AMBIENT AIR SAMPLING FOR DIOXINS, FURANS AND COPLANAR PCBs IN AN URBAN INDUSTRIALIZED CORRIDOR IN CALCASIEU PARISH, LOUISIANA

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Introduction

Dioxin and dioxin-like compounds are of increasing concern in various populations. Uncertainty regarding health impacts has created a demand for information about the environmental impacts to these populations. While dietary intake is the primary path of exposure to dioxins in the human body, atmospheric deposition is another potential source of exposure. In response to reports of elevated dioxin concentrations in the blood of several people in southern Louisiana[1] and requests by local citizens and regulatory agencies, United States Environmental Protection Agency Region 6 (EPA) and the Louisiana Department of Environmental Quality (LDEQ) implemented an ambient air monitoring study for dioxins and dioxin-like compounds in Calcasieu Parish, Louisiana. The monitoring study is a collaborative effort between the EPA, the LDEQ, and the Lake Area Industry Alliance (LAIA), which represents a coalition of twenty-one local industries. Calcasieu Parish is a heavily industrialized urban corridor, consisting of mixed land use including agricultural, industrial and residential. Four sampling stations were selected based on air dispersion modeling used to predict the areas of greatest impact from surrounding industry, and one station was established as a control (Figure 1). The monitoring network was established to determine ambient levels of dioxins, furans, and coplanar PCBs in Calcasieu Parish.

Methods and Materials

Dioxin samples were collected every other month from January 2001, through December 2001. An additional sample was collected at the Mossville site during March and April of 2002. Field techniques and analytical techniques employed during this study are modeled after those used in the National Dioxin Air Monitoring Network (NDAMN).[1] Modeling NDAMN methodology was implemented to enhance data comparability between the Calcasieu data set and the data from rural and agricultural areas across the United States. Samples were collected through a glass fiber pre-filter and a polyurethane foam filter (PUF) using a PS-1 high volume air-sampling device.[2] Every six days, the glass fiber pre-filter was replaced and maintenance was performed on the sampling device. After thirty days, the polyurethane foam filter was harvested and combined in a container with the four glass fiber pre-filters. The samples were analyzed for a series of dioxins and dioxin-like compounds by EPA's Environmental Chemistry Laboratory using high-resolution gas chromatography/high resolution mass spectrometry in accordance with EPA Method 1613.[3] These include polychlorinated dibenzo-*p*-dioxins, polychlorinated dibenzofurans, and coplanar polychlorinated biphenyls.

A passive field blank was collected during each sampling period in a co-located PS-1 sampler that did not have a motor, and served as a housing unit for a field blank. The field blank served as in indicator of potential passive dioxin deposition on the sampling media independent of an active vacuum. An additional PS-1 sampling unit equipped with motor and sampling apparatus, was also located with the field blank as a rotating field duplicate. The field duplicate serves as a mechanism to detect variations in dioxin concentrations that are introduced as a function of sample handling and field technique.

Results and Discussion

Results from the Calcasieu Parish dioxin monitoring project are presented in Figure 2 (dioxins and furans) and Figure 3 (coplanar PCBs). Data are expressed as Toxicity Equivalent Quantities (TEQs) calculated using the World Health Organization's (WHO) 1998 report.[4] The data generally follow the predicted global pattern of increasing concentrations in the winter months (November-December).[5] However, the levels in Calcasieu Parish were distinctly lower than predicted for an urban industrialized area.

Concentrations in Calcasieu Parish averaged 14.56 fg/m^3, with a range from 2.7 to 92.4 fg/m^3. The average dioxin concentration calculated in the 1998-1999 NDAMN study was 12 fg/m^3. The NDAMN data represent a measured atmospheric background of dioxin-like compounds in the United States, and are generally collected from rural, agricultural and non-impacted areas. The research hypothesis was that Calcasieu Parish ambient air samples would reflect a higher concentration of dioxins and dioxin-like compounds due to impacts from local industry such as vinyl chloride manufacturing, petrochemical manufacturing, and refining.

A parametric t-test was used to determine statistical differences between Calcasieu Parish dioxin and dioxin-like compounds in ambient air to data collected in the NDAMN study. Statistical analysis revealed no statistically significant differences between the Calcasieu Parish data set for dioxins and furans and the NDAMN data set from a similar sampling season (alpha = 0.05). A similar analysis was conducted for the coplanar PCBs. A statistical difference was detected in one sampling moment (May-June). However, a closer inspection of the data reveals that this could be an artifact of a small data set with very small variance. Coplanar PCB levels averaged 1.5 fg/m^3, with a range from 0.4 to 2.7 fg/m^3. A parametric analysis of variance (ANOVA) was conducted on the dioxin/furan and coplanar PCB data to determine if there was a statistically significant difference in data collected between the sites in Calcasieu Parish. Acceptance of the null hypothesis of no statistical difference in data between the sites would suggest that there is a uniform distribution of dioxins and dioxin-like compounds in ambient air in the Calcasieu region, and no sampled area is experiencing micro-impacts from local industry. The parametric ANOVA results indicate no statistical difference between the sampling locations for the dioxin and furan data (alpha = 0.05), however this may be an artifact of unequal variances. A statistical difference was detected between the sites for the coplanar PCB data, as the PCB data had very small variances.

References

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2. USEPA (1997). Compendium Method TO-9a. EPA/625/R-96/010b.
3. USEPA (1998). EPA 821-B-94-005.
4. WHO
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Figure 1. Map of Calcasieu Parish Air Sampling Stations

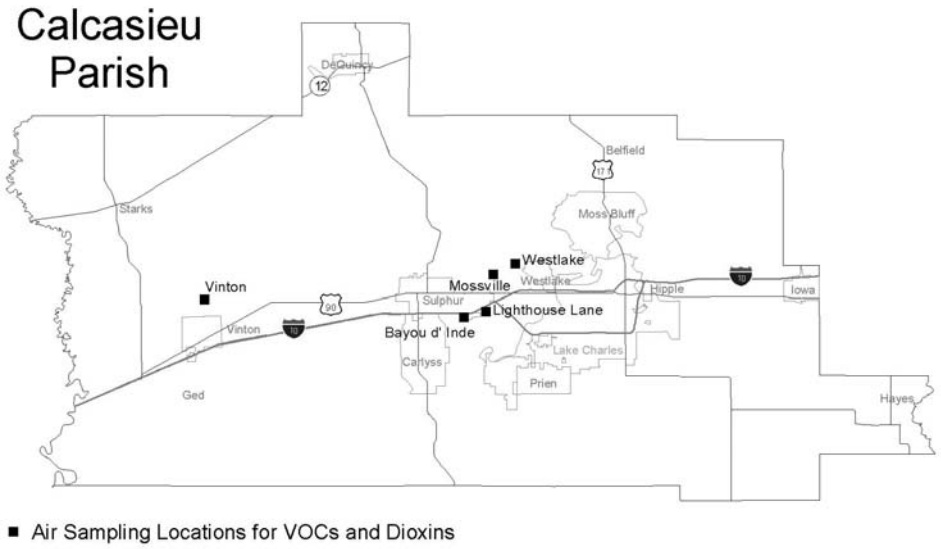

Figure 1. Total TEQ concentration (fg/m3) of dioxins and furans in Calcasieu Parish, LA January-December, 2001 (including additional sampling in Mossville, (March, 2002)

Sampling Station	Sampling Period						
	Jan-Feb	Mar-Apr	May-June	July-Aug	Sep-Oct	Nov-Dec	March '02
Vinton	8.25	----	9.23	9.49	2.72	6.00	----
Mossville	----	----	7.00	8.16	13.50	92.12	20.37
Bayou D'Inde	10.50	5.34	4.14	5.53	5.25	45.18	----
Westlake	14.01	6.63	5.79	25.06	16.29	30.66	----
Lighthouse	8.97	10.10	----	3.72	10.17	17.10	----

Sampling Station	Sampling Period						
	Jan-Feb	Mar-Apr	May-June	July-Aug	Sep-Oct	Nov-Dec	March '02
Vinton	0.42	----	0.90	1.18	0.47	0.42	----
Mossville	----	----	2.07	2.21	1.67	2.59	1.84
Bayou D'Inde	1.16	1.07	2.00	2.37	1.37	1.56	----
Westlake	1.00	1.04	1.12	2.13	1.35	1.25	----
Lighthouse	0.78	1.96	2.65	2.67	1.66	1.06	----

Figure 2. Total concentration (fg/m3) of coplanar PCBs in Calcasieu Parish, LA January-December, 2001 (including additional sampling in Mossville, (March, 2002)