UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: EAB Recommendation for Retrospective Studies Concerning Surface Water Contamination as a Result of Termiticide Use of Chlorinated Cyclodienes

FROM: Matthew Lorber, Agricultural Engineer
EPGS/EAB/HED (TS-769)

TO: Michael Firestone, Chemist
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TO: Michael McDavitt, Review Manager
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Attached to this memorandum is an in-depth discussion on the possibility of termiticidal use of chlordane resulting in surface water contamination. Since the physical and chemical properties of chlordane are similar to those of other chlorinated cyclodiene termiticides (aldrin, heptachlor), than environmental fate and transport of the these chemicals are expected to be similar.

Briefly, two urban lakes in Region VII were found contaminated with chlordane as measured by fish concentrations exceeding health guidelines, and significant bottom sediment concentrations. Since there was no agricultural land draining these lakes, the source of contamination was thought to be urban uses of chlordane, or more precisely, termiticidal or insecticidal uses of chlordane. In one of the towns, Cedar Rapids, Iowa, the Iowa Department of Water, Air and Waste Management sampled potential urban sources, including storm sewer drainage following major storms (to test the possibility of insecticidal uses on lawns and golf courses), a water treatment plant, sanitary sewers draining home foundations, and a sump pump. While the storm sewers showed no positive results, the water treatment plant showed traces of chlordane (.18 ppb), the sanitary sewer showed measurable amounts (2.5, 4.7 ppb), and the sump pump showed significant amounts (180 ppb).

On the basis of these tests, and the evidence of chlordane contamination of the urban lakes, EAB recommends that the registrants of chlordane, aldrin, and heptachlor be required to perform follow-up studies. Of two studies briefly outlined in the attached discussion, the retrospective study is recommended. In this type of study, potential sources of contamination are sampled for presence of the chlorinated cyclodienes. Since the termiticide use is implicated, the candidate for further study would most likely be sump pumps draining home foundations. In the design phase of the study, all houses chosen for testing must have documented termiticide application within the past several years by a professional applicator. As well, it would not be inappropriate to continue testing other urban sources of the chlorinated cyclodienes including storm sewers, drainage ditches, and so on. EAB will review the registrant's protocol when submitted.

cc. Stuart Cohen
Carolyn Offutt

Attachment

Title: The possibility of urban sources of chlordane contaminating fish in Region VII

The contamination of fish with chlordane in Region VII has been a documented fact since a regular program of testing began in 1980. Currently there are 85 sites in the four states of Region VII which sample annually. This program is run by Region VII with cooperation with state agencies. When a site is found contaminated, a more extensive follow up study is initiated.

The bottom-feeders carp and catfish are found to have the highest concentrations, quite often exceeding 1.00 mg/kg. The FDA action level for chlordane in 0.3 mg/kg, although this level is for edible portions of fish, and quite often the samples are of whole fish. It is reasonable that these bottom feeders would have the highest concentrations, since chlordane is typically bound to sediments and any sediment-bound or soluble chlordane would migrate to the bottom sediments of lakes and rivers. However, other fish which have been found to have concentrations exceeding the action level include: smallmouth and bigmouth buffalo, bullheads, bluegill, stoneroller, shovelnose sturgeon, white bass, and minnows. Other fish which have shown to be contaminated with chlordane at lower levels include: white crappie, largemouth bass, golden shiners, green sunfish, quillback, and golden red-horse. The complete data set from Region VII is available in EAB.

Originally, the source of chlordane was thought to be from runoff over agricultural lands treated with chlordane prior to its cancellation from agricultural uses in 1978. However, the 1984 sampling of the Meramac River in St. Louis and the Blue River in Kansas produced high levels of chlordane from areas that did not receive agricultural drainage. This brought up the possibility of urban sources of chlordane, including home and garden use, termaticide use, and/or improper disposal.

A routine fish monitoring program in Iowa in the Cedar Rapids area in 1984 showed fish concentrations of chlordane exceeding the FDA action level. As a result, a more extensive monitoring program was undertaken in 1985. Sampling occurred in the spring and late summer in the Cedar River and Cedar Lake. Sampling in the Cedar River showed little contamination, with only 2 of 25 samples exceeding the FDA action level. However, samples from the Cedar Lake showed extensive contamination. A composite of five fish samples in the spring showed an average concentration of 1.00 mg/kg. In late summer sampling, carp, quillback, and catfish had average chlordane concentrations of 0.48, 1.33, and 1.00 mg/kg in Cedar Lake, while bass and bullhead had concentrations of 0.23 and 0.17 mg/kg. Sediment samples from Cedar Lake also showed higher concentrations than samples from Cedar River: 170 and 460 ppb from Cedar Lake, in comparison to <5, 6, 16, and 17 from Cedar River.

The big difference between Cedar Lake and Cedar River is that Cedar Lake is an urban lake and does not receive agricultural drainage, as does Cedar River. These results prompted the Iowa Department of Water, Air and Waste Management to sample urban sources of chlordane which potentially could have caused contamination of fish in Cedar Lake. Sampling in the city of Cedar Rapids took place in the Fall of 1985. The sites were carefully chosen to represent a range of potential urban sources. The results of their sampling program are given in Table 1.

Two of the sampling dates occurred immediately after rainfall/runoff events. The Mcloud Run drainage ditch represented storm sewer discharge with some agricultural drainage. Mount Farm Drive and Elm Crest were also storm sewers which drained a residential section and a golf course, which would test the hypothesis that chlordane contamination may arise from lawn and garden treatments. A sanitary sewer in the vacinity of Teresa Drive drains the foundations of several homes known to be treated with chlordane for termite control. Twenty-four hour composite sampling from influent and effluent of the Cedar Rapids Pollution Control Plant provided general information on unknown sources feeding the Cedar River. As seen on Table 1, Mcloud Run, Mount Farm Drive, and Elm Crest Country Club all showed non-detectable amounts after both storm events. Although not definitive evidence, this would indicate that above-land lawn, garden, and agricultural sources may not be contaminating the river. On the other hand, the sanitary sewer at Teresa and 26th draining the foundations of homes showed detectable levels on both dates, which implies that chlordane applied to home foundations may be a contributing source. The influent to the PCP showed low levels of chlordane, while the effluent did not show any chlordane.

The most surprising evidence came from the only other site sampled, a basement sump pump from a residence on Yellow Pine Drive known to be treated with chlordane four years prior to the 1985 sampling. The one sample extracted from this pump showed 180 ppb. Extrapolating this result to all homes with basement sump pumps and chlordane treatments might alone tell the story.

Monica Wnuk of the Iowa Department of Water, Air and Waste Management has been working on a follow-up study plan, but currently is lacking in funds. Robert J. Steiert, chief of the Planning/Evaluation Section in Region VII, also believes the problem worthy of follow-up study as he states in memo to Mike McDavitt, dated Apr. 8, 1986:

> We think additional studies of specific small watersheds containing houses treated with chlordane using existing termite protection procedures would be a good idea to help prove/disprove the concept of chlordane movement. Unfortunately, the Region and states have only limited funds and the actual fish monitoring is stretching those.

Should the registrant be required to perform studies to investigate the contribution of termiticide uses of Chlordane to fish contamination, two possible studies are recommended:

1) a retrospective study which would continue to sample sanitary sewers draining home foundations known to have chlordane termite control measures and sampling of sump pumps or drainage tiles draining houses also having chlordane control. This would be a logical extension of the source examination done by the Iowa Department of Water, Air and Waste Management. Follow-up plans put together by Monica Wnuk should be solicited if possible.

2) a prospective study in which a house(s), perhaps newly built, will first have its ground water sampled to insure freedom of chlordane, and then following application of chlordane for termite control, will then continue to have its drains and sump pumps sampled for appearance of chlordane over a period of two or three years. This study is mechanistic and would show a cause-effect relationship between chlordane use for termiticide control and transfer of chlordane from home foundations to where ever sump pumps send water.

The restrospective study is recommended, since its results will yield answers immediately, and those answers will be of practical value. The second study would not yield results for several years.

Matthew Lorber

Matthew Lorber, Agricultural Engineer

Table 1. Chlordane concentrations in source sampling in Cedar ~~River~~ Rapids, 1985 (concentrations in ppb)

Location	Sep 10	Oct 11	Oct 24
McCloud Run	ND	ND	not collected
Mount Farm Drive N.E.	ND	ND	not collected
Elm Crest Country Club	ND	ND	not collected
Teresa and 26th	2.5	4.7	not collected
Yellow Pine Drive N.E.	not collected	not collected	180.0
Cedar Rapids PCP influent	0.18	0.18	not collected
Cedar Rapids PCP effluent	ND	ND	not collected

Title: Summary of environmental fate data of chlordane, aldrin, and heptachlor

Summary

The data in EAB files is generally lacking for these three pesticides. For example, there are no estimates of the adsorption partition coefficient for any of the pesticides. This is an important parameter in determination of environmental mobility. As well, there are few field half-lives determined, and data was not submitted for hydrolysis and anaerobic soil metabolism, both of which are very important for determining persistance in the saturated zone. Therefore, any conclusions drawn are based on an incomplete data set.

Based on a survey of the available data, it can be said that all three are immobile/very slowy mobile and persistant. One cannot make a valid distinction on the environmental fate of the three. In other words, any conclusions drawn about the fate of one of these pesticides used as termiticides should also be considered valid for either of the other two pesticides. Therefore, the decision on whether chlordane should be replaced by one of the other alternatives evaluated in this summary should be based on issues such as differing application rates, toxicity, bioaccumulation, or other issues rather than environmental fate.

The following is a brief summary of data that was available in EAB files.

Chlordane Application rates are expressed as 1.0-1.5 gal/10 ft^2 or 2-4 gal/10 linear feet. Only one study submitted dealt with movement in the environment. In this study, chlordane was broadcast over golf course turf at a rate of 9 kg ai/ha. After 56 days, 1.6-2.1 ppm was observed in the 0-1 cm depth, and $\leq$ 0.3 ppm was observed in 1-3.5% layer. Total residues after 56 days declined to 69% of originally applied. In a study in which chlordane was sprayed on top of a lake, the concentration of chlordane in the water was 4-5.5 ppb after 7 days and 0.008-.011 ppb after 421 days. In lake sediments, the concentration reached 20-30 ppb during the first 279 days after application, and 10 ppb 421 days after application. In studies began in Beltsville, Maryland in 1951, in which all three were applied to soil plots, chlordane was applied to sandy loam soil at rates of 56, 112, and 224 kg/ha. Results indicate that approximately 83% of that applied was still in the soil in 1952, and 45% of chlordane was still in the soil in 1966, 15 years after application.

Aldrin Application rates are expressed as 1.0-1.5 gal/10 ft^2 or 2-4 gal/10 linear ft. In column studies, aldrin was found to be immobile in Hagerstown silty clay loam and Lakeland sandy loam. On a scale of 1 (immobile) to 6 (mobile), aldrin was rated as 1.00. In an aerobic metabolism study in which samples were incubated in flasks, 91 and 84% was recovered in the lower layer in flasks, and >99% was found attached to lake mud when lake mud was added to the flasks. In another column study, aldrin was found in the 0-5 cm and 5-20 cm layer (of 60 cm total column length) when over 35 inches of water was added to a sandy clay loam. In field plots treated with 20 and 200 lb/a incorporated 4-5 inches, 93% of that recovered after 17 months was found in the 0-6 inch layer.

Aldrin degrades to dieldrin in the environment. In surface treatments of aldrin at 1.5 and 15 lb/ac to a silt loam soil, no aldrin was found below 2 inches after 15 months, although dieldren was found at 2 inches. When incorporated at rates of 1, 2, 3, and 15 lb/ac, dieldrin was found at 6 inches at the highest application rate. Laboratory studies indicate that the degradation of aldrin to dieldrin occured mostly in wet, non-sterile conditions in a study which tested permutations of wet/dry and sterile/non-sterile conditions. Estimated half-lives from this study ranged from 122 to 197 days. In the long term studies originating in Beltsville in 1951, aldrin residues were found at 75-100% of initially applied after one year, and 30-40% of applied after fifteen years. In a registrant submitted fact sheet, the field half-life was listed at 2-4 years. Finally, in a study in Hawaii, after applications resulting in 44-252 ppm to three soils in haway, 0.38-0.99 ppm were still present after 7 years, and 0.21-0.37 ppm were also found in control plots not treated with aldrin, indicating perhaps some environmental movement.

Heptachlor Like the other two termiticides, rates of application are listed at 1.0-1.5 gal/10 ft^2 or 2-4 gal/10 linear ft. In a similar column study as aldrin with Hagerstown silty clay loam and a Lakeland sandy loam, heptachlor was evaluated as 1.00 in terms of mobility (1.00 = immobile, 6 = mobile). This was the only mobilit study in EAB files.

When incorporated 7.5 cm at a rate of 5.6 kg ai/ha into a Rayno Silt loam, it dissipated from the surface 0-23 cm layer with a half-life of 336-551 days. The primary degradate of heptachlor is heptachlor-epoxide, which is, in fact, more toxic than parent compound. In field experiments including this degradate in the estimate of the half-life, an estimate of 5-6 months was determined after incorporated into a Carrington loam soil. In aerobic metabolism studies, total toxic residue half-life was estimated at 37-42 days in dry and wet nonsterile Carrington loam but >112 days in wet sterile soils. In the long term studies in Beltsville, Maryland, estimated half-lives ranged from 2 to 4 years. In Hawaii experiments similar to those done with aldrin, applications resulting in concentrations of 89-503 ppm declined to 0.68-8.28 ppm heptachlor + heptachlor-epoxide after 7 years. As well, nearby plots not treated with heptachlor had residues of 0.33-0.52 ppm after 7 years, indicating some mobility.

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