

**A Study of Dry Cleaning Solvents and Clothing:**

*Source of Dioxin Exposure?*

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## A Study of Dry Cleaning Solvents and Clothing: Source of Dioxin Exposure?

Toshiharu Fukui, Yoshitomo Nakata

Clean Water World Initiative, Japan, 195-3 Akiwa, Ueda-shi, Nagano 386-0041 Japan  
Institute of Sosei Water Cleaning, 754 Yudani, Kasai-shi, Hyogo 675-2404 Japan

### Introduction

Both the government and private researchers around the world have used dioxin contaminations in the air, water, soil and foods for assessing the amount of daily dioxin exposure to human beings. However, not many of the dioxin studies focused on clothes or other fabrics as a possible source for dioxin contamination and exposure. However, the data presented in this paper indicate that fabrics should be considered as one of sources of dioxin exposure. A study by the University of Bayreuth, Germany, showed that the sludge residues of the dry-cleaning solvent distillation were contaminated with dioxins.<sup>1</sup> CWWI and ISWC began to research on possible dioxin contaminants in the dry-cleaning related industries since 1997. CWWI and ISWC contacted and requested the analysis of dioxin amount in sample materials at several qualified dioxin-measurement/research institutes<sup>2</sup>, designated by Japanese government. This paper is about the findings resulted from the analysis.

### Methods and Materials

Methods: Gas chromatograph method was applied for fabric dioxin analysis. The analysis was applied according to the Dioxin Analysis Manual for Residues presented by Ministry of Environment Japan (Water Pollution and Prevention Division, July 1998). PCDDs and PCDFs were measured for fabric dioxin analysis, but Coplanar PCBs were not, because Coplanar PCBs were not officially considered as dioxins in Japan until July 1999. International Toxicity Equivalency Factor (I-TEF) and World Health Organization Toxicity Equivalency Factor 1997 (WHO-TEF) were used for calculating Toxicity Equivalency Quantity (TEQ) in the sample materials.

Materials: CWWI purchased the brand-new clothes samples from various stores in Japan between the years 1997 and 2000 and sent the clothes to the institutes for analysis. As for the dry-cleaned clothes samples, CWWI purchased brand-new clothes and brought them to several dry cleaners to be dry-cleaned. CWWI pick them up after the dry-cleaning and sent them to the institutes for analysis. For the dry-cleaning solvent samples, ISWC mixed together dry-cleaning solvents and CWWI sent them to the institutes. (At the dry cleaners, several types of dry-cleaning solvents are normally mixed together for better results.)

### Results and Discussion

#### Results

Dry-cleaning solvents. Samples: 3 types of brand-new solvents and 1 type of petrol-based solvent that is currently in use were analyzed. The brand-new perc-based solvent<sup>3</sup> measured 7.8 pg WHO-

TEQ/l of dioxin concentration. The brand-new petrol-based solvent<sup>4</sup> measured 7.3 pg WHO-TEQ/l of dioxin concentration. The brand-new stain-remover (spot cleaning) solvent measured 76 pg-TEQ/l of dioxin concentration. The currently in use petrol-based solvent measured 780.0 pg-TEQ/l of dioxin concentration<sup>5</sup>. (Table1)

Table 1 Analysis of dioxins in dry-cleaning solvents

CDD/PCDF/ Coplanar PCBs	unit	Types of dry-cleaning solvents			
		Perc-based solvent (new)	Petrol-based solvent (new)	Spot cleaning solvent (new)	Perc-based solvent (used)
PCDDs	ng/liter	1.4	1.3	2.0	20
PCDFs	ng/liter	2.8	3.4	3.8	55
PCDDs+PCDFs	ng/liter	4.2	4.7	5.8	75
PCDDs/DFs TEQ	pg TEQ/l	7.2	6.8	75	270
Coplanar PCB TEQ	pg TEQ/l	0.55	0.47	1.3	510
Total TEQ	pg TEQ/l	7.8	7.3	76	780

TEF: WHO-TEF (WHO/IPCS 1998)

TEQ: 2,3,7,8 TeCDD (pg-TEQ/liter)

Table 2: Brand-new Fabrics; Actual value of dioxin concentration and TEQ (pg I-TEQ/g)

Samples	PCDDs/PCDFs			
	PCDDs	PCDFs	PCDDs+PCDFs	I-TEQ
Suit 1 (Black)	164.4	120.6	285	4.4
Suit 2 (Black)	268	154.8	420	8.5
Suit 3 (Black)	281.2	179	460	9.3
Suit 4 (Black)	141.6	514	660	13 *
Suit 5 (Black)	250	450	700	19 *
Suit 6 (Blue)	171.5	50.7	220	2.0
Suit 7 (Blue)	45.4	95	140	3.1
Suit 8 (Grey)	65.2	57.2	120	1.8
Suit 9 (Red)	42.6	34.7	77	0.82
Windbreaker (Grey)	50.2	49.2	99	1.5
Underwear 1 (Black)	26.96	31.1	58	1.4
Underwear 2 (Black)	164	60.7	220	2.8
Jersey knit (Black)	166.1	474	640	20
Kimono (Black)	23.73	5.69	29	0.28
Futon (Blue)	15.9	12.14	28	0.38
Jeans (Blue)	2.93	8.42	11	0.36
Uniform (Blue)	17.4	75.7	93	1.0
Sports wear (Blue)	3.82	15.2	19	0.11
Curtain (Blue)	7.18	5.24	12	0.073
Sweater (Purple)	4.08	2.98	7.1	0.034
Skirt (Purple)	60.5	19.2	80	0.85
Pants (Grey)	12.59	8.77	21	0.13
Blanket (Beige)	1.28	1.28	2.6	0.0055
Smock (White)	2.82	2.86	5.7	0.020
Sheet (White)	4.156	0.68	4.8	0.0075

TEF: International-TEF

TEQ: 2,3,7,8 TeCDD (pg-TEQ/g)

\*: includes Coplanar PCBs TEQ

**The Brand-new Clothes Samples:** 25 samples of new clothes and other new fabrics were analyzed. Some clothes were additionally analyzed for Coplanar PCBs TEQ as exceptions. The results shows that all the samples were contaminated with dioxins. The actual value of dioxin concentration ranged from 2.56 pg/g to 700 pg/g. (Table 2) Toxicity Equivalency Quantities were calculated ranging from 0.055 pg I-TEQ/g to 20 pg I-TEQ/g (Table 2).

**The Dry-cleaned Clothes Samples:** 9 brand-new clothes were dry-cleaned by different dry-cleaners and were measured dioxins. Dioxin concentration ranged from 0.0330pg I-TEQ/g to 3.4 pg I-TEQ. CWI compared the actual value of concentration of dioxin and TEQ in/on the fabric samples before and after dry-cleaning. (Table 3)

Table 3: Comparison of actual value of dioxins concentration and I-TEQ concentration in the clothes samples before and after the dry-cleaning (Petrol-based solvent and Perc-based solvent)

Petrol-based solvent	Samples				
	Blanket	Pants <sup>a</sup>	Uniform	Mouton Rug	
Before cleaning	2.6 (0.0055)	21 (0.13)	93 (1.0)	Not measured	
After cleaning	7.0 (0.01)	28 (0.30)	180 (1.2)	520 (3.4)	

Perc-based solvent	Samples				
	Blanket	Pants 1 <sup>b</sup>	Pants 2 <sup>b</sup>	Pants 3 <sup>b</sup>	Futon
Before cleaning	2.6 (0.0055)	2.6 (0.13)	2.6 (0.13)	2.6 (0.13)	28 (0.38)
After cleaning	15 (0.033)	34 (0.14)	35 (0.16)	34 (0.37)	97 (0.39)

Actual value of dioxin; pg/g      International TEQ; (pg TEQ/g)

**Wastewater from a Dye Factory:** A sample of wastewater from a dye factory in Nagano Prefecture was analyzed for dioxin and measured to have 2.1 pg I-TEQ/l of dioxin concentration.

Table 4: Dioxin analysis in wastewater from a Dye Factory

TEF: International

Sample	PCDD/PCDF			I-TEQ
	PCDDs	PCDFs	PCDDs+DFs	
Wastewater	103 pg/liter	74 pg/liter	180 pg/liter	2.1 pg I-TEQ/liter

### Discussion

**The Dry-cleaning Solvents Samples:** The data shows that brand-new dry-cleaning solvents were contaminated with dioxins. The study by the university of Bayreuth, Germany concluded that the dioxins in the residues are extracted from the dioxins of the clothes, but this analysis indicates that dry-cleaning solvents are also a source of dry-cleaning related dioxin contamination.

**The Brand-new Clothes Samples:** The data shows that all the new clothes samples were contaminated with dioxins. Because of new, and not yet dry-cleaned fabrics were contaminated with dioxins, a textile-making-process could be a source of dioxins. In the analysis, there is a tendency that the dark colored fabrics contain more dioxins than light colored ones. There is a possibility that the fabric dyeing process produces dioxins as by-products. The possibility is supported by the results of analysis of dioxins in the wastewater from a dye factory.

**The Dry-cleaned Clothes Samples:** The comparison of dioxin concentration shows that dry-cleaned fabrics contain more dioxins than the same fabrics before being dry-cleaned. It can be concluded

that the dry-cleaning process adds dioxins on clothes.

#### **Conclusion and Perspective**

Dry-cleaning solvents and brand-new as well as dry-cleaned clothes are contaminated with dioxins. The dry-cleaning solvents that CWWI analyzed, could be the sources of dry-cleaning related dioxin contamination. Dye factory could be a source of fabric dioxin contamination. It is possible that fabrics are contaminated with dioxins first in the process of dyeing and then with additional dioxins in the dry-cleaning process. Dry-cleaning solvents are distilled, and the distillation extracts dioxins in the solvents. There are filters in the dry-cleaning machine, but fabrics could play the role of filters and catch dioxins (The clothes are cleaned in a dry-cleaning washer which has 200liter solvent that contains, we calculate, appropriately 156,000 pg l-TEQ dioxins.)

This study can be important for the dioxin inventory, because we could conclude that the dioxin emission from the wastewater of dye industry is more than the emission of aluminum industry. The assessment of total daily exposure of dioxins needs to consider the exposure from clothes and other fabrics both brand-new and dry-cleaned. In addition, the assessment needs further studies for dioxin absorption through skins.

#### **Acknowledgement**

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#### **References**

- <sup>1</sup> Fuchs, Towara, Hutzinger et al. PCDD/F in Dry-Cleaning Process. Universitat Bayreuth, FRG. Organohalogen Compounds 3. 441 1991.
- <sup>2</sup> Japan Quality Assurance Organization, Tokyo/ Joetsu Environmental Science Center, Niigata/ The Chiba Pharmaceutical Association Research Center, Chiba/ Shizuoka Industrial Environment Center, Shizuoka/ Shimazu Techno Research, Nagoya/ Nippon Total Science, Hiroshima/ Field Science, Sapporo/ Environmental Research Institute, Tokyo/ Maxxam Analytics Inc., Canada/ Seika Corp., Tokyo/ Chugai Technos, Environmental Tech Center/ Gesellschaft fur Arbeitsplatz. unt Umweltanalytik mbH, Germany
- <sup>3</sup> Combination of Perchloroethylene, dry-cleaning soap and sizing (P-480)
- <sup>4</sup> Combination of Trichlorotrifluoroethane, dry-cleaning soap and sizing (TBF-N)
- <sup>5</sup> Only petrol-based solvent was analyzed as used solvent.
- <sup>6</sup> The same pants are dry washed at different cleaners.

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In/on Brand-new clothes  
Actual value of Dioxins & TEQ

Constituent	Toxicity Equivalency Factor: International TEF													Toxicity Equivalency Quantity: pg International TEQ/g												
	Black Suit #1	Black Suit #2	Black Suit #3	Black Suit #4	Black Suit #5	Blue Suit #1	Blue Suit #2	Grey Suit	Red Suit	Grey Windbreaker	Black Underwear #1	Black Underwear #2	Black Jersey													
2,3,7,8-TeCDD	ND	ND	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	0.04													
1,2,3,7,8-PeCDD	ND	0.06	0.049	0.047	0.03	ND	0.044	ND	0.057	0.097	ND	0.04	0.26													
1,2,3,4,7,8-HxCDD	ND	0.13	0.082	0.058	ND	ND	ND	ND	0.11	0.2	ND	ND	0.11													
1,2,3,6,7,8-HxCDD	2.4	4.8	4.6	1.1	1.8	1.7	0.85	0.55	0.35	0.24	0.6	2.5	4.2													
1,2,3,7,8,9-HxCDD	0.91	1.6	1.7	0.46	0.90	0.68	0.27	0.25	0.16	0.23	0.22	0.65	1.9													
1,2,3,4,6,7,8-HpCDD	30	56	58	19	34	25	7.9	8.7	5.5	4.2	5.2	2.9	35													
OCDD	51	70	80	70	100	110	11	34	14	20	6.9	20	46													
<b>Total PCDDs (pg I-TEQ/g)</b>	<b>0.692</b>	<b>1.313</b>	<b>1.3227</b>	<b>0.3968</b>	<b>0.662</b>	<b>0.638</b>	<b>0.224</b>	<b>0.201</b>	<b>0.1605</b>	<b>0.1695</b>	<b>0.1409</b>	<b>0.635</b>	<b>1.157</b>													
2,3,7,8-TeCDF	0.689	0.24	0.12	0.27	0.22	0.069	0.24	0.13	0.18	0.21	0.063	0.27	0.34													
1,2,3,7,8-PeCDF	0.09	0.14	0.12	0.36	0.11	0.079	2.8	0.79	0.24	0.79	ND	0.11	0.38													
2,3,4,7,8-PeCDF	0.75	1.5	0.72	1.6	1.6	0.29	1.4	0.36	0.24	1.1	0.27	0.25	3.2													
1,2,3,4,7,8-HxCDF	1.7	1.8	2.2	7.7	ND	1.2	4.5	0.58	2.3	1.3	0.26	1.3	2.2													
1,2,3,6,7,8-HxCDF	1.1	1.4	1.9	0.87	7.5	0.14	0.39	0.33	0.21	0.27	ND	0.16	0.71													
1,2,3,7,8,9-HxCDF	ND	0.15	0.15	0.78	3.7	ND	0.18	0.12	0.1	0.23	ND	ND	0.12													
2,3,4,6,7,8-HpCDF	30	59	70	70	66	9.1	13	12	1.4	4.8	11	18	160													
1,2,3,4,6,7,8-HpCDF	6.7	8.4	11	32	20	13	15	5.7	3.3	2.3	1.9	7.9	95													
1,2,3,4,7,8,9-HpCDF	1.8	3.3	3.1	24	23	1.3	1.4	3	0.87	0.35	0.35	1.7	4.1													
OCDF	5.8	4.8	7.51	39	25	10	14	5.2	3.6	3.7	2.3	5.8	73													
<b>Total PCDFs (pg I-TEQ/g)</b>	<b>3.78</b>	<b>7.1378</b>	<b>7.951</b>	<b>11.2259</b>	<b>17.0745</b>	<b>1.3544</b>	<b>2.849</b>	<b>1.59215</b>	<b>0.6573</b>	<b>1.3007</b>	<b>1.2911</b>	<b>2.2053</b>	<b>18.92</b>													
TeCDDs	8.3	28	23	41	9.2	1.9	6.1	1.3	3.2	8.3	0.89	44	31													
PeCDDs	3.1	11	9.2	6.5	12	1.6	2.3	1.7	4	5.5	0.77	12	6													
HxCDDs	25	39	38	16	42	15	10	8.2	13	7	5.8	28	44													
HpCDDs	77	129	130	45	83	43	18	20	11	9.4	13	60	67													
OCDD	51	70	80	70	100	110	11	34	14	20	6.9	20	46													
<b>Total PCDDs</b>	<b>164.4</b>	<b>268</b>	<b>281.2</b>	<b>141.6</b>	<b>250</b>	<b>171.5</b>	<b>45.4</b>	<b>65.2</b>	<b>42.6</b>	<b>50.2</b>	<b>26.86</b>	<b>164</b>	<b>166.3</b>													
TeCDFs	28	23	22	38	36	3.9	20	8	8.3	22	7.1	4.9	36													
PeCDFs	29	29	36	120	180	4.8	17	10	8.9	9.8	3.5	12	55													
HxCDFs	46	83	95	240	170	13	22	22	6.4	9.6	15	26	200													
HpCDF	12	15	19	77	58	19	22	12	5.9	4.1	3.2	12	110													
OCDF	5.8	4.8	7	39	25	10	14	5.2	3.6	3.7	2.3	5.8	73													
<b>Total PCDFs</b>	<b>120.6</b>	<b>154.3</b>	<b>179</b>	<b>514</b>	<b>450</b>	<b>50.7</b>	<b>95</b>	<b>57.2</b>	<b>34.7</b>	<b>43.2</b>	<b>31.1</b>	<b>60.7</b>	<b>474</b>													
<b>Total (PCDDs+PCDFs)</b>	<b>289</b>	<b>420</b>	<b>460</b>	<b>660</b>	<b>700</b>	<b>220</b>	<b>140</b>	<b>120</b>	<b>77</b>	<b>99</b>	<b>58</b>	<b>220</b>	<b>640</b>													
<b>Total I-TEQ (pg TEQ/g)</b>	<b>4.4</b>	<b>8.5</b>	<b>9.3</b>	<b>13*</b>	<b>19*</b>	<b>2.0</b>	<b>3.1</b>	<b>1.8</b>	<b>0.82</b>	<b>1.5</b>	<b>1.4</b>	<b>2.8</b>	<b>20</b>													

Institute analyzed

Item	Material	Make
*1 Black suit #1	wool 100%	Shurum co
*2 Black suit #2	wool 100%	Shurum co
*3 Black suit #3	wool 100%	Shurum co
*4 Black suit #4	wool 85% silk 15%	World corp
*5 Black suit #5	wool 85% silk 15%	World corp
*6 Blue suit	wool 100%	Itokin corp
*7 Blue suit	wool 100%	World corp
*8 Grey suit	wool 100%	Renown corp
*9 Red suit	wool 100%	Yagai Kagaku
*10 Grey windbreaker	wool 100%	Yagai Kagaku
*11 Black underwear #1	cotton 100%	Yagai Kagaku
*12 Black underwear #2	cotton 100%	Yagai Kagaku
*13 Black jersey knit	polyester 100%	Descante corp

\* Subject Quality Assurance Organization

**in/on Brand-new clothes**  
Actual value of Dioxins

Constituent	Toxicity Equivalency Factor: International TEF					Toxicity Equivalency Quantity: pg International TEQ/g						
	Black Kimono #14	Blue Futon #15	Blue Jeans #16	Blue Uniform #17	Blue Sports Wear #18	Blue Corsac. #19	Purple Sweater #20	Purple Shirt #21	Grey Pants #22	Beige Blazer #23	White Smock #24	White Sheet #25
2,3,7,8-TeCDD	ND	0.066	0.061	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8-PeCDD	0.05	0.08	ND	ND	ND	ND	ND	0.07	ND	ND	ND	ND
1,2,3,4,7,8-HxCDD	ND	ND	ND	ND	ND	ND	ND	0.15	ND	ND	ND	ND
1,2,3,6,7,8-HxCDD	0.87	0.14	ND	0.38	ND	ND	ND	0.72	ND	ND	ND	ND
1,2,3,7,8,9-HxCDD	0.43	0.12	ND	ND	ND	ND	ND	0.39	ND	ND	ND	ND
1,2,3,4,6,7,8-HpCDD	2.5	1.7	0.25	2	0.38	0.57	0.19	6.5	0.84	ND	0.15	0.47
OCDD	10	7.2	1.2	7.7	1.6	3.5	1.5	28	6	0.49	0.8	2.8
<b>Total PCDDs (pg I-TEQ/g)</b>	<b>0.17</b>	<b>0.1582</b>	<b>0.0647</b>	<b>0.0657</b>	<b>0.0054</b>	<b>0.0088</b>	<b>0.0034</b>	<b>0.255</b>	<b>0.0124</b>	<b>0.0049</b>	<b>0.0023</b>	<b>0.0075</b>
2,3,7,8-TeCDF	0.22	0.84	1.4	0.079	0.076	0.057	0.94	0.32	0.13	ND	0.14	ND
1,2,3,7,8-PeCDF	0.04	0.2	0.2	0.74	0.076	0.062	ND	0.18	0.2	ND	0.05	ND
1,2,3,4,7,8-PeCDF	0.07	0.14	1.29	0.1	0.063	0.061	0.05	0.21	0.1	ND	ND	ND
1,2,3,4,7,8-HxCDF	ND	0.2	ND	0.94	0.27	0.1	ND	0.21	0.16	ND	ND	ND
1,2,3,6,7,8-HxCDF	ND	0.11	ND	0.096	0.086	ND	ND	ND	ND	ND	ND	ND
1,2,3,7,8,9-HxCDF	0.49	0.2	ND	ND	0.16	0.085	ND	4.2	0.21	ND	ND	ND
2,3,4,6,7,8-HxCDF	0.32	0.46	0.55	7.5	0.65	0.47	0.17	0.95	0.29	ND	0.065	ND
1,2,3,4,6,7,8-HpCDF	ND	ND	ND	0.16	0.28	0.14	ND	0.23	0.41	ND	ND	ND
OCDF	0.4	0.54	ND	1.2	4.7	4.5	ND	6.8	0.41	ND	ND	ND
<b>Total PCDFs (pg I-TEQ/g)</b>	<b>0.1116</b>	<b>0.22014</b>	<b>0.28425</b>	<b>0.9371</b>	<b>0.1085</b>	<b>0.08435</b>	<b>0.0307</b>	<b>0.58946</b>	<b>0.11331</b>	<b>0.005</b>	<b>0.01735</b>	<b>0</b>
<b>Total PCDDs+PCDFs</b>	<b>0.28</b>	<b>0.38</b>	<b>0.36</b>	<b>1.0</b>	<b>0.11</b>	<b>0.073</b>	<b>0.034</b>	<b>0.85</b>	<b>0.13</b>	<b>0.0055</b>	<b>0.020</b>	<b>0.0075</b>
TeCDDs	3.1	2	0.46	2	0.36	1.2	1.1	8.8	2.9	0.33	0.92	0.26
PeCDDs	0.73	1.7	0.27	0.7	0.34	0.7	0.51	2.7	1.1	0.15	0.37	0.076
HxCDDs	5.4	1.7	0.36	3	0.61	0.82	0.55	9.2	0.99	0.15	0.39	0.16
HpCDDs	4.5	3.3	0.64	4	0.91	0.96	0.42	12	1.6	0.16	0.34	0.86
OCDD	10	7.2	1.2	7.7	1.6	3.5	1.5	28	6	0.49	0.8	2.8
<b>Total PCDDs</b>	<b>23.73</b>	<b>15.9</b>	<b>2.93</b>	<b>17.4</b>	<b>3.82</b>	<b>7.18</b>	<b>4.08</b>	<b>59.5</b>	<b>12.59</b>	<b>1.28</b>	<b>2.82</b>	<b>4.156</b>
TeCDFs	3	6.5	6.2	40	2.3	1.5	1.6	6.4	4	0.52	1.8	0.27
PeCDFs	1	2.2	0.87	4.9	2.4	1.3	0.79	4.6	2.1	0.30	0.58	0.14
HxCDFs	0.75	1.9	0.45	8.8	4	0.99	0.39	5.7	1.5	0.31	0.3	0.12
HpCDFs	0.54	1	0.9	10	1.8	1	0.2	1.7	0.76	0.15	0.18	0.15
OCDF	0.4	0.54	ND	12	4.7	0.45	ND	0.8	0.41	ND	ND	ND
<b>Total PCDFs</b>	<b>5.89</b>	<b>12.14</b>	<b>8.42</b>	<b>73.7</b>	<b>15.2</b>	<b>5.24</b>	<b>2.98</b>	<b>19.2</b>	<b>6.77</b>	<b>1.28</b>	<b>2.86</b>	<b>0.69</b>
<b>Total (PCDDs+PCDFs)</b>	<b>29</b>	<b>28</b>	<b>11</b>	<b>93</b>	<b>19</b>	<b>12</b>	<b>7.1</b>	<b>80</b>	<b>21</b>	<b>2.6</b>	<b>5.7</b>	<b>4.8</b>
<b>Total I-TEQ (pg TEQ/g)</b>	<b>0.28</b>	<b>0.38</b>	<b>0.36</b>	<b>1.0</b>	<b>0.11</b>	<b>0.073</b>	<b>0.034</b>	<b>0.85</b>	<b>0.13</b>	<b>0.0055</b>	<b>0.020</b>	<b>0.0075</b>

**Institute analyzed**

- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku
- Yagai Kagaku

**Make**

- Misawa
- Jusco
- Revis
- Fujiwara
- Mazuno
- xxxxxxx
- World corp
- Gmward Kashiyama
- Hanyama
- Yagai Kagaku
- Nishimatsuya
- Chitsuki
- Gainshome

**Material**

- silk 100%
- silk 100%
- cotton 100%
- wool 100%
- cotton 100%
- wool 100%
- rayon 100%
- polyester 100%
- wool 100%
- cotton 100%
- polyester 55% cotton 35%
- cotton 100%

**Item**

- #14 Black kimono
- #15 Blue Futon
- #16 Blue Jeans
- #17 Blue Uniform
- #18 Blue Sports wear
- #19 Blue Curtain
- #20 Purple Sweater
- #21 Purple Shirt
- #22 Grey Pants
- #23 Beige Blazer
- #24 White Smock
- #25 White Sheet

New fabrics before and after dry clean  
 Comparison of Actual value of Dioxins  
 Perc-based solvent dry cleaning  
 Actual value of dioxins: pg/g

Constituent	Blanket		Pants A		Pants B		Pants C		Futon	
	Before	After	Before	After	Before	After	Before	After	Before	After
Dioxin	2,3,7,8-TeCDD	ND	ND	ND	ND	ND	ND	ND	0.066	0.046
	1,2,3,7,8-PeCDD	ND	ND	ND	ND	ND	0.051	0.087	0.08	0.087
	1,2,3,4,7,8-HxCDD	ND	ND	ND	ND	ND	0.045	0.11	ND	0.11
	1,2,3,6,7,8-HxCDD	ND	0.086	ND	0.087	ND	0.25	0.14	0.14	0.14
	1,2,3,7,8,9-HxCDD	ND	ND	ND	0.080	ND	0.15	0.12	0.12	ND
	1,2,3,4,6,7,8-HpCDD	ND	1.5	0.64	1.6	2.8	1.9	1.7	1.7	4.3
OCDD	0.49	8.0	6	13	6	8.0	6	7.2	7.2	67
Dioxin isomer	PCDDs I-TEQ	0.00049	0.0316	0.0124	0.0456	0.0124	0.097	0.0124	0.1562	0.2245
	2,3,7,8-TeCDF	0.050	ND	0.13	0.12	0.34	0.082	0.13	0.84	0.28
	1,2,3,7,8-PeCDF	ND	ND	0.2	0.14	0.15	0.36	0.2	0.2	0.22
	2,3,4,7,8-HxCDF	ND	ND	0.1	0.088	0.094	0.11	0.14	0.14	0.12
	1,2,3,4,7,8-HxCDF	ND	ND	0.16	0.15	0.14	0.58	0.16	0.2	0.18
	1,2,3,6,7,8-HxCDF	ND	ND	ND	ND	ND	0.17	ND	0.11	0.19
Dioxin Congener	1,2,3,7,8,9-HxCDF	ND	ND	ND	ND	ND	ND	ND	ND	0.11
	2,3,4,6,7,8-HxCDF	ND	ND	0.21	0.13	ND	1.0	0.21	0.2	0.12
	1,2,3,4,6,7,8-HpCDF	ND	0.14	0.29	0.32	0.28	1.3	0.29	0.46ND	0.53
	1,2,3,4,7,8,9-HpCDF	ND	ND	ND	0.34	0.17	0.26	ND	ND	ND
	OCDF	ND	ND	0.41	0.54	0.40	1.3	0.41	0.54	0.9
	PCDFs I-TEQ	0.005	0.0014	0.11331	0.09814	0.11331	0.2731	0.11331	0.22014	0.1652
Dioxin Congener	TeCDDs	0.33	0.78	2.9	3.6	2.8	3.3	2.9	2	1.6
	PeCDDs	0.15	0.54	1.1	1.2	1.0	2.9	1.1	1.7	1.3
	HxCDDs	0.15	0.99	0.99	2.2	1.5	2.7	0.99	1.7	2.8
	HpCDDs	0.16	3.4	1.6	3.7	5.6	4.0	1.6	3.3	15
	OCDD	0.49	8.0	6	13	16	8.0	6	7.2	67
	Total PCDDs	1.28	13.71	12.59	23.7	26.9	20.9	12.59	15.9	87.7
Dioxin Congener	TeCDFs	0.52	0.70	4	5.2	4.1	3.4	4	6.5	3.5
	PeCDFs	0.30	0.46	2.1	2.2	2.1	3.1	2.1	2.2	1.8
	HxCDFs	0.31	0.35	1.5	1.2	0.95	3.4	1.5	1.9	1.8
	HpCDF	0.15	0.27	0.76	1.1	0.90	2.2	0.76	1	1.2
	OCDF	ND	ND	0.41	0.54	0.40	1.3	0.41	0.54	0.9
	Total PCDFs	1.28	1.78	8.77	10.24	8.45	13.4	8.77	12.14	9.2
Total (PCDDs+PCDFs)	2.6	15	21	34	35	34	21	28	97	
	0.0055	0.033	0.13	0.14	0.16	0.37	0.13	0.38	0.39	

**New fabrics before and after dry clean**

Comparison of Actual value of Dioxins

Petrol-based solvent dry cleaning

Actual value of dioxins: pg/g

Constituent	TEF: International TEF				TEQ: International TEQ (pg-TEQ/g)				
	Blanket		Pants		Uniform-A		Mouton		
	Before	After	Before	After	Before	After	Before	After	
Dioxin	2,3,7,8-TeCDD	ND	ND	ND	ND	ND	ND	ND	0.049
	1,2,3,7,8-PeCDD	ND	ND	ND	0.052	ND	ND	ND	0.74
	1,2,3,4,7,8-HxCDD	ND	ND	ND	0.068	ND	ND	ND	1.5
	1,2,3,6,7,8-HxCDD	ND	ND	ND	0.30	0.38	2.7	ND	6.7
	1,2,3,7,8,9-HxCDD	ND	ND	ND	0.18	ND	0.64	ND	7.2
	1,2,3,4,6,7,8-HpCDD	ND	0.7	0.64	1.4	2	11	ND	110
	OCDD	0.49	3	6	5.1	7.7	23	ND	190
	PCDDs I-TEQ	0.00049	0.01	0.0124	0.0999	0.0657	0.487	ND	3.249
	2,3,7,8-TeCDF	0.050	ND	0.13	0.090	0.079	0.069	ND	0.060
	1,2,3,7,8-PeCDF	ND	ND	0.2	0.31	0.74	1.3	ND	0.15
Dibenzofuran	2,3,4,7,8-PeCDF	ND	ND	0.1	0.089	0.1	0.078	ND	0.20
	1,2,3,4,7,8-HxCDF	ND	ND	0.16	0.44	0.54	1.4	ND	0.13
	1,2,3,6,7,8-HxCDF	ND	ND	ND	0.12	0.096	ND	ND	0.17
	1,2,3,7,8,9-HxCDF	ND	ND	ND	ND	ND	0.11	ND	0.17
	2,3,4,6,7,8-HxCDF	ND	ND	0.21	0.66	6.9	3.8	ND	0.17
	1,2,3,4,6,7,8-HpCDF	ND	ND	0.29	1.0	7.5	4.5	ND	1.3
	1,2,3,4,7,8,9-HpCDF	ND	ND	ND	0.20	0.16	0.44	ND	ND
	OCDF	ND	ND	0.41	0.80	12	9.8	ND	0.48
	PCDFs I-TEQ	0.0055	0	0.11331	0.20380	0.9371	0.7011	ND	0.19098
	Congener	TeCDDs	0.33	1.3	2.9	3.6	2	1.6	ND
PeCDDs		0.15	0.15	1.1	2.4	0.7	5.8	ND	17
HxCDDs		0.15	0.21	0.99	2.9	3	50	ND	71
HpCDDs		0.16	1.1	1.6	2.9	4	26	ND	200
OCDD		0.49	3	6	5.1	7.7	23	ND	190
Total PCDDs		1.28	5.76	12.59	16.9	17.4	106.4	ND	490
TeCDFs		0.52	0.61	4	3.7	40	37	ND	13
PeCDFs		0.30	0.31	2.1	2.6	4.9	11	ND	14
HxCDF		0.31	0.24	1.5	2.5	8.8	6.5	ND	2.8
HpCDF		0.15	0.13	0.76	1.6	10	6.0	ND	2.6
OCDF	ND	ND	0.41	0.80	12	9.8	ND	0.49	
Total PCDFs	1.28	1.29	8.77	11.20	75.7	70.3	ND	32.88	
Total (PCDDs+PCDFs)	2.6	7.0	21	28	93	180	ND	520	
Total I-TEQ (pg I-TEQ/g)	0.0055	0.01	0.13	0.30	1.0	1.2	ND	3.4	

Analysis of Dioxins in  
**Petrol-based dry cleaning solvent (unused)**  
 Material: Petrol-based dry cleaning solvent

Analysis Method: Gas Chromatograph Analyzing

Results Analyzed by Shimazu Techno Research  
 Reported on 16 March, 2001

Constituent	Unit	Quantity
PCDDs	ng/liter	1.3
PCDFs	ng/liter	3.4
PCDDs+PCDFs	ng/liter	4.7
PCDDs/DFs TEQ	pg-TEQ/l	6.8
Coplaner PCBs TEQ	pg-TEQ/l	0.47
DIOXINS TEQ	pg-TEQ/l	7.3

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)		
Dioxins	Isomer	Dioxin	2,3,7,8-TeCDD	<0.1	1	0
			1,2,3,7,8-PeCDD	<0.1	1	0
			1,2,3,4,7,8-HxCDD	<0.2	0.1	0
			1,2,3,6,7,8-HxCDD	<0.2	0.1	0
			1,2,3,7,8,9-HxCDD	<0.2	0.1	0
			1,2,3,4,6,7,8-HpCDD	<0.2	0.01	0
			OCDD	1.0	0.0001	0.10
			PCDDs TEQ	—	—	0.10
	Dibenzofuran	2,3,7,8-TeCDF	<0.1	0.1	0	
		1,2,3,7,8-PeCDF	<0.1	0.05	0	
		2,3,4,7,8-PeCDF	<0.1	0.5	0	
		1,2,3,4,7,8-HxCDF	<0.2	0.1	0	
		1,2,3,6,7,8-HxCDF	<0.2	0.1	0	
		1,2,3,7,8,9-HxCDF	<0.2	0.1	0	
		2,3,4,6,7,8-HxCDF	<0.2	0.1	0	
		1,2,3,4,6,7,8-HpCDF	0.65	0.01	6.5	
		1,2,3,4,7,8,9-HpCDF	<0.2	0.01	0	
		OCDF	2.2	0.0001	0.22	
PCDFs TEQ		—	—	6.72		
Total TEQ		—	—	6.8		
Congener	Dioxin	TeCDDs	<0.1	Notes 1. Actual value of concentration: PCDD/DF concentration ng/l 2. Sample quantity: 10 ml 3. Toxicity Equivalency Quantity: 2,3,7,8TeCDD (pg-TEQ/l) 4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS 1998) 5. Detection limits: 4~5 Chloro-DDs/DFs: 0.1 ng/l 6~7 Chloro-DDs/DFs: 0.2 ng/l 8 Chloro-DDs/DFs: 0.5 ng/l		
		PeCDDs	<0.1			
		HxCDDs	<0.2			
		HpCDDs	0.31			
		OCDD	1.0			
	Total PCDDs		1.3			
	Dibenzofuran	TeCDFs	<0.1			
		PeCDFs	<0.1			
		HxCDF	0.37			
		HpCDF	0.85			
OCDF		2.2				
Total PCDFs		3.4				
Total (PCDDs+PCDFs)		4.7				

Analysis Method: Gas Chromatograph Analyzing

Analysis of Coplanar PCBs in  
**Petrol-based dry cleaning solvent (unused)**

Material: Petrol-based dry-cleaning solvent

Analyzed by Shimazu Techno Research  
 Reported on 16 March, 2001

Result

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)
Coplanar PCBs	3,3',4,4'-TeCB (#77)	<1	0.0001	0
	3,4,4',5'-TeCB (#81)	<1	0.0001	0
	3,3',4,4',5'-PeBC (#126)	<1	0.1	0
	3,3',4,4',5,5'-HxCB (#169)	<1	0.01	0
	2,3,3',4,4'-PeCB (#105)	1.1	0.0001	0.11
	2,3,4,4',5'-PeCB (#114)	<1	0.0005	0
	2,3',4,4',5'-PeCB (#118)	3.6	0.0001	0.36
	2',3,4,4',5'-PeCB (#123)	<1	0.0001	0
	2,3,3',4,4',5'-HxCB (#156)	<1	0.0005	0
	2,3,3',4,4',5'-HxCB (#157)	<1	0.0005	0
	2,3',4,4',5,5'-HxCB (#167)	<1	0.00001	0
	2,3,3',4,4',5,5'-HpCB (#189)	<1	0.0001	0
	Total Coplanar PCBs		4.7	—

Notes

1. Actual value of concentration: Coplanar PCBs (ng/liter)
2. Sample quantity: 10ml
3. Toxicity Equivalency Quantity: 2,3,7,8-TeCDD TEQ (pg-TEQ/liter)
4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
5. Detection limits: 1 ng/liter

Analysis of Dioxins in  
**Parc-based dry cleaning solvent (unused)**  
 Material: Parc-based dry cleaning solvent

Analysis Method: Gas Chromatograph Analyzing

Results

	Unit	Quantity
PCDDs	ng/liter	1.4
PCDFs	ng/liter	2.8
PCDDs+PCDFs	ng/liter	4.2
PCDDs/DFs TEQ	pg-TEQ/l	7.2
Coplaner PCBs TEQ	pg-TEQ/l	0.55
DIOXINS TEQ	pg-TEQ/l	7.8

Analyzed by Shimazu Techno Research  
 Reported on 16 March, 2001

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)	
Dioxins	Dioxin	2,3,7,8-TeCDD	<0.1	0	
		1,2,3,7,8-PeCDD	<0.1	0	
		1,2,3,4,7,8-HxCDD	<0.2	0.1	
		1,2,3,6,7,8-HxCDD	<0.2	0.1	
		1,2,3,7,8,9-HxCDD	<0.2	0.1	
		1,2,3,4,6,7,8-HpCDD	0.27	0.01	
		OCDD	0.95	0.0001	
	PCDDs TEQ		—	—	2.795
	Isomer	Dibenzofuran	2,3,7,8-TeCDF	<0.1	0
			1,2,3,7,8-PeCDF	<0.1	0.05
			2,3,4,7,8-PeCDF	<0.1	0.5
			1,2,3,4,7,8-HxCDF	<0.2	0.1
			1,2,3,6,7,8-HxCDF	<0.2	0.1
			1,2,3,7,8,9-HxCDF	<0.2	0.1
			2,3,4,6,7,8-HxCDF	<0.2	0.1
			1,2,3,4,6,7,8-HpCDF	0.43	0.01
			1,2,3,4,7,8,9-HpCDF	<0.2	0.01
			OCDF	1.1	0.0001
PCDFs TEQ		—	—	4.41	
Total TEQ		—	—	7.2	
Congener	Dioxin	TeCDDs	<0.1	Notes 1. Actual value of concentration: PCDD/DF concentration ng/l 2. Sample quantity: 10 ml 3. Toxicity Equivalency Quantity: 2,3,7,8TeCDD (pg-TEQ/l) 4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998) 5. Detection limits: 4~5 Chloro-DDs/DFs: 0.1 ng/l 6~7 Chloro-DDs/DFs: 0.2 ng/l 8 Chloro-DDs/DFs: 0.5 ng/l	
		PeCDDs	<0.1		
		HxCDDs	<0.2		
		HpCDDs	0.49		
		OCDD	0.95		
	Total PCDDs		1.4		
	Dibenzofuran	TeCDFs	<0.1		
		PeCDFs	0.21		
		HxCDF	0.65		
		HpCDF	0.8		
OCDF		1.1			
Total PCDFs		2.8			
Total (PCDDs+PCDFs)		4.2			

Analysis of Coplanar PCBs in  
Parc-based dry cleaning solvent (unused)

Material: Parc-based dry-cleaning solvent

Analyzed by Shimazu Techno Research  
Reported on 16 March, 2001

Result

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)
Coplanar PCBs	3,3',4,4'-TeCB (#77)	<1	0.0001	0
	3,4,4',5'-TeCB (#81)	<1	0.0001	0
	3,3',4,4',5'-PeCB (#126)	<1	0.1	0
	3,3',4,4',5,5'-HxCB (#169)	<1	0.01	0
	2,3,3',4,4'-PeCB (#105)	1.3	0.0001	0.13
	2,3,4,4',5'-PeCB (#114)	<1	0.0005	0
	2,3',4,4',5'-PeCB (#118)	4.2	0.0001	0.42
	2',3,4,4',5'-PeCB (#123)	<1	0.0001	0
	2,3,3',4,4',5'-HxCB (#156)	<1	0.0005	0
	2,3,3',4,4',5'-HxCB (#157)	<1	0.0005	0
	2,3',4,4',5,5'-HxCB (#167)	<1	0.00001	0
	2,3,3',4,4',5,5'-HpCB (#189)	<1	0.0001	0
	Total Coplanar PCBs		5.5	—

Notes

1. Actual value of concentration: Coplanar PCBs (ng/liter)
2. Sample quantity: 10ml
3. Toxicity Equivalency Quantity: 2,3,7,8-TeCDD TEQ (pg-TEQ/liter)
4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
5. Detection limits: 1 ng/liter

Analysis of Dioxins in  
**Stain remove spot cleaning solvent (unused)**  
 Material: Stain remove spot cleaning solvent

Analysis Method: Gas Chromatograph Analyzing

Results

	Unit	Quantity
PCDDs	ng/liter	2.0
PCDFs	ng/liter	3.8
PCDDs+PCDFs	ng/liter	5.8
PCDDs/DFs TEQ	pg-TEQ/l	75
Coplaner PCBs TEQ	pg-TEQ/l	1.3
DIOXINS TEQ	pg-TEQ/l	76

Analyzed by Shimazu Techno Research  
 Reported on 16 March, 2001

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)	
Dioxins	Dioxin	2,3,7,8-TeCDD	<0.05	0	
		1,2,3,7,8-PeCDD	<0.05	0	
		1,2,3,4,7,8-HxCDD	<0.1	0	
		1,2,3,6,7,8-HxCDD	<0.1	0	
		1,2,3,7,8,9-HxCDD	<0.1	0	
		1,2,3,4,6,7,8-HpCDD	0.22	0.01	2.2
		OCDD	0.95	0.0001	0.095
	PCDDs TEQ		—	—	2.295
	Dibenzofuran	2,3,7,8-TeCDF	<0.05	0.1	0
		1,2,3,7,8-PeCDF	<0.05	0.05	0
		2,3,4,7,8-PeCDF	0.07	0.5	35
		1,2,3,4,7,8-HxCDF	<0.1	0.1	0
		1,2,3,6,7,8-HxCDF	0.10	0.1	10
		1,2,3,7,8,9-HxCDF	<0.1	0.1	0
		2,3,4,6,7,8-HxCDF	0.22	0.1	22
		1,2,3,4,6,7,8-HpCDF	0.44	0.01	4.4
		1,2,3,4,7,8,9-HpCDF	0.10	0.01	1.0
	OCDF	0.75	0.0001	0.075	
	PCDFs TEQ		—	—	72.475
Total TEQ		—	—	75	
Congener	Dioxin	TeCDDs	0.26	Notes 1. Actual value of concentration: PCDD/DF concentration ng/l 2. Sample quantity: 70 ml 3. Toxicity Equivalency Quantity: 2,3,7,8TeCDD (pg-TEQ/l) 4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998) 5. Detection limits: 4~5 Chloro-DDs/Dfs: 0.05 ng/l 6~7 Chloro-DDs/DFs: 0.1 ng/l 8 Chloro-DDs/DFs: 0.2 ng/l	
		PeCDDs	0.11		
		HxCDDs	0.27		
		HpCDDs	0.43		
		OCDD	0.95		
	Total PCDDs		2.0		
	Dibenzofuran	TeCDFs	0.43		
		PeCDFs	0.49		
		HxCDF	1.2		
		HpCDF	0.90		
OCDF		0.75			
Total PCDFs		3.8			
Total (PCDDs+PCDFs)		5.8			

Analysis of Coplanar PCBs in  
Stain remove spot cleaning solvent (unused)

Material: Stain remove spot cleaning solvent

Analyzed by Shimazu Techno Research

Reported on 16 March, 2001

Result

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)	
Coplanar PCBs	3,3',4,4'-TeCB (#77)	0.95	0.0001	0.095	
	3,4,4',5'-TeCB (#81)	<0.5	0.0001	0	
	3,3',4,4',5'-PeCB (#126)	<0.5	0.1	0	
	3,3',4,4',5,5'-HxCB (#169)	<0.5	0.01	0	
	2,3,3',4,4'-PeCB (#105)	1.3	0.0001	0.13	
	2,3,4,4',5'-PeCB (#114)	<0.5	0.0005	0	
	2,3',4,4',5'-PeCB (#118)	4.3	0.0001	0.43	
	2',3,4,4',5'-PeCB (#123)	<0.5	0.0001	0	
	2,3,3',4,4',5'-HxCB (#156)	1.2	0.0005	0.6	
	2,3,3',4,4',5'-HxCB (#157)	<0.5	0.0005	0	
	2,3',4,4',5,5'-HxCB (#167)	0.55	0.00001	0.0055	
	2,3,3',4,4',5,5'-HpCB (#189)	0.60	0.0001	0.060	
	Total Coplanar PCBs		8.9	—	1.3

Notes

1. Actual value of concentration: Coplanar PCBs (ng/liter)
2. Sample quantity: 70ml
3. Toxicity Equivalency Quantity: 2,3,7,8-TeCDD TEQ (pg-TEQ/liter)
4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
5. Detection limits: 0.5ng/liter

Analysis of Dioxins in  
**Petro-based dry cleaning solvent (used)**  
 Material: **Used Petro-based dry cleaning solvent**

Analysis Method: Gas Chromatograph Analyzing

Results

	Unit	Quantity
PCDDs	ng/liter	20
PCDFs	ng/liter	55
PCDDs+PCDFs	ng/liter	75
PCDDs/DFs TEQ	pg-TEQ/l	270
Coplaner PCBs TEQ	pg-TEQ/l	510
DIOXINs TEQ	pg-TEQ/l	780

Analyzed by Shimazu Techno Research  
 Reported on 16 March, 2001

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)	
Dioxins	Dioxin	2,3,7,8-TeCDD	<0.2	1	0
		1,2,3,7,8-PeCDD	<0.2	1	0
		1,2,3,4,7,8-HxCDD	<0.5	0.1	0
		1,2,3,6,7,8-HxCDD	<0.5	0.1	0
		1,2,3,7,8,9-HxCDD	<0.5	0.1	0
		1,2,3,4,6,7,8-HpCDD	1.5	0.01	15
		OCDD	10	0.0001	1
		PCDDs TEQ	—	—	16
	Dibenzofuran	2,3,7,8-TeCDF	<0.2	0.1	0
		1,2,3,7,8-PeCDF	<0.2	0.05	0
		2,3,4,7,8-PeCDF	0.23	0.5	115
		1,2,3,4,7,8-HxCDF	<0.5	0.1	0
		1,2,3,6,7,8-HxCDF	<0.5	0.1	0
		1,2,3,7,8,9-HxCDF	<0.5	0.1	0
		2,3,4,6,7,8-HxCDF	0.66	0.1	66
		1,2,3,4,6,7,8-HpCDF	6.3	0.01	63
		1,2,3,4,7,8,9-HpCDF	0.58	0.01	5.8
		OCDF	29	0.0001	2.9
PCDFs TEQ	—	—	252.7		
Total TEQ	—	—	270		
Congener	Dioxin	TeCDDs	4.9	Notes 1. Actual value of concentration: PCDD/DF concentration ng/l 2. Sample quantity: 10 ml 3. Toxicity Equivalency Quantity: 2,3,7,8TeCDD (pg-TEQ/l) 4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPOS, 1998) 5. Detection limits: 4~5 Chloro-DDs/Dfs: 0.2 ng/l 6~7 Chloro-DDs/DFs: 0.5 ng/l 8 Chloro-DDs/DFs: 1 ng/l	
		PeCDDs	0.95		
		HxCDDs	1.8		
		HpCDDs	2.8		
		OCDD	10		
	Total PCDDs	20			
	Dibenzofuran	TeCDFs	11		
		PeCDFs	2.9		
		HxCDF	3.9		
		HpCDF	8.6		
OCDF		29			
Total PCDFs	55				
Total (PCDDs+PCDFs)	75				

Analysis of Coplanar PCBs in  
Petrol-based dry cleaning solvent (used)

Material: Used petrol-based dry-cleaning solvent

Analyzed by Shimazu Techno Research  
Reported on 16 March, 2001

Result

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)
Coplanar PCBs	3,3',4,4'-TeCB (#77)	38	0.0001	3.8
	3,4,4',5'-TeCB (#81)	2.4	0.0001	0.24
	3,3',4,4',5'-PeCB (#126)	2.7	0.1	270
	3,3',4,4',5,5'-HxCB (#169)	<2	0.01	0
	2,3,3',4,4'-PeCB (#105)	380	0.0001	38
	2,3,4,4',5'-PeCB (#114)	30	0.0005	15
	2,3',4,4',5'-PeCB (#118)	1000	0.0001	100
	2',3,4,4',5'-PeCB (#123)	33	0.0001	3.3
	2,3,3',4,4',5'-HxCB (#156)	130	0.0005	65
	2,3,3',4,4',5'-HxCB (#157)	29	0.0005	14.5
	2,3',4,4',5,5'-HxCB (#167)	49	0.00001	0.49
	2,3,3',4,4',5,5'-HpCB (#189)	9.4	0.0001	0.94
	Total Coplanar PCBs		1700	—

Notes

1. Actual value of concentration: Coplanar PCBs (ng/liter)
2. Sample quantity: 1.0ml
3. Toxicity Equivalency Quantity: 2,3,7,8-TeCDD TEQ (pg-TEQ/liter)
4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
5. Detection limits: 2 ng/liter

Analysis of Dioxins in

Charcoal filter (used) for petrol-based dry cleaning machine

Material: Used charcoal filter for petro-based dry cleaning machine

Analysis Method: Gas Chromatograph Analyzing

Results

	Unit	Quantity
PCDDs	pg/g	23000
PCDFs	pg/g	2700
PCDDs+PCDFs	pg/g	26000
PCDDs/DFs TEQ	pg-TEQ/g	82
Coplaner PCBs TEQ	pg-TEQ/g	11
DIOXINS TEQ	pg-TEQ/g	93

Analyzed by Shimazu Techno Research  
Reported on 16 March 2001

Constituent		Actual value of concentration (pg/l)	TEF (WHO)	TEQ (pg-TEQ/g)	
Dioxins	Dioxin	2,3,7,8-TeCDD	2.5	1	2.5
		1,2,3,7,8-PeCDD	8.2	1	8.2
		1,2,3,4,7,8-HxCDD	9.6	0.1	0.96
		1,2,3,6,7,8-HxCDD	90	0.1	9.0
		1,2,3,7,8,9-HxCDD	31	0.1	3.1
		1,2,3,4,6,7,8-HpCDD	2500	0.01	25
		OCDD	17000	0.0001	1.7
	PCDDs TEQ		—	—	50.46
	Dibenzofuran	2,3,7,8-TeCDF	25	0.1	2.5
		1,2,3,7,8-PeCDF	33	0.05	1.65
		2,3,4,7,8-PeCDF	24	0.5	12
		1,2,3,4,7,8-HxCDF	33	0.1	3.3
		1,2,3,6,7,8-HxCDF	26	0.1	2.6
		1,2,3,7,8,9-HxCDF	2.1	0.1	0.21
		2,3,4,6,7,8-HxCDF	69	0.1	6.9
		1,2,3,4,6,7,8-HpCDF	190	0.01	1.9
		1,2,3,4,7,8,9-HpCDF	21	0.01	0.21
	OCDF	430	0.0001	0.043	
PCDFs TEQ		—	—	31.313	
Total TEQ		—	—	82	
Congener	Dioxin	TeCDDs	640	Notes 1. Actual value of concentration: PCDD/DF concentration pg/g 2. Sample quantity: 21.85 g 3. Toxicity Equivalency Quantity: 2,3,7,8-TeCDD (pg-TEQ/g) 4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998) 5. Detection limits: 4~5 Chloro-DDs/Dfs: 1 pg/g 6~7 Chloro-DDs/DFs: 2 pg/g 8 Chloro-DDs/DFs: 5 pg/g	
		PeCDDs	320		
		HxCDDs	820		
		HpCDDs	4100		
		OCDD	17000		
	Total PCDDs		23000		
	Dibenzofuran	TeCDFs	860		
		PeCDFs	640		
		HxCDF	380		
		HpCDF	420		
OCDF		430			
Total PCDFs		2700			
Total (PCDDs+PCDFs)		26000			

Coplantar PCBs in

Charcoal filter (used) for petrol-based dry cleaning machine

Material: Used charcoal filter for petrol-based dry-cleaning solvent

Analyzed by Shimazu Techno Research  
Reported on 16 March, 2001

Result

Constituent		Actual value of concentration (pg/g)	TEF (WHO)	TEQ (pg-TEQ/g)
Coplantar PCBs	3,3',4,4'-TeCB (#77)	1300	0.0001	0.13
	3,4,4',5-TeCB (#81)	67	0.0001	0.0067
	3,3',4,4',5-PeCB (#126)	97	0.1	9.7
	3,3',4,4',5,5'-HxCB (#169)	28	0.01	0.28
	2,3,3',4,4'-PeCB (#105)	2000	0.0001	0.20
	2,3,4,4',5-PeCB (#114)	150	0.0005	0.075
	2,3',4,4',5-PeCB (#118)	4700	0.0001	0.47
	2',3,4,4',5-PeCB (#123)	150	0.0001	0.015
	2,3,3',4,4',5-HxCB (#156)	610	0.0005	0.305
	2,3,3',4,4',5'-HxCB (#157)	140	0.0005	0.070
	2,3',4,4',5,5'-HxCB (#167)	210	0.00001	0.0021
	2,3,3',4,4',5,5'-HpCB (#189)	43	0.0001	0.0043
Total Coplantar PCBs		9500	—	11

Notes

1. Actual value of concentration: Coplantar PCBs (pg/g)
2. Sample quantity: 21.85g
3. Toxicity Equivalency Quantity: 2,3,7,8-TeCDD TEQ (pg-TEQ/liter)
4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
5. Detection limits: 10pg/g

Analysis in  
 Solvent filter (used) for petrol-based dry cleaning machine  
 Material: Used solvent filter for petrol-based dry cleaning machine

Analysis Method: Gas Chromatograph Analyzing

Results

	Unit	Quantity
PCDDs	pg/g	980
PCDFs	pg/g	220
PCDDs+PCDFs	pg/g	1200
PCDDs/DFs TEQ	pg-TEQ/g	5.6
Coplaner PCBs TEQ	pg-TEQ/g	2.7
DIOXINS TEQ	pg-TEQ/g	8.3

Analyzed by Simazu Techno Research  
 Reported on 16 March 2001

Constituent		Actual value of concentration (pg/g)	TEF (WHO)	TEQ (pg-TEQ/g)	
Dioxins	Dioxin	2,3,7,8-TeCDD	1	0.44	
		1,2,3,7,8-PeCDD	1	0.79	
		1,2,3,4,7,8-HxCDD	0.1	0.11	
		1,2,3,6,7,8-HxCDD	0.1	0.23	
		1,2,3,7,8,9-HxCDD	0.1	0.18	
		1,2,3,4,6,7,8-HpCDD	0.01	0.62	
		OCDD	0.0001	0.072	
	PCDDs TEQ		—	—	2.442
	Isomer	Dibenzofuran	2,3,7,8-TeCDF	0.1	0.19
			1,2,3,7,8-PeCDF	0.05	0.195
			2,3,4,7,8-PeCDF	0.5	1.55
			1,2,3,4,7,8-HxCDF	0.1	0.34
			1,2,3,6,7,8-HxCDF	0.1	0.28
			1,2,3,7,8,9-HxCDF	<1	0
			2,3,4,6,7,8-HxCDF	0.1	0.46
			1,2,3,4,6,7,8-HpCDF	0.01	0.15
			1,2,3,4,7,8,9-HpCDF	0.01	0.016
OCDF			0.0001	0.0026	
PCDFs TEQ		—	—	3.1836	
Total TEQ		—	—	5.6	

Congener	Concentration (pg/g)	
Dioxin	TeCDDs	69
	PeCDDs	26
	HxCDDs	40
	HpCDDs	120
	OCDD	720
Total PCDDs		980
Dibenzofuran	TeCDFs	80
	PeCDFs	50
	HxCDF	32
	HpCDF	27
	OCDF	26
Total PCDFs		220
Total (PCDDs+PCDFs)		1200

Notes

- Actual value of concentration: PCDD/DF concentration pg/g
- Sample quantity: 50.24 g
- Toxicity Equivalency Quantity: 2,3,7,8TeCDD (pg-TEQ/g)
- Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
- Detection limits:  
 4~5 Chloro-DDs/DFs: 0.4 pg/g  
 6~7 Chloro-DDs/DFs: 1 pg/g  
 8 Chloro-DDs/DFs: 2 pg/g

Analysis of Coplanar PCBs in  
 Solvent filter (used for petrol-based dry cleaning machine)  
 Material: Used solvent filter for petrol-based dry-cleaning solvent

Analyzed by Shimazu Techno Research  
 Reported on 16 March, 2001

## Result

Constituent		Actual value of concentration (pg/g)	TEF (WHO)	TEQ (pg-TEQ/g)
Coplanar PCBs	3,3',4,4'-TeCB (#77)	200	0.0001	0.020
	3,4,4',5'-TeCB (#81)	11	0.0001	0.0011
	3,3',4,4',5'-PeCB (#126)	19	0.1	1.9
	3,3',4,4',5,5'-HxCB (#169)	<4	0.01	0
	2,3,3',4,4'-PeCB (#105)	1300	0.0001	0.13
	2,3,4,4',5'-PeCB (#114)	120	0.0005	0.060
	2,3',4,4',5'-PeCB (#118)	3300	0.0001	0.33
	2',3,4,4',5'-PeCB (#123)	88	0.0001	0.0088
	2,3,3',4,4',5'-HxCB (#156)	440	0.0005	0.22
	2,3,3',4,4',5'-HxCB (#157)	100	0.0005	0.050
	2,3',4,4',5,5'-HxCB (#167)	170	0.00001	0.0017
	2,3,3',4,4',5,5'-HpCB (#189)	30	0.0001	0.0030
	Total Coplanar PCBs		5800	—

## Notes

1. Actual value of concentration: Coplanar PCBs (pg/g)
2. Sample quantity: 50.24g
3. Toxicity Equivalency Quantity: 2,3,7,8-TeCDD TEQ (pg-TEQ/liter)
4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
5. Detection limits: 4pg/g

Analysis of Dioxins in  
**Sludge from parc-cleaning machine**  
 Material: Sludge from parc-cleaning machine(after solvent distillation)

Analysis Method: Gas Chromatograph Analyzing

Results Analyzed by Shimazu Techno Research  
 Reported on 16 March 2001

	Unit	Quantity
PCDDs	ng/liter	110
PCDFs	ng/liter	16
PCDDs+PCDFs	ng/liter	130
PCDDs/DFs TEQ	pg-TEQ/l	400
Coplaner PCBs TEQ	pg-TEQ/l	150
DIOXINS TEQ	pg-TEQ/l	550

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)		
Dioxins	Dioxin	2,3,7,8-TeCDD	1	28		
		1,2,3,7,8-PeCDD	1	45		
		1,2,3,4,7,8-HxCDD	<0.05	0.1	0	
		1,2,3,6,7,8-HxCDD	0.25	0.1	25	
		1,2,3,7,8,9-HxCDD	0.13	0.1	13	
		1,2,3,4,6,7,8-HpCDD	7.7	0.01	77	
		OCDD	82	0.0001	8.2	
	PCDDs TEQ		—	—	196.2	
	Isomer	Dibenzofuran	2,3,7,8-TeCDF	0.16	0.1	16
			1,2,3,7,8-PeCDF	0.20	0.05	10
			2,3,4,7,8-PeCDF	0.18	0.5	90
			1,2,3,4,7,8-HxCDF	0.25	0.1	25
			1,2,3,6,7,8-HxCDF	0.16	0.1	16
			1,2,3,7,8,9-HxCDF	<0.05	0.1	0
			2,3,4,6,7,8-HxCDF	0.33	0.1	33
			1,2,3,4,6,7,8-HpCDF	1.4	0.01	14
			1,2,3,4,7,8,9-HpCDF	0.16	0.01	1.6
			OCDF	3.0	0.0001	0.3
PCDFs TEQ		—	—	205.90		
Total TEQ		—	—	400		

Notes

1. Actual value of concentration: PCDD/DF concentration ng/l
2. Sample quantity: 10 ml
3. Toxicity Equivalency Quantity: 2,3,7,8TeCDD (pg-TEQ/l)
4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
5. Detection limits:  
 4~5 Chloro-DDs/Dfs: 0.02 ng/l  
 6~7 Chloro-DDs/Dfs: 0.05 ng/l  
 8 Chloro-DDs/Dfs: 0.1 ng/l

Congener		Actual value of concentration (ng/l)
Dioxin	TeCDDs	5.0
	PeCDDs	1.7
	HxCDDs	2.5
	HpCDDs	14
	OCDD	82
Total PCDDs		110
Dibenzofuran	TeCDFs	4.7
	PeCDFs	3.3
	HxCDF	2.1
	HpCDF	2.6
	OCDF	3.0
Total PCDFs		16
Total (PCDDs+PCDFs)		130

Analysis of Coplanar PCBs in  
 Sludge from parc-based dry cleaning machine  
 Material: Sludge residues from parc-based dry-cleaning machine

Analyzed by Shimazu Techno Research  
 Reported on 16 March, 2001

## Result

Constituent		Actual value of concentration (ng/l)	TEF (WHO)	TEQ (pg-TEQ/l)
Coplanar PCBs	3,3',4,4'-TeCB (#77)	15	0.0001	1.5
	3,4,4',5-TeCB (#81)	0.68	0.0001	0.068
	3,3',4,4',5-PeCB (#126)	1.0	0.1	100
	3,3',4,4',5,5'-HxCB (#169)	<0.2	0.01	0
	2,3,3',4,4'-PeCB (#105)	71	0.0001	7.1
	2,3,4,4',5-PeCB (#114)	5.7	0.0005	2.85
	2,3',4,4',5-PeCB (#118)	190	0.0001	19
	2',3,4,4',5-PeCB (#123)	7.8	0.0001	0.78
	2,3,3',4,4',5-HxCB (#156)	23	0.0005	11.5
	2,3,3',4,4',5'-HxCB (#157)	5.1	0.0005	2.55
	2,3',4,4',5,5'-HxCB (#167)	8.4	0.00001	0.084
	2,3,3',4,4',5,5'-HpCB (#189)	1.8	0.0001	0.18
	Total Coplanar PCBs		330	—

## Notes

1. Actual value of concentration: Coplanar PCBs (ng/l)
2. Sample quantity: 10 ml
3. Toxicity Equivalency Quantity: 2,3,7,8-TeCDD TEQ (pg-TEQ/liter)
4. Toxicity Equivalency Factor: WHO-TEF (WHO/IPCS, 1998)
5. Detection limits: 0.2ng/l