Greenpeace Research Laboratories Analytical Results 2015-07

Metals and metalloids concentrations in surface wipes collected in the vicinity of chemical explosions in Tianjin, China, 2015

October 2015

1. Introduction

Three samples of surface wipes containing surface dusts, together with three identical unused wipes, were received at the Greenpeace Research Laboratories from Greenpeace East Asia (Beijing) on 16th September 2015. According to documentation supplied, the samples were collected between 28th August 2015 and 29th August 2015, from the vicinity of an explosion and fire in Tianjin, China. Each of the wipe samples collected surface dusts from an area of 30cm by 30cm.

The samples were analysed quantitatively for the presence of a range of metals/metalloids within each wipe.

Sample code	type	date	Distance from site (km)	location
CN15012	sample	28.08.15	2.8	School; wooden gym stage floor (cleaned and waxed two days after the explosion)
CN15013	sample	28.08.15	3.6	Window sill of a 12th floor flat
CN15014	sample	29.08.15	60	Control site; living room cabinet, 1st floor, Zhonghao Century Garden
CN15015	blank	-	-	-
CN15016	blank	-	-	-
CN15017	blank	-	-	-

Table 1: details of samples received at the Greenpeace Research Laboratories

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2. Materials and methods

For each sample, a wipe was used to collect surface dust from an area of 30 cm by 30 cm. Following collection, the wipe was placed in a pre-cleaned 100ml glass bottle which was immediately sealed.

The masses of each metal/metalloid in the each of the wipe samples were determined by ICP mass spectrometry (ICP-MS) following acid digestion. Quality control checks included analysis of a blank sample, the analysis of three blank wipe samples, and an indoor dust certified reference material.

More detailed descriptions of the sample preparation and analytical procedures are presented in the Appendix 1.

3. Results and Discussion

The results for the samples are reported as mass in each dust sample (Table 2) and as mass by unit area (m^2) of the surface from which dust was collected (Table 3). In both cases, the data presented are for the dust collected on the wipe, with the value for each metal calculated by subtraction of the average for the blank wipes from the value for the dust loaded wipe sample.

	Sample	CN15012	CN15013	CN15014	CN15015	CN15016	CN15017
Metal/metalloid (μg in dust)	**Distance from site (Km)**	2.8	3.6	60	Blank	Blank	Blank
Arsenic		2.00	0.74	1.47	<0.08	<0.08	<0.08
Barium		84.7	35.2	38.4	0.27	0.33	0.29
Beryllium		0.091	0.034	0.066	<0.006	<0.006	<0.006
Cadmium		0.3	0.2	0.3	<0.04	<0.04	<0.04
Chromium		27.5	7.5	7.56	0.105	0.114	0.107
Cobalt		4	1.5	1.4	<0.02	<0.02	<0.02
Copper		34	48.6	12.7	0.44	0.47	0.22
Iron		5800	2110	1900	8.2	7.3	7.1
Lead		30.6	38.6	12.7	0.06	<0.04	<0.04
Manganese		305	71.7	40.2	0.15	0.14	0.13
Mercury		<0.08	<0.08	<0.08	<0.008	<0.008	<0.008
Nickel		51.2	19.3	3.68	0.06	0.06	0.25
Selenium		0.3	0.1	0.3	<0.1	<0.1	<0.1
Vanadium		6.79	2.24	3.55	<0.04	<0.04	<0.04
Zinc		158	232	86	<4	<4	<4

Table 2. Mass of metals in the collected dust (μg), following subtraction of blank wipe concentrations

Metal/metalloid (μg/m²)	Sample Distance from site (Km)	CN15012 2.8	CN15013 3.6	CN15014 60	CN15015 Blank	CN15016 Blank	CN15017 Blank
Arsenic		22.2	8.2	16.3	<0.9	<0.9	<0.9
Barium		941	391	427	3	3.7	3.2
Beryllium		1.01	0.38	0.73	<0.07	<0.07	<0.07
Cadmium		3	2	3	<0.4	<0.4	<0.4
Chromium		306	83.3	84	1.17	1.27	1.19
Cobalt		44	17	16	<0.2	<0.2	<0.2
Copper		378	540	141	4.9	5.2	2.4
Iron		64400	23400	21100	91	81	79
Lead		340	429	141	0.7	<0.4	<0.4
Manganese		3390	797	447	1.7	1.6	1.4
Mercury		<0.9	<0.9	<0.9	<0.09	<0.09	<0.09
Nickel		569	214	40.9	0.7	0.7	2.8
Selenium		3	1	3	<1	<1	<1
Vanadium		75.4	24.9	39.4	<0.4	<0.4	<0.4
Zinc		1760	2580	960	<40	<40	<40

Table 3. Concentration of metals in the collected dust by unit area of surface from which dust was collected (μg/m²), following subtraction of blank wipe concentrations

For more information please contact: Kevin Brigden or David Santillo

Disclaimer: Description of samples and sampling sites are purely according to information supplied with the samples by Greenpeace East Asia (Beijing).

Appendix 1: Details of methodologies

For each sample, the whole wipe was transferred into a digestion vessel, to which was added 12 ml concentrated nitric acid. The samples were digested, firstly overnight at room temperature, then using microwave-assisted digestion with a CEM MARS Xpress system in a two stage process; In the first stage with a temperature ramp to 120°C over 20 minutes followed by holding at 120°C for a further 20 minutes. Following cooling to room temperature, excess pressure in the vessel was released and then the vessel resealed. The second stage involved a temperature ramp to 180°C over 20 minutes followed by holding at 180°C for a further 20 minutes. Following cooling to room temperature the digest was filtered and made up to 50 ml with deionised water. Each sample was subsequently diluted by 1:4 using deionised water to give a final volume of 200ml. In all cases, no solid material from the wipe remained after the 2 stage digestion process.

Analysis

Prepared sample digests were analysed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) using an Agilent 7900 Spectrometer utilizing a collision cell with helium as the collision gas to minimize polyatomic interferences. Multi-element standards, matrix matched to the samples, were used for instrument calibration (at concentrations of 1, 10, 100 and 1000 μg/l respectively, other than for mercury; 0.5, 5 and 50 μg/l respectively). Analysis employed in-line addition of an internal standard mix at 1000 μg/l (scandium, germanium, yttrium, indium and terbium).

Quality control

The digestion procedure employed a digested blank sample (12 ml nitric acid) with the batch of samples. To check the method efficiency, a certified reference material (CRM) sample was prepared in an identical manner; 2584, Trace Elements in Indoor Dust, certified by the National Institute of Standards and Technology (NIST).

Calibration of the ICP-MS was validated by the use of quality control standards at 800 μg/l and 80 μg/l (40 μg/l and 4 μg/l for mercury) prepared in an identical manner but from different reagent stocks to the instrument calibration standards.