

The European Experience in Waste Management

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Abstract: The overall situation in waste management in the EU in connection with coming into effect of Framework Directive of 2008 that changed the approach to waste management is analyzed in the article. The experience of Germany in the area of waste management, in particular, waste management policy, the organization of waste collection and waste disposal is analyzed in detail. Special attention is paid to preventing the occurrence of waste and recycling waste, including waste from landfills, in different industries; the effectiveness of different forms of waste utilization. A new approach to understanding production waste is presented. The process of consolidation in the EU for joint problem solving in waste utilization is shown. The evaluation of the situation in Russia is given and the conclusion about the necessity to use the European experience in waste management is drawn. The adherence to the principle of responsibility for Russia for the production collection and recycling after using it and the necessity to develop technical legislation in the area of waste management by taking into consideration the European regulations is manifested.

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1. Introduction

The new European Waste Framework Directive came into effect on December 12, 2008. The future policy of the EU in waste management found its reflection in it. The questions of waste utilization started to be regulated at the European level since 1975 when the EU Waste Framework Directive (July 15, 1975), containing the basic terminology that is used now in majority acts of legislation of the EU on waste and in the national legislation of many European countries and determining the directions of states in the area of waste management appeared.

In the subsequent period a number of documents regulating the management of particular type of waste, such as *hazardous waste* (Directive 91/689/EEC of 12 December 1991 on hazardous waste, supplemented with Directive 94/31/EC of June 27, 1994), *used packaging* (the EU Directive on packaging and packaging waste of December 20, 1994), *polymer waste* (Council Directive 96/59/EC of 16 September 1996 on the disposal of polychlorinated biphenyls and polychlorinated terphenyls), *waste electrical and electronic equipment* (Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment and Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of certain hazardous substances in electrical and electronic equipment) were coordinated and approved. Rules are set for dumping waste in landfills (Directive 99/31/EC of 26 April 1999 on the landfills of waste), waste incineration regulations (Directive 2000/76/EC of the European

Parliament and of the Council of 4 December 2000 on the incineration of waste), regulations for the transport of waste in the EU (EEC Regulation 259/93 of 1 February 1993 on the supervision and control of shipment of waste within, into and out of the European Community). Besides, the European Waste Catalogue - EWC (European Waste Catalogue) was approved (Commission Decision 2000/532/EC of 3 May 2000 establishing the European Waste Catalogue) and the issues of reducing harm to the environment are discussed (The Sixth Community Environmental Action Program approved the decision No 1600/2002 of the European Parliament and of the Council of 22 July 2002).

The introduction of the new Framework Directive was preceded by long preliminary work at the European level and in the EU member countries since 2005. Political unity was achieved in June 2007. The European Parliament discussed it after the first reading in February 2008, it was formally adopted by the Council on October 20, 2008, it was published on November 22 and came into effect in 20 days, on December 12, 2008. Two years were given for its realization, during this time the EU member countries had to issue the Directive legally in the national legislation. Since December 12 new regulations of the EU became legally binding for all member countries [1].

The objectives of the Directive: clarifying unclear legal concepts concerning waste: the definition of "waste", "waste recycling", the formulation and strengthening of the European standards of waste disposal. It reflected the EU policy

concerning resources: the integrated policy of the product on the basis of the life cycle concept.

The new EU Framework Directive

- introduces the five-stage waste hierarchy;
- introduces the concept of the product life cycle into waste management;
- offers new tools for the prevention of waste;
- determines the goals for recycling waste;
- requires to use waste to get energy;
- clearly determines the concepts and the area of the use of waste;
- simplifies the legal setting concerning waste;
- presupposes the exchange information and advanced experience among countries.

The Directive offers a principally new approach to understanding waste – it is considered to be a by-product, raw material that can be used and not just useless, to be eliminated product. It includes such types of waste as mackle-paper, building waste, certain types of ash waste and waste slag, granular stone waste, tires, textiles, compost, glass, wood etc.

Waste hierarchy is understood as a sequence of priorities in waste management. Existing up to now three-stage hierarchy to avoid the occurrence of waste, to recycle waste occurring inevitably and eliminate waste without harm to the environment is replaced with a five-stage hierarchy. Article 5, Section 1 of the Directive states: "The basis of the legal regulations and political activities in the field of prevention waste and waste management is the following hierarchy as a sequence of priorities:

- a. warning;
- b. preparation for re-use;
- c. recycling;
- d. other uses such as energy;
- e. removal"

From this hierarchy it is seen that the use of wastes as a source of raw materials in the EU is becoming increasingly important.

The Directive determines the areas of the use of wastes, the responsibility of producers for the occurrence of waste and for waste management, determines the European Waste Catalogue. The center of gravity is transferred to the prevention of waste occurrence and recycling. The Directive also outlines programs for the prevention of the occurrence of waste [2,3].

2. Methods.

This article is of expository nature. On the basis of the analysis of literature and practical study of the experience of waste utilization in several towns of Germany (Myunster, Bochum, Cologne) the following tasks are solved in it:

-studying the EU's waste management policy;

-studying the German experience in the area of realization of the EU policy and developing an effective system of waste management;

-the analysis of the situation with waste collection and disposal in Russia;

-the evaluation of possibilities to use the German experience in Russia.

3. Main part.

At present the situation with waste in the EU member countries looks different. If in Switzerland, the Netherlands, Sweden, Denmark, Belgium, Germany, Austria, Luxembourg, the overwhelming majority of waste is recycled and only a small proportion of it is deposited in landfills, in other countries, especially in the new EU member countries the amount of deposited waste significantly exceeds recycled [2].

The Directive had to contribute to raising the effectiveness of the EU policy realization, according to which all the EU member countries had to take action to ensure maximum positive result for the environment. The EU strategy in modern conditions of overload of using natural resources and the global growth of the population and the economy is to remove the direct connection between the increased demand and the use of natural resources and to raise the environmental effectiveness of the use of natural resources. This strategy presupposes preventing occurrence of waste, creating strong recycling markets, the simplification of waste management, raising effectiveness of energy use and the use of the resources, and, at last, further transformation of waste policy into the coherent resources policy.

Further steps in the EU policy include the development of the programs of the most effective realization, especially transportation and depositing of waste, the creation of recycling markets and the development offers in special regulation of the utilization of electronic waste and hazardous substances in waste electrical and electronic devices, biowaste, sludge and some other types of waste. The change in thematic strategies in the areas of preventing the occurrence and accumulation of waste, its recycling and also the development of the direction of the sustainable use of the resources are planned. The analysis of the first results and the development of offers in introduction of new methods and strengthening their effectiveness is planned to be realized in 2014.

In the area of depositing waste as well as reducing the volumes of the deposited waste getting resources from old closed landfills moves to the forefront. The role of landfills changes significantly –

they transform from the place of dumping wastes into the source of resources. For example, the functioning EU project “ETOILE” in calorific waste extraction from old closed landfills, that involves Austria, Bulgaria, Greece, Italy, Romania, Slovakia, Slovenia, Hungary.

In the solution of the problem of waste one of the most advanced countries is Germany.

Over the last 40 years waste management in Germany changed considerably. Previously, waste was only collected and eliminated, the bulk of waste was deposited in landfills or burnt in few plants, only one type of containers was used for the residual waste. In the 1970s the idea of recycling started to develop, new market and separate waste collection emerged, specialized plants for sorting and composting and power plants running on waste incineration appear. The deposition of unprocessed waste was prohibited, a lot of landfills were closed. By 2020 the amount of the deposited waste should reduce and recycling should considerably increase. In 1990 in Germany a non-profit company “Green Dot - Dual System Germany” was created that in 1997 became a limited liability company („Der Grüne Punkt — Duales System Deutschland – Gesellschaft für Abfallvermeidung und Secundärrohstoffgewinnung mbH“). The task of „Dual System” is to realize the obligations of firms in waste reception and the recycling of commercial packaging waste on a contractual basis[4].

In industrial society the attitude is to waste management changes. Up to now harmless management and the management that does not pollute the environment was meant. Now the development moves to the production of electricity. Available resources and energy reserves are limited (lignite, bituminous coal, uranium, gas, oil), especially critical is the situation with chromium, molybdenum, niobium, platinum, tantalum, zirconium, barium, fluorine, lithium. In this connection we should not underestimate the role of landfills as a source of raw materials.

The slogan of obtaining “treasures from waste” is advanced: now in Germany 65% of all waste is recycled or used as a substitute for primary energy sources. The use of recycled materials saves 3.7 billion euro annually, it also saves 20% of expenses for metal raw materials and 3% of the expenses for energy imports. In future approx. 70-90% of waste incinerators in Germany will be used to produce energy according to the EU legislation. The long-term perspective is to reduce the amount of landfills [5,6].

The legal implementation of the new European Directive in Germany occurred by the addition of the novel to the Law on the Circulation Economy and Waste (KrWG) and the implementation of the EU requirements and new terminology into

German legislation. The Directive corresponds to the previous development of the waste elimination policy in Germany from the task of environmental protection to resource management with the necessary legal regulation.

The duality of the private and state structures of waste utilization developed in Germany is justified. In accordance with the European Directive the responsibility for household waste utilization still belongs to the state.

31.07.2013 the Cabinet of Ministers approved the Program of preventing the occurrence of waste (Abfallvermeidungsprogramm – AVP). Five years were provided for its preparation, the competencies were divided between the federation and the provinces and preparatory works were carried out, including corresponding research with the evaluation of the situation taking into account the recommendations of the Directive. In different forums – scientific conferences, public hearings, the discussions concerning such questions as policy of the federation and provinces concerning waste, recycling of the economy, re-use of particular types of waste (biowaste, polymers, paper) as raw material for production of different products, as a source of energy to produce combustible materials, including the production of biogas, special attention is paid to the management of the quality. Every year the analysis of the situation is carried out, it is presented in the publications of the Federal Ministry for the Environment, Nature Conservation [3].

At present 89 plants of processing waste of different types (mechanical and biological processing etc.) with the total volume of input of 7 million tons per year operate in Germany. Unlike waste incinerators only 60% of the volume are completely disposed there. Approx. 3 million remain in the output and in future can be used thermally. The experience, however, shows that because of high expenses, the quality of the fuel and prices these high-calorie waste streams are not always used. The main task here is the improving of the management of quality [7].

There are different types of positive experience in all directions of the Directive. Numerous new systems and technologies led to the fact that Germany in many segments of the economy has a high degree of recycling.

The government of North Rhine-Westphalia, for example, for several years aims to transform waste management systems into rotation systems. The emphasis is on the participation of the economy and citizens. As a result of such policy an agreement with the companies ThyssenKrupp Steel AG and Krupp Mannesmann was reached, according to which blast furnace slag is considered to be a by-product of steel production. By the use of slag in the cement industry,

according to Mannesmann company, together with the saving of a large number of natural minerals there is the reduction in the emission of CO₂ to the atmosphere in the amount of one million tons. The agreement was signed between the Ministry for the Environment and the energy concern RWE that ensures the use of the forest biomass in power stations working on biomass. RWE plans to build up to 10 of such power stations that will generate electricity and heat from wood. The government of the provinces is obliged to provide for processing the necessary amount of wood (residues that are usually left to rot in the forest). The technology of generating and using biogas is improving: high quality biogas is fed to a natural gas pipeline [8].

Over the past 20 years considerable changes in the area of "classical" waste management system took place - gas emission reduction achieved by the complete elimination from depositing of biological waste and the use of landfill gas. The study conducted at the Institute of ecology showed that in the period of 1990-2005 the system of domestic waste management system gave the equivalent of 46 million tons of CO₂. The major amount of saving is due to the excluding methane emissions from landfills. By 2020 according to the prognosis of the Ministry the emission will be reduced by 5 million tons of CO₂ and in total in 1990-2020 approx. 10% of the total amount of CO₂.

Most of the waste in North Rhine-Westphalia is re-used materially or energetically, residues are deposited. In the territory of the province there is a differentiated network of plants of various capacities - composting, sorting, machining, mechanical and biological processing, incineration. There are 16 plants for incineration of household rubbish, along with that rubbish is burnt in power and cement plants.

The research of old landfills was concentrated so far on the potential of pollution of the

environment. Accordingly, the sanitation took place to protect them from acute hazards (such as dumping of hazardous substances with drainage water).

According to the initial assessment based on the available in the literature data since 1975 have been deposited approx. 2.5 billion tons of household waste, construction and industrial waste, of which approx. 960 million tons are household waste, including minerals - 545 million tons, polymers - 178 million tons, gas - 97 million tons, iron - 83 million tons (other metals) non-metals - 13 million tons. Presumably, more than 10 million tons of sewage sludge (sludge after lightening) and more than 1 million tons of phosphate were deposited. From 16 million tons of waste of iron and steel industries occurring each year approx. 10% are deposited.

In connection with this old waste landfills are opened, part of the waste is used, the rest is processed and re-deposited. The use of the salvage extracted from landfills saves 3.7 billion euro, in particular, it saves 20% of expenses for raw metals and 3% of expenses for energy imports.

The opening of old landfills gives the following positive effect – the deposited amount decreases taking into account the light fraction by 40-55% without taking into consideration the light fraction by 20-40%, the potential of negative influence of the landfill on the environment decreases, the possibility arises to obtain calorific fraction for thermal use.

In Germany (excluding landfills of the old GDR of the period before the unification of Germany) landfills contain approx. 750 million tons of household garbage and industrial waste similar to it. This waste presumably contains considerable energy and thermal potentials and contains valuable substances (see Table 1).

Table 1. The evaluation of waste landfills of Germany in energy and thermal potential and the content of valuable substances (according to G. Rettenberger) [6].

Type of substance	Amount in landfills	Annual demand	% from annual demand
Calorific fraction	Approx. 8 mln. MJ heating value (calorific value)	Approx. 4000 MW of primary energy including approx. 550 MW for generating electricity	58%
Scrap iron	26 mln. t	21 mln. t	124%
Copper	850 thous. t	600 mln. t	142%
Aluminium	500 thous. t	1,2 mln. t	54%
Phosphates	650 thous. t		

Multipurpose use of different technologies of waste recycling gets spread. For example, in Asdonkshof (Wesel District of North Rhine-Westphalia) since 1997 operates the center for waste processing (Abfallentsorgungszentrum Asdonkshof). It has the reception service for small amounts of waste and problematic waste, equipment for sorting and preparation of bulky and factory waste, a warehouse for intermediate storage of valuable substances and the landfill for depositing inert substances, equipment for the preparation of slag, waste incinerator, drying plant for sludge and plant biocomposting (Figure 4-5). The central structure is the equipment for the preparation of the thermal use of waste with the capacity of 245-270 thousand tons per year (depending on the heating value) of household and industrial waste.

Energy usage:

- Annual capacity of incinerators is approx. 250000 tons.

-Nominal capacity depending on the incineration line and the heating value is up to 19.1 tons per hour.

- Production of steam per line 55 t / h at 400 ° C and 4 MPa.

-Turbine capacity is 22 MW / hour

- Specific electricity production is 545 kWh / ton of waste.

- Specific production of centralized heat: 947 kWh / ton of waste.

The roof of the composting plant is used for the solar photovoltaic power unit with the capacity of 255 kW.

The unit is effective in climate protection and the replacement of fossil energy sources (the electricity of the unit replaces the current 82000 tons of lignite per year, generated heat and process steam - 7000 tons of brown coal and 12.7 million liters of fuel oil per year). There is a reduction in CO₂ emissions due to the high proportion of biogenic waste in the tails.

The biocomposting plant recycles wood and other organic waste (cutting) into certified RAL compost with the mark of quality. For the citizens of the District of Wesel the platform for the delivery of waste is organized to facilitate the recycling of metal scrap, old tires and paper [9].

The experience of Germany became the basis for the formation of the common European system of waste utilization. The unified economic policy of the EU member countries requires coordinated policies in the area of waste utilization. This means, for example, that the reduction in the amount and recycling of packaging may function in Europe only in general in collective work of all countries.

4. Conclusion.

Russia faces the same "garbage" problems as the European countries, but lags behind in solving them for 15-20 years from the EU member countries. The current situation of waste management in Russia is still unfavorable and a threat to the environmental security of the country. Dynamics of education and waste management show the constant advanced growth of the generation of waste and a steady tendency to reduce waste utilization. Landfills and dumps that host industrial and domestic waste occupy large areas, many of which do not comply with environmental and health standards, resulting in the contamination of soil, surface and groundwater and air. At the same time, the problems of use and neutralization of waste are still ineffectively solved.

The debate in connection with the discussion of the concept of the Federal Law on the secondary material resources has shown that the main factors of low-level use of waste as secondary material resources in Russia are insufficiency and imperfection of legislative and regulatory framework; the lack of sufficient economic incentives for the collection and processing of large masses of waste; imperfect tools of regulation in this field; the drawbacks of the formed in Russia practice of collection and disposal of MSW, not ensuring selective waste collection and selection of their useful components suitable for re-use; the low level of technical and technological development for waste disposal; insufficient participation of small and medium business in the collection and processing of secondary resources; the lack of information support of the business community about the opportunities and perspectives and the economic attractiveness of work in the field of the use of secondary resources [10, 11].

The effect of the EU directives imposes certain obligations on the exporters from Russia, obliges them to comply with the EU principle of responsibility for the collection and recycling of the products after using them. In its turn, the Russian Federation, in the case of recognition of those directives, can put forward similar demands to the producers of the EU countries that supply products to the Russian market.

5. Summary.

In the course of study of the current condition of the system of waste management in Europe it was found out that the system is constantly developing. Relatively recently the most relevant was the question of separate waste collection. The experience of the recent years shows that the current state of technology allows to work effectively with

unseparated waste. At the same time the question of re-use of waste containing valuable components and raw materials including deposited before in landfills as material and energy resources. The approach to understanding the industrial waste changed, now it is considered to be by-product within the concept of the product lifecycle. Within the EU there is consolidation in collective solution of the problems of waste utilization.

Russia will have to form its own strategy in the area of waste management taking into account the European experience in connection with the decision to integrate into the world community and to join the WTO. The improvement of the domestic system of waste management and the formation of the new legislation base in the area of waste management remain the most important tasks on the way to the integration of Russia into the European economic space and the development of partnership relations with the EU. The development of the domestic technical legislation in the area of waste management according to the European regulations is fundamental for the realization of the policy of ensuring environmental safety in Russia.

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