

ENVIRONMENTAL LEVELS - POSTERS

DIOXINS AND PCBS IN JAPANESE TAP WATER

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Introduction

Determination of the concentration and congener and/or isomer distributions for PCDDs/PCDFs and PCBs in tap water (raw and/or treated water) is indispensable for tracing the source of these compounds in tap water, and thereby assess the risk to humans. However, data regarding PCDDs/PCDFs and PCBs in tap water is scarce, probably due to the very low concentrations of these contaminants.

A large volume "*in situ*" pre-concentration system for tap water sampling was developed for the determination of ultra low concentrations of PCDDs/PCDFs and PCBs and used to sample tap water.

Methods and Materials

The design of the "*in situ*" pre-concentration system used for this study was previously reported ¹. Water samples were collected by GF filter (300mm ID, 0.5µm pore size), and PUF (100mm ID, 100mm height). The system's design makes it possible to sample m³ level of water at a flow rate of 1.5L/min (=90L/hrs =2160L/day). After using this system for sampling, the concentrations of PCDDs/PCDFs and co-planer PCBs in tap water samples were determined.

Sampling

The "*in situ*" pre-concentration system was applied to 90 raw and 84 treated water samples from Japanese water purification plants. 2000L (for treated water) and 200L (for raw water) water samples were collected.

Analysis

Detection of PCDDs/PCDFs and co-planer PCBs was carried out using an isotope dilution HRGC/HRMS (AutoSpec-Ultima, Micromass, UK) method after Soxhlet extraction and gel clean-up procedures. All seventeen native (Wellington Laboratories, Canada) and ¹³C 2,3,7,8- substituted PCDDs/PCDFs isomers (Wellington Laboratories, Canada) and twelve (IUPAC #77, #81, #126, #169, #105, #114, #118, #123, #156, #157, #167, and #189) native (AccuStandard, USA) and ¹³C (Wellington Laboratories, Canada) co-PCBs (all compounds which have a TEF in WHO-1998 were used) were used as calibration standards and isotopic spikes for accurate measurement. All

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organic solvents used were purified by sub-boiling distillation. Glassware and GF filters were heated to 450°C (4hrs.) after washing with organic solvents. PUFFs were pre-washed by soxhlet (methylene chloride, >24hrs) after a water and acetone wash. All procedures were carried out in a clean room (class<10000, US, FS209E). BPX5 and BPX50 (60m length, 0.25 mm ID, 0.25 µm film thickness, SGE, Australia) are designed for HRGC to obtain high sensitivity and reduce chemical background from the liquid phase.

Results and Discussion

Large volume sampling, low sampling/reagents/operation blank values, and high sensitivity GC-MS operations made these low detection limits possible. In this study, detection limits achieved for each compound are about 0.0005-0.003pg/L, including full operation laboratory blanks. A TEQ detection limit of 0.001pg-TEQ/L (at 2000L sampling) was achieved at the level of "Estimated Maximum Possible Concentration". Using this system, it was possible to detect low pg/L concentrations of PCDDs, PCDFs and co-PCBs in raw and treated water at levels of interest.

Raw Water

Histograms of measured concentration and TEQ values for the 90 raw water samples are shown in *Figure 1* and *2*. Average concentrations for PCDDs, PCDFs and co-PCBs are about 40, 4, and 13pg/L, respectively. In terms of TEQ representation, average values for PCDDs, PCDFs and co-PCBs are 0.075, 0.063, and 0.009pg-TEQ/L, respectively. The average total PCDDs/DFs + co-PCBs TEQ for raw water is 0.148pg-TEQ/L. The dominant fraction (about 70%) in raw water samples is PCDDs in measured concentration basis, on a TEQ basis, PCDDs and PCDFs accounted for 50% and 40% of the entire TEQ value (*Figure 3*). Co-planer PCBs contributed less than 10%. Dissolved and particulate fractionations were done on 2 of the water samples. (Results are not shown in this article). Obtained results indicate that the dissolved fraction (trapped by PUFF) contained only <10% on a TEQ basis. Relationship between turbidity and dioxin concentration in raw water (*Figure 4*) support this dissolved/particulate distribution ratio.

Treated Water

Histograms of measured concentration for the 84 treated water samples are shown in *Figure 5*. Average concentrations for PCDDs, PCDFs and co-PCBs were about 1.6, 0.6, and 2.1pg/L, respectively. On a TEQ basis, average values for PCDDs, PCDFs and co-PCBs were about 0.002, 0.016, and 0.001pg-TEQ/L, respectively. The average total PCDDs/DFs + Co-PCBs TEQ for treated water is 0.019pg-TEQ/L. Congener and isomer composition of treated water were different from raw water (*Figure 6*). The dominant compound in terms of measured concentration for treated water samples was mono-ortho, PCBs. On a TEQ basis, PCDFs accounted for >80% of the TEQ value. 2,3,7,8-TeCDF accounts for about 60% of total TEQ in treated water samples. This difference of congener and isomer distribution is likely caused by the difference of the behavior of each compounds and/or the difference of removal and/or formation mechanism in water treated system.

References

1. Magara, Y., Aizawa, T., Andoh, M., Morita, M. and Matsumura, T. (1999), Dioxins and co-planer PCBs concentration in tap water using large volume "in situ" water sampler., *Organohalogen Compounds*, **40**, 205-208

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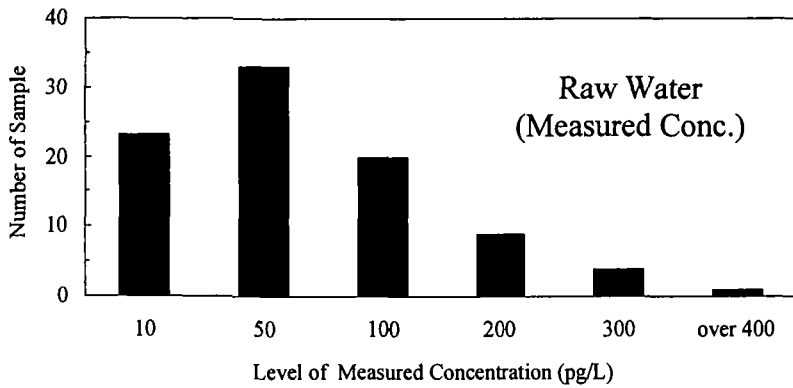


Figure 1. Histogram of dioxin concentration for raw water on a measured concentration basis.

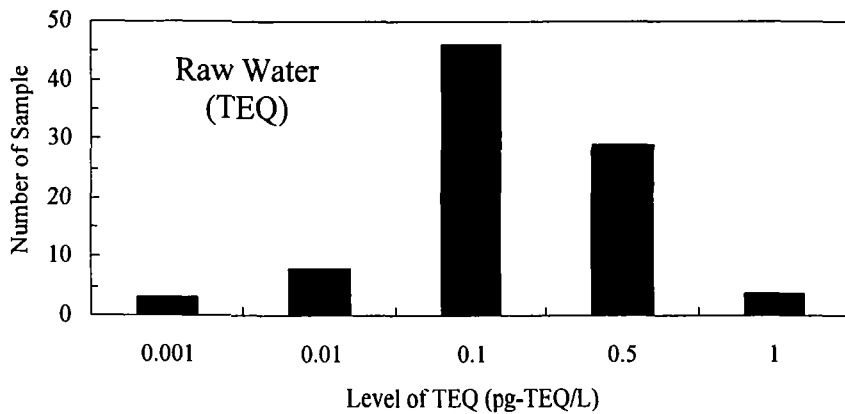


Figure 2. Histogram of dioxin concentration for raw water on a TEQ basis.

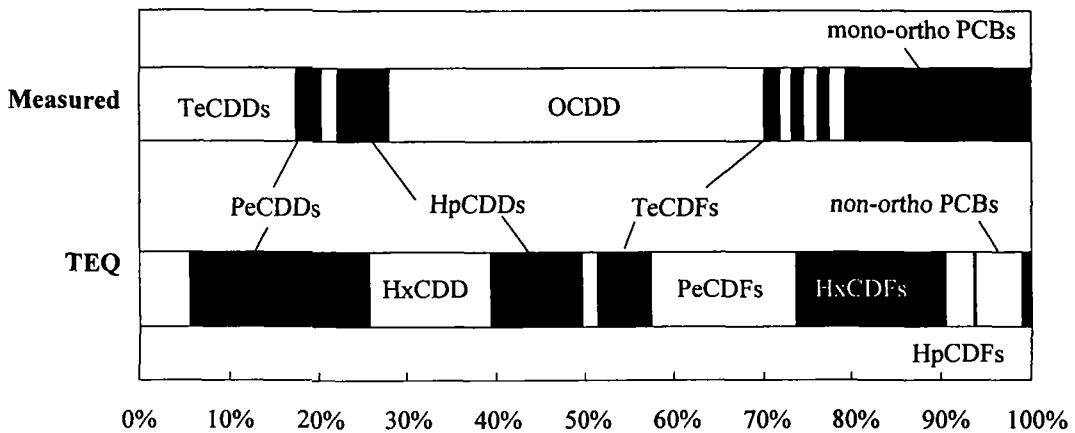


Figure 3. Congener distribution of dioxins for raw water.

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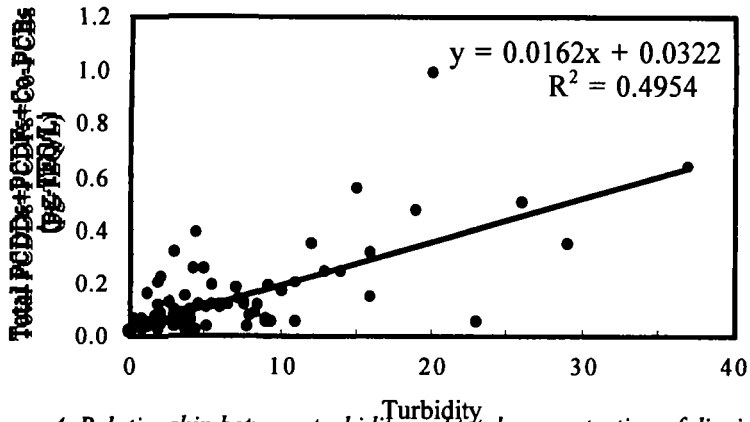


Figure 4. Relationship between turbidity and total concentration of dioxins.

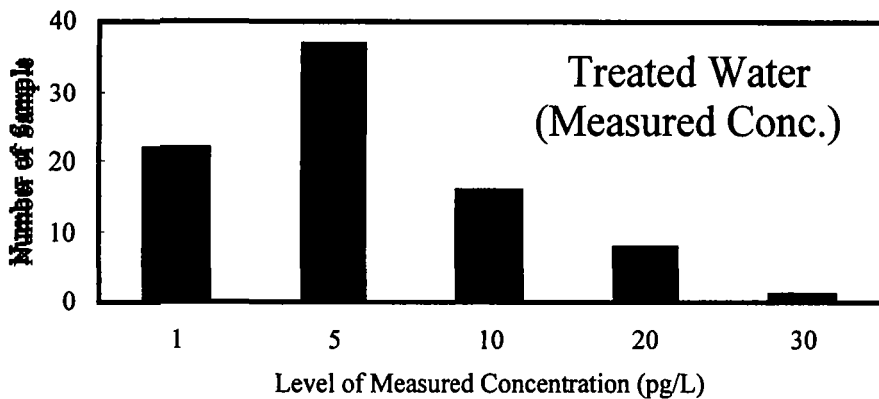


Figure 5. Histogram of dioxin concentration for raw water on a TEQ basis.

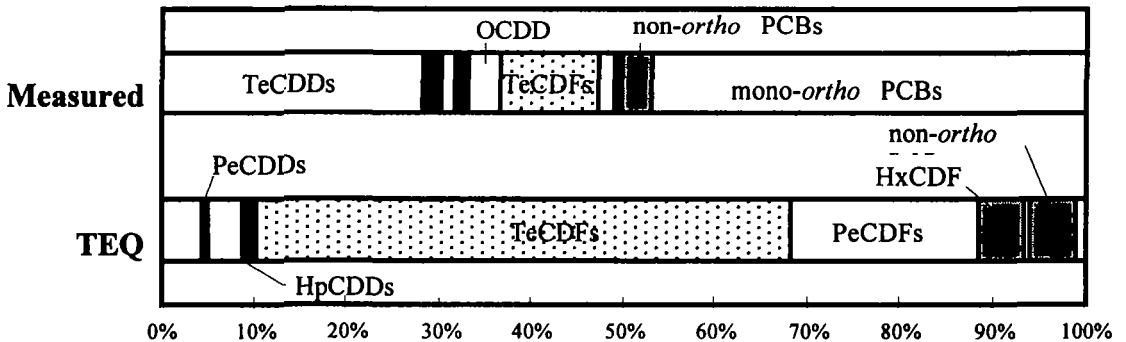


Figure 6. Congener distribution of dioxins for treated water.