EXECUTIVE SUMMARY
of Report EH 98-05 Entitled
"Diazinon and Chlorpyrifos in the Central Contra Costa Sanitary District Sewer System, Sumner 1996"

Environmental Monitoring and Pest Management Branch
Department of Pesticide Regulation

BACKGROUND

Historically, agricultural activities have been the focus of investigations into pesticide impacts on water bodies. In recent years, however, pesticide use in urban areas is increasingly being examined as a potential source of aquatic pollutants. Although applications of pesticides in urban areas are typically on a small scale, the wide variety of chemicals used and the frequency of applications can result in a substantial amount of pesticides used. Urban-use pesticides can move off application sites and enter storm drains which route surface runoffs into urban creeks. These pesticides can also end up in urban sewage which then travels to wastewater treatment plants.

Although conventional wastewater treatment techniques employed by Publicly Owned Treatment Works (POTWs) may remove certain pesticides with high efficiency, others may not be sufficiently removed. Thus, these pesticides can be present in the treated effluent and eventually be released into a receiving water body. Under the California Porter Cologne Act, the Regional Water Quality Control Boards (RWQCBs) regulate the quality of treated effluent by issuing wastewater discharge permits to POTWs. These permits prohibit toxic substances in the treated effluent at concentrations that may cause harm to aquatic species.

In 1986, the San Francisco Bay RWQCB asked the Central Contra Costa Sanitary District (CCCSD) in Martinez, California, to initiate an Effluent Toxicity Characterization Program. The aim of this program was to help characterize the toxicity of CCCSD's treated effluent on selected aquatic test species. Twelve of the 18 tests performed under this program revealed that the treated effluent was acutely toxic to the water flea, *Ceriodaphnia dubia.* The RWQCB then requested that CCCSD perform toxicity identification evaluation (TIE) studies to determine the cause of the toxicity. The TIE studies suggested that two organophosphate insecticides, diazinon and chlorpyrifos, were responsible for the toxicity in CCCSD's effluent. Diazinon and chlorpyrifos are commonly found in consumer and commercial products marketed for urban uses. These uses are generally related to lawn/garden care, indoor pest control, and pet care products.

PURPOSE

This study was jointly conducted by CCCSD and the Department of Pesticide Regulation to: 1) characterize the mean daily diazinon and chlorpyrifos concentrations and flow in the sewage of residential areas, selected commercial sites, and CCCSD treatment plant influent; 2) determine the relative importance of residential and commercial sources to the total influent load; and 3) compare the mean daily concentration and mass of CCCSD's influent to those of two other POTWs.

STUDY METHODS

Source sampling efforts were focused on the residential sector (single-family and multi-family residences) which contributes about 82% to CCCSD's influent load, and the commercial sector which contributes about 6%. Five residential areas were sampled daily in conjunction with daily sampling of CCCSD's influent for a one-week period. The areas contained as few as 829 and as many as 2,079 residences. Residential sampling occurred July 9-15, 1996.

Twelve commercial sites in the CCCSD service area (consisting of pet groomers, kennels, and pest control businesses) were also sampled. These three business types were selected because reconnaisance sampling by CCCSD had shown notable amounts of diazinon and/or chlorpyrifos in their effluent. Although sewage from other business types such as nurseries, restaurants, waste management facilities, and industrial facilities may also contain varying amounts of the two active ingredients, limited resources excluded their investigation. Unannounced sampling of selected commercial sources was done from July 18 through September 8, 1996.

The CCCSD influent samples were taken on a semi-weekly basis from June 22 through September 10; daily sampling occurred during July 9-16, August 4-11, and August 31 through September 7, 1996. For one week of the study, influent samples were collected from two other treatment plants in an effort to compare diazinon and chlorpyrifos concentrations among the POTWs: Union Sanitary District (USD) in Alameda County, and the Palo Alto Regional Water Quality Control Plant (RWQCP) in Santa Clara County. Simultaneous daily sampling of the USD and RWQCP occurred from August 5-11, in conjunction with the daily sampling of CCCSD.

The general sampling period was chosen so that warmer months would be included. Insect problems and subsequent urban organophosphate use were expected to be greater during this period. Sewage samples were collected using programmed automatic samplers. For residential and commercial sampling, automatic samplers were suspended underneath manhole covers during operating periods and filled with blue-ice packs. Influent samplers were refrigerated units that were housed at the point of sewage entry into the treatment plants. All of the samples analyzed were flow-proportionally cornposited samples.

Representative flow data for residential, commercial, and influent sampling sites were also collected to allow the estimation of mass loads. Residential and CCCSD influent flow data were generated by CCCSD's flow modeling program known as the Sewer Network Analysis Program (SNAP). Commercial, USD influent, and RWQCP influent flow data were collected using inline flowmeters.

RESULTS

Influent Sampling:

Diazinon and chlorpyrifos were detected (reporting limit = 50 parts per trillion or ng/L) in all 37 of CCCSD's wastewater influent samples during the sampling period. The mean concentrations (calculated as the Uniformly Minimum Variance Unbiased estimator) of influent diazinon and chlorpyrifos were 310 ppt (parts per trillion) and 190 ppt, respectively. Influent diazinon concentrations ranged from 103 to 940 ppt. There are no diazinon and chlorpyrifos compliance criteria for treatment plant influent and other raw sewage concentrations. The treatment plant effluent; however, has to meet the "no toxicity" criteria enforced by the RWQCB.

Residential Sampling:

Residential sampling for diazinon and chlorpyrifos from five neighborhoods over a seven-day period (July 9-15, 1996) yielded 35 samples. The mean daily diazinon concentrations for each neighborhood were 740, 420, 120, 110, and 340 ppt. For chlorpyrifos, the mean daily concentrations for the same neighborhoods were 550, 110, 80, 110, and 180 ppt. Residential area diazinon concentrations ranged from none-detected to 4,300 ppt. Residential area chlorpyrifos concentrations ranged from none-detected to 1,200 ppt. The CCCSD service area's total daily residential mass loads for diazinon and chlorpyrifos were projected from sampling results to be approximately 42 g and 24 g, respectively.

Commercial Sampling:

Sampling of selected commercial businesses within the CCCSD occurred from July 18 through September 8, 1996. Of the 12 sites monitored, both diazinon and chlorpyrifos were found at seven sites. At two sites, only diazinon was detected. At two other sites, only chlorpyrifos was detected. Neither active ingredients were detected at the remaining commercial site. Daily concentrations of diazinon and chlorpyrifos were also variable. The highest level of diazinon (20,000 ppt) was found in the sewage from a kennel. The highest chlorpyrifos level (38,000 ppt) was found in the sewage from a pet groomer. Diazinon was detected on 17 out of the 32 days sampled. Chlorpyrifos was detected on 23 out of the 32 days sampled. CCCSD service area's total pet groomers, kennels, and pest control operators daily mass loads for diazinon and chlorpyrifos were projected from sampling results to be approximately 2.2 g and 2.3 g, respectively.

Concurrent POTW Sampling:

Concurrent sampling of the CCCSD, USD, and the RWQCP showed that the mean daily influent diazinon concentrations for the three POTWs were 300, 230, and 150 ppt, respectively. For chlorpyrifos, the mean daily influent concentrations were 190, 230, and 110 ppt, in the same order. Influent diazinon concentrations for CCCSD, USD, and RWQCP ranged from 130 to 750 ppt, 91 to 530 ppt, and 66 to 240 ppt, respectively. Influent chlorpyrifos concentrations ranged from 140 to 230 ppt, 130 to 330 ppt, and none-detected to 150 ppt, in the same order. The only statistically significant finding among the POTWs was that the median influent chlorpyrifos concentration at RWQCP was less than those of CCCSD and USD.

CONCLUSIONS

Mass balance estimates revealed that residential sewage contributed the majority of the diazinon and chlorpyrifos to CCCSD's influent. Although much higher concentrations were occasionally seen in the sewage of selected commercial sources, the larger residential area flows translated to a greater residential contribution. Therefore, a source reduction strategy that focuses on reducing diazinon and chlorpyrifos loads from residential sources would be the most effective strategy. If such a source reduction program can successfully increase the pollution prevention awareness of service area residents, input from commercial and unknown sources may also decrease. The reduction of diazinon and chlorpyrifos influent loads will likely result in increased compliance with waste discharge permits.