



## PESTICIDE CONTAINER MANAGEMENT STATUS AND PERSPECTIVES IN SERBIA

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### Abstract

*Objective of the paper is to give the overview of the current situation in Serbia regarding management of used pesticide containers. Based on EU Member States experience in this field, analyze the possibilities for management of the containers and identified the obstacles for its development. The use of pesticides has increased rapidly in low and middle income countries over the last decade. Appropriate management of used pesticide containers is important issue for protection of human health and the environment in these areas. In order to reduce the risk in the application of plant protection products, good management of packaging and packaging waste, before and after the use of the product in it, is of paramount importance. In Serbia, use of pesticide is growing every year. Majority of used pesticides, are not managed properly and disposed in nearby non-controlled landfills or left in field. In European Union range of actions are undertaken, through the legal framework and establishment of container management programs, to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment. Solving the problem of hazardous packaging waste from plant protection products in Serbia encounters numerous obstacles. Main problem is the lack of experience in this field requires us to be more aware of the management system for this type of waste in the EU Member States. In addition, it is important to raise awareness of the proper handling of packaging waste from plant protection products, from the manufacturer to the end users. We can conclude that improvement of pesticide packaging waste should be based on two models of management of this type of waste: voluntary and legally prescribed, implemented throughout the EU.*

**Keywords:** waste management, hazardous waste, pesticide containers, EU accession country

### 1. INTRODUCTION

In particular phases of intensive farming, use of pesticides are common, and they results in the generation of hazardous waste. Due to lack of knowledge and guidelines for management of pesticide waste packaging, hazardous chemicals pose a great environmental risk. In many developing countries, frequent reuse of contaminated pesticide packaging has been identified as well, which pose a health risk [1].

Over the past 50 years, the use of pesticides in the world has undergone changes and it has grown as result of high population demand for food, because of population growth [2].

Fungicides, herbicides and insecticides are the most important products for the protection of plants in agriculture. The most dominant group of pesticides are fungicides and herbicides, while insecticides are less used [2].

Europe is the largest pesticide consumer in the world, while Asia is second, followed by North and South America. China, the United States, Argentina, Thailand and Brazil are at the same time, individually by country, the world's largest producers and consumers of pesticides [3].

The total quantity of pesticides sold in tonnes of active substance in 20 European countries in 2005 was about 340.000 tons. The total quantity of pesticides sold in 2008 and

2009 was 330.814 and 291.406 t, respectively, while in 2010 it amounted to 281.000 t. Based on these data, there is a clear tendency of declining pesticide sales. Total reduction of the amount of pesticides on the European market for 2009 is 12.8% or 43.000 t and the downward trend is much similar in the past few years [4].

In 2014, the total amount of pesticide sales in the EU-28 amounted to close to 400.000 tonnes. Fungicides and bactericides were the most sold group of pesticides with a 44% share, followed by herbicides [5].

Pesticide packaging waste due to its origin, composition and/or concentrations of dangerous substances has hazardous characteristics (toxicity, ecotoxicity, flammability, etc.) and is harmful for the health and lives of people, as well as the environment [6]. First of all, pesticide residues pollute the water and soil ecosystems and can affect the health of humans and animals. Furthermore, pesticide containers are made of plastic, which degrades very slowly and affect the quality of the environment.

However, there are very few data on collected and recycled containers from pesticides. In most countries, different container management programs are established, for containers collection, depending on the empty containers classification (hazardous or non-hazardous waste).

## **2. METHODOLOGY**

### ***Pesticide packaging waste management in eu***

In the packaging industry, since the 1980s, an approach that focuses on the life cycle of packaging has been followed and has been developed to include a wide range of actors. Its main goal is to achieve a safe and sustainable management of waste packaging material from plant protection products throughout Europe, whereby it is considered as a potential valuable resource [7].

The European Plant Protection Association (ECPA) estimates that around 34.000 tonnes of packing material from the plant protection products (PPP) is being marketed every year on the European market. France, Italy, Spain, Germany, UK, Portugal, Poland and Turkey are placing the largest quantities of packaging on the market. At least 80% of the packaging of plant protection products consists of plastic packs, mostly HDPE (high density polyethylene) and PET (polyethylene terephthalate), while the rest is based on paper and thin film. Plastic packaging is most often used for the packaging of liquid preparations and composites, and paper for solid formulations [7].

According to a study on the classification of this type of packaging waste in European countries, which was carried out by ECPA in 2006 a different approach has been identified for the classification of the rinsed packaging waste within the EU, with at least a third of countries classifying this packaging as hazardous waste. In some countries it was not possible to get data, because this problem has not yet been considered by the competent institutions. This level of inconsistency across Europe has major current and future consequences for the collection and reuse programs of the pesticide packaging waste [7].

Regarding the handling the packaging waste, ECPA member companies have developed and implemented a voluntary industry standard relating to the plastic packaging of PPP and subsequently accepted by the industry as a whole. This standard ensures easy discharging of the packaging, swelling of the product from it, rinsing and recycling [7].

The result of the implementation of this standard allows farmers to effectively decontaminate the packaging by washing and drying. The rinse water can then be applied to the crops so that additional waste is not generated. In addition, complete discharge of the packaging is achieved by rinsing, so that there is no residual content in it [7].

The handling, storage and transport of pesticides are regulated by a series of European and national regulations preceding the Directive, and NAPs in many cases provide little detail in this area.

All six members have systems for safe disposal of empty packaging and pesticide residues. Germany and the Swedish pesticide industry apply a voluntary system for the disposal of empty pesticide packaging. In the Netherlands, the system is jointly implemented by industry and public authorities, and almost 100% of packaging is disposed of in this way. On the other hand, the system of safe disposal of empty packaging in Poland is a legal requirement, without any costs for farmers, and only half of the total used packaging is collected and disposed of using this system [8].

In Germany, the pesticide industry has established a voluntary system for the disposal of empty pesticide packaging more than 20 years ago. All 17 types of packages accepted under this scheme must be triple rinsed. There is no fee for this scheme and it is estimated that 75% of the total pesticide packaging is being disposed of through this scheme. Italy provided an example of reducing administrative burden for professional pesticide users. In their case, all companies involved in the storage, processing and disposal of waste, including empty containers for pesticides and residues, must be authorized and must keep records of hazardous waste on behalf of their clients. This record-keeping is carried out at the national level using the Web Waste Tracking Platform, which facilitates the monitoring of empty pesticide and hazardous waste packaging from the user to the collection centre, and on the other hand reduces the administrative burden for individual professional users [8].

Based on the EWC (European Waste Catalog) it is possible to establish the classification of waste packaging from the PPP because the EWC links the classification of certain categories of hazardous waste with the concentration of hazardous substances in the waste. The classification of waste packaging from the PPP depends on the quantity of hazardous substances that remain in the bottle after rinsing, in accordance with the European waste catalog [4].

Packaging from PPP is considered hazardous waste if it contains biocides and agrochemical preparations (pesticides) in a certain percentage, and the limit values of the amount of residue in the packaging varies from 1.000 to 250.000 ppm depending on whether the substance is very toxic, corrosive, irritant or harmful [9].

According to ECPA analysis of data from the survey involving 180 samples of rinsed packaging from the PPP, it was concluded that the average rinsing efficiency, whether triple or integrated, is 0.008% of the contaminating residue. These claims are confirmed by other studies that have shown that the percentage of the contaminating residue in the packaging by rinsing is reduced to below 0.01%. These results clearly point to the fact that packages of PPP, and even those containing residues classified as very toxic, can be classified as non-hazardous waste after adequate rinsing [4].

Within European Union, there is several legal documents which regulate management of pesticide packaging. Directive 2009/128 / EC of the European Parliament and of the Council on sustainable use of pesticides, was adopted on October 21, 2009 under the Thematic Strategy on Sustainable Use of Pesticides from 2006. The Directive determines a series of actions to achieve sustainable use of pesticides in the European Union. The emphasis is on reducing the risks and impacts of pesticide use on human health and the environment, as well as promoting integrated pest control and alternative approaches or techniques, such as non-chemical alternatives to pesticides [10].

In order to obtain comprehensive statistics on the sale and use of pesticides in the EU, Regulation (EC) No 1185/2009 sets out the rules for the collection of data for each Member State.

Article 13 of the Directive 2009/128/EC requires Member States to ensure that the handling and storage of pesticides and treatment of their packaging and remnants do not endanger human health or the environment. The Directive identifies specific measures that Member States are required to include in their plans for proper implementation. The main actions relate to training of users, advisors and distributors, inspection of pesticide application equipment, the prohibition of aerial spraying, limitation of pesticide use in sensitive areas, and information and awareness raising about pesticide risks. A cornerstone of the Directive is the promotion of integrated pest management (IPM), for which general principles are laid down in Annex III to the Directive [10].

The deadlines established by the Directive for implementation of all above measures were phased over the period November 2011 to November 2016. Since November 2016, (when inspection of pesticide application equipment inspection became compulsory), Member States have been required to implement all the relevant measures of the Directive. Member States were required to adopt National Action Plans (NAPs) to implement the Directive for the first time by November 2012. These plans should contain quantitative objectives, targets, measurements and timetables to reduce the risks and impacts of pesticide use [10].

Systems for controlling the handling and storage of pesticides are in place in nearly all Member States, their effectiveness cannot always be assessed due to the lack of measureable targets (Report to EU). In 2016, 25 Member States had put in place systems for the collection and safe disposal of empty containers and packaging of PPP, and in 21 Member States, these systems extend to the collection and safe disposal of obsolete and expired pesticides and their remnants.

In Serbia, by entering into force of the Law on Packaging and Packaging Waste and defining the National Packaging Management and Packaging Waste Management Objectives, all responsible entities for packaging and packaging waste management; importers or producers of plant protection products are obliged to ensure adequate disposal of packaging waste.

The Law on Waste Management defines the management of packaging and packaging waste in which it is stated that materials used for packaging must be produced and designed in a way that they fulfill conditions of environmental protection during their life cycle, safety and health of people, health safety of the packaged product, as well as conditions for transport of products and waste management. As well as packaging and packaging waste is managed in accordance with a special law [11].

According to Article 70 of the Law on Plant Protection, a pesticide or fertilizer can be placed on the market only in the original packaging of the prescribed species for the purposes specified in the permit for its placing on the market, the manner specified in the user guide [12].

The conditions for pesticide trade are given in Article 31 of the Law on Plant Protection Products stating that registered plant protection products can be put into traffic if their packaging is safe for human health and the environment. The declaration and the instructions for the use of plant protection products must also include specific labelling of risks and warnings for humans and the environment [13].

Law on Chemicals, Ordinance on types of packaging for pesticides and fertilizers and on the destruction of pesticides and fertilizers and the Ordinance on the contents of the declaration and instructions for the use of plant protection products as well as the specific requirements and labels of risks and warnings for man and the environment and the way of handling the empty packaging of plant protection products also prescribe the requirements that the pesticide packaging must meet [14][15][16].

Regarding, management of pesticide waste containers in Serbia, Envipack, Secopack and PWW that takes over the pesticide packaging on the territory of the Republic of Serbia (at the expense of foreign and domestic producers of chemical plant protection products) are the operators who are invited by consumers, and the arrangement and assistance in the organization can be provided by associations, local communities, producer groups and agricultural pharmacies.

From 2006 to 2014 (data from the Ministry of Agriculture, Forestry and Water Management, Plant Protection Directorate), the amount of imported plant protection substances increased from 2.356 tonnes to 10.811 tonnes. Also, there are 947 registered companies that distribute and import plant protection products in Serbia [17].

In 2017 Envipack collected and disposed of 43.6 tons of discharged packaging produced by GalenikaPhytopharmacy, which was 23.5% more than in 2016. From the location of GalenikaPhytopharmacy, about 37 tons of raw materials for the production of plant protection products were collected during the year, which is 40.3% less than in 2016, when it was collected about 62 tons [17].

The total number of registered pesticides in 2017 on the Serbian market was around 1.250. The largest number of registered products are by foreign generic companies (51.5%),

followed by products of development research companies (24.1%) and products of domestic producers (24.4%). GalenikaPhytopharmacy, as the largest domestic producer, participates with 138 products in the Serbian market or 45% of the total number of domestic registered products. Individual market participation of companies is difficult to determine precisely because official data are not available [17].

### 3. RESULTS AND DISCUSSION

Based on European practice in management of packaging waste pesticides, we have identified obstacles to implementation of PPP waste management. There are a number of facts that pose the greatest challenges for the establishment of a system for disposal of hazardous packaging waste. First of all there is no warehouse for the storage of hazardous PPP packaging waste and there is no a company that has a license for the export of hazardous waste from Serbia. Another problem is lack of cement factory in Serbia with adequate equipment and permission for destruction of hazardous packaging waste from PPP. The problem of wastewater due to possible contamination of soil and water during the rinsing of the packaging also must be solved and the procedures for sampling and analysis of collected packaging waste (eco-test) on plant protection agents (maximum residue: 0.01%) must be adopted. Besides all this, the lack of experience in this area is also a problem.

The most important expected challenges in the process of realization of the system for disposal of non-hazardous packaging waste are adequate rinsing of the packaging, inspection during the collection of packaging that should be carried out by an independent and trained person and poor experience in recycling this type of waste: qualified and reliable recycling (recycler).

Throughout the EU there are two models for managing this type of waste: voluntary and legally prescribed.

The model of a voluntary system is a model on the principle of a voluntary agreement, that is, a model by which the system is formed by a polluter without a legal obligation or pressure from the authorities to do so. Organizations that have established systems based on a voluntary agreement have included manufacturers, wholesalers and small and non-governmental organizations. Manufacturers and sellers have established many such systems based on a voluntary agreement around the world as a component of a program for managing finished products. Non-governmental organizations initiated the creation of an operator for the management of packaging waste from pesticides as pilot projects. Later, these pilot projects turned into mature systems that solved the issue of this type of packaging waste. Operators based on a voluntary agreement can be successful, especially where all suppliers are part of a trade association and participate in the system. However, some stores are also supplied with pesticides whose producers are not members of trade associations and do not want to be part of a voluntary system. Financing the collection of their packaging is currently underway. In the long run, this is unacceptable. Companies that are part of the system are discouraged by this and it can easily happen to slowly exit one at a time from the system.

A sustainable collection system for packaging waste from pesticides is only feasible if funding is provided. This is most easily achieved when the operator is legally authorized. Legally authorized operators are those operating within the framework of national legislation. Generally, as it is mandatory to register and authorize the preparation, it is therefore necessary to participate in the collection system for packaging waste, to be a member of the operator. If the state chooses to legally authorize the operator, a viable source of funding may be established by legal or sub-legal acts. Where a pesticide supply fee is established, they are all obliged to fund the system. This avoids the problem of "free-riders" (companies outside the system) that appear in the voluntary agreement system, as mentioned above. Threats to be established by legally prescribed operators by the state, it is very often sufficient to approach the establishment of a system based on a voluntary agreement.



Legally authorized distributors can specify the level of services they offer to their clients. A system where it is easy to return empty containers will be much more efficient.

The system must be economically independent if it wants to be sustainable. For legally authorized operators, the government should determine the way in which the system is to be financed: Compensation to suppliers; Tax on the sale of pesticides and General tax.

The system should avoid paying the bail that end users will get back when they return empty containers. The place of return of the empty packaging should be suitable and not too far from the end users.

Whatever the legal basis for the establishment of the system is, it must work in accordance with all applicable laws in the field of environmental protection, waste management and transport.

Of course, it is necessary to promote the waste management hierarchy, so that the collected packaging waste should be treated in the following order of priority:

1. Recycling

2. Thermal treatment:

- incineration: Serbian legislation on incineration should be developed and implemented in accordance with the process of issuing permits for incineration plants, all in accordance with the Waste Disposal Directive.

- co-incineration in the process of clinker production in cement plants. In this case, plants from Serbia should continue to invest in order to fulfill all the necessary legal requirements needed to become hazardous waste operators.

- plastic packaging can also be used as an alternative fuel in high-speed furnaces for the production of steel in the process of reducing iron ore.

3. Disposal at an adequate landfill for that type of material, if any.

Taking into account the above recommendation, it is necessary to implement the system of primary pesticide packaging with triple rinsing of primary pesticide packaging with an operator that would be controlled by the ministry responsible for environmental protection, following the fact that recycling is done only in plants that can ensure the traceability of finished products or to co-incineration in cement factories. The last option is conditioned by the fact that the cement industry is granted a permit for the re-use of such waste.

However, management of hazardous waste, including pesticide waste packaging should be collected separately to ensure that such half-empty packaging does not reach the system of collection and treatment of non-hazardous municipal waste. Other legal acts, including NAP, that will be adopted in the future in the Republic of Serbia need to strengthen the legal framework, increase the capacity building for sustainable pesticide waste management, including management of pesticide waste containers.

## Conclusions

The Serbian authorities need to develop a collection system for hazardous packaging waste, taking into account lessons learned from EU Member States in combination with specific national conditions. In addition, in order to ensure the sustainability of the hazardous packaging waste system, the legal framework need to be further developed under the Law on Packaging and Packaging Waste and also to be implemented in other area, i.e. agriculture legal framework.

Municipal hazardous packaging waste should be collected in a special way, especially one containing active substances. Combined collection is also one of the options that can be proposed (certain days to organize collection by the local government or companies entrusted with these jobs or/and through collecting points where citizens would bring such a type of waste). Information campaigns should emphasize the need for adequate collection, storage and treatment in order to reduce the negative impacts on the environment.

The largest number of EU member states has implemented a separate collection for municipal hazardous waste since the early nineties of the last century. Some countries have introduced separate collection through strategic documents, not through regulations. Various

collection systems have already been established, but most countries rely on active public participation, such as free collecting in collection centers.

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