

POND EXPERIMENT

The basic objective of this experiment is to study the relative accumulations in fish exposed to various PCB products over long periods of time.

Five self-supporting fish ponds have been established at the site of Monsanto Limited in Ruabon, North Wales. Each pond has a surface area of about 6 m² and contains about 1,000 litres of water. They are stocked with plants and molluscs, and have acquired a natural population of water beetles, algae and other forms of aquatic life.

Goldfish were chosen as the fish in which to study the accumulation. Initially some experiments were made with fairly high dosages of Aroclors 1254, 1242 and 1016 in the range of 15-20 µg/litre. At these levels fish rapidly accumulated concentrations of around 20 ppm (whole fish, wet weight) probably through physical absorption. It was decided to repeat the experiment at much lower levels of PCB in the water.

By a succession of partial emptying and refilling, the levels of PCBs (A 1254, 1242 and 1016) were reduced to around 1 µg/litre or less and, after a period of time for equilibration, 75 goldfish were introduced to each pond. Fish have been removed periodically for analysis and water samples have also been analysed from time to time.

This particular experiment was started in June 1973 and has been in progress for about two years, but difficulties in catching the few remaining fish resulted in a termination of the fish analysis at the end of 1974. Further analyses of water will be made in order to improve our confidence in measurements of PCB concentrations at low levels.

The results in the table show that for Aroclor 1254 a reasonably consistent pattern emerges. The level of Aroclor 1254 in the water has remained at about 0.1 µg/litre. After four to six weeks the level of PCB in fish had risen to about 1 µg/g (wet weight, whole fish) and then over a period of a year had increased to around 5 µg/g. A subsequent set of measurements indicated a drop in the level of PCB in fish, but owing to sampling difficulties no further results are available to confirm this. The maximum accumulation ratio for fish/water for Aroclor 1254 thus appears to be about 50,000.

For Aroclor 1242 the initial concentration in the water appeared to be around 1.6 µg/litre; this seemed to drop steadily, for about a year, to rather less than 1.0 µg/litre, but then dropped rapidly in a few months to less than 0.1 µg/litre. During this whole period the accumulation in fish increased from about 0.6 µg/g to about 3 µg/g. The accumulation factor which increased only slowly from about 400 to 2,500 during the first year then appeared to jump to a high value of 40,000.

We have no rational explanation for this behaviour and cannot rule out that errors in the measurement of Aroclor 1242 in water may be responsible. Both direct liquid/liquid extraction and polyurethane foam extraction methods have been used in this work and whereas good correlations have been achieved for Aroclor 1254, the correlation for Aroclor 1242 has not been good, with suspected contamination during analysis being a major factor. Further work on estimating Aroclor 1242 levels in pond water is in progress in an attempt to resolve this.

It may also be significant that whereas the chromatograms of the water containing Aroclor 1254 show relatively small changes in the major peaks, in the case of Aroclor 1242, only the peaks towards the higher boiling end of the chromatogram remain relatively unchanged, and these tend to be used for quantification.

TABLE

DATE	A 1254		A 1242		A 1016	
	WATER μg/l	FISH μg/g	WATER μg/l	FISH μg/g	WATER μg/l	FISH μg/g
20/07/73		1.2		0.6		
07/03/73	0.12		1.6			
22/08/73		0.8		0.8		
19/09/73		2.4		0.5		
30/04/74		3.3	1.1	2.5		
08/03/74		5.0		2.4		2.4
17/08/74	0.12		0.9			
21/10/74	0.11	2.2	0.08	3.8	0.06	1.2

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