THE CASE OF SPOLANA NERATOVICE – MONITORING THE EFFECTS OF SOURCE AND THE IMPACTS OF SITE REMEDIATION

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Abstract

The aims of this study was focused on and the using of this simple tool for the study and evaluation of real environmental effects of industrial source where the direct effects of the chemical technology is combined with the old environmental burden and ongoing remediation of this site. As a model case was selected Spolana Neratovice in the Czech Republic, where remediation of a part the factory area was started in 2005. The POPs in the surroundings of remediation site, where BCD non-combustion technology is deployed, are evaluated using by polyurethane passive samplers.

Introduction

The Spolana chemical site is a large chemical complex based on chlorine chemistry in the Czech Republic. This chemical factory is situated approximately 25 km north of Prague at the Elbe River. During the 1960s, the production unit called PCP (pentachlorophenol) produced insecticides and herbicides. It also produced in the period of 1965-68 the chlorine herbicide 2,4,5-T and chlorinated phenols. A part of 2,4,5-T was even exported to the USA and was applied as the component of "Agent Orange" within the Vietnam war. During the production due to breaking technological conditions, a huge amount of dioxins (in particular, the most toxic 2,3,7,8-TCDD) was formed and former factory buildings containing products, intermediates, installations, etc. belong currently to the most dioxin-contaminated sites on the globe. Moreover, soil in the factory is highly contaminated with organochlorine pesticides produced there, as well. The 2,4,5-T and chlorophenols production was stopped in 1968 when about 80 cases of occupational diseases developed (55 workers were hospitalized mainly with severe chloracne manifestations and porphyria. [1]

Chemical analysis proved an extremely a high degree of the contamination of waste products stored in production buildings, building walls and floors, air, soil and ground water. The highest concentration of dioxins (over 24 ppm of 2378-TCDD) was measured in the residues of chemical substances. It is assumed that there are tons of that waste stored in the buildings. The immediate toxic impact of dioxins in the air of the contaminated buildings was proven by a rabbit experiment in the 1970s. Rabbits in cages were located in the buildings to be exposed only to dioxin-contaminated air. The rabbits started to died on the 7th day of the experiment. Autopsy showed a significant damage of the liver, lung and kidney.

A lot of risk analyses and studies, which were performed after 1989, have confirmed the extremely high level of contamination and classified this area as old environmental burden.

The Spolana factory including some of the dioxin-contaminated buildings was flooded in 2002 and one can expect dioxin release into agricultural fields and Elbe River and its sediment. An extend of environmental contamination was mapped in detail without delay as well as to start with the definitive solution of dioxin-contaminated buildings and soil in their vicinity in Spolana Neratovice. [1]

The remediation of site

The decontamination and remediation of site started after very complicated procedure at 2005 with using of base catalysed dechlorination non-combustion technology. These processes consist from the decontamination and demolition of 2 buildings (9 000 tones of wastes), excavation and treatment of surrounding soils of these two buildings (23 000 tones), treatment of chemicals stored closed to main building (160 tones), dissemble and treatment of the process unit (3 000 tones of metals) and backfill and final restoration.

The main requirements for the process of decontamination and remediation were the treatment of contaminated waste in site, final destruction of toxic waste, use of non incineration technology, use of proven technology, protection of environment, safety and health for population. All these steps are monitored by the sampling and analytical methods which respect the international standard and procedures.

The BCD technology was selected by the Czech Ministry of Environment for the deployment in this case. From the emission point of view, two main aspects of the deployment of BCD technology are follows. Firstly, the main bulk work done by the BCD plant is the treatment of cyclone dust and filter cake from the ITD off gas filtration, both of which are mainly mineral dust from the treated soil and represent the ultimate destruction of the contaminants stripped from the soil by thermal desorption. Secondly, the products of a BCD reaction are process oil and the solid residue from the reaction. The oil is recycled in its entirety and as such it does not strive for complete destruction. The solid residue from the BCD centrifuges, are submitted to a further thermal treatment to recover the residual oil in the centrifuge cake. In this process too any residual contaminants are stripped from the sludge.

Company does not strive in this operation for complete destruction, but a significant reduction so that they are sure there is no accumulation. It is a possible to increase the severity of the reaction conditions. The reason they do not do this is to get maximum recycling of process oil, since more severe conditions lead to a faster reduction of the flash point of the oil. At low flash point company disposes of the oil, dioxin free, off-site and destroys usually by combustion. Only recent chemical wastes are also treating, since the low contaminant values in the mineral cake and dust do not demonstrate. The chemicals are treated on an irregular basis, as they are recovered from the different phases and area of the buildings decontamination.

The study of effects of source and the impacts of site remediation

Air monitoring for POPs has conventionally been conducted at a very limited number of sites using ‘active’ or high volume air samplers. These are expensive, require electricity and a trained operator. Regulatory and other developments mean there will be a pressing need to obtain more POPs data for air, in a much more routine and cost-effective way, to ensure compliance. This provides the incentive to develop new and cheaper passive air sampler (PAS) options. Passive air sampling as a cheap and versatile alternative to the conventional high volume air sampling is one of the methods currently considered as suitable for the purpose of such monitoring programmes. [2, 3]

National Environment Agencies increasingly need to identify ‘less obvious’ diffusive sources of POPs, as they seek to further reduce emissions, now that more obvious primary sources have been/are becoming better controlled. PAS can be used to conduct ‘screening/reconnaissance surveys’, and are sensitive to site-/source-specific compound fingerprinting. They can therefore be used to help identify sources, and be used to help direct/target cost-effective active air sampling campaigns. [4, 5] Feasibility of obtaining such data on seasonal variations in ambient air concentrations of persistent organic pollutants on the local scale using the passive air samplers, was studied very intensively. [4]

RECETOX studies confirmed that they are sensitive enough to mirror even small-scale differences, which makes them capable of monitoring of spatial, seasonal and temporal variations. Passive samplers can be used for point sources evaluation in the scale of several square kilometers or even less - from the local plants to diffusive emissions from transportations or household incinerators - as well as for evaluation of diffusive emissions from secondary sources. While not being sensitive to short time accidental releases passive air samplers are suitable for measurements of long-term average concentrations at various levels. [4]

Very good capability of passive air samplers to reflect temporal and spatial fluctuation in concentrations of persistent organic pollutants in the ambient air was confirmed by our studies. While this sensitivity makes them suitable for the monitoring of local sources, it also needs to be considered when designing large scale monitoring networks.

Results and Discussion

Up to ten parallel PUF passive air samplers were deployed in the area and vicinity of the Spolana Neratovice since the 2004. The polyurethane filters were exposed for 28 days. The samples collected on each site were analyzed for PAHs, PCBs, OCPs. [4] The aims of this study was focused on and the using of this simple tool for the study and evaluation of real environmental effects of industrial source where the direct effects of the chemical technology is combined with the old environmental burden and ongoing remediation of this site. The first results were published recently. [4]

Very good capability of passive air samplers to reflect temporal and spatial fluctuation in concentrations of persistent organic pollutants in the ambient air was confirmed in this study. While this sensitivity makes them suitable for the monitoring of local sources, it also needs to be considered when designing large scale monitoring networks.

In the case of the Spolana Neratovice, a point source of secondary air pollution in mainly the volatilization from contaminated soils and contaminated buildings. Fig. 1 shows the levels of HCHs in the area and in the vicinity of the factory including the spatial distribution of HCHs around the factory and comparison with some other sites. These sites are a part of the Czech national POPs ambient air monitoring which is operated by the RECETOX. The same distribution was found in the case of DDTs.

This study suggests the passive samplers are sensitive enough to mirror even small-scale differences, which makes them capable of monitoring spatial, seasonal and temporal variations. Passive samplers can be used for point source evaluation in the scale of several square kilometres or even less from the local plants to diffusive emissions from transportations or household incinerators as well as for evaluation of diffusive emissions from secondary sources.

The deployment of these samplers also clearly shows the potential impacts of the industrial source on the vicinity nearby this source. The differences between the levels of HCHs in the area of the factory and the levels in the nearby surroundings are high and confirm that the impacts of the industrial sources could not be as dramatic as is a usually described.

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Figure 1: The comparison of the HCHs levels in the area of Spolana Neratovice with the levels nearby factory and some other site in the Czech Republic (x-axys – months of sampling; y-axys – the level of HCHs [ng/filter])