

1

MONITORING OF ACTIVITIES IN THE FIELD OF INDUSTRIAL WASTE MANAGEMENT

1.1 INTRODUCTION

The production of waste is the integral part of human economic activity and the recovery of waste is a problem of all societies. The wastes are a threat for all components of environment: the surface of the earth, hydrosphere, biosphere and atmosphere. Industrial wastes are by-products from mining processes and industrial processing. They usually arise within the industrial plant and they are harmful or dangerous for the environment [14].

In Poland, the amount of industrial waste in recent years has decreased significantly, but they still account for over 90% of all generated waste. There are produced 120 mln ton of waste per annum [5], and consequently Poland belongs to the group of major producers of industrial waste in Europe. Thanks to modern technologies there is a growing possibility of the use of industrial waste, mainly in construction and road works. Unfortunately, there is still a large amount of waste that goes to the landfill as well. The most of waste that going to the landfill are either unsuitable for the use or disposal, or left to the discretion of such entities as steelworks or coal mines and cannot be traded [14]. In order to rationally use of the generated waste and prevent the threats connected with their disposal it is necessary to monitor the activities undertaken by entities in all stages of industrial waste management (i.e. during their generation and collection, transportation, utilization and treatment as well as during their storage). Therefore it is needful to develop a new methods and tools that supporting the process of monitoring and control of entities which dealing with the industrial waste.

1.2 THE ESSENCE OF INDUSTRIAL WASTE MANAGEMENT

The industrial waste that are generated in the economic sector are the dominant stream of all produced waste in Poland. In 2013 the total number of generated industrial waste was 128.3 mln ton, that accounts for approx. 90% of all produced waste [5]. More than 80% of these wastes come from mining industry (especially from bituminous coal mining) and energy industry and metallurgy [12]. Hence, the largest amount of wastes is generated in regions where the mining industry, energy industry and metallurgy are located (primarily in the Upper Silesia, Lower Silesia and Małopolska Province).

The largest share in waste are primarily the waste from washing and cleaning of minerals (34,4%), waste from floatation dressing of non-ferrous metal ores (30,2%)

and dust-slag compounds from wet treatment of furnace waste (11,5%) [5]. The percentage share of particular groups of waste in 2013 is shown in Tab. 1.1.

Tab. 1.1 The percentage share of the largest groups of produced industrial waste in Poland in 2013

Waste by group	The amount of produced waste	
	[mln ton]	[%]
TOTAL	128,3	100,0
Waste from washing and cleaning of minerals	34,4	26,8
Waste from floatation dressing of non-ferrous metal ores	30,2	23,5
Dust-slag compounds from wet treatment of furnace waste	11,5	8,9
Coal fly ash	4,5	3,5
Soil and stones	4,0	3,1
Mixtures of fly ash and solid waste originating from limestone methods of desulphurisation of waste gases	3,8	2,9
Waste from mineral non-metalliferous excavation	3,5	2,7

Source: Own elaboration based on: [5]

The areas of industrial waste utilization can be different depending on their physico-chemical properties. Thanks to new technologies the possibilities of the use of industrial waste are getting larger. At present, the most of industrial waste is applied in construction, road works, mining industry and agriculture, among other to [9]:

- production of Portland clinker,
- production of cement,
- production of building ceramics and aggregates,
- fertilization and soil melioration,
- recovery of coal,
- neutralization of sewage and wastes,
- engineering works,
- reclamation works,
- other works in mining technologies.

The level of recovery of industrial waste in Poland in 2009-2013 is shown in Fig. 1.1. The percentage share of recovered industrial waste in recent years is about 70%. Approximately 5% of waste has undergone treatment and, unfortunately, up to 25% of unused economically waste are still landfilled or temporarily stored.

Production companies that generate the waste are legally obliged to pursue a policy of management of produced waste. Each of these entities implements their own, individual waste management system. Dealing with such a large amount of industrial waste is related to undertaking many activities. According to the Waste Act of 14 December 2012 waste management is considered to be "waste gathering, transport and processing, including supervision over such activities as well as further conduct on the places of waste treatment and activities undertaken by waste seller or intermediary

in waste trade (...)” [13]. Therefore, the individual waste management system of each company consists of many processes. Implemented in company the waste management system should take into account the type and quantity of produced waste, the existing technological solutions and the applicable standards, legal acts and regulations [15].

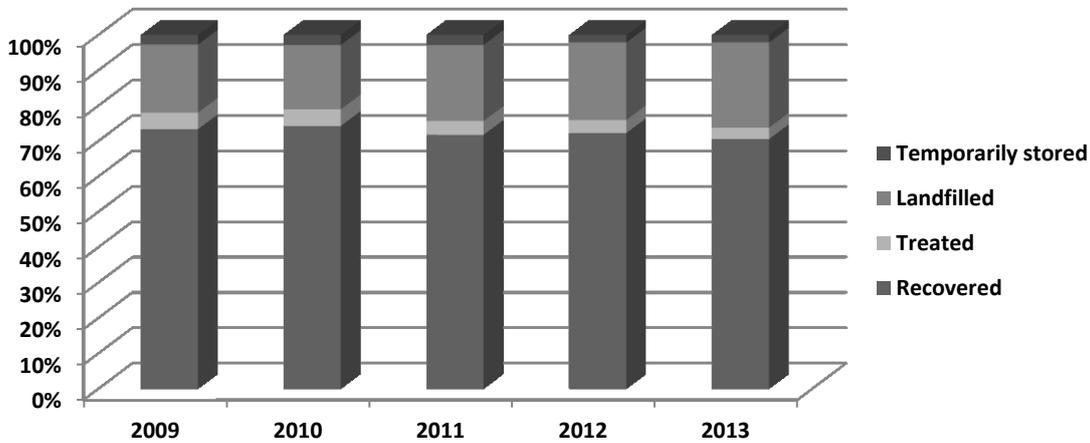


Fig. 1.1 The level of recovery of industrial waste in Poland in 2009-2013

Source: Own elaboration based on: [5]

In accordance with the objectives and tasks (related to waste management) that are contained in National Waste Management Plan should aim to [6]:

- reduce to a minimum the movements of waste,
- increase the share of recovered waste,
- increase the share of treatment of waste (without storage),
- reduce the amount of waste stored in landfills,
- increase the degree of the use of industrial waste in underground mine workings (including recovery).

Additionally, companies that implement the waste management system should take into account the objectives which are included in provincial waste management plan. The systems of particular companies are a secluded systems. In the most cases, the companies are managing only those residues from which they obtain the financial benefits [15]. At the moment, does not exist one complex industrial waste management system on the national or even provincial level. Incomplete use of waste generated by the different companies causes the stream of waste directed on the landfill is a problem on a large scale. There are many legal obligations incumbent on the companies. These include above all [13]:

- conducting waste documentation (waste transfer note, waste record card),
- handing a yearly compiled list of waste produced in to the Marshal of Voivodeship until 15th March each year,
- possessing of the relevant decisions (permission for waste transport, permission for waste production or an integrated permission in the case of conducting installations that causes the environmental pollution).

However, often the regulations are not being fully respected and the efforts to protect the environment and waste management are taken improperly. The most common reasons of this situation are: economic aspects, ignorance of regulations and insufficient control of the supervisory authorities.

1.3 THE ROLE OF MONITORING OF INDUSTRIAL WASTE MANAGEMENT

According to the Polish dictionary, the notion of "monitoring" is understood as a continuous observation and control of processes and phenomena or a continuous supervision over some protected objects [10]. The monitoring of waste should therefore involve the observation and controls of all the processes connected with waste management and also involve the supervising activities over the subjects that produce such wastes or manage them.

In Poland, the first activities aimed at organizing the monitoring of waste were undertaken in the year 1990 by the State Inspection of Environmental Protection within the frames of state monitoring of environment condition [9]. Until the year 2006 the Inspectorates for Environmental Protection were responsible for the monitoring of waste that gathered information about [7]:

- the amount of waste produced with the inclusion of its usage, neutralization, also in terms of neutralization through storage,
- the largest producers of hazardous waste,
- waste disposals including a degree and way of securing them,
- a full turnover of hazardous waste.

An obligation to monitor the activities concerning waste management results from legal acts, among others, the Waste Act of 14 December 2012. At present the data on waste production and management along with a registry of granted permissions are gathered by the Voivodeship Marshal Offices, however, the Inspectorates for Environmental Protection supervise law abiding concerning the environment protection and conduct the research and evaluation of environment condition.

The obligation of conducting monitoring is also incorporated in the EU law related to both waste management and environment protection. One of the most important acts of EU law on environment protection is the Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control). As it concerns an integrated pollution prevention it also includes the regulations directly related to waste management [3].

This Directive says that each installation should be utilized only when it had an integrated permission granted which refers to appropriate requirements regarding waste monitoring and management that are produced by such installation [3].

On the basis of the Directive, there may be 3 main types of monitoring distinguished, connected with the activity of enterprises [8]:

- emission monitoring,
- process monitoring,
- monitoring of influence on the environment.

The monitoring of activities concerning industrial waste management is only a part of the entirety of the system of environment monitoring and is placed in the group of “process monitoring”. The bodies, granting the integrated permissions for the enterprises possessing installations, the functioning of which causes environment pollution, should take into account some factors concerning the conduction of monitoring, e.g. what is the purpose of monitoring conduction, who should conduct monitoring, what should be monitored and in what manner. These factors are presented and described in Tab. 1.2.

Tab. 1.2 The factors taken into account when issuing the integrated permission

Factors	Description
„Why” monitor?	The main purpose of monitoring is the compliance assessments as well as the environmental reporting of industrial emission (however, monitoring data obtained for one purpose can serve other purposes). In all cases it is important that the objectives for undertaking the monitoring are clear for all the parties involved.
„Who” carries out the monitoring?	The responsibility for monitoring is generally divided between the competent authorities (Marshal Office, Voivodeship Environmental Protection Inspectorates) and the operators (companies that conduct the installations). It is highly important that monitoring responsibilities are clearly assigned to all relevant parties (operators, authorities, third party contractors) so that they are all aware of how the work is divided and what their own duties and responsibilities are.
„What” to monitor?	The parameters to be monitored depend on the production processes, raw materials and chemicals used in the installation.
„How” to monitor?	A method of monitoring and expressing the emission limit value depends on the objectives set for monitoring of waste management. Different types of units can be applied. In all cases, the units should be clearly stated and they should match the relevant parameter, application and context. Monitoring results are presented as a report. The report includes the summary and the conclusions from the compliance assessment.

Source: Own elaboration based on: [8]

The monitoring of waste ought to constitute the grounds for the elaboration of plans and strategies of waste management, both on the level of community and the whole country as it enables observation of changes in the amount of waste produced, possibilities of its utilization, neutralization or storage, as well as changes in the domination of the individual waste groups [7]. The structure of monitoring is presented in Fig. 1.2.

The objective of monitoring on a domestic level is to gather information from the voivodeship databases for the decision-makers of central level, however, the monitoring on a local level is organized for the needs of the particular objects (e.g. disposal sites) in order to determine their impact on the environment [9].

When conducting the monitoring one should, if only possible, take actions connected with the optimization of the costs of monitoring but always having in mind the objectives of monitoring that are supposed to be achieved. A return on the monitor-

ing conduction may be improved through undertaking such activities as: selecting appropriate quality requirements to comply with, optimization of a number of monitoring parameters and frequency, supplementing the regular monitoring with special research and so on [8].

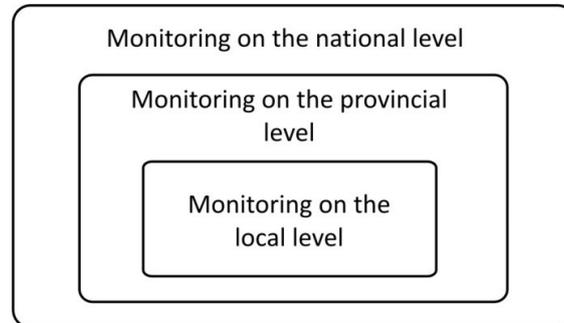


Fig. 1.2 The structure of waste monitoring

Source: Own elaboration

In general, the subjects taking part in the system of industrial waste monitoring involve both the supervising bodies and the enterprises themselves. In connection with this, those subjects undertake various activities that include among others [1], [2], [14]:

- examining waste properties (monitoring of waste stream),
- submitting evaluation, reports on waste management,
- obtaining/granting integrated permissions,
- submitting total reports on environment condition (including the ones on waste management),
- evaluation of the effectiveness of technical solutions adjusted for a maximal impact reduction of objects on the environment,
- developing the characteristics of particular waste (“basic characteristics” and “compliance tests”) – in order to know whether the particular waste may be stored on a disposal site and where it can be managed,
- verifying the compliance of the ways of industrial objects utilization with the conditions set in the administrative decisions,
- developing the programs and plans of waste management.

The entities that participating in the system of industrial waste monitoring in Poland are presented in Fig. 1.3.

The owners, producers, disposal sites and carriers are obliged to send information on waste management to Marshal Offices. Furthermore, the Marshal Offices submit a total report to the Minister of Environment Protection who also supervises the Chief Inspector of Environmental Protection. The Voivodeship Environmental Protection Inspectorates supervise the subjects dealing with waste management and are obliged to prepare and send the reports on control to the Chief Inspectorate of Environmental Protection.

Unfortunately, the current system of industrial waste monitoring in Poland has some drawbacks. The monitoring of subjects dealing with waste management is not

of continuous character but only a periodical one in a form of submitting a yearly statement on the amount of waste produced by waste producers. There are no tools that could control whether the amounts submitted in the yearly reports are consistent with the real state. The possible distortions may be detected only through a direct control by the Voivodeship Environmental Protection Inspectorates. Moreover, the activities of each enterprise concerning waste management are perceived and evaluated individually, a system of monitoring does not include the relationships among all the subjects engaged in the management process.

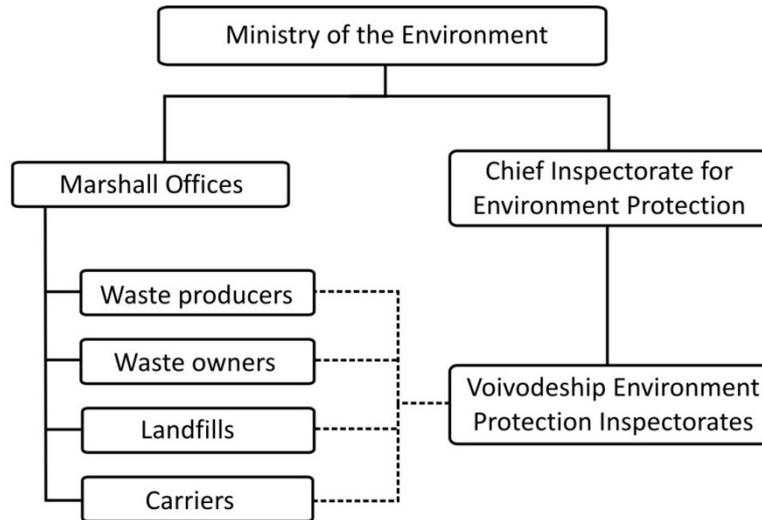


Fig. 1.3 The system of monitoring of industrial waste management in Poland

Source: Own elaboration

1.4 IT TOOLS SUPPORTING THE MONITORING OF INDUSTRIAL WASTE MANAGEMENT

Until the monitoring of waste was conducting by Voivodeship Environmental Protection Inspectorates the information about the waste was collecting in the computer database SIGOP ('Information System of Industrial Waste Management'). The source materials to update this database were polls sent to the largest producers. The system enables collecting data about: producers of hazardous waste, the amount of waste and the installations to managing the waste. At present, this database is no longer updated, and the data about producers and waste management are collected in Central System of Waste (CSO). This system is replenished by Marshal Offices and closely cooperates with sixteen Voivodeship Systems of Waste (WSO). The base of WSO includes information about [2]:

- the amount and the types of produced waste,
- the ways of managing of different types of waste (with the category of recovery or treatment),
- management of waste oils (specifying of amount of recycled or disposal waste oils and the number of approval decisions and registers in the field of waste oil management),

- municipal sewage sludge management (specifying the composition and properties of municipal sewage sludge and the places of their application),
- register of issued decisions in the field of producing and managing of waste (with the register of waste owners which are exempted from obligation to obtain a business license for the collection, transport, recovery or disposal of waste),
- waste management plans, (taking into account the scope of the plans and the timing of subsequent stages of drawing up the plans),
- installations used for recovery or disposal of waste (in separating the landfill and installations for thermal treatment of waste).

The data included in the WSO are obtained on the basis of the yearly compiled list of waste produced and information obtained from prefects. Unfortunately, not all yearly compiled lists of produced waste go to the Marshal Offices. Most often, it is the effect of the ignorance of environmental law, low environmental awareness and resulting from it the aversion to the need to fill the next document (and – in practise – the lack of sanctions for non-compliance) [4]. WSO and CSO are available electronically via the Internet on the basis of the access password. However, the free access to database has only some authorities [2]:

- Minister for the Environment,
- Minister for the Economy,
- Chief Inspector for Environmental Protection,
- board of the National Fund for Environmental Protection and Water Management,
- board of the Voivodeship Fund for Environmental Protection and Water Management,
- General Director of Environmental Protection,
- Regional Director of Environmental Protection,
- Prefects,
- Mayor or President of the City,
- Voivodeship Environmental Protection Inspector,
- public statistics service.

The employees of particular country or municipal offices receive the access only to some parts of database that concern the waste management in their area [11].

The unquestionable advantage of this system is comprehensive collection of data, that give the possibility of grouping many valuable information in one place. However, this system seems to be underdeveloped and the entered data unreliable. Database require implement many amendments. The quantity of produced waste and exploited waste is not balanced, that makes it impossible to draw any conclusions about waste management in a given area [1]. Therefore it seems to be necessary to carrying out further research for development the systems supporting the monitoring and control of activities in the field of waste management, primarily in the context of verification of the entered information. The research should be carrying out with the future users of these systems – in order to be easy to use and functional.

CONCLUSIONS

Production of industrial waste is still a significant problem. Despite undertaking many activities aimed at waste management, there is some amount of wastes stored at disposal sites. The reason is a lack of one, complex waste management system, common for all wastes. Each enterprise has its own individual system that does not always include the objectives set in the voivodeship and domestic plans of waste management due to the financial aspects. It also constitutes a problem for the bodies supervising waste management. Some enterprises do not comply with all the reporting requirements what is caused by a lack of knowledge in terms of environmental protection law, low level of ecological consciousness of the society and small (sometimes even none) sanctions for not respecting the obligations. Therefore, a very important issue became the monitoring and control of this area, both on a domestic and regional level. However, the system of industrial waste monitoring functioning these days has some gaps. First of all, the monitoring of activities of the subjects dealing with waste management is not of continuous character but of periodical one and is only based on yearly statements on the amounts of waste produced and information from prefects.

Moreover, the IT tools supporting the work of supervising bodies also require introducing the improvements, mainly in terms of verification of the data entered. The databases should be extended with additional modules that would gather information concerning the relationships among all the subjects involved in the waste management process.

REFERENCES

- 1 Bazy danych o odpadach – zbieranie danych. [Online]. Available: http://www.proekologia.pl/e107_plugins/content/content.php?content.8557.1. [Accessed: Fer. 11, 2015].
- 2 Baza WSO – warunki i zakres dostępu. [Online]. Available: http://wrotapomorza.pl/pl/bip/umwp/urząd/sprawy/sprawy_do_zalatwienia/wso. [Accessed: Fer. 12,2015].
- 3 Z. Bukowski, P. Manczarski (ed.). *Zarządzanie gospodarką odpadami. Nowe regulacje prawne*. Poznań: PZTiS, 2013.
- 4 M. Krucka-Adamkiewicz. „Porównanie banków informacji na przykładzie woj. wielkopolskiego”. *Przegląd komunalny*, no. 2007-1. [Online]. Available: <http://e-czytelnia.abrys.pl/przegląd-komunalny/2007-1-260/gospodarka-odpadami-2996/porownanie-bankow-informacji-na-przykladzie-woj-wielkopolskiego-692>. [Accessed: Fer. 14,2015].
- 5 Mały rocznik statystyczny Polski, Warszawa: GUS, 2014.
- 6 National Waste Management Plan 2014, Annex to Resolution No 217 of the Council of Ministers of 24 December 2010, Monitor Polski of 31 December, Warszawa, 2010.

- 7 Raport o stanie środowiska w Wielkopolsce w roku 2006. [Online]. Available: <http://poznan.wios.gov.pl/monitoring-srodowiska/Monitoring%20gospodarki%20odpadami/Inne%20opracowania%20dotyczace%20gospodarki%20odpadami/mgo.pdf>. [Accessed: Fer. 8,2015].
- 8 Reference Document on the General Principles of Monitoring, European Commission, July 2003. [Online]. Available: http://eippcb.jrc.ec.europa.eu/reference/BREF/mon_bref_0703.pdf. [Accessed: Fer. 10,2015].
- 9 C. Rosik-Dulewska. *Podstawy gospodarki odpadami*. Warszawa: PWN, 2007.
- 10 Słownik języka polskiego, PWN. [Online]. Available: <http://sjp.pwn.pl/sjp/monitoring;2568296>. [Accessed: Fer. 7,2015].
- 11 W. Sobczyk, A. Biedrawa. „Systemy informatyczne w modelowaniu procesów zarządzania środowiskiem, Edukacja – Technika – Informatyka. Wybrane problemy edukacji technicznej i zawodowej”. *Scientific Annual*, no. 2, part 1, Rzeszów, 2011, p. 325-336.
- 12 Stan środowiska w Polsce. Raport 2014, Warszawa: Główny Inspektorat Ochrony Środowiska, Biblioteka Monitoringu Środowiska, 2014.
- 13 The Act on Waste of 14 December 2012 (Dz.U. 2013 poz. 21).
- 14 A. Wasiak. „Gospodarka odpadami przemysłowymi”. *Inżynieria i utrzymanie ruchu zakładów przemysłowych*, marzec 2012, no. 2 (80) Rok IX, p. 71-75.
- 15 B. Zwolińska, P. Kisiel. „Systemy zagospodarowania odpadów przemysłowych”, *Logistyka-Nauka, Logistyka*, no. 3, 2011, p. 3144-3150.

MONITORING OF ACTIVITIES IN THE FIELD OF INDUSTRIAL WASTE MANAGEMENT

Abstract: *The main purpose of this paper is the attempt to assess the currently existing system of monitoring of activities in the field of industrial waste management. The article characterized the state of industrial waste management in Poland in recent years and listed the main groups of waste and main areas of their application. In the paper there is the role of waste monitoring and the description of tasks of different entities in the field of control and supervision of waste management. Moreover, the paper shows the structure of waste monitoring and describes the system of waste monitoring in Poland, and presents the IT systems that supporting the work of supervisory authorities as well.*

Key words: *waste management, waste monitoring, industrial waste*

MONITOROWANIE DZIAŁAŃ W ZAKRESIE GOSPODARKI ODPADAMI PRZEMYSŁOWYMI

Streszczenie: *Głównym celem pracy była próba oceny obecnie funkcjonującego systemu monitorowania działań w zakresie gospodarki odpadami przemysłowymi. W artykule scharakteryzowano stan gospodarki odpadami przemysłowymi w Polsce w ostatnich latach, wymienione zostały główne grupy odpadów oraz główne kierunki ich zagospodarowania. Opisano rolę monitoringu odpadów oraz scharakteryzowano zadania różnych podmiotów w zakresie kontroli i nadzoru gospodarki odpadami. Ponadto w pracy zaprezentowana została struktura monitoringu odpadów, opisany został system monitorowania odpadów w Polsce, a także przedstawione zostały systemy informatyczne, które wspomagają pracę organów nadzorczych.*

Słowa kluczowe: *gospodarka odpadami, monitoring odpadów, odpady przemysłowe*

Mgr Karina HERMANN
Silesian University of Technology
Faculty of Organization and Management
Institute of Production Engineering
ul. Roosevelta 26, 41-800 Zabrze, Poland
e-mail: Karina.Hermann@polsl.pl

Dr hab. inż. Witold BIAŁY
Silesian University of Technology
Faculty of Organization and Management
Institute of Production Engineering
ul. Roosevelta 26, 41-800 Zabrze, Poland
e-mail: Witold.Bialy@polsl.pl

Date of submission of the article to the Editor: 02/15/2015
Date of acceptance of the article by the Editor: 04/20/2015