



COAL FLY ASH MANAGEMENT IN THE LIGHT OF POLISH AND EU LEGAL REGULATIONS

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Abstract:

The article includes the analysis of current legal acts in Poland and European Union, which concerns the management of coal fly ash in organizational and technical aspects. The main aim of this paper is to identify the responsibilities and the legal obligations of entities dealing with the coal fly ash management, and to create the model of the flow of documents and information between these entities. Moreover the paper shows technical conditions of management of coal fly ash and describes the role and tasks of the authorities that supervise the observance the environmental laws.

Key words: coal fly ash, waste management, reverse logistic

INTRODUCTION

Poland as European Union member country is obliged to adjust its legal norms and acts to EU law. In the recent years a new Waste Act has become effective which implements as much as 13 EU Directives within the range of its regulation (among others, Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste, Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste, Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions, etc.). In the new Waste Act the range of obligation was changed concerning some entities dealing with municipal and industrial waste management. The basic change concerns the regulation referring to the obligation of obtaining appropriate decisions in the area of waste production connected with the conduction of installation – what directly regards fly ash producers. A part of records concerning the requirements to obtain permission for waste production in installation were transferred to the Environment Protection Act. The Waste Act also introduces changes in some definitions such as “waste” or “management”, several new definitions are introduced as well. Furthermore, it determines the kinds of waste that may lose the status of waste if it fulfills the conditions set in the act. Unfortunately, despite a wide range of fly ash utilization in business activity it is difficult to define its definite status due to various prosperities and chemical compound.

COAL FLY ASH – WASTE OR PRODUCT?

Coal fly ash is one of Coal Combustion Products (CCPs) created during transformation of chemical energy from fuel into thermal energy in power plants as well as in heat and power stations. It is a remain of hard coal or lignite combustion in boilers, floating with fumes in which the content of mineral grains smaller than 0.075 mm constitutes more

than 50% of all grains [12]. According to the list being an attachment to the Regulation of Minister of Environment of 27 September 2001 on waste catalogue (Journal of Laws 2001 no. 112 item 1206), coal fly ash possesses the status of waste and is qualified to the waste group of code 10 01 – wastes from power stations and other combustion plants (except 19) [17]. Inside this group there is also slug, bottom ash, boiler dust, mixture of sludge, mixture of fly ash and calcium-based reaction wastes from flue-gas desulphurization in solid form.

The percentage share of different types of waste in all produced Coal Combustion Products in 2012 in Poland shows Figure 1.

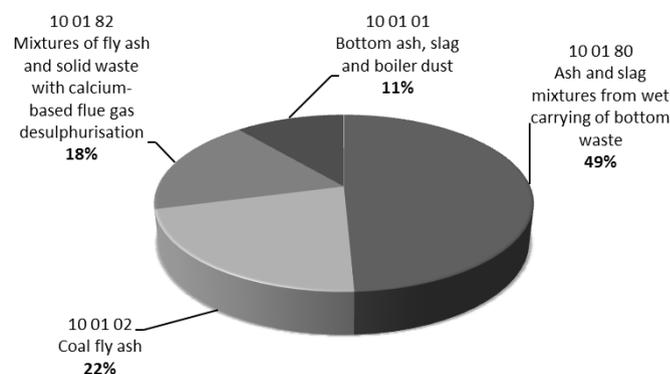


Fig. 1 The percentage share of different types of energetic waste in Poland in 2012

Source: based on [4, 35].

Clean coal fly ash (10 01 02) constitutes about 22% of all wastes generated by power plants and heat and power stations, however, it also appears in a form of mixture with solid waste – approx. 18% and with slags – approx. 49%. In total, power waste consists of fly ash in 80-90%, in 10-20% slag.

The basic legal act treating of waste (fly ash among others) is the Act of 14 December 2012 on waste (Journal of Laws 2013 item 21). With reference to this act each waste producer should take action aimed at waste recycling if he is not able to prevent from waste production. At present the possibilities of fly ash and its mixture management are very wide. Due to its binding properties it stopped being treated as waste, currently it is a valuable product which may replace other products or constitute their basic ingredient.

The main areas of fly ash utilization are:

- underground mining (it is used, among others, for grouting of carving areas, filling the redundant longwalls, for solidifying backfill, fire prevention and extinguishing underground fire) [9],
- construction material industry (among others, for the production of clinker, Portland cement, concrete, lightweight aggregate, construction ceramics) [2],
- engineering works and road works (it includes, among others, materials for embankment construction, for dumping ground construction, bituminous mass filler, ground stabilizer in road works) [10],
- farming and forestry (as unconventional calcium-magnesium fertilizers used for soil liming and irrigation, reclamation of forest land) [10],
- others (used as SO₂ sorbent in the process of flue-gas desulfurization) [10].

In Poland, according to the data of Central Statistical Office, coal fly ash has undergone recovery in about 87% in the recent years and its mixture even in 100% (Table 1).

Nevertheless, the possibilities of fly ash management depend on its contents and physicochemical properties, these in turn depend on the quality of coal combusted in power plants and heat and power stations, and also on the combustion technology. The chemical compound of fly ash from conventional boilers clearly differs from the ash compound and properties coming from fluid heaters as combustion in traditional boilers is connected with the use of various flue-gas desulfurization technologies, however, the use of fluid heaters allows reducing sulfur dioxide emission (SO₂) directly in hearth [12].

A detailed classification of fly ashes is included in the old industry standard BN-79/6722-09 – „Ash and slag from hard and brown coal-fired boilers. Classification, terms and designations” (Table 2).

This standard does not take fly ash from the new types of boilers (fluid ones, among others) into account. In the chemical compound of liquid ash (coming both from hard and brown coal combustion) the decrease of SiO₂ content may be observed along with the increase of CaO and SO₃ content in comparison with the ash from the traditional boilers (Table 3).

Apart from the aforementioned, basic ingredients, fly ash may also contain small amounts of so called by-products, that is Na₂O₃, K₂O, Cl⁻, TiO₂, P₂O₅, MnO and trace amounts of heavy metals such as Zn, Cr, Mo, Cd, Ni, Cu, Pb [23]. It is important as in order for waste to be managed, it must have the same compound and properties so that the technical requirements are met that are set in the standardized documents in force for the particular industry (especially in construction and road works).

Table 1
Recovery of coal fly ash and mixtures of fly ash solid waste with calcium-based flue gas desulphurisation in 2010-2013 in Poland

Years	Waste by type	Grand total		Recovered	
		mIn t		mIn t	%
2010	10 01 02 Coal fly ash	3,98		3,55	89,3
	10 01 82 Mixtures of fly ash and solid waste with calcium-based flue gas desulphurisation	3,82		3,82	100
2011	10 01 02 Coal fly ash	4,51		4,29	95,2
	10 01 82 Mixtures of fly ash and solid waste with calcium-based flue gas desulphurisation	4,17		4,17	100
2012	10 01 02 Coal fly ash	4,64		3,92	84,4
	10 01 82 Mixtures of fly ash and solid waste with calcium-based flue gas desulphurisation	3,84		3,83	99,9
2013	10 01 02 Coal fly ash	4,5		3,91	87
	10 01 82 Mixtures of fly ash and solid waste with calcium-based flue gas desulphurisation	3,8		3,8	100

Source: based on [5, 6, 7, 8].

Table 2
Polish classification of coal fly ash according to the chemical composition

Name of the type of coal fly ash	Symbol	Content of basic components [%]			
		SiO ₂	Al ₂ O ₃	CaO	SO ₃
Siliceous	K	> 40	< 30	< 10	< 4
Aluminous	G	> 40	≥ 30	< 10	< 3
Calcium	W	> 30	< 30	> 10	≥ 3

Source: [14].

Table 3
The chemical composition of CFB fly ash

Name of the type of CFB fly ash	Content of basic components [%]						
	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	CaOwIn	MgO	SO ₃
CFB fly ash from bituminous coal	32,52-40,81	15,50-20,77	3,27-7,50	9,08-21,80	0,76-7,06	1,31-3,52	4,80-11,08
CFB fly ash from lignite coal	36,50-42,20	26,70-30,00	2,85-6,35	11,50-16,20	2,83-5,91	1,17-2,50	2,26-3,85

Source: based on [13].

The next issue connected with the chemical compound of waste are legal regulations concerning the ecological aspect. The regulations concerning the utilization of industrial waste mostly come from the Act of 27 April 2001, the Environment Protection Act (Journal of Laws 2001 no. 62 item 627), defining the rules of using the environmental resources with the inclusion of sustainable development requirements. This act determines the conditions for the introduction of substances or energy into the environment, among others [22]. The substances introduced should not contain heavy or radioactive metals, as they would be considered as hazardous in that case. An acceptable level of a particular element that determines whether the waste is a hazardous waste is included in the Regulation of Minister of Environment of 13 May 2004 on conditions in which it is assumed that waste is not hazardous (Journal of Laws 2004 no. 128 item 1347) [15]. In the light of the regulations in force fly ash, despite containing trace amounts of heavy metals, does not have a status of hazardous waste as the concentration of these elements are compliant with the acceptable levels¹. Nevertheless, the Polish Union of Coal Combustion Products Association² continuously monitors changes in the legal regulations of European Union as change in the fly ash status into hazardous would trigger huge, unfavorable changes for many industries and the whole country concerning CCP. An additional consequence would also be a necessity of changing the status of the existing disposal sites of fly ash and status of building new disposal sites adjusted for hazardous waste storage.

An important act from the point of view of health and environment protection is European Parliament and Council Regulation (EC) No 1907/2006 of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). The purpose of the regulation is, among others, providing a free trade of chemicals

on the territory of EU [19]. The obligations resulting from this regulation are also included in the Act of 25 February 2011 on the chemical substances and their mixtures (Journal of Laws 2011 no. 63 item 322). In order to conduct research on different types of ashes concerning fulfillment of the requirements for the chemicals introduced to the EU market, the Polish Union of CCP established Consortium on CCP-REACH [25]. In 2010 record taking of classic and liquid ash substances took place according to the requirements of REACH [1].

THE RESPONSIBILITIES AND LEGAL OBLIGATIONS OF ENTITIES DEALING WITH COAL FLY ASH MANAGEMENT

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 (...)” [21]. Consequently, legal regulations concern each member of fly ash supply chain who becomes its owner, starting from waste producer, through intermediaries and to final recipients. Depending on the type and number of entities dealing with fly ash management the various types of supply chain are created, which is presented in Figure 2.

In Polish legislation an industrial waste producer is considered to be anyone whose activity or existence causes waste production and also anyone who conducts a preliminary waste processing, mixing or other activities leading to change in waste character or compound [21]. A direct producer (production place) of fly ash are mainly power plants and heat and power stations, however, it is worth emphasizing in this moment that electricity and heat is used by all of us – we become an indirect power waste producer at the same time.

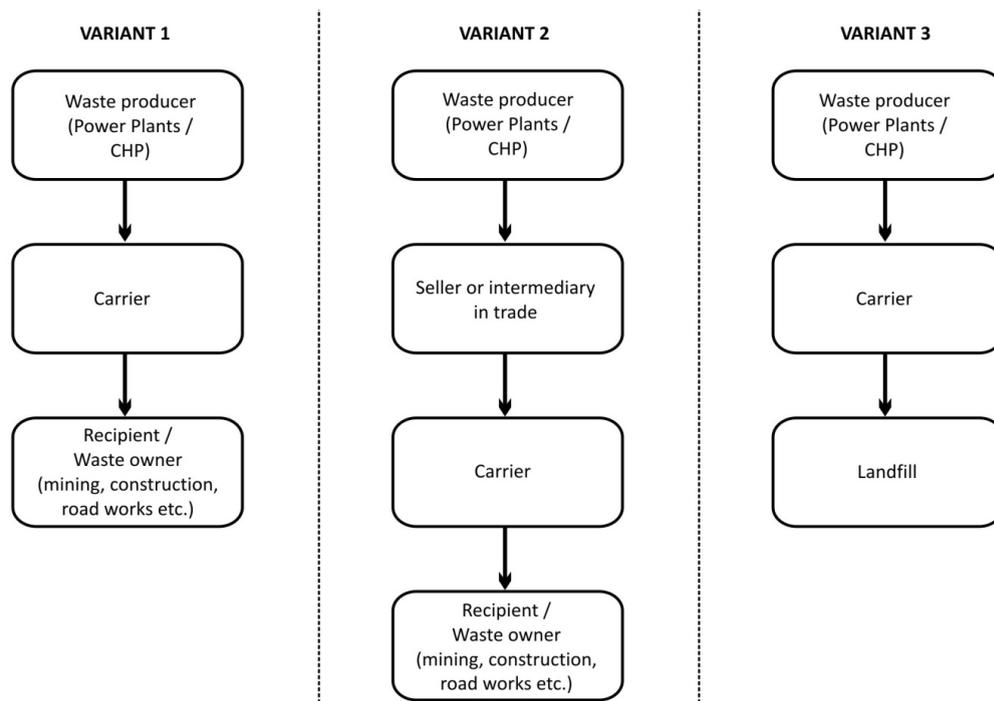


Fig. 2 The variants of supply chain of coal fly ash

¹ Acceptable levels of heavy metals are individually determined for each industry in which fly ash is used. For example, in farming acceptable levels of heavy metals in soil of 0-30 cm layer amount to: Pb < 80, Cd < 3, Hg < 1,5, Ni < 50, Zn < 180, Cu < 75, Cr < 100 mg/kg of dry matter [16].

² The Polish CCP Union (Polska Unia UPS) – the organization dealing with dissemination of the issue of power industry waste utilization, its members are the representatives of power plants/heat and power stations, power waste management enterprises, scientific institutes and research laboratories, www.unia-ups.pl [28].

Table 4
The basic legal obligations of entities involved in the management process of coal fly ash

Entity/Supply chain link	Legal obligations	Documents required
producer	<ul style="list-style-type: none"> – conducting quantitative and qualitative evidence according to waste catalogue – issuing waste transfer note – storing waste record cards for the period of 5 years – granting access to waste record cards on demand of the body authorized to carrying out control – handing a yearly compiled list of waste produced in to the Marshall of Voivodship until 15th March each year 	<ul style="list-style-type: none"> – permission for waste production – waste transfer note – waste record card – compiled list of waste produced
carrier (conducting transport service only)	<ul style="list-style-type: none"> – keeping a simplified waste record – delivering waste to its destination place and transferring it to waste owner 	<ul style="list-style-type: none"> – permission for waste transport – waste transfer note
seller/intermediary in trade (non-owners)	-	-
owner	<ul style="list-style-type: none"> – conducting quantitative and qualitative evidence according to waste catalogue – confirmation of waste transfer on a waste transfer note – handing a yearly compiled list of waste in to the Marshall of Voivodship until 15th March each year – storing waste record cards for the period of 5 years – granting access to waste record cards on demand of the body authorized to carrying out control 	<ul style="list-style-type: none"> – waste transfer note – waste record card – compiled list of waste
landfill	<ul style="list-style-type: none"> – possessing waste disposal site construction, use and closure permit as well as possessing instruction of site management – conducting quantitative and qualitative evidence according to waste catalogue – handing a yearly compiled list of waste in to the Marshall of Voivodship until 15th March each year – conducting waste disposal site monitoring – handing a report on site monitoring in to Voivodeship Environmental Protection Inspector 	<ul style="list-style-type: none"> – waste transfer note – waste record card – compiled list of waste – basic waste characteristics – results of compliance tests

Source: based on [21].

The producer is obliged to conduct fly ash management that he creates or commission the management duty to other entities that possess a permission for waste collection and processing, license for underground waste storage or entry in the register (this concerns: waste carriers, waste sellers and intermediaries in waste trade). In the moment of waste transfer to the next waste owner the responsibility for waste management is passed to the next owner in the moment of its transfer. However, the waste owner still bears the responsibility for waste collection and processing during transport until the moment of waste collection by the next owner.

The duties concerning waste producers and owners may differ depending on the type and amount of waste produced. Nevertheless, every waste producer and owner is obliged to perform in a way consistent with the requirements of environment protection and land development plans.

The entities producing over 5000 Mg of waste other than hazardous one per year have to obtain a permission for waste production issued by the Marshall of Voivodship of competent venue [22]. The waste producer also becomes its first owner, therefore the duties of waste owner concern him as well. The most important legal obligations of the entities dealing with fly ash management are presented in Table 4.

The basic obligation of fly ash owners and producers is to conduct the quantitative and qualitative evidence according to waste catalogue using two documents: waste record card and waste transfer note [26]. Furthermore, they have a yearly obligation to compile and hand a yearly compiled list of waste produced and the way of its management in to the Marshall of Voivodship of competent venue.

Slightly different duties are served by the entities dealing with transport. The carrier is obliged to keep a simplified waste record using a waste transfer note as he does not become waste owner. According to the Waste Act of 14 December 2012, the transporting entities should possess entry in the registry at the Marshall of Voivodship Office, however, in the period before the registry is created, the carriers are obliged to obtain a permission based on the current regulations determined in the Waste Act of 27 April 2001, that is a permission granted by the town president or prefect.

The sellers or intermediaries in fly ash trade are not even obliged to keep a simplified waste record³ unless they physically own waste and they do not have to possess a permission for waste management.

The largest number of obligations rests on the entities responsible for waste storage. On each stage of disposal site life cycle waste owners need to possess the appropriate decisions concerning waste management issued by a competent body (prefect, marshall of voivodship).

³ In case of hazardous waste, sellers or intermediaries in waste trade are obliged to maintain records using hazardous waste record card.

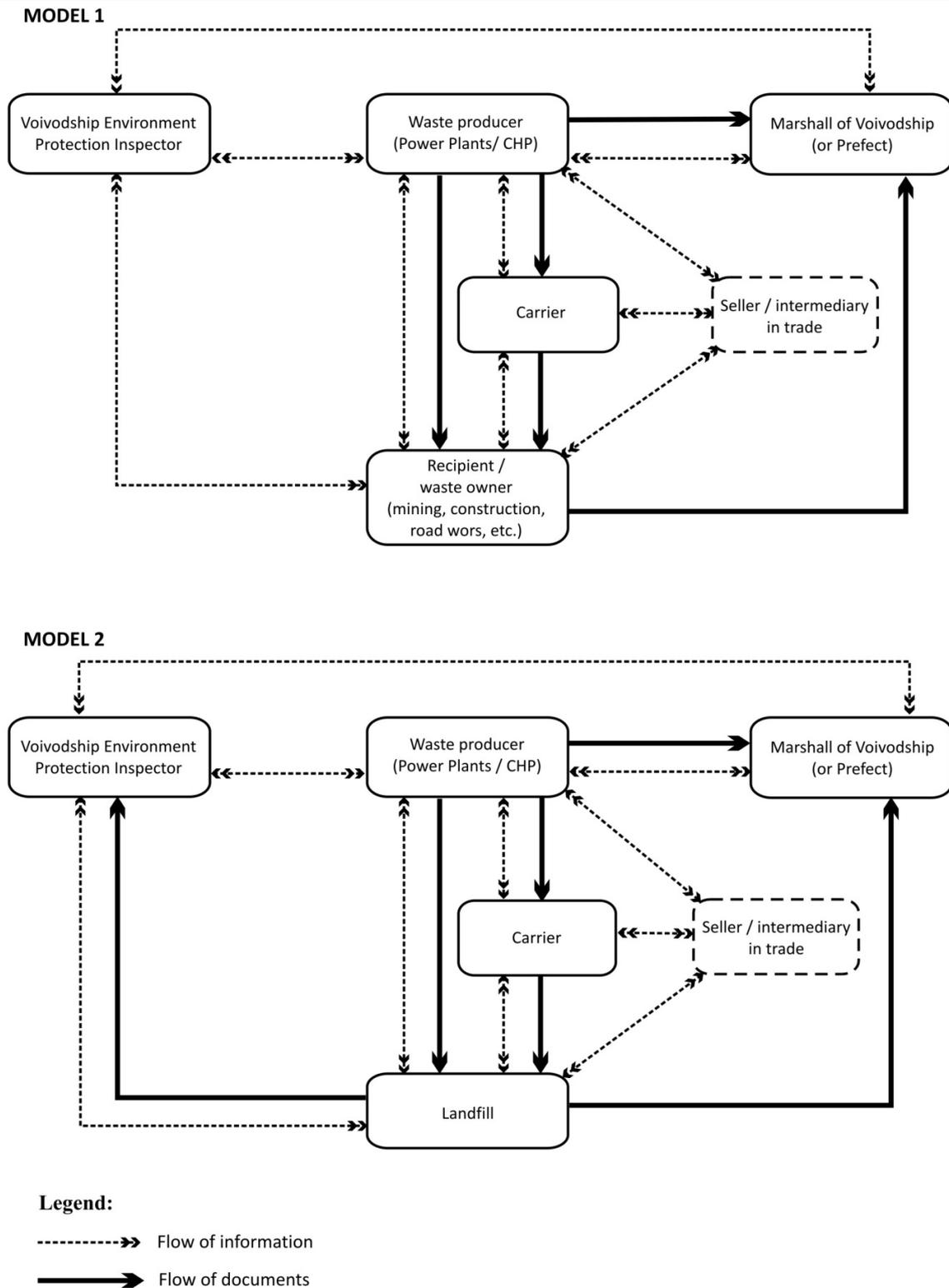


Fig. 2 The models of the flow of documents and information in the area of coal fly ash management

Firstly, they must obtain a permission for disposal site construction and management instruction, then permission for site utilization and finally, in the last stage of exploitation, permission for closing the site down [24]. Beside conducting quantitative and qualitative waste evidence, one of the most important obligations of site managers is to carry out monitoring in all stages of site life cycle and sending the results of monitoring to the Voivodeship Environmental Protection Inspector each year.

The models of the flow of documents and information in the area of coal fly ash management are shown in Fig. 3.

The first model of document flow concerns the variants in which fly ash is transferred from the producers to the enterprises using it in its activity as a ready product or as an ingredient of another product (construction, mining, cement production etc.). Information exchange and document flow takes place among the parties interested and the fly ash carrier. In some cases the parties interested in fly ash purchase/sales use the intermediary services – at that time the intermediary participates in the information exchange but does not participate in the document flow. The second model presents the document and information flow

among the entities in a case when fly ash is passed to a waste disposal site. These days the waste producers most often contact the fly ash disposal site directly, however, the participation of intermediary in trade is also possible – in this case, similarly to model 1, the intermediary participates in the information exchange only. Both in the first and second model each participant of fly ash supply chain (apart from intermediary in trade) is obliged to pass information and to obtain appropriate documents concerning the activity conducted from the state body of competent venue.

THE LEGAL REGULATIONS IN RELATION TO THE TECHNICAL CONDITIONS OF COAL FLY ASH MANAGEMENT

The legal regulations related to the technical conditions of fly ash management involve, among others:

- gathering (collection) process,
- storage process,
- transport process to the recipient (next owner),
- disposal process.

According to the article 23, section 1 of the Waste Act, waste collection should take place in a selective way, therefore, waste with different codes produced in a coal combustion process (fly ash, slag and its mixtures) is gathered in separate, isolated places where it is temporarily stored. The waste storage and transport processes should be conducted *“according to the requirements concerning environment protection and human life and health protection, especially in a way taking the chemical and physical properties of waste into account, such as state of matter and hazard that may be caused by waste [...]”* [21]. Taking fly ash physical and chemical properties into account, its storage should take place in closed tanks so that dusting does not occur, what in consequence could pose a threat for the environment and for the people who are not in a direct contact with this type of waste. Fly ash is most often stored in a steel or concrete silo of different capacity [3], depending on the producer’s needs. Construction of such tanks should include the technological transport system [3] and possibilities of plugging other appliances in such as loading conveyors with in-built filters thanks to which loading into the transport means may be conducted in a safe way (without dusting).

Fly ash transport may be conducted by any transport mean under the condition that it is of closed type. Large trucks or railway cars of various types are most often used for this purpose. In road transport these are tank trucks and silo semi-trailers, in railway transport tank wagons or self-unloading ones with sliding roof [4]. Load and storage capacity of cars and trailers varies, depending on the amount and type of ash transported.

The detailed technical requirements concerning the process of waste storage are defined by Regulation of the Minister of Environment of 30 April 2013 on waste disposal sites (Journal of Laws 2013 item 523). The requirements depend on the type of waste disposal site – they are different for hazardous waste, other for neutral or municipal waste. They mostly include the selection of appropriate place for disposal site, its construction and conditions of site management. The main purpose of setting these requirements is human health and life protection and prevention from surface and ground water, soil, ground and air [21]. Not all restriction concern fly ash in the act, however, disposal site should be:

- placed in a location with a natural geological barrier, sealing the walls and bottom,
- surrounded by greenbelt in order to reduce ash floating and spreading by wind,
- equipped with a system enabling mass measurement of waste collected [18].

In the regulation also the minimal disposal site’s distance from residential buildings, residential areas and public utility facilities are determined.

STATE ENVIRONMENTAL MONITORING

The supervision over the law abiding concerning environment protection is served by the Chief Inspector for Environmental Protection (GIOŚ). The duties of the Inspection for Environmental Protection in the particular voivodships are performed by Voivodeship Environmental Protection Inspectors (WIOŚ).

The detailed information concerning the duties conducted by WIOŚ are described in the Act on Inspection for Environmental Protection (consolidated text, Journal of Laws 2013 item 686) [20]. The range of duties performed by the inspectors is quite wide, however, in terms of waste management WIOŚ is mostly obliged to:

- taking decisions on activity suspension which violates the obligations connected with environment protection or which violates the conditions of environment utility,
- controlling law abiding concerning entrepreneurs’ obligations of some types of waste management,
- controlling law abiding and permissions obtained on its base,
- verification of yearly reports,
- cooperation concerning environment protection with other inspection bodies,
- controlling the exploitation of installations and appliances for environment protection from pollution [27].

Possession of the competencies above provides a possibility for the Voivodeship Environmental Protection Inspector to suspend the activity of fly ash owner or producer in a case of finding violation determined in the Waste Act that may pose a threat for environment, human life or health. WIOŚ may also issue a decision to cease waste disposal site utilization if the site manager does not fulfill the obligations resulting from the Waste Act, among others, obligation of handing in the results on waste disposal site monitoring before a set date.

In future the inspectors for environmental protection will also control whether the entities dealing with fly ash management possess the appropriate entry in the registry. The registry will be an integral part of BDO – Database on product and packaging and on waste management, which should be completed by the 22nd January 2016. The BDO administrator is the Minister of Environmental Protection of competent venue or a subject designated by him that is obliged to provide access to the database for the inspectors during inspection.

SUMMARY

Although fly ash is treated as a full-value product its management is burdened with many restrictions. They concern the entities dealing with fly ash management as well as technical conditions that must be fulfilled by the storage rooms, installations and transport means that carry fly ash.

Different legal obligations rest on these entities depending on the role served in the fly ash supply chain. The obligations mostly result from such legal acts as the Waste Act and the Environment Protection Act, further requirements stem from the detailed Regulations of the Ministry of Environment as well as from the technical standards. Permissions and decisions on fly ash management are issued by the Marshall of Voivodship (or Prefect) of competent venue, however, supervision over abiding the limitations and fulfilling the requirements is served by the Voivodeship Environmental Protection Inspectors (WIOŚ).

These days in Poland fly ash management, from the point of view of legal regulations, is successfully conducted and the degree of this type of waste management reaches 90%. Unfortunately, there is a real risk that the status of fly ash as waste would be changed into the status of hazardous waste (mainly because of trace amounts of heavy metals), what in result would trigger huge changes in the whole system of fly ash management, at the same time bringing about unpleasant consequences not only for many industries using it in their activity (construction, road works, mining) but also for the whole country.

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