The 13th International HCH and Pesticides Forum

The 13th International HCH and Pesticides Forum created a platform for discussing the national and regional strategies, action plans and financial resources for elimination of obsolete pesticides with a special focus on the need for accelerated action. Valuable scientific results and best practices were exchanged; and the progress of EECCA region was showcased in special sessions, emphasizing the importance of Government determination and focus. On November 3-6th the 13th Forum on HCH and Pesticides Forum was held in Zaragoza, Spain with participation of more than 230 experts from more than 35 countries.

The International HCH and Pesticides Forum in Zaragoza was sponsored by:

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SURVEY AND RISK ASSESSMENT EVALUATION OF AN AREA CONTAMINATED BY DIOXINS IN VIETNAM, PHONG MY COMMUNE AND A SO SITE

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Summary

Between 2006 and 2009 a detailed survey of PCDD/PCDF contamination in Phong My Commune has been carried out. Based on the results a human health risk assessment was elaborated and later second risk assessment has been done for A So site a former US military air base in Dong Son Commune. Both Communes are located in Thua Thien Hue province in central Vietnam which was heavily affected by the herbicide spraying during the war between 60s and in the beginning of 70s of the last century. As a consequence of herbicides spraying a significant amount of PCDD/PCDF has been released into the environment and is still present in the basic environment matrices (soil, sediment) and has already entered various food chains. Local inhabitants have limited information about the potential threat they are faced with and are continuously exposed to the increased concentrations of PCDD/PCDF mainly in the locally produced foodstuff.

Based on the findings of both risk assessments, dietary exposure is the most risky one and represents carcinogenic and non-carcinogenic risk at both sites. Dermal contact with contaminated soil shows increased carcinogenic and non-carcinogenic risks too at A So site. Comparison of the two sites shows some important differences in the level of risks and contamination of the environment. Higher contamination and risks were identified at the A So site, where the herbicides were stored and handled. However; Phong My Commune as a typical area affected by herbicide spraying shows significant and non-acceptable carcinogenic and non-carcinogenic risks arising from the dietary exposure.

Key words: PCCD/PCDF, Dioxins, Agent Orange, Vietnam, Risk Assessment

Introduction

The company DEKONTA, a.s. in cooperation with the unincorporated association DWW (Development Worldwide) implemented in the years of 2006-2009, in the framework of official development cooperation of the Czech Republic in the Social Republic of Vietnam a project "Rehabilitation of Thua Thien Hue province affected by dioxins". This project, which was implemented in Phong My Commune was focused on rehabilitation of an area, which was heavily affected by spraying of herbicide preparations during the Vietnam war in the end of 60s and in the beginning of 70s of the last century.

Spraying affected approximately 10% of the Southern and Middle Vietnam (approx. 1.2 million ha) A number of military defoliants were used for these purposes, most of all the substance called "Agent orange", the mixture of 2,4-Dichlorphenoxyacetic acid (2,4-D) and 2,4,5 Trichlorphenoxyacetic acid (2,4,5-T). The dioxins and particularly the most toxic congener TCDD (2,3,7,8-Tetrachlorodibenzo-p-dioxin) coming from the herbicidal mixture was identified as a contaminant in the given area. Unlike the substances 2,4-D and 2,4,5-T, which decompose relatively fast (during several months), dioxins are more stable and persist in the environment for dozens of years.

Phong My Commune

In the years of 2006 and 2007 a detailed survey of the selected area was carried out, in the framework of which 246 samples of various matrices including basic elements of environment (soils, sediments, surface and groundwater), food (meat, fat tissue, fruits and vegetables), as well as human blood. PCDD/PCDF, or as the case may be, 17 monitored congeners were analyzed in the collected samples. Apart from these substances, selected organochlorinated pesticides, PCB and heavy metals were also monitored.

Based upon average detected PCDD/PCDF concentrations in food components and results of questionnaires focused on lifestyle and eating habits of inhabitants in the Phong My commune, the average lifetime daily consumption was derived in WHO-TEQ units, ranging at the level of 5 to 7 times bigger in comparison to chronic exposure to these substances in industrial countries of the Western Europe, or North America. Based upon these data a risk analysis was elaborated, which was primarily focused on a dietary exposure, with regard to significant cumulative nature of dioxins.

In the framework of assessment of health risks resulting from the PCDD/PCDF exposures of inhabitants of the Phong My commune, several key exposure scenarios were identified, for which model calculations were made on the quantitative assessment of average and lifetime exposure doses of PCDD/PCDF and non carcinogenic health risks and risks of rise of cancer diseases resulting from them.

Matrices	Unit	Average concentration	Maximal concentration
Soil and sediments	[pg.kg^{-1}]	1678 ± 863	5100
Fish	[pg.kg^{-1}]	780 ± 1090	4800
Poultry	[pg.kg^{-1}]	640 ± 450	1700
Other meat	[pg.kg^{-1}]	57 ± 38	130
Vegetables (sweet potatoes, casawa)	[pg.kg^{-1}]	16 ± 2	18
Fruit (bananas, papaya)	[pg.kg^{-1}]	25 ± 5	30

Table 1: Average and maximal concentration of PCDD/PCDF in the mayor matrices, Phong My Commune

The dietary exposure was clearly the most risky scenario, most of all with regard to detected PCDD/PCDF concentrations in foodstuffs, especially in fish and poultry, which exceeded the maximum permissible limits determined for these substances by the European legislation by order of magnitude. The most risky foodstuffs from the perspective of PCDD/PCDF intake were especially fish, poultry and wild animals (snakes, frogs). Consumption of vegetables and fruits insufficiently cleaned/peeled from soil particles containing contaminants were also potentially risky. This concerns above all root vegetables, underground bulbs, low growing foliage vegetables, etc.).

Calculations were made according to standard equations for calculation of exposure and health risks, for which exposure parameters recommended by the US EPA and the Ministry of Environment of the Czech Republic were used. Further to this, results of a questionnaire were used for more detailed specification of exposure parameters, these questionnaires served as the most crucial source of information on a monitored population of inhabitants, including their dietary habits (e.g. a number of individual meals during the day and their composition).

The results of model calculations proved that prerequisites connected with this exposure scenario were justifiable and both the noncarcinogenic and carcinogenic risk coming from the dietary exposure was confirmed for all studied groups of inhabitants.

Ascertained values of the HI risk index in the case of noncarcinogenic risk in the monitored age categories ranged from 13.3 to 17.7 for the maximum PCDD/PCDF concentrations in foodstuffs, while the ILCR values (Incremental Lifetime Cancer Risk) in the monitored population groups ranged from $2.8.10^{-5}$ to $1.5.10^{-3}$,, which corresponds to the probability of development of cancer disease approximately in the range of 28 individuals out of the group of 1,000,000 of inhabitants to 15 individuals out of 10,000. The cumulative lifetime risk of development of cancer diseases in the monitored population corresponded to the value of $2,1.10^{-3}$ for the maximum ascertained PCDD/PCDF concentrations in foodstuffs.

Age category	Noncarcinogenic risk		Carcinogenic risk	
	CID [mg.kg^{-1}.den^{-1}]	HI	LCD [mg.kg^{-1}.den^{-1}]	ILCR
1 – 2	4,6E-09	**4,6**	6,5E-11	**9,8E-06**
2 - 6	5,1E-09	**5,1**	2,9E-10	**4,4E-05**
6 – 10	5,7E-09	**5,7**	3,3E-10	**4,9E-05**
10 – 18	6,1E-09	**6.1**	7,0E-10	**1,0E-04**
18 – 70	4,6E-09	**4.6**	3,4E-09	**5,1E-04**
Lifetime exposure	-	-	4,8E-09	**7,2E-04**

Table 2: Total exposure dose and health risks from dietary PCDD/PCDF exposure derived from average values of concentrations of PCDD/PCDF in foodstuffs, Phong My Commune

Age category	Noncarcinogenic risk		Carcinogenic risk	
	CID [mg.kg^{-1}.den^{-1}]	HI	LCD [mg.kg^{-1}.den^{-1}]	ILCR
1 – 2	1,3E-08	**13,3**	1,9E-10	**2,8E-05**
2 - 6	1,5E-08	**14,6**	8,4E-10	**1,3E-04**
6 – 10	1,7E-08	**16,6**	9,5E-10	**1,4E-04**
10 – 18	1,8E-08	**17,7**	2,0E-09	**3,0E-04**
18 – 70	1,3E-08	**13.3**	9,9E-09	**1,5E-03**
Lifetime exposure	-	-	1,4E-08	**2,1E-03**

Table 3: Total exposure dose and health risks from dietary PCDD/PCDF exposure derived from maximum values of concentrations of PCDD/PCDF in foodstuffs, Phong My Commune

A So site

A So site is a forms US military air base in Dong Son Commune where the herbicides and number of agents were stored and later pumped into the planes and sprayed. This site is reported as one of the contaminated sites with “Agent Orange” e.g. PCDD/PCDF. As a part of the project a risk assessment has been done for the site. No site survey was done; however previously the site has been investigated by Hatfield Consultants (1998).

Data presented in this report were used for the calculation of the identified human health risk scenarios (same as for Phong My Commune). Risk Assessment was primarily focused on a dietary exposure. A questionnaire campaign has been done the same way as in Phong My Commune to specify exposure parameters, especially their dietary habits.

According to the calculation done both dietary and dermal exposure represent a carcinogenic and non-carcinogenic risks to local inhabitants. Significant non-carcinogenic and carcinogenic risk for all population groups studied from dietary exposure, primarily from the consumption of fish and poultry has been proved. The lifetime risk of cancer development for the studied population corresponds to the maximum detected concentrations of PCDD / PCDF in food value of $9.25 \,.\, 10^{-3}$. Contact with contaminated soil, where transport through dermal contact and incidental ingestion of contaminated soil pose a significant exposure pathways of PCDD / PCDF in terms of non-carcinogenic and carcinogenic health risks. Especially for children non-carcinogenic risk and carcinogenic risk arise from lifetime exposure.

Matrix	Unit	Average concentration	Maximal concentration
Soil	[pg.kg^{-1}]	44610	897000
Sediments	[pg.kg^{-1}]	2520	17600
Fish	[pg.kg^{-1}]	7610	51300
Poultry	[pg.kg^{-1}]	4710	82000
Beef	[pg.kg^{-1}]	280	1800
Eggs	[pg.kg^{-1}]	2400	12900
Vegetables (sweat potatoes, cassava)	[pg.kg^{-1}]	16	18
Fruits (bananas, papaya)	[pg.kg^{-1}]	25	30
Rice	[pg.kg^{-1}]	150	-

Table 4: Average and maximal concentration of PCDD/PCDF in the mayor matrices, A So site (Dong Son Commune)

Age category	Noncarcinogenic risk		Carcinogenic risk	
	CID [mg.kg^{-1}.den^{-1}]	HI	LCD [mg.kg^{-1}.den^{-1}]	ILCR
1 – 2	3,68E-08	**36,8**	5,26E-10	**7,90E-05**
2 - 6	2,46E-08	**24,5**	1,40E-09	**2,11E-04**
6 – 10	1,84E-08	**18,4**	1,05E-09	**1,58E-04**
10 – 18	1,23E-08	**12,2**	1,40E-09	**2,11E-04**
18 – 70	6,72E-09	**6,7**	4,99E-09	**7,48E-04**
Lifetime exposure	-	-	9,38E-09	**1,41E-03**

Table 5: Total exposure dose and health risks from dietary PCDD/PCDF exposure derived from average values of concentrations of PCDD/PCDF in foodstuffs, A So site

Age category	Noncarcinogenic risk		Carcinogenic risk	
	CID [mg.kg^{-1}.den^{-1}]	HI	LCD [mg.kg^{-1}.den^{-1}]	ILCR
1 – 2	2,43E-07	**243,3**	3,48E-09	**5,22E-04**
2 - 6	1,62E-07	**162,2**	9,27E-09	**1,39E-03**
6 – 10	1,22E-07	**121,6**	6,95E-09	**1,04E-03**
10 – 18	8,11E-08	**81,1**	9,27E-09	**1,39E-03**
18 – 70	4,40E-08	**44,0**	3,27E-08	**4,91E-03**
Lifetime exposure	-	-	**6,17E-08**	**9,25E-03**

Table 6: Total exposure dose and health risks from dietary PCDD/PCDF exposure derived from average values of concentrations of PCDD/PCDF in foodstuffs, A So site

Conclusion

As expected the level of contamination is much higher at the site where the herbicides with trace content of PCDD/PCDF were stored and handled (A So site) to sprayed areas (Phong My Commune). However; the level of contamination in sprayed areas is still increased and accumulated PCDD/PCDF in some of the animals exceed significantly the limit values for these chemicals in foodstuff according to the EU standards and WHO recommendation of daily intake. At both sites dietary expose scenario shows unacceptable carcenogenic and non-carcenogenic risks for local inhabitants.

Fairly low PCDD/PCDF concentration in soil and sediment in Phong My Commune doesn´t represent any human health risk, however; much higher concentration at A So site represents a serious carcenogenic and non-carcenogenic risk for dermal contact with contaminated soil/sediment.

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MOBILE THERMAL DESORPTION UNIT: Small scale contaminated sites solution

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Summary

Laboratory semi-pilot tests of thermal desorption proved its high efficiency in removal of different types of contaminants from different types of matrices. It can be also used for treatment of dangerous substances but for that detailed laboratory research is needed to prevent dangerous situations. Based on results of semi-pilot tests mobile thermal desorption pilot plant with indirect heating system was designed, constructed and tested. Modular system allows high variability especially for off-gas treatment system. Dimensions of the system, its capacity of 1 – 2 tons per hour and low demand of electric power make the unit useable also as a full scale system for remediation of smaller contaminated sites. Functional tests of pilot unit were carried out with pesticides contamination with promising results.

Keywords: thermal desorption, pesticides, mobile unit, POPs

Introduction

Besides of commercial activities DEKONTA is working on development of new innovative technologies. Through years several research projects focused on thermal desorption have been carried out. Based on results of the research projects a mobile unit of continuous indirectly heated thermal desorption technology was designed and constructed. This system has low demand of electrical power and can be powered by diesel generator set.

Thermal desorption is very effective and fast remediation technology which can be used for treatment of various types of contamination – petroleum hydrocarbons, PCBs, pesticides, mercury etc. It removes contaminants from soil, sludge or sediments by heating the input material in "hermal desorber" to evaporate the contaminants. Evaporation changes the contaminants into vapors (gases) and separates them from the solid material. The final temperatures vary from relatively low temperatures up to 600 °C. Thermal desorption itself doesn't deal with vaporized contaminants so additional technology for off-gas treatment is needed - mostly the incineration or condensation. Incineration destroys evaporated substances, condensation enables to concentrate contaminants and reuse them, recycle them or just radically cut down the amount of toxic waste. In case of chlorinated substances as pesticides or PCBs dechlorination methods as base catalysed dechlorination (BCD) or gas phase catalytic reduction (GPRC) can be used as part of whole technological system.

Research and Development

Thermal desorption research and testing in DEKONTA is mainly focused on system upgrade and lowering of initial and operational costs. Different types of samples are tested to find out if the thermal desorption would be suitable or not. Laboratory or semi-pilot testing can bring valuable information about material behavior, e.g. its tendency for lumping or sintering, and about off-gas quality which can be very important in case of safety.

Set no.	Incoming concentration ENP (mg.kg^{-1})	Pressure (mbar)	Final temperature (°C)	Efficiency (% wt.)	Condensate pH	H_2S (ppm)	SO_2 (ppm)	CO (ppm)
1	166 500	150	355	75	3.2	> 13 000	2 100	5 000
2	203 800	150	352	79	1.6	> 13 000	3 000	2 600
3	102 300	150	356	93	2.7	> 13 000	150	2 500
4	91 400	50	356	98	2.5	> 13 000	3 000	4 000
5	144 700	50	356	99	1.8	> 13 000	500	2 700
6	59 300	50	357	99	3.3	> 13 000	3 100	5 000
7	155 100	50	360	99	3.0	> 13 000	3 000	4 500
8	176 500	800	355	15	2.1	> 13 000	100	1 600

Tab. 1: Semi-pilot desorption trials of acid oil sludge.

Main research testing is carried out in semi-pilot laboratory unit which can be mobilized if needed. Besides standard samples dangerous materials are also tested, e.g. highly flammable samples, acid sludge from petro chemistry with risk of high concentrations of methane and hydrogen in off-gas, NORM containing samples when tests must be carried out on site, PCDD/F containing samples when tests should be carried out on site. Examples of obtained data are shown in tables below - Tab. 1 shows results obtain from testing of acid oil sludge, Tab. 2 show data from testing of pesticides containing soil.

Methane and hydrogen concentrations were held under 2 % vol. by continuous dosing of nitrogen so they are not mentioned in the table.

Set no.	**Incoming concentration** S **OCP** (mg.kg^{-1})	**Pressure** (mbar)	**Final temperature** (°C)	**Efficiency** (% wt.)
1	180	50	350	97
2	365	50	352	98
3	230	50	350	99
4	80	50	351	> 98
5	415	50	353	98

Tab. 2: Semi-pilot desorption trials of pesticides containing rubble.

Mobile unit description

Mobile thermal desorption unit which was constructed in DEKONTA was designed as modular system. This makes the transport and the use of the unit easier because the system is now more variable – condensation module or catalytic oxidation module can be used for off-gas treatment or if needed they can be connect in series. With this the unit can be used for treatment of various types of contaminants without any significant changes in the whole system.

Pilot plant consists of these main parts:

- rotary kiln (Fig. 1)
- off-gas pretreatment (Fig. 2)
- supply unit 1 – nitrogen supply, water supply
- supply unit 2 – control room.

Rotary kiln can continuously process 1 – 2 tons of input material per hour. Off-gas is dusted off by cyclone and fine filter. If needed, off-gas can be cool down by quenching system. Endpoint of this technology can vary according to contaminant type and aim of the pilot test as mentioned above. System can be inertized by nitrogen from one of supply units.

Unit was designed as pilot testing unit and its size is determined by demand of mobility. Still even as pilot scale unit it can be effectively used as smaller sites where excavating and transport of thousands of tons wouldn't be possible. Contaminants can be handled (destroyed or concentrated) on site.

Rotary kiln has these parameters:

- capacity: 1 – 2 tons per hour
- diameter: 1.2 m, length: 8 m
- rotation: 0 – 10 rpm
- indirect heating system
- temperature: 400 -500 °C

Fig. 1 Rotary kiln of continuous thermal desorption pilot unit.

Fig. 2 Off-gas pre-treatment module of continuous thermal desorption pilot unit.

Functional tests prove sufficient efficiency for treatment of different types of matrices contaminated by various types of contaminants. Results from pesticides contamination are summarized in Tab 3. As end-pipe technology condensation was used. Condensate was then treated by incineration. Depending of input properties as moisture content and contamination type pilot unit can be effective solution for some contaminated sites. It can't be used as full scale application for oil sludge lagoons remediation but for some local mercury, PCB or pesticide contamination pilot unit can be very promising – it offers relatively fast and very efficient solution with low initial costs because the unit can be used repeatedly. Operational costs depend on many factors and are specific for each site – mainly on fuel price and its availability, transportation distance and costs and availability of competent subsuppliers.

Set no.	Contaminant	Incoming concentration ($mg.kg^{-1}$)	Efficiency (% wt.)
1	DDT	164	> 95
2	Σ HCH	360	> 98.5
3	HCB	282	> 97
4	Σ OCP (HCH, DDT)	620	> 96

Tab. 3: Desorption pilot trials for pesticides contamination.

Conclusion

DEKONTA has experience with various types of contamination even with dangerous materials explosive or poisonous. Experiences gained through semi-pilot tests were turned into design and construction of mobile pilot thermal desorption unit with indirect heating system. Functional tests proved that unit can be effectively used for treatment of soil contaminated by chlorinated pesticides and other POPs.

REMOVING THE THREATS OF OBSOLETE PESTICIDES IN MOLDOVA

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Summary

Since 2011, DEKONTA has been responsible to dispose approximately 752 tonnes of obsolete pesticides (and pesticides contaminated materials) from eight different warehouses in Moldova (Gradinita, Ciobalaccia, Clocusna, Pascani,Singerei, Oliscani, Pelivan and Paupati). The obsolete pesticides have been repacked into appropriate containers and transported abroad for final disposal in incineration facilities in Europe.
In this paper, it will be presented the process of safeguarding illustrating the challenges encountered and lessons learned from the implemented projects in Moldova.

Keywords

Persistent Organic Pollutants (POPs), Moldova, Contaminated Sites, Safeguarding, Disposal

Introduction

For decades, pesticides have been used worldwide as a mean to increase agricultural output, fight pests and control tropical diseases. Now, obsolete, these chemicals are highly toxic, highly dangerous substances that pose a direct threat to human health. In Moldova, it is not uncommon for local residents to use the dismantled warehouses as building materials for their own sheds, houses and fences and even re-use obsolete pesticides for agriculture. It is clear that obsolete pesticides lying out in the open or in ruined stores can easily pollute the environment and are a risk to human health. For this reason, Moldovan authorities with the co-operation of international donors like FAO, NATO, the Czech Government and others, have implemented several projects with the aim to remove this threat from the environment.
Since 2011, DEKONTA has been co-operating with the Moldavian authorities and has removed 752 tonnes of obsolete pesticide waste from several pesticides storehouses in the country.

Project Activities

DEKONTA's approach for the implementation of the projects was divided in six main phases: health and safety plan elaboration, inventory, safeguarding, transportation, disposal and site hand-over.
A summarized description of the phases is illustrated in the flowchart below.

Project	Amount (t)	Summary
Remediation of environmental burdens caused by pesticides in Moldova	202	• Gradinita, Ciobalaccia and Clocusna storehouses • Disposed in Germany
Remediation of environmental burdens caused by pesticides in Moldova II	250	• Singerei, Oniscani, Pelivan, Papauti storehouses • Disposed in Germany
Safeguarding and Disposal of hazardous chemical waste in Moldova	300 (estimated)	• Pascani storehouse • Project is running • To be disposed in Poland

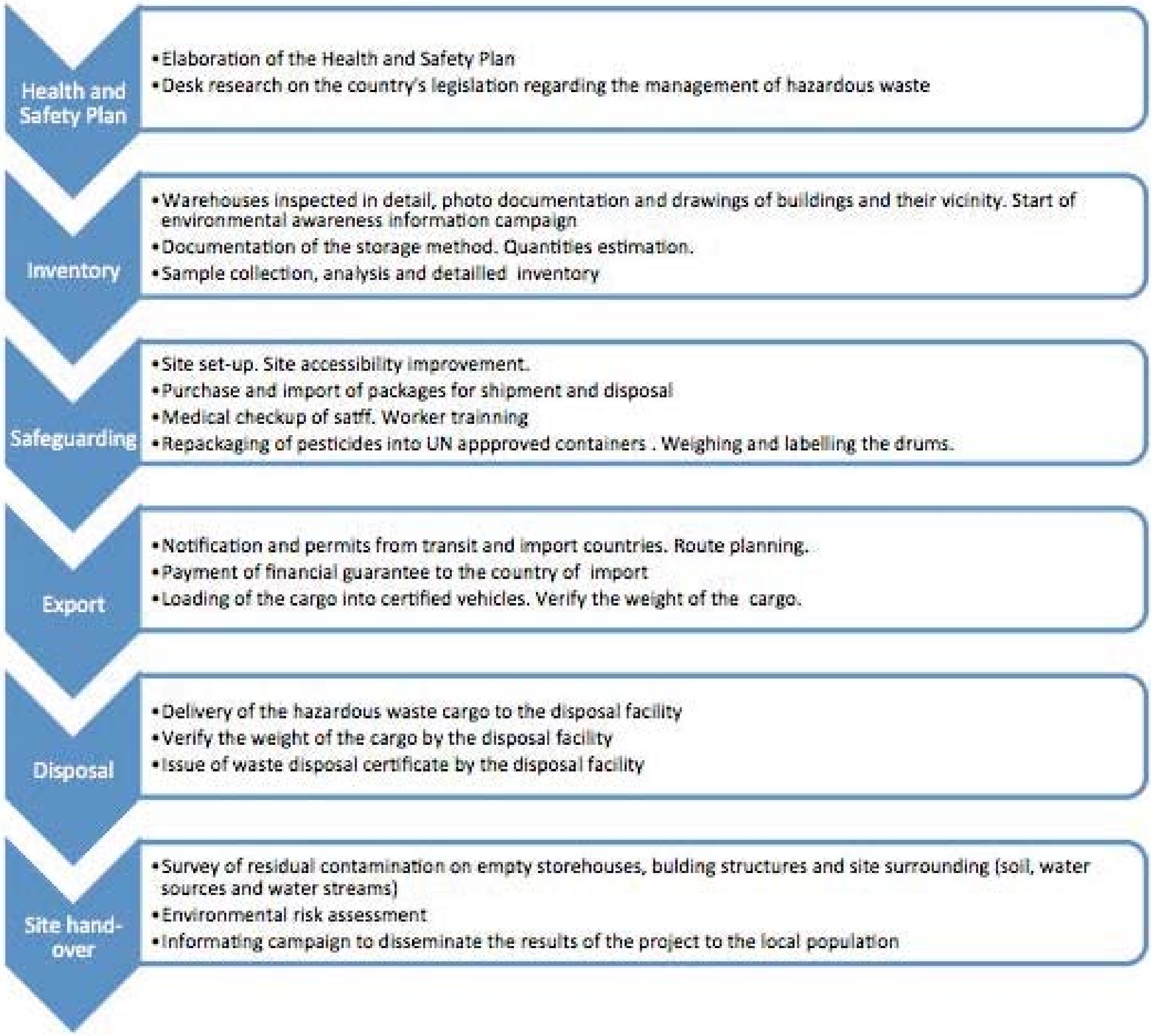

Figure 1 - Main phases of the projects

Pesticides Analysis

The results of qualitative analyses of pesticide samples and contaminated debris indicate presence of a wide spectrum of substances. The most represented pesticides in solid matrices include trifluralin, α, β, γ, δ – HCH, atrazine, carboxin, proparil (DCPA), diazinon, diphenamid, chlorobenzilat / chloropropylat / etoxinol, mefenoxam / metalaxyl, prometryn, propazine, simazine / triazine, sulfotep and triadimefon. Acetochlor, metochlor and atrazine, dimethachlor, propazine, simazine/triazine, terbuthylazine and 2,4,D were found in liquid matrices.

According to the origin and properties, the wastes were classified into three codes according to the European catalogue of wastes (Decision of the Commission 2000/532/EC) and at the same time the wastes were classified into three classes of hazardous character according to the European Agreement Concerning the International Carriage of Dangerous Goods by Road, the so-called ADR. The list of wastes and their classification is synoptically stated in the following table.

Waste code	Waste designation	characteristic of risk	UN number	Name	Class of hazardousness	Packing group
02 01 08	Agrochemical wastes containing dangerous substances	Toxicity	2588	pesticide, solid, toxic, unspecified	6.1	II
			2902	pesticide, liquid, toxic, unspecified	6.1	II
15 01 10	Containers containing the rest of dangerous substances or contaminated containers	Ecotoxicity	3077	environmentally hazardous substance, solid, unspecified.	9	III
19 13 01	Soil remediation solid wastes containing dangerous substances	Ecotoxicity	3077	environmentally hazardous substance, solid, unspecified.	9	III

Table 1 - List of wastes and their classification

Main Challenges and Lessons Learned

The implementation of these projects proved to be challenging. The main challenges encountered were:

- Lack of information regarding the pesticides stored in the storehouses. Storehouses in very poor conditions.
- Presence of strong oxidizers in the storehouses. Permanent risk of fire.
- Routes for the transportation of the pesticides should be planned considering the countries of transit/import. Some authorities are quicker to approve the movement of the waste through/to their territory.
- Maritime transportation companies may refuse to transport the waste in their vessels.

The lessons learned from these projects were:

- Insisting on maximal safe conditions during the work. The presence of unknown substances and poses a constant threat for the safety of the workers.
- Strict usage of PPE and safety equipment at the site. Due to the uncertainties regarding the identities of the chemicals present at the site, DEKONTA´s approach is to be one step ahead and use more PPE than the minimum required.
- Detailed analysis in the field, cross analysis (Raman spectography and RTG) for the identification of unknown chemicals.
- Elemental analysis of every drum for presence of limiting elements regarding incineration limits.
- Close cooperation with analytical laboratory - identification of all chemicals including the metabolites of pesticides, specific pesticides that were tested in Moldova during the Soviet times

Conclusion

The projects had very positive impact in the condition of the environment. The most benefitted group of these projects were the workers who move directly around the premises of pesticide warehouses, people who live in the surroundings of pesticide warehouses and the inhabitants of respective districts, who could be adversely affected by collected toxic substances, due to flue dust particles, improper handling, escape of liquids and etc.

As the direct benefits in the social sphere we can see the opportunity of an additional income of local inhabitants from auxiliary works associated with removal of wastes. These concerned miscellaneous small repairs (of warehouses, tools and equipment, vehicles), transport of material, manual help when loading and unloading goods, guarding of buildings, forklift operation, etc.

It is also necessary to mention that repackaging and disposal of the obsolete pesticides only removes the source of the contamination. It is common that residual contamination remains at the site (contaminated building structures, soil, water bodies and etc.) and it should also be addressed in future projects. As an example, soil samples (soil probes, surface soil) collected from the Oniscani site after the pesticides repackaging activities have been completed revealed concentrations above 50 mg/kg in soil, i.e. the level when materials are classified as hazardous waste according to the Moldavian regulations.

For these reasons, a comprehensive information campaign to raise awareness must be carried out until further projects addressing residual contamination are implemented. Situations were locals perceive the old storehouses, now empty of pesticides, as safe are not uncommon. In many cases building materials are at risk of being removed from the site and used as building material for houses or stables.

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