Investigation of Dioxins and Mercury in the Atmosphere Particulates and Rainwater Runoff from CPDC An-Shun Site and Surrounding Environment

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Abstract

This study investigated the dispersion of dioxins and mercury from the CPDC An-Shun Plant site that is contaminated with high concentration of mercury, dioxins and pentachlorophenol. The results showed that the averaged dioxin concentrations in the atmospheric particulates, water in the seawater storage pond (old wastewater discharge pond) and neighboring Chu-Fa-Gang Creek, and the runoff from the site were 0.020~0.072 pg-I-TEQ/Nm^3/d, 14.1~68.7 pg I-TEQ/L, 1.86~15.0 pg I-TEQ/L and 3.54~3052 pg-I-TEQ/L, respectively. As for mercury, except for the runoff from a hot spot which reached a level of 0.0385 mg/L, the concentrations of total mercury for the analyzed samples were all below 0.002mg/L. Overall findings revealed that the seawater storage pond may play an important role in reducing the dispersion of the pollutants of CPDC An-Shun Plant site to the surrounding environment.

Introduction

CPDC An-Shun Factory, a decommissioned chloroalkaline and pentachlorophenol manufacturing plant in Tainan City, Taiwan (coordinates：N2548198, E159133) was identified as a heavily contaminated site where the soil, the groundwater and the sediment of a seawater storage pond were contaminated with high concentration of mercury, dioxins and pentachlorophenol (PCP). As requested by Taiwan's Environmental Protection Administration (TEPA) in 2003, the hot-spot soils with high levels of PCDD/PCDFs (highest up to 64, 100 μg I-TEQ/Kg)[1,2] and PCP were removed and contained in safe storage consisting of RC tanks and impermeable covered and lined area. Also, PCP-contaminated

groundwater has been treated by an activated carbon adsorption process for years. In consideration of its close proximity to a community of 4,000 people and the governmental requirement of proper site management, the CPDC An-Shun site of 38.4 ha and the surrounding environment have been monitored periodically.

The CPDC site is located near to the shoreline of Taiwan Strait. It is of great concern that the sea wind may blow the soil particles over the surrounding area, leading to a wide dispersion of mercury and dioxins pollution. Likewise, the rainwater runoff in the raining season may also bring the pollutants from the site to the unpolluted area. To address the issue of potential movement of the pollutants in the environment, the levels of mercury and dioxins occurred in the atmosphere and in the runoff were investigated accordingly.

Materials and Methods

In this study, air particulates were sampled using a high volume air sampler in the CPDC An-Shun site and the locations as shown in Fig. 1. Total mercury in the dust and air particulate was measured by HG-AAS, while the mercury ion in the air particulate was detected using ICP-MS method. Dioxins in the air particulate were extracted by a Soxhlet protocol and then subject to species identification and concentration measurement using a HRGC/HRMS.

Prior to the analysis of mercury and dioxin in the runoff, water samples (SR1~SR4) from the drainage and overflow samples (L1 and L2) from the seawater storage pond in the CPDC An-Shun site during a heavy rain (rainfall > 90 mm) were collected. In addition, water samples (W1~W3) were taken during the tide time from the Chu-Fa-Gang Creek and then analyzed.

Results and Discussion

The results showed that the dioxins in the air particulates ranged from 0.020 to 0.072 pg-I-TEQ/Nm^3/day on a daily average basis, with the highest detected from the G1 location in the site. This value is in the range (0.005~0.131 pg-TEQ/Nm^3/d)[3] of air quality in Taiwan reported by TEPA 2006 annual investigation, while it is lower than the dioxins standards (0.6 pg-TEQ/Nm^3/d) of atmospheric environment in Japan. Regarding the mercury in the air particulates, only the sampling point G5 in the east of the site could be detected with a mercury concentration of 0.37 μg/m^2/d. The concentration of mercury ion detected in the

particulates sampled by the high-volume air sampler was in the range of 9.20~27.0 pg/Nm^3. These results clearly showed that the concentrations of mercury pollutant within and near the site were comparable to the background level in Taiwan, suggesting that transfer of mercury through the atmospheric route may be insignificant. This may be attributed to the fact that most land in the site is covered by plant species.

According to the analysis of runoff samples, it showed that the sampling point SR1 at the east-north of the chloroalkaline plant detected a dioxin concentration of 3.54 pg-I-TEQ/L. The dioxin concentrations at the SR2 and SR3 near the seawater storage pond were 22.1 and 69.8 pg-I-TEQ/L, respectively, which were similar to the level in the soil. The dioxin concentration of sampling point SR4 in the location of the chloroalkaline plant was 3052 pg-I-TEQ/L, which was much higher than other points. These results suggested that the high level of dioxins was originated from the suspended solids in the runoff. On the other hand, for the mercury analysis in the runoff, it was observed that the highest level, 0.0385 mg/L, was associated with the sampling point SR3 at the chloroalkaline plant, which is in agreement with the high mercury concentrations detected in the soil of the chloroalkaline plant. Since the destination of runoff was the seawater storage pond, the investigation in the present study suggested that the concentration of the mercury and dioxins have been accumulating in the sediment of seawater storage pond.

The analysis of water samples from the seawater storage pond showed a dioxin concentration ranging from 14.1 to 68.7 pg-I-TEQ/L. It was observed that the highest level occurred in the point L2 sampled during a period of heavy rain. Likely, the L2 location near the hot spot of the seawater storage pond can account for the high value of dioxins in the overflow water. However, this level is still much lower than the input one from the runoff. For the analysis of mercury in the water, the detected concentrations of all sampling points were lower than the TEPA water quality standard (0.002 mg/L). These data revealed that the seawater storage pond played an important role in reducing the dispersion of pollutants to the unpolluted areas nearby.

For the water from Chu-Fa-Gang Creek, a canal near the seawater storage pond, the data showed that the concentrations of dioxin and mercury ranged from 1.86 to 15 pg-I-TEQ/L and <0.002 mg/L, respectively. The water-insoluble nature of dioxins and mercury and the data of this study suggested a low potential of the pollutant dispersion via water of Chu-Fa-Gang

Creek.

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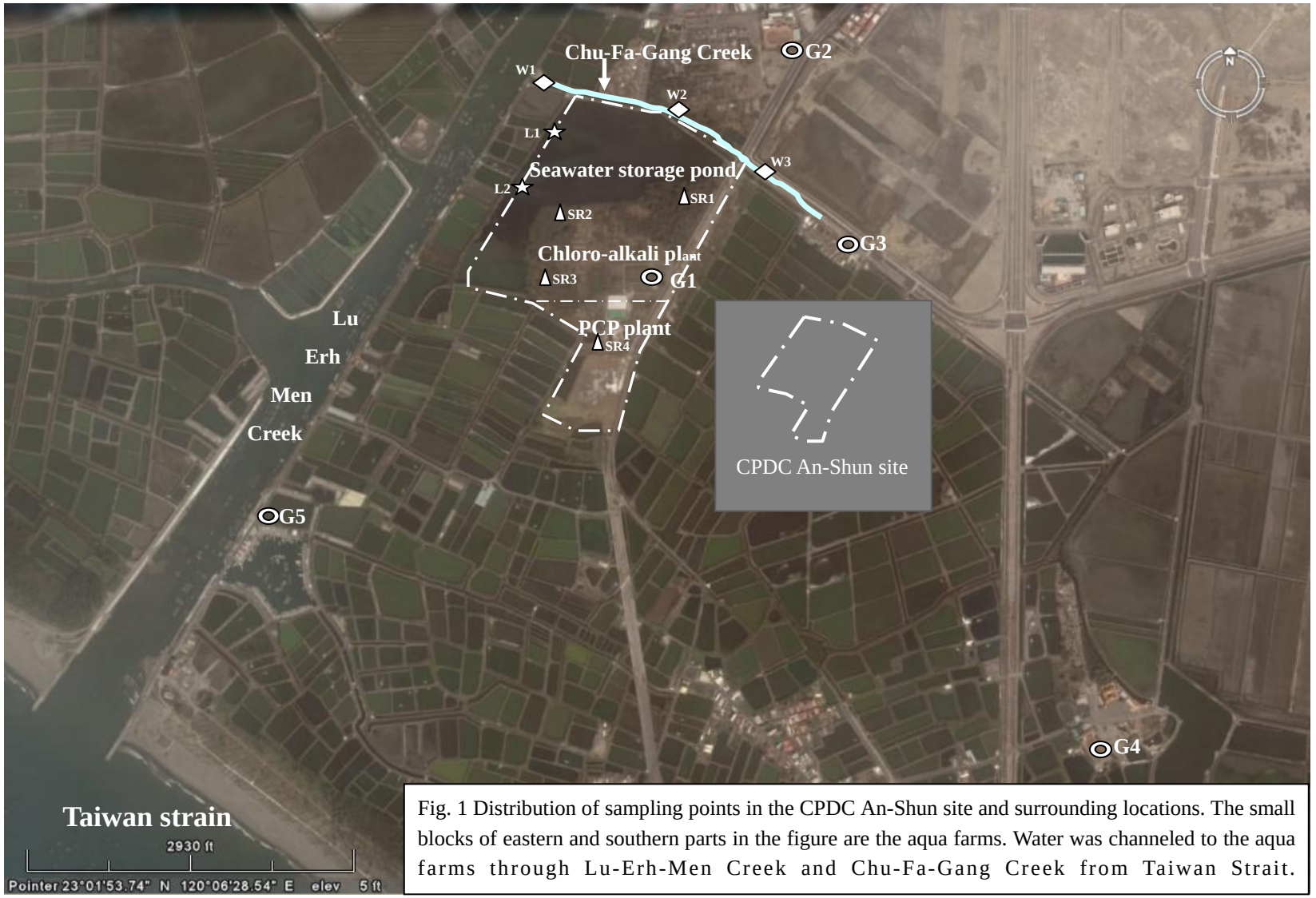

Fig. 1 Distribution of sampling points in the CPDC An-Shun site and surrounding locations. The small blocks of eastern and southern parts in the figure are the aqua farms. Water was channeled to the aqua farms through Lu-Erh-Men Creek and Chu-Fa-Gang Creek from Taiwan Strait.