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INPUTS OF DDT AND PCB

With the support of the U.S. Environmental Protection Agency, we have continued our investigation of the input rates of chlorinated hydrocarbons into the waters off southern California. The main routes are municipal wastewaters, surface runoff, aerial fallout, direct industrial discharge, antifouling paint application, and ocean current advection. During the past year, we have concentrated our efforts on quantifying the inputs via the first four routes.

One of the principal goals of this research has been to determine the concentrations and emissions of chlorinated hydrocarbon contaminants from the major municipal wastewaters discharged to the Bight. During the 2 years of the study, we have analyzed a number of 1-week effluent composites from each of southern California's six largest outfall systems, which account for approximately 95 percent of the submarine discharge of such wastewaters. Detailed intercalibration programs on split samples have been conducted with laboratories at the University of California and the University of Washington, and at the major sanitation districts responsible for routine monitoring.

One of our major conclusions from these intercalibrations is that the determinations of DDT compounds in Joint Water Pollution Control Plant (JWPCP) final effluent (once the dominant source of chlorinated hydrocarbons) made by the County Sanitation Districts of Los Angeles County have been in good agreement (±20 percent) with those of the other laboratories since the beginning of that monitoring effort in 1971. This is important in light of the fact that the JWPCP annual mass emission rate decreased from approximately 22,000 kg in 1971 (a mean effluent concentration of 42 u.g/1) to 1,400 kg in 1974 (a mean concentration of 3.0 u.g/1): Because of the rapid changes, occasional surveys by outside laboratories such as ours could provide only a coarse evaluation of the effect of control efforts in reducing coastal inputs that have been dominated by this discharge. The agreement between the DDT determinations of the other major sanitation agencies and those of outside laboratories was not as good, but the DDT levels in these effluents were generally quite low (less than 0.3 ug/1, except for Hyperion's 7-mile sludge, which was an order-of-magnitude higher). The only other chlorinated hydrocarbon pesticide we have observed in local wastewaters is Dieldrin; typical concentrations now appear to be on the order of 0.1 u.g/1 or lower-

The situation for the polychlorinated biphenyls is less satisfactory. These industrial materials often are a complex mixture of synthetic organic compounds that are difficult to identify and quantify by gas chromatography. For 1254 PCB, which has an average 54 percent chlorination, some degree of agreement on analytical data is now being reached between the outside laboratories and the monitoring agencies. However, major discrepancies still exist, and these must be resolved before confidence can be placed in this part of the effluent monitoring programs. The most significant recent finding is that 1242 PCB appears to be the dominant known polychlorinated biphenyl in most of the local municipal wastewaters. Effluent levels of 1242 PCB range from 0.1 to 8.0 ug/1, and Hyperion sludge contains 70 ug/1.

In contrast to DDT compounds, PCB's are widely discharged from submarine outfalls along the southern California coast. A comparison of estimated 1974 mass emission rates

for total DDT and PCB compounds in the major municipal wastewaters to the Bight is given in Table 1. This comparison shows that approximately 90 percent of the DDT com-pounds released with municipal wastewaters during 1974 came from the JWPCP discharge off Palos Verdes Peninsula, in spite of the fact that control efforts instituted by the Los Angeles County Sanitation Districts in 1970 resulted in a 93 percent decrease in DDT waste emissions between 1971 and 1974. Emission of PCB compounds via these sources was much more uniform off Los Angeles, Orange, and San Diego Counties; the highest mass emission rate estimate (2,100 kg/yr, off Newport Beach) was only about two times the lowest (950 kg/yr, into Santa Monica Bay). PCB's now constitute the major chlorinated hydrocarbon contaminant found in municipal wastewaters discharged to the Bight, amounting to approximately three and one-half times the input of DDT compounds (5,500 vs. 1,600 kg/yr, respectively) . Other chlorinated pesticide inputs via this route appear to be relatively minor; Dieldrin is the only other pesticide we have observed, and its estimated 1974 mass emission rate from municipal wastewaters appears to be less than 100 kg/yr.

Because pesticides are often widely dispersed following application in the field, surface runoff is generally assumed to be one of the dominant modes of chlorinated hydrocarbon transport to the sea. To determine the importance of such inputs in southern California during Water Year 1971-72, we conducted an intensive sampling of storm runoff in four major channels flowing into the Bight. During the following year, we limited our efforts to one of the largest of these channels, sampling the Los Angeles River over four storm periods. We also conducted two seasonal samplings of dry weather flow from ten channels widely spaced throughout the Bight.

On the basis of very satisfactory agreement obtained between Los Angeles River storm runoff results for the 2 years, we have used the 1971-72 flow-weighted mean con-centrations in storm runoff to obtain Bight-wide mass emission rates for Water Year 1972-73. The results for this year, which was not unusually wet or dry, are summarized in Table 2. These data indicate that, although dry weather flow from the coastal plain constituted approximately 20 percent of the total surface runoff during 1972-73, it accounted for only about 3 per-cent of the mass emissions of chlorinated hydrocarbons

Only 1254 PCB was detected in the aerial fallout samples, and a preliminary estimate of this input is about 1,500 kg/yr. We do not yet have a corresponding value for the lighter polychlorinated biphenyls such as 1242 PCB. However, it appears that surface run-off contains more 1242 than 1254 PCB; thus, the aerial fallout contribution of the lighter polychlorinated biphenyls may also be significant.

Surface runoff carries almost the same amounts of total DDT and 1254 PCB to the coastal waters (about 300 kg/yr, each). Thus, preliminary estimates for the aerial fallout inputs of these contaminants (1,300 and 1,500 kg/yr, respectively) are in good agreement with the relative amounts found in runoff.

An investigation of the importance of vessel anti-fouling paints as a potential source of chlorinated hydrocarbons (particularly PCB's) has demonstrated that, by 1973, this was a completely insignificant mode of input, although it may have been an important source in the past.

Our survey of approximately 40 industrial effluents being discharged directly into San Pedro and San Diego Harbors has produced no evidence that such discharges presently constitute a significant source of chlorinated hydrocarbons to the local marine waters.

In conclusion, it appears that inputs of PCB com-pounds to the Southern California Bight from the adjacent coastal plain are several times larger than those of DDT compounds. In contrast to DDT, the major PCB inputs are broadly distributed along the coast; thus, it may be considerably more difficult to obtain significant reductions in the quantities of PCB reaching the local marine ecosystem.

Table 1. Estimated 1974 annual mass emission rates of total DDT and total PCB discharged to the Bight via major municipal wastewaters.

Discharger	Flow (mgd)	Total DDT (kg/yr)	Total PCB (kg/yr)
Oxnard, Ventura County	10	4	5
Hyperion, Santa Monica Bay			
5-mile effluent	340	56	160
7-mile sludge	5	17	790
Total	350	73	950
JWPCP, Palos Verdes Peninsula	350	1,440	1,300
Orange County Sanitation Districts, Orange County	170	54	2,100
Point Loma, San Diego	100	14	1,100
Total, Southern California Bight	980	1,600	5,500

Table 2. Estimated 1972-73 annual mass emission rates of chlorinated hydrocarbons carried into southern California coastal waters via storm and dry weather runoff.

Type	Volume (10^6 cu m)	Total DDT (kg/yr)	Dieldrin (kg/yr)	PCB 1254 (kg/yr)
Storm	574	313 – 318	61.6	241 – 274
Dry Weather	127	7.1 – 7.2	4.9	7.3 – 7.6
Total	701	320 – 325	66.5	248 – 282
Dry Weather	18.1%	2.2%	7.4%	2.6 – 3.1%

Table 3. Estimated annual mass emission rates of chlorinated hydrocarbons via six routes to the Southern California Bight.

Route	Year	Total DDT (kg/yr)	Dieldrin (kg/yr)	Total PCB (kg/yr)
Municipal Wastewater	1974	1,600*	80	5,550
Direct Industrial Discharge (San Pedro Bay)	1973	20	5	50
Antifouling Paint	1973	<1	<1	<1
Surface Runoff	1973	320	70	≤ 800**
Aerial Fallout	1973-74	1,300	–	1,500†
Ocean Currents	1973	7,000	–	4,000†

*90 percent from JWPCP.
**1,254 PCB: 300 kg/yr.
†1254 PCB only.