

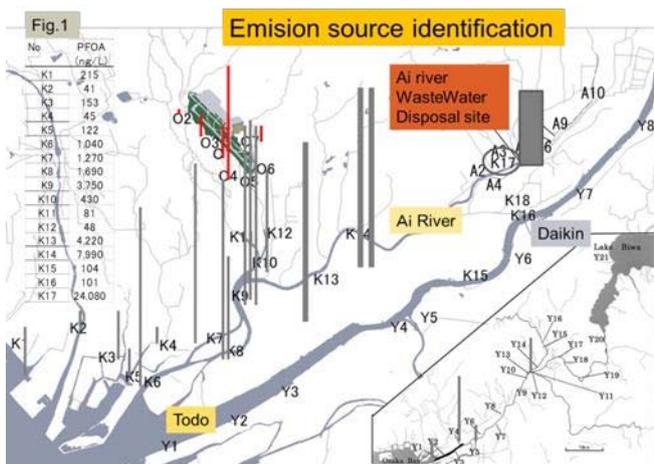
Long-term monitoring and publicity activities successfully reduced levels of perfluorooctanoic acid (PFOA) in drinking water in Kyoto-Osaka-Kobe area in Japan

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Abstract. Contamination of drinking water with persistent organic compounds is now an emerging problem. In most cases, reduction of such contaminants has been a difficult task. We have experienced a unique drinking water contamination case in Japan. Our nationwide survey revealed a very intensive contamination of surface water with Perfluorooctanoic acid (PFOA) in Yodo river system, which provides drinking water to a local population about 15 millions. Further studies identified Daikin as a culprit of this contamination. Mass medias and local politicians responded to our publicity activities to manage this contamination. Daikin company voluntary phased out the production of PFOA. Due to this precautionary measure, human exposure to PFOA reduced significantly.

Keywords: PFOA, Human specimen bank, Water monitoring, Human exposure, Publicity activity



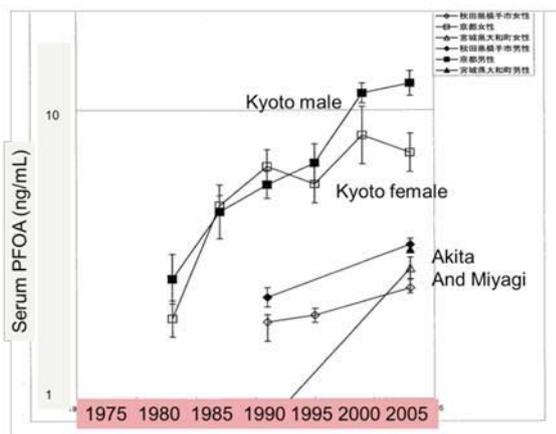
1. INTRODUCTION

Perfluoroalkyl compounds (PFCAs) have been widely used globally and are a class of chemicals used in a variety of applications lubricants, paints, cosmetics, and fire-fighting foams. Perfluorooctanoic acid (PFOA) is a representative of PFCAs and has been shown to be universally detectable contaminants in various biota including humans. Worldwide distribution of PFOA has been attributed to its persistency in the ecological system: it is not degraded in the environment nor metabolized by biota. Several epidemiological studies suggest adverse effects on

human health (1).

2. NATIONWIDE MONITORING AND HUMAN EXPOSURE IN KYOTO-OSAKA-KOBE POPULATION (KEIHANSIN POPULATION):

Fig. 2 Long term trend of PFOA



In 2002, we started to monitor the environmental contamination levels of PFOA in surface water all over Japan. Nationwide search revealed surprisingly extensive contamination with PFOA in Ai River (Fig.1)(2). Its highest level reached 24ppb, while in other surface water, PFAO levels (ppt mean) were 0.97 in Tohoku, 2.84 in Kanto, 2.50 in Chubu, 1.51 in Chugoku-Shikoku and 1.93 in Kushu.

Since Ai river flows into Yodo river, which provides drinking water in Keihansin population, we suspected that the exposure levels of PFOA in drinking water had been much larger in Keihansin people than in other areas. We first determined the historical trends of serum PFOA levels from 1980s to 2000s using serum samples in our historical specimen bank at Kyoto University. The results clearly demonstrated that Keihansin

population had been more heavily exposed to PFOA from 1980s to 2000s than rural population (Fig.2) (3). To confirm larger exposure to PFOA through drinking water, tap water samples were analyzed to determine PFOA concentrations in 2003 (n=5 per city, GM (GSD) ng/L) contained 40.0 (1.1) in Osaka city and 12.5 (1.6) in Amagasaki city, while 0.7 (1.5) in Morioka city, 0.13 (1.3) in Sendai city and 0.12 (1.2) in Akita city (3). Extensive field studies identified Daikin company located in Settu City to be a culprit for PFOA contamination episodes of Ai river (2,4).

Fig.3 A News Article on PFOA



2.1. PUBLICITY ACTIVITIES TRIGGERS POLITICAL PRESSURES: Traditionally local environmental problems had raised severe conflicts between local residents and industrial sectors. In this case, however, the decisive action to decrease emission was taken spontaneously by Daikin in 2012 after moderate publicity activities. Due to the PFOA environmental problems in EU and US, Mass medias had been keen on domestic environmental problems associated with PFOA. Several major Mass media had felt a great interest in our findings and reported articles on PFOA in Keihanshin (Fig.3). After appearing on the PFOA issues on News medias, local assemblypersons had become aware of the problem - drinking water contamination with PFOA. Furthermore, at this point in 2007, several assembly parties and a member of the House of Representatives had begun to recognize the scale of the population at risk as large as population of 15 millions. Actually, an assemblyman asked questions and management on this issue in the assembly venue of Osaka prefecture.

3. RESULTS AND DISCUSSION:

Recently the eight global major perfluoropolymer manufacturers took voluntary efforts to eliminate emissions and production of PFOA (USEPA, 2015)(5). Daikin Industry, which operates a chemical plant located in Settsu Osaka, Japan, declared reduction of PFOA emissions in 2012 to less than 1% of those in 2000 (Daikin, 2012) (6). We continuously monitored PFOA levels in surface water and human serum levels of PFOA (Table 1). Monitoring data confirmed a decreasing trend (6).

4. CONCLUSIONS

In this case, levels of PFOA in drinking water has successfully decreased due to the voluntary phase out of PFOA production by Daikin. Although Daikin action is voluntary, several activities gave a strong momentum on the company; generation of evidence on the long term increasing trends in serum levels of PFOA by the human specimen bank, field monitoring, Mass Media mobilization, local politics and international precautionary measures. Environmental scientists should be aware of those components and mechanisms.

Medium	Location	Year	2005	2010	2011	2013
Well water (ng/L)	Zuikoji Temple		8300	660	853	
	Jakouji Temple		57000	9800		
Tap water (ng/L)		Year	2003	2010	2011	
	Osaka		40	7	5.7	
	Kyoto		5.4	3.1	3.3	
Surface water (ng/L)		Year	2003	2010	2011	2013
	Ai river		19400	190	75.9	40.7
Serum (ng/mL)		Year	2004	2008	2015	
	Settu		31.4 (1.25) (n=10)	14.2(1.73) (n=50)	5.6 (n=1)	

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APPENDIX A. APP-SECTION

9. Capacity building, awareness raising and cultural aspects A.1. APP-SUB-SECTION

- Public involvement and awareness