

# Disposal of pesticides as an alternative fuel in cement kiln: project outline

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## Introduction

Availability of various hazardous waste disposal technologies is an important element of effective waste management. To make them accessible requires a number of pilot projects that test out different technologies used worldwide in conditions characteristic of a particular country, using the type of waste available in that country. The pilot project currently being launched in Poland is the EU's PHARE sponsored project No. PL9608-01-02-03 "Pilot project of disposal of unwanted pesticides as alternative fuels used in cement kilns".

The estimated amount of pesticide waste (obsolete plant protection products) stored around the country totals 50-60 thousand tonnes. Around 9 thousand tonnes is stored in so-called tombs (underground wells), 20-25 thousand tonnes in old warehouses and another 20-25 thousand held by individual farmers. Waste from tombs cannot be used as an alternative fuel due to its composition, i.e. mixtures of various compounds, empty containers, contaminated soil, etc. Fuel can only contain identified pure chemicals that have been analysed and separated from their containers and whose properties are known. These requirements limit the possibility of using obsolete pesticides for this purpose to only those collected from warehouses and possibly later on those from individual farmers.

The project consists of eight major tasks:

**Task 1:** Selection and preparation of waste

**Task 2:** Waste transport

**Task 3:** Waste analyses

**Task 4:** Set-up of technological line

**Task 5:** Supervision of alternative fuel production process

**Task 6:** Analyses of outcome fuel

**Task 7:** Management of waste disposal process

**Task 8:** Sampling of the disposal process

Carrying out these tasks in close collaboration with Chemical Plant "Organika Azot" S.A. and Cement Works "Rejowiec" S.A. requires good coordination of technical and logistic activities. Production of 100 tonnes of alternative fuel at the Chemical Plant "Organika Azot" based on light heating oil mixed with liquid waste pesticides will take place at an installation that has been purchased under a sister PHARE project, especially for this project equipped with appropriate safety devices.

## Pesticide source

Warehouses that belong to different districts of the National Forest Preserve were selected for the project. The warehouses store large amounts of similar products, which is important for the logistics. Additionally, pesticides used in forest protection have a high heating value (high calorific value) and contain small amounts of biologically active ingredients - mainly from insecticides. These are advantageous features as for their usefulness in alternative fuel production.

The following waste selection criteria were adopted:

- type of waste,
- amount of waste at each site,
- distance from Sośnicowice,
- time of filing a request for disposal.

Table 1 lists the Regional Offices of National Forestry that were included into the program and turned in up their pesticide wastes. At each Regional Office the wastes were collected from 1 to 11 local units. Pesticides were collected from the total of 43 sites around the country.

**Table 1. List of Regional Offices from which wastes have been collected**

No.	National Forestry Regional Office	Number of divisions from which wastes have been collected
1.	RADOM	3
2.	KROSNO	3
3.	BIAŁYSTOK	5
4.	OLSZTYN	8
5.	WROCŁAW	8
6.	SZCZECIN	2 (waste collected from 11 locations)
7.	PIŁA	1 (waste collected from 6 locations)
8.	WARSZAWA	1
9.	POZNAŃ	1
10.	KATOWICE	11
<b>TOTAL</b>		<b>43</b>

Collection proceeded according to the rule that each unit turned in all of its pesticide stock, including containers. By this way the National Forestry Offices got rid of the obsolete pesticides problem.

Table 2 lists products used in three recipes developed for fuel production.

**Table 2. List of waste products to be used in alternative fuel production**

No.	Product name	Net weight (kg)	No.	Product name	Net weight (kg)
1.	Lasochron	11,375	12.	Ksylan + pesticide residues	156
2.	Kornikol	4,949	13.	Marshal 250 EC	115
3.	Liquid Thiodan 350 EC	2,181	14.	Metation E-50	93
4.	Mgławik 10	1,543	15.	Decis 2,5 EC	70
5.	Mgławik Extra	1,292	16.	Ikar 95 EC	63
6.	Liquid Owadofos 50 EC	1,014	17.	Reglone 200 SL	62
7.	Liquid Metox 30	847	18.	Dursban 480 EC	59
8.	Liquid Tritox 30	447	19.	Decis 0.5 ULV	53
9.	Decis 1,5 ULV Concentrate	429	20.	Ekotech 15 OF	47
10.	Sumi-alpha 050 EC	392	21.	Sumithion 500 EC	47
11.	Lebaycid 500 EC	340	22.	Lignopur forte	37
<b>TOTAL</b>					<b>25,611</b>

A total of 25,611 kg of pesticide waste was prepared for fuel production.

## Waste preparation

A special team who had received appropriate training and medical examinations carried out all activities related to the disposal of pesticides. It was necessary to use full anti-chemical personal protection.

Stores were emptied through repacking of their contents into drums after sorting. Sorting aimed at dividing the waste, whenever possible, into groups and types of preparations. Samples were taken during this process for identification purposes. Ways of securing the waste depended on its type. Information on security measures; drum weight and substance types were entered into a computer database. In case of repacking, old containers must have also been secured, weighed, labelled and disposed of like other waste. Repacking and securing of waste should take place inside a store or close to an exit from a building, in a special HDPE tub.

Waste will be secured in 60 l HDPE drums fitted with lids with anti-chemical inserts and clip bands (according to UN/Y PZH HZ/11470/98). Drums are additionally lined with polyethylene inserts, which are tightly fastened, lids carry IOR seals, drums are numbered and carry 6.1 class labels.

## Transport

A special truck transported drums with waste with a back container equipped for hazardous material transportation, according to ADR. Trucks comply with ADR rules that set requirements for international shipping of hazardous materials. Drivers have been appropriately trained and certified to transport loads of hazardous materials according to ADR.

## Waste storage

After sorting, analysing and grouping the substances according to recipes, closing, securing and labelling (labels according to ADR), the drums were stored at Organika-Azot S.A. Chemical Works, the company that is the producer of the fuel. Drums are stored on pallets in a hazardous materials warehouse (according to guidelines on safe storage), until they are mixed with light heating oil.

## Composition of alternative fuel

The project resulted in the development of three different alternative fuel recipes. According to an agreed formula, the total amount of waste within the output fuel must not exceed 10 %, measuring the biologically active ingredients. The components for each type of fuel were empirically selected for small-scale laboratory production. Components must be combined so as the outcome fuel has appropriate physical and chemical properties and stability. After satisfactory parameters are obtained, a large-scale laboratory batch is produced in the amount of about 20 kilograms and this batch is then subject to comprehensive testing. The right recipe is crucial for the overall success of the project.

**Recipe 1** contains 8 biologically active ingredients: methoxychlor, fenitrothion, fenthion, endosulfan, gamma-HCH, alpha-HCH, pp'-DDT and p-dichlorobenzene. The total contents of the toxic substances (active ingredients) are 2.293%. When converted to amounts of waste (plant protection preparations) the amount totals 2,860 kg within 25,000 kg of fuel, i.e. 11.44%

**Recipe 2** consists of 7 biologically active ingredients giving 3.22% of fuel active ingredients and 28.20% of fuel weight. The recipe uses a lot of low-percentage formulation (little amounts of active ingredient), so compared to recipe 1 the difference is not significant.

**Recipe 3** is more universal and consists of 10 biologically active ingredients (9.098%) with the ratio of pesticide waste to fuel being 69.92%. It is a terminal recipe due to fuel functional properties.

## Fuel analyses

Fuel undergoes laboratory analyses. Table 3 includes parameters measured for alternative fuel batches.

**Table 3. Alternative fuel parameters**

No.	Test type	Details
1.	Heating value	-
2.	Specific gravity	-
3.	Chemical composition	- Chlorine - Nitrogen - Sulphur
4.	Flash point	-
5.	Freezing point	-
6.	Ashes	-
7.	Sulphur	-
8.	Water	-
9.	Kinematic viscosity at 80°C	-
10.	Density at:	- 20°C - 40°C - 80°C - 100°C
11.	Nitrogen	- total nitrogen
12.	Aggressive components	- NO <sub>2</sub> - SO <sub>2</sub> - HCl
13.	Contents of combustibles	- at 600°C - at 800°C
14.	Cloud point	-
15.	Biologically active ingredients in fuel	Each biologically active ingredient
16.	Trace metals	Cr, V, Se, As, Pb, Cd, Cu, Ni, Mn, Zn, Be, Co, Sn, Ag, Hg, B
17.	Explosiveness	Vapour pressure, flash point, auto ignition point, explosive limit, explosive concentration

## Alternative fuel production - General information

The technological installation for production of alternative fuel has been assembled at "Organika-Azot" S.A. The company is the beneficiary of the sister PHARE project No. PL 9608.01.02.03.01: "Delivery of equipment for the pilot project of utilising obsolete pesticides as alternative fuel for cement kiln".

Under the project, the company received the following equipment:

- Enamel reactor for fuel production,
- Container,
- Pumps,
- Waste feeder.

All the equipment was placed in a hall and assembled into a technological line.

The Chemical Company "Organika-Azot" S.A. in Jaworzno has been a large producer of chemicals since the 1960s, producing pesticides, also these used in fuel production (Mgławik, Kornikol, Owadofos, etc.). The Company has the required expertise, experience and practice in pesticide manufacturing, and the necessary equipment and installations equipped with environmentally safe devices.

Formulation of alternative fuel will take place in the installation for production of liquid preparations.

Due to the fact that pesticide waste used as a component of the fuel are hazardous or toxic and both the pesticides and fuel pose a danger of fire or explosion, the installation used for producing alternative fuel must comply with Ex standard and the facilities must be equipped with appropriate anti-explosive and fire-preventing devices.

Environmental protection with regard to alternative fuel formulation relies mainly on minimising the emissions of exhaust gases containing hazardous and toxic substances and posing fire and explosion dangers.

Despite the short-period nature of the alternative fuel formulation, the process will take place in a closed system under nitrogen cushion. The technology does not require temperature increases and proceeds in ambient temperature, so the vapour pressure of the ingredients mixed with nitrogen will be relatively low. Gases emitted mainly during the filling of the mixer will be directed to the carbon absorber, from which mostly nitrogen will escape to the atmosphere.

## **Project stage**

The project is ongoing. It still needs some formal agreements and permits from various departments, for both production and utilisation of alternative fuel as an additional source of energy during the production of clinker at a cement plant.