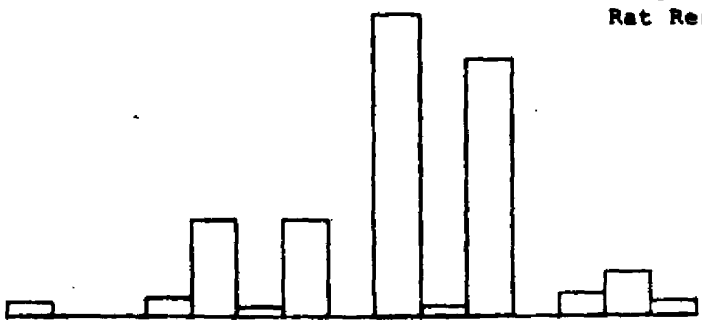
FIGURE 14



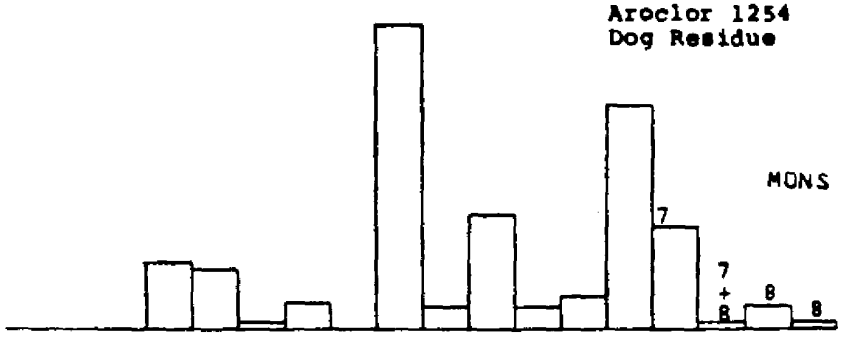
Aroclor 1254
Standard



Aroclor 1254
Chicken Residue



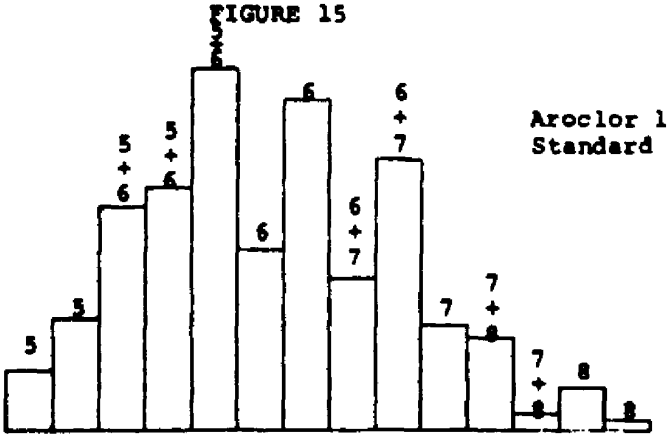
Aroclor 1254
Rat Residue



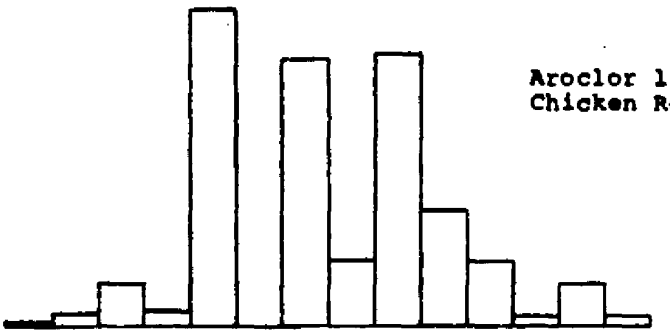
Aroclor 1254
Dog Residue

MONS 049165

FIGURE 15



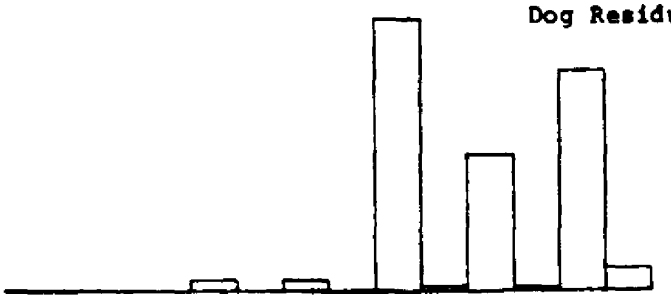
Aroclor 1260
Standard



Aroclor 1260
Chicken Residue



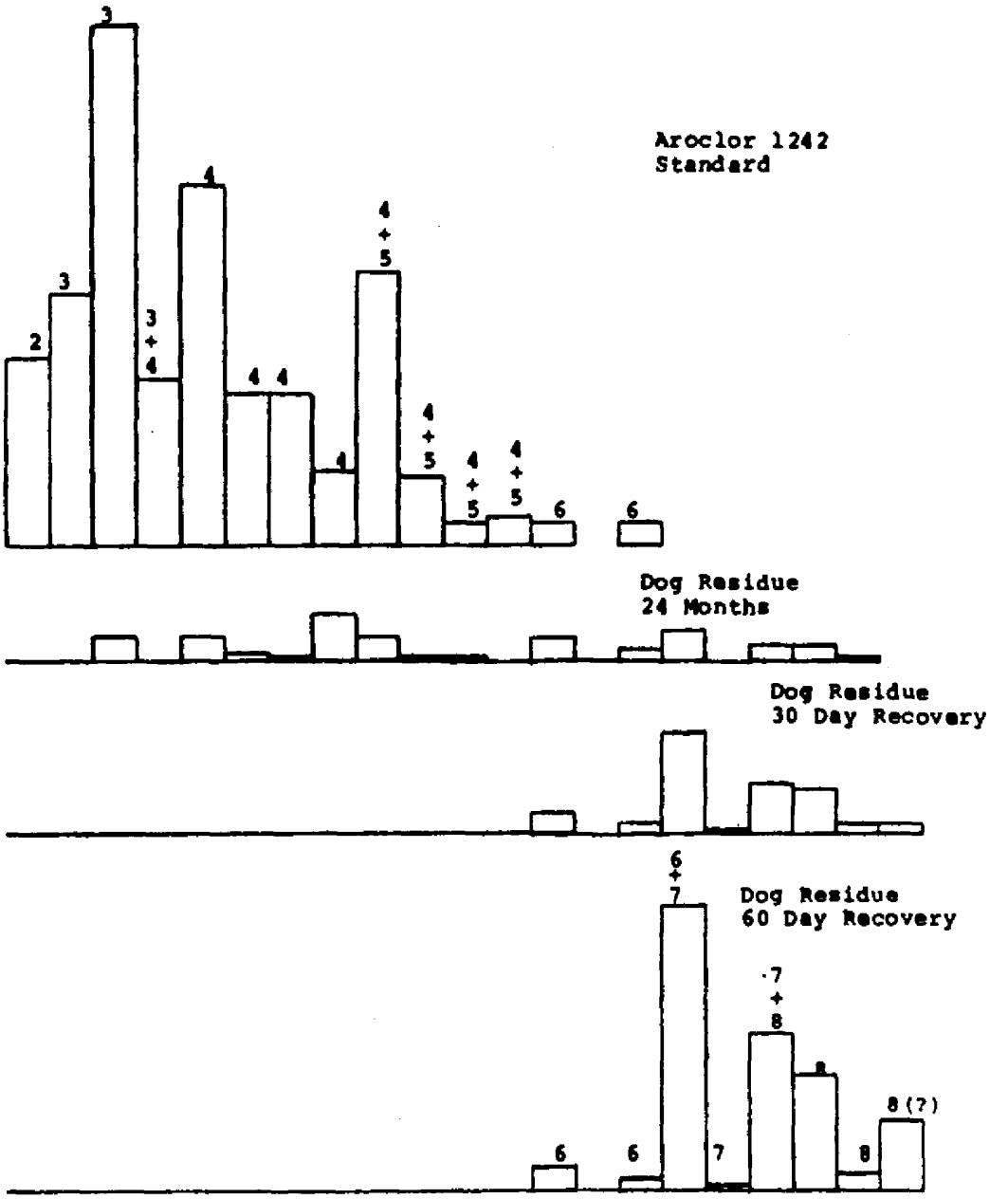
Aroclor 1260
Rat Residue



Aroclor 1260
Dog Residue

MONS 049166

FIGURE 16



MONS 049167

FIGURE 17

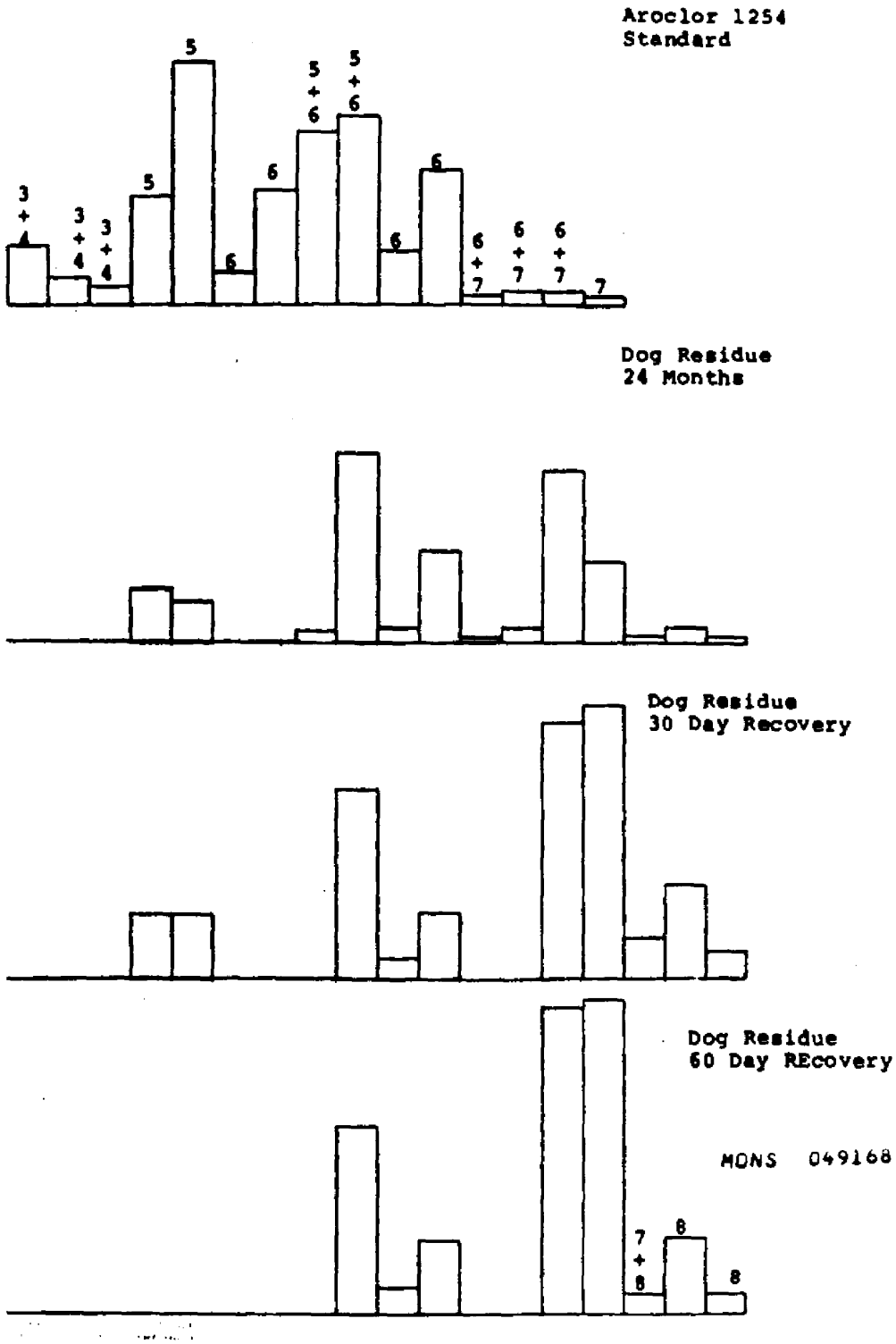
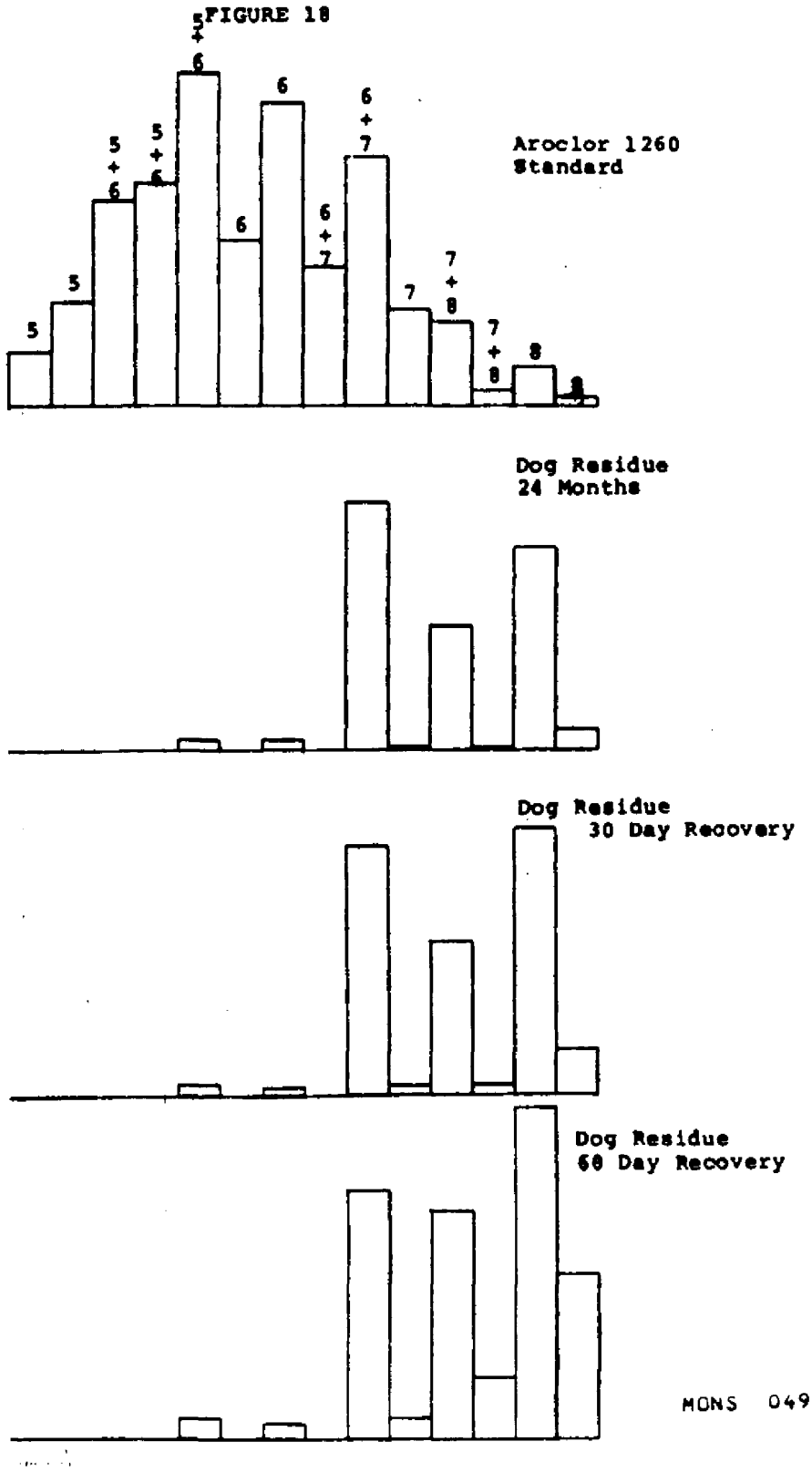
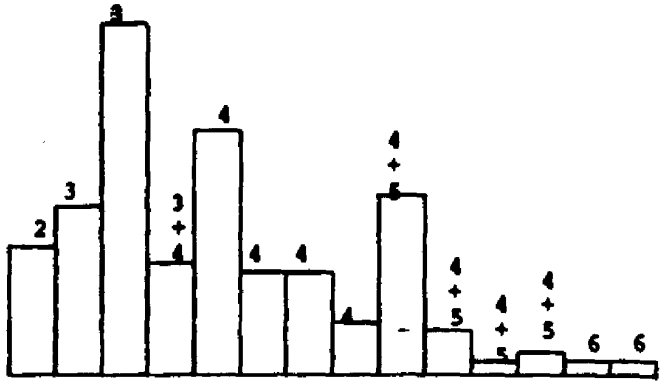

Aroclor 1254
Standard
3 + 4
3 + 4
3 + 4
5
5
6
5 + 6
5 + 6
6
6
6 + 7
6 + 7
6 + 7
7
Dog Residue
24 Months
Dog Residue
30 Day Recovery
Dog Residue
60 Day REcovery
MONS 049168
7 + 8
8
8

FIGURE 18

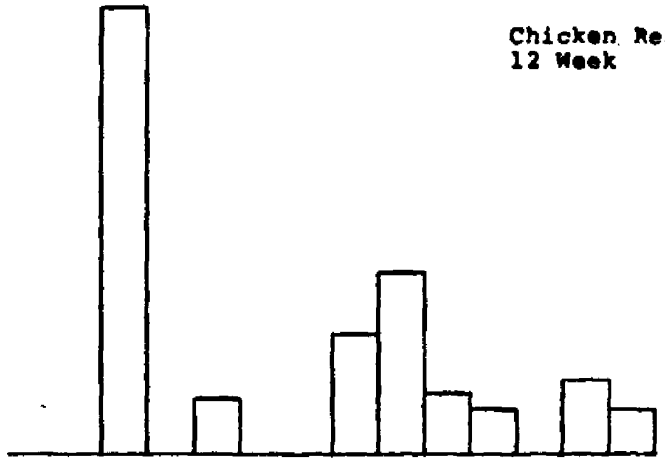


MONS 049169

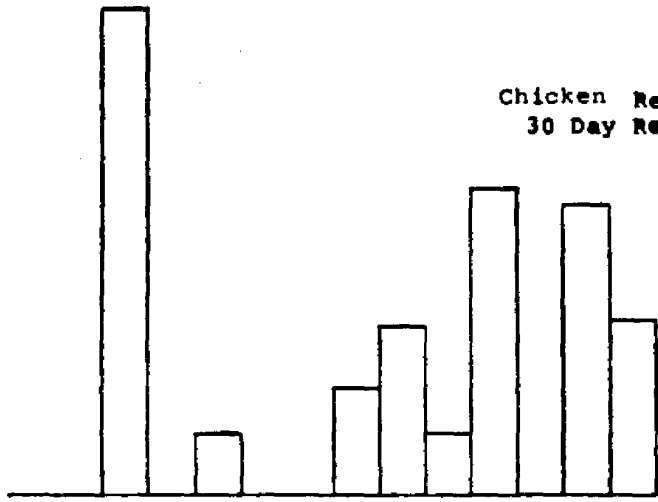
Aroclor 1242
Standard



Chicken Residue
12 Week

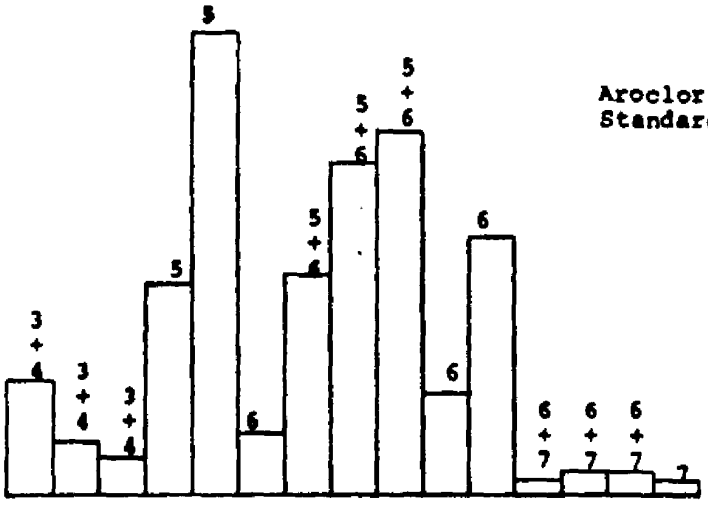


Chicken Residue
30 Day Recovery

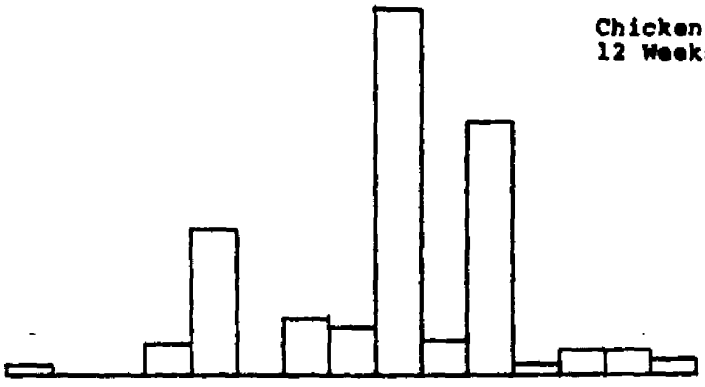


MONS 049170

FIGURE 20

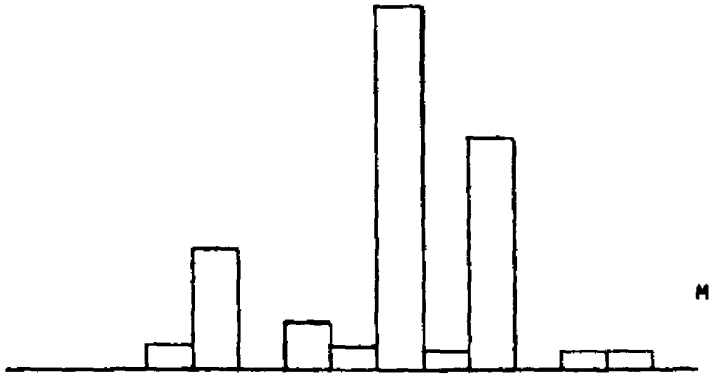


Aroclor 1254
Standard

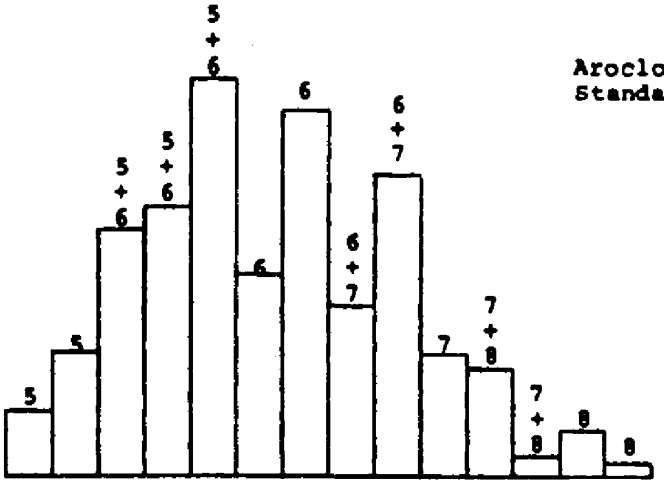


Chicken Residue
12 Weeks

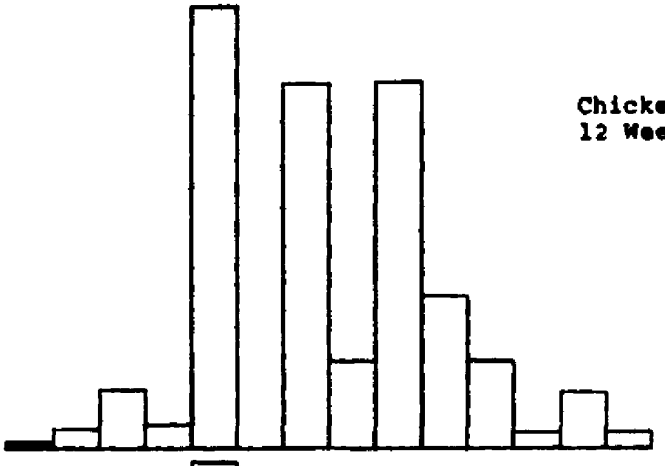
Chicken Residue
30 Day Recovery



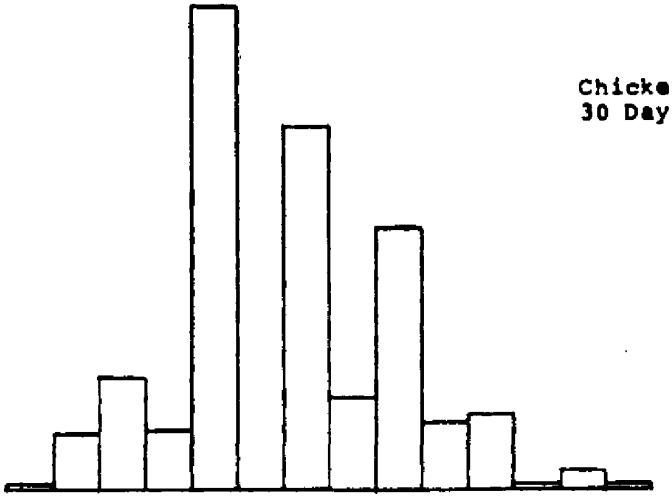
MONS 049171



Aroclor 1260
Standard



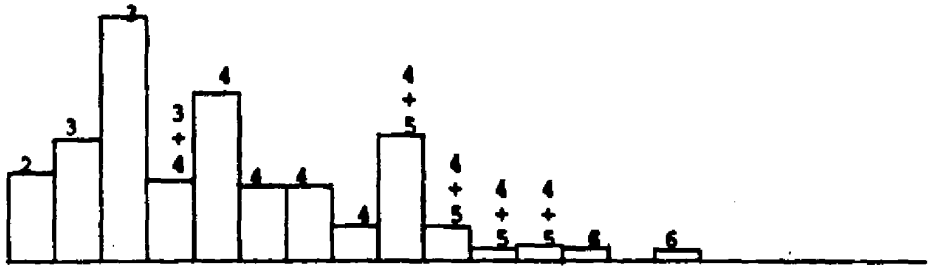
Chicken Residue
12 Weeks



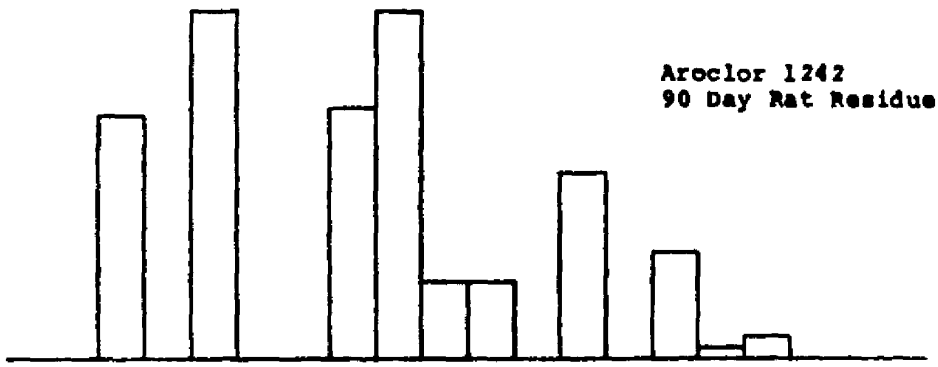
Chicken Residue
30 Day Recovery

MONS 049172

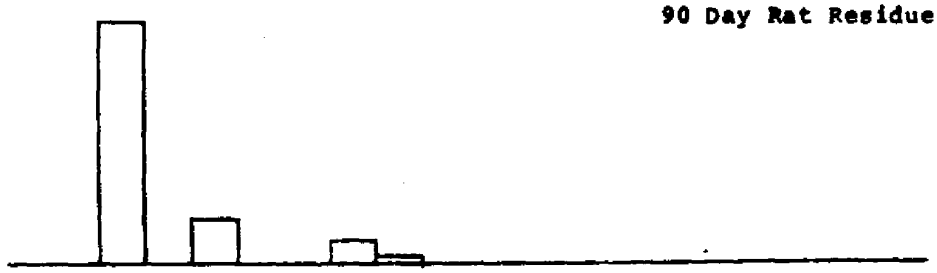
Aroclor 1242
Standard

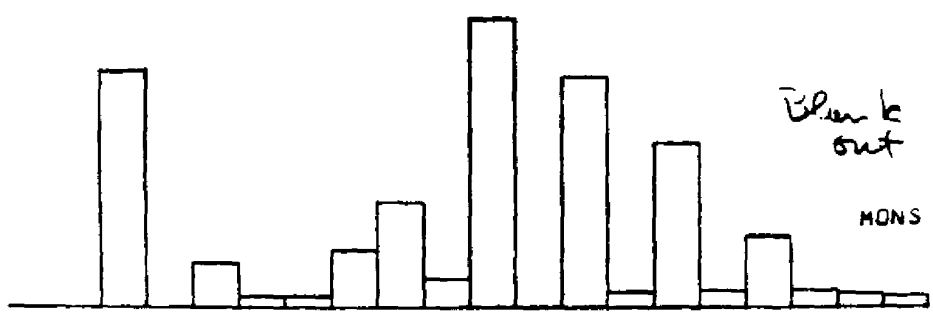


Aroclor 1242
90 Day Rat Residue



Aroclor 1016
90 Day Rat Residue





Blank out

MONS 049173

TABLE XIII

IBT #B7009 30-Day Tissue Collection Study in Albino Rats with Aroclors

ppm PCB in Rat Tissues (Wet Weight Basis)

Material	Tissue	30 Day Sacrifice				Sacrifice
		300 ppm		1000 ppm		Exposure Level
		♂	♀	♂	♀	Sex
Aroclor 1242	Muscle	5	12	17	29	
	Kidney	1	2	5	2	
	Liver	3	5	10	17	
	Fat	—	276	377	412	
Aroclor 1254	Muscle	56	36	271	167	
	Kidney	8	13	47	156	
	Liver	57	54	176	227	
	Fat	695	660	4660	3430	
Aroclor 1260	Muscle	82	136	266	555	
	Kidney	29	16	72	91	
	Liver	126	125	200	206	
	Fat	2130	2035	9190	11970	

MONS 049174

TABLE XIV

IBT #B7009 30 Day Tissue Collection Study in Albino Rats with Aroclors

ppm PCB in Rat Tissues (Lipid Weight Basis)

Material	Tissue	30 Day Sacrifice				Sacrifice
		300 ppm		1000 ppm		Exposure Level
		♂	♀	♂	♀	Sex
Aroclor 1242	Muscle	37	58	736	855	
	Kidney	12	28	276	146	
	Liver	61	220	753	793	
	Fat	—	395	816	722	
Aroclor 1254	Muscle	1396	1274	7735	6202	
	Kidney	655	1895	3325	12972	
	Liver	2370	3358	5318	6678	
	Fat	1094	1289	7208	7544	
Aroclor 1260	Muscle	2470	4849	8879	24111	
	Kidney	2056	2671	5181	7579	
	Liver	3808	6226	6263	10300	
	Fat	3061	3430	13715	19088	

MONS 049175

TABLE XV

IBT #B7009 30 Day Tissue Collection Study in Albino Rats with Aroclors

Predicted ppm PCB in Rat Tissues (Lipid Weight Basis)

Material	Tissue	30 Day Sacrifice				Sacrifice
		300 ppm		1000 ppm		Exposure Level
		♂	♀	♂	♀	Sex
Aroclor 1242	Muscle	44	83	608	821	
	Liver	105	199	765	1033	
	Fat	105	199	765	1033	
Aroclor 1254	Muscle	721	1239	5602	6859	
	Liver	1145	1997	4694	5748	
	Fat	1145	1997	4694	5748	
Aroclor 1260	Muscle	2921	4779	17004	19823	
	Liver	3784	6190	11630	13557	
	Fat	3784	6190	11630	13557	

Regression Equation - log ppm PCB = $-0.9861 - 0.2309$ (if muscle) $+ 0.1855$ (% Cl_2) $+ 0.3329$ (log ppm fed) $+ 0.1124$ (if female) $+ 0.1471$ (% Cl_2 if muscle) $+ 0.5306$ (log ppm fed if muscle) $- 0.3994$ (log ppm fed x % Cl_2) $- 0.3552$ (% Cl_2 if female) $- 0.2815$ (log ppm fed if female)

MONS 049176

TABLE XVI

IBT # B7298 Two-Year Chronic Oral Toxicity Study of Aroclor in Albino Rats

ppm PCB in Rat Tissues (Wet Weight Basis)

Material	Tissue	1 ppm			10 ppm			100 ppm			Exposure Level
		3 mo.	12 mo.	24 mo.	3 mo.	12 mo.	24 mo.	3 mo.	12 mo.	24 mo.	Sacrifice
Aroclor 1242	Muscle	0.7	1	1.8	1.4	6	14	5	33	73	
	Liver	0.1	0.2	0.5	0.2	0.6	1	0.9	5	5	
	Fat	6	7	6	12	30	43	60	144	220	
Aroclor 1254	Muscle	2	2	13	8	131	98	46	94	352	
	Liver	0.1	0.4	1.2	1	23	6	15	24	133	
	Fat	6	19	45	75	632	315	1208	794	1533	
Aroclor 1260	Muscle	6	8	15	8	50	116	10	419	785	
	Liver	0.2	1	0.8	2	3	5	18	53	107	
	Fat	28	56	50	417	224	298	482	2000	4447	

MONS 049177

TABLE XVII

IBT # B7298 Two-Year Chronic Oral Toxicity Study of Aroclor in Albino Rats

ppm PCB in Rat Tissues (Lipid Weight Basis)

Material	Tissue	1 ppm			10 ppm			100 ppm			Exposure Level
		3 mo.	12 mo.	24 mo.	3 mo.	12 mo.	24 mo.	3 mo.	12 mo.	24 mo.	Sacrifice
Aroclor 1242	Muscle	8	6	5	16	38	74	76	236	239	
	Liver	11	16	18	26	40	52	77	241	234	
	Fat	6	8	9	13	32	47	67	151	227	
Aroclor 1254	Muscle	10	11	38	96	721 (196)	389	756 (800)	1092	2164	
	Liver	18	24	82	115	914 (292)	307	1137 (2000)	869	1810 (4800)	
	Fat	6	19	55	76	688 (231)	348	329 (900)	860	1894	
Aroclor 1260	Muscle	16	47	44	60	259	436	146 (689)	2247	5154	
	Liver	20	50	56	102	189	442	1677	1752	6310	
	Fat	32	60	62	138	262	354	866	2143	5060	

( ) – Smoothed data, used to develop second regression equation

MONS 049178

TABLE XVIII

IBT #87298 Two Year Chronic Oral Toxicity Study of Aroclor in Albino Rats

Predicted ppm PCB in Rat Tissues (Lipid Weight Basis)

Material	Tissue	1 ppm			10 ppm			100 ppm			Exposure Level
		3 mo	12 mo	24 mo	3 mo	12 mo	24 mo	3 mo	12 mo	24 mo	Sacrifice
Aroclor 1242	Muscle	5	8	10	20	32	45	77	133	206	
	Liver	8	12	15	30	48	68	115	199	307	
	Fat	5	8	10	20	32	45	77	133	206	
Aroclor 1254	Muscle	11	21	36	81	163	305	584	1264	2611	
	Liver	17	31	53	121	242	455	870	1884	3893	
	Fat	11	21	36	81	163	305	584	1264	2611	
Aroclor 1260	Muscle	16	30	51	116	234	439	840	1819	3758	
	Liver	19	36	62	140	281	527	1008	2182	4509	
	Fat	20	38	65	147	296	554	1061	2297	4746	

Regression Equation log ppm PCB = 3.3550 − 1.3446 (if 1242) − 0.3696 (if 1254) + 0.2881 (if liver) + 0.8936 (log ppm fed) + 0.0626 (time − 12) − 0.2761 (log ppm fed if 1242) − 0.0246 (time − 12 if 1242)

MONS 0091279

TABLE XIX

IBT # P7297 Three-Generation Reproduction Study in Albino Rats with Aroclor

ppm PCB in Rat Pups (Wet Weight Basis)

	21 Day Sacrifice			Sacrifice
Material	1 ppm	10 ppm	100 ppm	Exposure Level
Aroclor 1242	0.2	4	32	
Aroclor 1254	2	16	155	
Aroclor 1260	1	8	104	

ppm PCB in Rat Pups (Lipid Weight Basis)

	21 Day Sacrifice			Sacrifice
Material	1 ppm	10 ppm	100 ppm	Exposure Level
Aroclor 1242	67	78	578	
Aroclor 1254	48	170	2328	
Aroclor 1260	21	213	2371	

MONS 081640

TABLE XX

IBT # 9888C
9888D

90-Day Subacute Oral Toxicity Study of Aroclor in Albino Rats

ppm PCB in Rat Tissues (Wet Weight Basis)

		90 Day Sacrifice						Sacrifice
		30 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1016	Muscle	14	4	20	15	8	5	
	Liver	5	1	10	16	4	0.5	
	Fat	24	27	138	193	6	88	

		90 Day Sacrifice						Sacrifice
		1 ppm		10 ppm		100 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1221	Muscle	0.5	0.4	3	1	3	2	
	Liver	0.06	0.1	0.06	0.5	0.2	2	
	Fat	2	4	16	5	36	50	

MONS 049181

TABLE XXI

IBT # 9888 C, 9888 D — 90-Day Subacute Oral Toxicity Study of Aroclor in Albino Rats

ppm PCB in Rat Tissues (Lipid Weight Basis)

		90-Day Sacrifice						Sacrifice
		30 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1016	Muscle	28	40	125	16000	4501	4272	
	Liver	160	43	160	376	68	11	
	Fat	30	34	175	294	7	115	

		90-Day Sacrifice						Sacrifice
		1 ppm		10 ppm		100 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1221	Muscle	5	5	29	18	64	74	
	Liver	3	7	4	22	10	65	
	Fat	3	5	19	5	42	56	

MONS 049182

TABLE XXII

IBT #9888C 9888D 90-Day Subacute Oral Toxicity Study of Aroclor in Albino Rats

Predicted ppm PCB in Rat Tissues (Lipid Weight Basis)

		* 90-Day Sacrifice						Sacrifice
		30 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1016	Muscle							
	Liver							
	Fat							

		90-Day Sacrifice						Sacrifice
		1 ppm		10 ppm		100 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1221	Muscle	5	5	19	19	76	76	
	Liver	2	8	5	22	14	60	
	Fat	5	5	13	13	36	36	

* Calculation of meaningful regression equation not possible, inconsistent data attributed to sample handling problems.

1221 Regression Equation $\log \text{ppm PCB} = 0.6689 + 0.4427 (\log \text{ppm fed}) - 0.4186 (\text{if liver}) + 0.1628 (\log \text{ppm fed if muscle}) + 0.6404 (\text{if female liver})$

MONS 069183

TABLE XXIII

IBT # C7299 Two-Year Chronic Oral Toxicity Study of Aroclor in Beagle Dogs

ppm PCB in Dog Tissues (Wet Weight Basis)

Material	Tissue	1 ppm						10 ppm						100 ppm						Exposure Level
		24 mo.		30 d.		60 d.		24 mo.		30 d.		60 d.		24 mo.		30 d.		60 d.		Sacrifice
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1242	Muscle	0.07	0.08	0.09	0.06			0.3	0.2		0.2		0.04	0.6	0.5	0.3	0.4	0.5		
	Liver		0.08	0.3	0.04		0.04	0.2	0.1		0.1	0.05		0.6		0.4	0.3			
	Fat	2	2	1	0.5	0.5		1	1		2	1	2	4	4	9	2			
Aroclor 1254	Muscle	0.3	0.08	0.2		0.1	0.1	0.7	0.3		0.7			4	3				3	
	Liver	0.1	0.2		0.2			0.4	0.7			0.5		2	2	1				
	Fat	4	3	2			2	5	4		18			95	73				34	
Aroclor 1260	Muscle	0.2	0.4		1		0.2	1	0.4		6		3	26	10		34	26		
	Liver	0.2	0.1	0.1			0.3	2	0.7	2	1	0.9	1	11	4		2	9		
	Fat	11	14		14		4	101	31	40	47		62	936	221		352	173		

MONS 049184

TABLE XXIV

IBT #C7299 Two-Year Chronic Oral Toxicity Study of Aroclor in Beagle Dogs

ppm PCB in Dog Tissues (Lipid Weight Basis)

Material	Tissue	1 ppm						10 ppm						100 ppm						Exposure Level
		24 mo.		30 d.		60 d.		24 mo.		30 d.		60 d.		24 mo.		30 d.		60 d.		Sacrifice
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1242	Muscle	2	2	1	2			6	3		2		1	19	20	10	10	6		
	Liver		4	11	2		2	8	8		9	4		29		23	18			
	Fat	2	3	1	1	0.6		1	2		2	2	2	6	7	13	3			
Aroclor 1254	Muscle	10	4	4		2	2	18	18		9			61	95				32	
	Liver	8	6		9			23	46			43		110	130	111				
	Fat	5	3	3			2	6	10		22			128	132				42	
Aroclor 1260	Muscle	9	7		8		3	78	20		66		37	796	100		491	301		
	Liver	17	13	11			21	175	43	112	135	55	120	762	288		81	699		
	Fat	14	18		20		5	159	39	54	72		78	1261	287		439	238		

MONS 049185

TABLE XXV

IBT #C7299 Two-Year Chronic Oral Toxicity Study of Aroclor in Beagle Dogs

Predicted ppm PCB in Dog Tissues (Lipid Weight Basis)

Material	Tissue	1 ppm						10 ppm						100 ppm						Exposure Level
		24 mo		30 d.		60 d.		24 mo.		30 d.		60 d.		24 mo.		30 d.		60 d.		Sacrifice
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1242	Muscle	2	2	1	1	0.7	0.7	5	4	4	3	2	2	20	10	9	6	6	4	
	Liver	3	3	2	2	1	1	10	8	7	5	5	4	28	18	18	12	11	8	
	Fat	2	2	1	1	0.7	0.7	5	4	4	3	2	2	20	10	9	6	6	4	
Aroclor 1254	Muscle	5	5	4	4	3	3	24	20	20	16	16	13	121	80	100	65	80	54	
	Liver	10	10	8	8	6	6	47	38	39	31	33	26	238	156	195	128	157	103	
	Fat	5	5	4	4	3	3	24	20	20	16	16	13	121	80	100	65	80	54	
Aroclor 1260	Muscle	8	8	8	8	7	7	54	44	50	40	47	38	355	233	333	217	308	202	
	Liver	16	16	14	14	14	14	106	84	98	80	91	74	698	457	654	426	605	397	
	Fat	8	8	8	8	7	7	54	44	50	40	47	38	355	233	333	217	308	202	

Regression Equation – log ppm PCB = −1.3450 − 0.0190 (day recovery) − 0.3888 (log ppm fed) + 0.2929 (if liver) + 0.0376 (% Cl_2) + 0.0202 (log ppm fed × % Cl_2) − 0.0917 (log ppm fed – if female) + 0.0003 (day recovery × % Cl_2)

MONS 049189

TABLE XXVI

IBT # 9887
9885

90-Day Subacute Oral Toxicity Study of Aroclor in Beagle Dogs

ppm PCB in Dog Tissues (Wet Weight Basis)

		90 Day Sacrifice						Sacrifice
		30 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1016	Muscle	0.3	0.06	2	0.3	7	1	
	Liver	0.1	0.1	0.4	0.1	1	0.2	
	Fat	8	1	9	3	24	4	

		90 Day Sacrifice						Sacrifice
		10 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1221	Muscle	0.04	0.04	0.2	0.2	0.2	0.2	
	Liver	0.07	0.02	0.2	0.1	0.02	0.2	
	Fat	0.7	0.8	5	3	8	9	

MONS 049187

TABLE XXVII

IBT #9887 9885 90-Day Subacute Oral Toxicity Study of Aroclor in Beagle Dogs

ppm PCB in Dog Tissues (Lipid Weight Basis)

		90 Day Sacrifice						Sacrifice
		30 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1016	Muscle	8	1	30	5	69	20	
	Liver	10	6	27	10	90	18	
	Fat	11	2	13	8	36	7	

		90 Day Sacrifice						Sacrifice
		10 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1221	Muscle	0.8	0.8	2	5	27	7	
	Liver	6	2	20	10	1	18	
	Fat	0.9	1	6	6	11	12	

MONS 049188

TABLE XXVIII

IBT #9887 9885 90-Day Subacute Oral Toxicity Study of Aroclor in Beagle Dogs

Predicted ppm PCB in Dog Tissues (Lipid Weight Basis)

		90 Day Sacrifice						Sacrifice
		30 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1016	Muscle	8	2	20	5	48	12	
	Liver	13	4	35	9	82	22	
	Fat	8	2	20	5	48	12	

		90 Day Sacrifice						Sacrifice
		10 ppm		100 ppm		300 ppm		Exposure Level
Material	Tissue	♂	♀	♂	♀	♂	♀	Sex
Aroclor 1221	Muscle	1	1	5	5	11	11	
	Liver	5	2	25	10	60	21	
	Fat	1	1	5	5	11	11	

1016 Regression Equation $\log \text{ppm PCB} = -0.2759 + 0.7885 (\log \text{ppm fed}) + 0.2382 (\text{if liver}) - 0.5815 (\text{if female})$

1221 Regression Equation $\log \text{ppm PCB} = -0.7730 + 0.7299 (\log \text{ppm fed}) + 0.7178 (\text{if liver}) - 0.4252 (\text{if female liver})$

MONS 0496189

TABLE XXIX

IBT #J7300 Toxicity Reproduction and Residue Study of Aroclor in White Leghorn Chickens

ppm PCB in Chicken Tissues (Wet Weight Basis)

		Residue Sacrifice						30 Day Check Sacrifice			1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	Final Sacrifice					
		1 ppm		10 ppm		100 ppm		1 ppm	10 ppm	100 ppm	1 ppm				10 ppm				100 ppm				1 ppm		10 ppm		100 ppm	
		♂	♀	♂	♀	♂	♀	♂♀	♂♀	♂♀	30 Day Recovery Period												♂	♀	♂	♀	♂	♀
Aroclor 1242	Muscle		0.06				2	0.07	0.05															0.06		0.1		5
	Liver				2			0.4	0.2															0.7		2		45
	Fat	26	17			1400	1231																	4				8
	Eggs			5		38									3	0.6	0.5		26	30	19	24						
Aroclor 1254	Muscle			0.9	0.7			0.02																		0.1		
	Liver		0.8				50	0.09																0.9				27
	Fat			561	189																					73		
	Eggs	0.7				132						2	0.6	0.4						68	75	36						
Aroclor 1260	Muscle		0.2				11	0.06	0.8															0.04				2
	Liver				6			0.09	0.2																	13		
	Fat	153	15			628	1157																	10				1010
	Eggs	1		13							1	0.7			13	8												

MONS 061640

TABLE XXX

IBT #J7300 Toxicity, Reproduction and Residue Study of Aroclor in White Leghorn Chickens

ppm PCB in Chicken Tissues (Lipid Weight Basis)

		Residue Sacrifice						30 Day Chick Sacrifice			1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week	Final Sacrifice					
		1 ppm		10 ppm		100 ppm		1 ppm	10 ppm	100 ppm	1 ppm				10 ppm				100 ppm				1 ppm		10 ppm		100 ppm	
		♂	♀	♂	♀	♂	♀	♂♀♀	♂♀♀	♂♀♀	30 Day Recovery Period												♂	♀	♂	♀	♂	♀
Aroclor 1242	Muscle		13				101	9	12															8		30		69
	Liver				52			14	12															10		28		150
	Fat	30	22			2460	1310																	4				9
	Eggs			37		472									33	5	5		383	461	219	340						
Aroclor 1254	Muscle			517	240			2																		61		
	Liver		18				1975	4																7				1380
	Fat			892	199															1220	626	692				78		
	Eggs	10				1410						14	6	5														
Aroclor 1260	Muscle		40				4080	5	125															13				887
	Liver				86			6	6																	58		
	Fat	183	16			3280	1308																	11				1809
	Eggs	12		146							13	7			135	71												

MONS 069191

TABLE XXXI

IBT #J7300 Toxicity, Reproduction and Residue Study of Aroclor in White Leghorn Chickens

Predicted ppm PCB in Chicken Tissues (Lipid Weight Basis)

		Residue Sacrifice						30 Day Chick Sacrifice			1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	Final Sacrifice					
		1 ppm		10 ppm		100 ppm		1 ppm	10 ppm	100 ppm	1 ppm				10 ppm				100 ppm				1 ppm		10 ppm		100 ppm	
		♂	♀	♂	♀	♂	♀	♂ & ♀	♂ & ♀	♂ & ♀	30 Day Recovery Period												♂	♀	♂	♀	♂	♀
Aroclor 1242	Muscle	20	12	196	119	1899	1152																10	6	92	56	893	541
	Liver	12	7	114	69	1104	669																12	7	104	63	1013	614
	Fat	20	12	196	119	1899	1152																10	6	92	56	893	541
	Eggs	3		40		498					2	0.9	0.6	0.4	25	16	10	7	424	362	308	263						
Aroclor 1254	Muscle	68	22	657	213	6358	2064																26	8	249	81	2409	782
	Liver	34	11	326	106	3163	1027																25	8	243	79	2338	759
	Fat	68	22	657	213	6358	2064																26	8	249	81	2409	782
	Eggs	7		92		1141					6	5	4	3	80	66	54	44	1007	881	775	681						
Aroclor 1260	Muscle	124	29	1196	284	11693	2762																42	10	379	90	3949	938
	Liver	57	24	552	131	5366	1275																42	10	366	87	3557	845
	Fat	124	29	1196	284	11693	2762																42	10	379	90	3949	938
	Eggs	11		140		1728					12	13	14	15	137	135	133	131	1543	1378	1231	1099						

Chicken Regression Equation log ppm PCB = − 0.5311 + 0.9868 (log ppm fed) + 0.7344 (if female) + 0.0438 (% Cl_2) + 0.2908 (if rec. liver) − 0.0056 (% Cl_2) if liver − 0.0078 (% Cl_2) if rec. − 0.0226 (% Cl_2) if female

Egg Regression Equation log ppm PCB = − 0.7478 − 1.1794 (rec. time) + 1.0920 (log ppm fed) + 0.0300 (% Cl_2) + 0.5316 (rec. time × log ppm fed) + 0.0202 (rec. time × % Cl_2) − 0.0096 (rec. time × log ppm fed × % Cl_2)

Chick Regression Equation — insufficient data

MONS 049192

TABLE XXXII

IBT #8746 Toxicity, Reproduction and Residue Study of Aroclor in White Leghorn Chickens

ppm PCB in Chicken Tissues (Wet Weight Basis)

		Residue Sacrifice			30 Day Chick Sacrifice			1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	Final Sacrifice		
		2 ppm	4 ppm	8 ppm	2 ppm	4 ppm	8 ppm	2 ppm				4 ppm				8 ppm				2 ppm	4 ppm	8 ppm
		♂♀♀	♂♀♀	♂♀♀	♂♀♀	♂♀♀	♂♀♀	30 Day Recovery Period												♂♀♀	♂♀♀	♂♀♀
Aroclor 1242	Muscle			1	0.02	0.04	0.03													0.5		1
	Liver		4		0.3	0.2	0.2														2	
	Fat			56	2	3	5													11		43
	Eggs	1							1		1	2		1			4					

MONS 049193

TABLE XXXIII

IBT #8746 Toxicity, Reproduction and Residue Study of Aroclor in White Leghorn Chickens

ppm PCB in Chicken Tissues (Lipid Weight Basis)

		Residue Sacrifice			30 Day Chick Sacrifice			1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	Final Sacrifice		
		2 ppm	4 ppm	8 ppm	2 ppm	4 ppm	8 ppm	2 ppm				4 ppm				8 ppm				2 ppm	4 ppm	8 ppm
		♂♀	♂♀	♂♀	♂♀	♂♀	♂♀													♂♀	♂♀	♂♀
Muscle	Muscle			84	5	8	13													19		71
Muscle	Liver		30		15	19	17														17	
Muscle	Fat			73	3	5	9													14		56
	Eggs	14							14		15	22		25			42		28			

MONS 049194

TABLE XXXIV

IBT #8746 Toxicity, Reproduction and Residue Study of Aroclor in White Leghorn Chickens

Predicted ppm PCB in Chicken Tissues (Lipid Weight Basis)

		Residue Sacrifice			30 Day Chick Sacrifice			1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	1st wk	2nd wk	3rd wk	4th wk	Final Sacrifice		
		2 ppm	4 ppm	8 ppm	2 ppm	4 ppm	8 ppm	2 ppm				4 ppm				8 ppm				2 ppm	4 ppm	8 ppm
		♂♀	♂♀	♂♀	♂♀	♂♀	♂♀													♂♀	♂♀	♂♀
Broods 12/12	Muscle	31	62	123	7	9	11													15	29	58
	Liver	18	36	71	15	15	15													17	33	66
	Fat	31	62	123	6	6	6													15	29	58
	Eggs	7	15	32				4	2	1	.25	8	5	3	1	19	12	7	4			

Chick Regression Equation - log ppm PCB = 0.7436 + 0.4385 (if liver) + 0.3817 (log ppm fed - if muscle)

MONS 091695

TABLE XXXV

Bionomics Inc. Acute Toxicity of Aroclor to Bluegill and Channel Catfish

% PCB in Fish Tissues (Wet Weight Basis)

		21 Day Sacrifice							Sacrifice
Material	Species		0.02 ppm	0.04 ppm	0.06 ppm	0.11 ppm	0.18 ppm	0.30 ppm	Exposure Level
Aroclor 1016	Bluegill		0.01	0.005	0.007	0.04	0.04		
	Channel Catfish		0.01	0.01	0.05	0.06	0.1	0.2	

		21 Day Sacrifice							Sacrifice
Material	Species	0.014 ppm	0.023 ppm	0.038 ppm	0.064 ppm	0.108 ppm	0.180 ppm	0.300 ppm	Exposure Level
Aroclor 1242	Bluegill	0.004	0.01	0.03	0.02	0.07			
	Channel Catfish	0.009	0.02	0.03	0.09	0.2	0.3	0.3	

SNOW 961640

TABLE XXXVI

Bionomics Inc. Acute Toxicity of Aroclor to Bluegill and Channel Catfish

% PCB in Fish Tissues (Lipid Weight Basis)

		21 Day Sacrifice							Sacrifice
Material	Species		0.02 ppm	0.04 ppm	0.06 ppm	0.11 ppm	0.18 ppm	0.30 ppm	Exposure Level
Aroclor 1016	Bluegill		0.8	0.5	0.7	3.8	3.2		
	Channel Catfish		0.8	0.3	3.8	3.3	5.3	7.5	

		21 Day Sacrifice							Sacrifice
Material	Species	0.014 ppm	0.023 ppm	0.038 ppm	0.064 ppm	0.108 ppm	0.180 ppm	0.300 ppm	Exposure Level
Aroclor 1242	Bluegill	0.5	0.8	1.6	1.6	5.6			
	Channel Catfish	0.2	0.5	1.0	2.0	4.2	5.6	6.6	

MONS 049197

TABLE XXXVII

Bionomics Inc. Acute Toxicity of Aroclor to Bluegill and Channel Catfish

Residues % PCB in Fish Tissues (Lipid Weight Basis)

		21 Day Sacrifice							Sacrifice
Material	Species		0.02 ppm	0.04 ppm	0.06 ppm	0.11 ppm	0.18 ppm	0.30 ppm	Exposure Level
Aroclor 1016	Bluegill		0.5	0.9	1.6	3.0	5.6		
	Channel Catfish		0.3	0.6	1.2	2.4	4.6	9.0	

		21 Day Sacrifice							Sacrifice
Material	Species	0.014 ppm	0.023 ppm	0.038 ppm	0.064 ppm	0.108 ppm	0.180 ppm	0.300 ppm	Exposure Level
Aroclor 1242	Bluegill	0.5	0.6	1.3	2.3	4.0			
	Channel Catfish	0.3	0.5	0.9	1.7	3.2	5.8	10.6	

Regression Equation: log % PCB = 1.6355 + 1.0635 (log ppm PCB in H_2O) + 0.1063 (log ppm PCB in H_2O if channel catfish) + 0.1232 (log ppm PCB in H_2O if 1016)

MONS 861640