Monsanto

FROM (NAME & LOCATION): J.H. MAINPRIZE, Ruabon.

DATE : 30th April, 1969. cc: R.A. Lidgett, Ruabon.

SUBJECT : BIODEGRADATION OF AROCLORS.

REFERENCE : JHM/BJO'G.

TO : R.A. BAXTER, Ruabon.

I have searched available literature (Water Poll. Abstracts etc.) for any references to work on the biodegradation of chlorinated bi-phenyls and have so far been unsuccessful. There is however considerable published information on the techniques for studying the breakdown of other potentially toxic, water insoluble materials, and these I think could be adapted for work on Aroclors.

Unfortunately, little evidence exists of any standardisation of technique amongst various workers, a fact which is commented on in the report of a U.S. committee published in 1967 [1]. (R.D. Swisher was a member).

In the context of water pollution the report defines biodegradation as "the conversion of chemical compounds to innocuous substances through the action of living organisms". Within this definition the following possibilities are said to exist.

1. Primary degradation - Biodegradation to the minimum extent necessary to change the identity of the compound.

2. Ultimate Biodegradation - Biodegradation to water carbon dioxide and inorganics.

3. Acceptable Biodegradation - Biodegradation to the extent to remove some undesirable property e.g. toxicity.

I have assumed that the immediate need is to demonstrate that primary breakdown of Aroclors can occur in nature, and that extensive study of the toxicity of any degradation products should not be considered at this stage.

No detailed test procedures are given in the report but as general guidance it is stated that the following biological environments should be considered in a search for active organisms.

1. Biologically populated surface waters.

2. Biological waste treatment facilities. (Activated sludge, trickling filters)

3. Soil systems.

An attempt to define a standard procedure for measuring biodegradability has been made by Bunch and Chambers[2]. Basically the procedure consists of inoculating a solution of the test material with settled sewage in the presence of buffer salts and essential minerals. Weekly sub cultures are made for three weeks, substrates being analysed for residual contaminant

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after each weekly period. Precautions are taken to ensure that concentrations are below toxic levels initially and that removal due to mechanisms such as adsorption is not interpreted as evidence of biodegradation. I think this method may be worth trying for initial screening of inocula from different sources but in the absence of any favourable results it will probably be necessary to attempt more long term acclimatisation procedures.

Our main problem will be to devise a method of introducing the chlorinated bi-phenyls into any chosen biological system. At the saturation concentration of 0.2 - 0.3 ppm. adsorptive effectscould be the major reason for disappearance from solution. Faced with a similar problem when studying the breakdown of DDT Okey and Bogan[3] dispersed the insecticides in water using a non toxic wetting agent of low biodegradability. For long term studies the dispersed materials were added in graduated quantities to 15 litre reactors over a period of six months. At the end of this period the entire reactor contents were solvent extracted for analysis by infra red.

A second method of adding very insoluble comp ounds to culture media is to prepare solutions in a volatile solvent e.g. Pet ether, which is removed by gentle warming before inoculum is added.

If we are requested to undertake the study of Aroclor degradation I would propose that we first use the standard procedure devised by Bunch and Chambers employing one of the methods mentioned above for introducing test materials into the culture vassels.

If no evidence of breakdown is found we would then attempt long term acclimatisation. For this I suggest we use the Okey and Bogan technique or possibly the type of perfusion units employed by John McIver for his work on Ruabon effluent.

(J.H. MAINPRIZE.)

Refs. 1. Journ. Water Poll. Control Fed. 39, 7, 1232 (July 1967)
2. " " " " " 39, 2, 181 (Feb 1967)
3. Proc. 11th Pacific Northwest Industrial Waste Conference 1963 p.222.

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