Case study: PCDDs/PCDFs, PCBs and other organic contaminants in soil and ash samples from the scene of a fire at a hazardous waste dumpsite in Poland

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Introduction

A series of a large scale fires occurred at the hazardous waste dumpsite located in Jakubów, Radwanice, Poland, during July-August 2018. About two acres of land and forest surrounding the dumpsite were affected directly by the fire and by substances stored on the site. Polish environmental protection services confirmed that the dumpsite was being used to store a wide variety of wastes including paints and varnishes, printing toner, adhesives and sealants, sludges of printing inks, emulsions and solutions from metal-working, technical oils (engine, gear, and lubricating), packaging of hazardous substances, sorbents and plastics.

In September 2018, we investigated contaminants present in samples of soils, ashes and other solid materials, within the areas of the site affected by fire, including analysis of a subset of the samples for PCDDs/PCDFs and PCBs.

Materials and Methods

Nine samples of soil and ash were received for analysis at Greenpeace Research Laboratories. Semiquantitative screening compounds (sVOCs) were isolated from samples using Accelerated Solvent Extraction (ASE) (pentafluoropropionic acid at 150°C, 100 bar). After separation of extracted compounds between organic (e.g. pentane) and aqueous phases, the latter was further extracted into methanol using Solid Phase Extraction (SPE) technique. Extracted compounds were subsequently identified as far as possible using gas chromatography/mass spectrometry (GC/MS) in SCAN mode and liquid chromatography-Orbitrap mass-spectrometry (LC-Orbitrap-MS).

In addition, two of the samples were analysed for chlorinated dioxins/furans and PCBs by Marchwood Scientific Services, Southampton, UK.

Results and Discussion

Organic compounds that could be reliably identified through GC/MS analysis were represented by a diverse range of toxic chemicals (see Table above), with chlorinated compounds being the most common (to a maximum of 89 individual chlorinated organic compounds in sample PL18004, see chromatogram above). It is important to note that organic chemicals detected in samples in this study could have arisen not only from the waste stocks localised at this dump site, but also as a result of thermal degradation and incomplete combustion of such wastes during the fires.

LC-MS targeted and non-targeted screening identified additional substances across the nine samples (see a sample chromatogram above). In total, 102 different sVOCs were identified, with chlorinated compounds being the most common. These included polyfluorinated surfactants, 5 phthalate esters, benzotriazole and its derivatives, and 4 pesticides (Imidacloprid, Thiamethoxam, N,N-Dimethyl-N’-(4-methylphenyl)sulfamide, and DEET).

Other compounds

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>PL18001</th>
<th>PL18002</th>
<th>PL18003</th>
<th>PL18004</th>
<th>PL18005</th>
<th>PL18006</th>
<th>PL18007</th>
<th>PL18008</th>
<th>PL18009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration of PCDDs/PCDFs and PCBs, ppt of dry weight</td>
<td>113193</td>
<td>199063</td>
<td>159</td>
<td>308.8</td>
<td>120</td>
<td>251</td>
<td>120</td>
<td>341</td>
<td>709</td>
</tr>
<tr>
<td>Concentration of PCDDs/PCDFs and PCBs, ppt WHO TEQ</td>
<td>4</td>
<td>8</td>
<td>12.00</td>
<td>26.00</td>
<td>20.00</td>
<td>28.00</td>
<td>23.00</td>
<td>40.00</td>
<td>25.00</td>
</tr>
</tbody>
</table>

Conclusion

The current study has shown that soils and ashes collected in September 2018 from areas of a chemical dumpsite located in Jakubów, Radwanice, Poland, following severe large-scale fires, are highly contaminated by a diverse range of toxic organic contaminants, including persistent organic pollutants, either as a result of the storage of such chemicals on site as subsequent incomplete combustion of such chemicals during the fires. This site must be subject to some urgent and more detailed investigations and analytical work to determine the precise magnitude of and severity of chemical contamination in the soils and residues on site, as well as looking for the potential spread of contaminated PCDDs/PCDFs and PCBs.

Steps must also be taken to contain hazardous residues until they can be properly dealt with, to compile thorough documentation on wastes stored at the site prior to the fire, and to evaluate the suitability of such sites for storage or disposal of hazardous wastes.