AROCLOR HALF LIFE IN BACTERIAL DEGRADATION PROCESSES

The half life of a material in a reaction or in a decomposition process such as radioactive decay is the time at which exactly 50% of the material has disappeared. The half life can be readily determined in a chemical reaction for a given reactant provided

1. The reaction rate is independent of the concentration of other reactants.

2. The half life sought is for a pure chemical element or compound (not a mixture).

3. The order of the raction is known.

These requirements make it impossible to get valid half lives for bacterial degradation of Aroclors. Some data have been obtained on bacterial degradation of the individual components of Aroclor 1242 and 1016.[1] These data show that the degradation of the individual components depends upon what other components are present. For example, 4,4'-dichlorobiphenyl degrades very slowly (half life>50 days) when tested alone, but very rapidly (half life 2 days) when tested as a component of Aroclor 1242 or 1016. In fact, the decomposition rates of identical components of 1242 and 1016 differ depending on which of the mixtures is being tested.

In addition to these difficulties the half-life of PCB in the environment would depend on the following:

1. Type and amount of bacteria present

2. Aerobic vs. anaerobic conditions

3. Presence of other nutrients

In the semi-continuous activated sludge units we found that the decomposition of pure chemicals such as p-nitroanaline, o-nitroaniline, etc., were first order, i.e., the reaction rate is expressed by

$$\frac{dc}{dt} = -kc$$

t = time
c = concentration
k = rate constant

In most chemical and physical situations where the term "half life" is used, this reaction mechanism prevails. The calculation of the half life is given by:

$$t_{1/2} = \frac{0.693}{k}$$

Attached are some charts from the reference report[1] which show calculated half life, and % remaining as a function of time, for individual components of 1016 and 1242. These apply only to the exact experimental conditions used to obtain them. They are not true half lives in the sense discussed above.

Reference

(1) MP 10227 Biodegradability of Aroclors 1242 and 1016, R. A. Lidgett, H. A. Vodden and P. E. Gilbert - Monsanto Review Report 9/13/71.

TABLE 2

Tensors Object to > 50 days

Isomer	Culture	With or without biphenyl	Time to Degrade to 50%
2,4'-dichloro-	C_2	With	5 days
	C_2	Without	2 days
4,4'-dichloro	C_2	With	>50 days
	C_2	Without	>50 days
	C_3	With	<10 days
	C_3	Without	<15 days
2,3-dichloro	C_2	With	4 days
		Without	4 days
3,4-dichloro	C_2	With	2 days
		Without	3 days
2,3,2'-trichloro-	C_2	With	3 days
		Without	7 days
2,3',4'-trichloro-	C_2	With	<2 days
		Without	3 days
3,3',4'-trichloro-	C_2	With	6 days
		Without	6 days
2,4,6-trichloro	C_2	With	>50 days
		Without	>50 days
2,2',4,4'-tetrachloro	C_2	With	>50 days
		Without	>50 days
2,2',4,6-tetrachloro	C_2	With	>50 days
		Without	>50 days
2',3',4',5',2,6-hexachloro*	C_2	With	<15 days
		Without	>50 days

* Mixed with 2,3,2' and 2,3',4',-trichlorobiphenyls to improve solubility.

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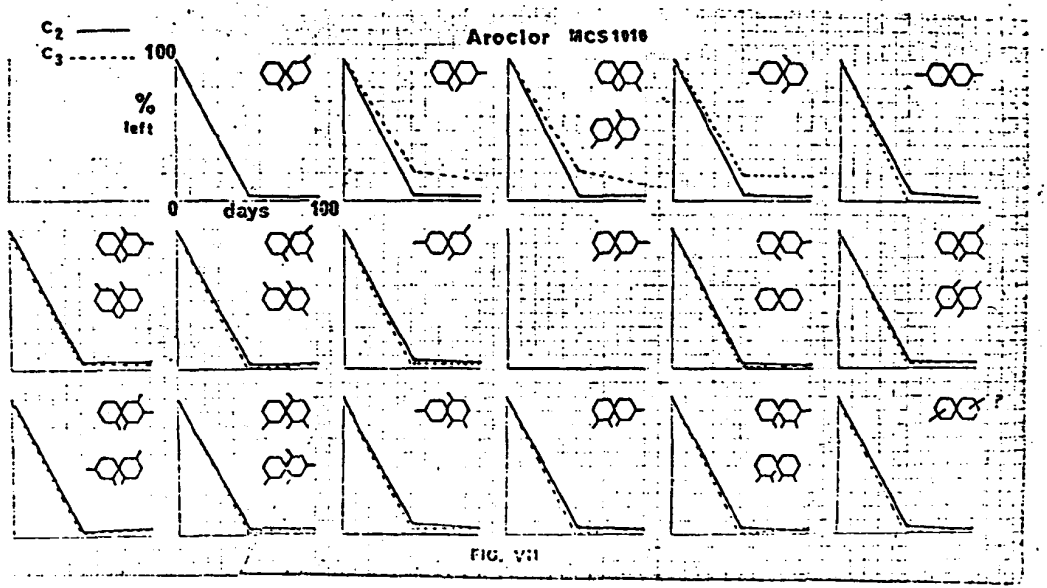

FIG. VII

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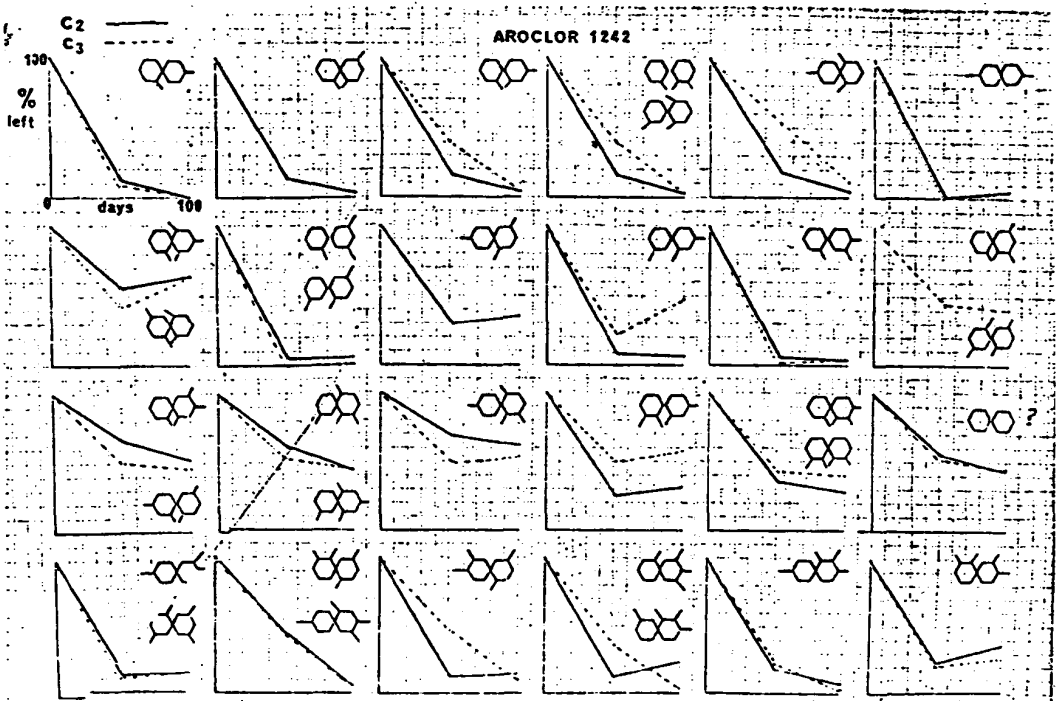

FIG VIII

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