



The Adopted Weight of Asbestos-Containing Products Versus Results of Stocktaking in the Area of Poland

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Abstract

The performance of detailed stocktaking of asbestos-containing products including the assessment of their quality is the basic action carried out in the process of cleaning the area from asbestos. The asbestos removal in Poland from the area of individual municipalities is carried out based on the Programme of Country Cleaning from Asbestos for the years 2009–2023. This document determines tasks necessary to perform by 2032 and the basis of actions consists of carrying out detailed stocktaking in field conditions. The results of stocktaking on a current basis are registered in the Asbestos Database kept by the Ministry of Economic Development, Labour and Technology (and before Ministry of Development) (<http://www.bazaazbestowa.gov.pl>). Values obtained during stocktaking in field conditions in units of area [m²] were converted according to 3 different weight conversion factors, used over the years, i.e. 11, 14, and 15 kg per 1 m². Potential accumulation and thereby generation of asbestos-containing waste may be estimated also based on the indices of generation by residents. Because of conditions in the urban and rural areas it is necessary to estimate separately waste generation indices for those areas. Moreover, individual voivodeships feature a specific nature and each of them should be considered on an individual basis. At present more than 480 million m² of asbestos-containing products were registered in the territory of Poland, which makes 7.2 million Mg. Those figures were obtained applying the conversion factor of area to weight equal to 15 kg. The greatest accumulation is observed in the Mazovian and Lublin voivodeships. On the entire country scale the deficit of landfilling capacity is now approx. 2,664,974 m³. The change of asbestos cement panel weight and the related change of conversion factor for the waste quantity from the area to weight does not affect the estimation of demand for additional landfill capacities. It should be clearly emphasised, that the amount of accumulated asbestos-containing waste, and hence the waste generation, should be provided in units of area [m²]. Values given in units of weight depend on the applied conversion factor.

Keywords: waste, asbestos, stocktaking, generation index, landfills capacity, Asbestos Database

Introduction

The performance of detailed stocktaking of asbestos-containing products including the assessment of their condition, i.e. quality, is the basic action carried out in the process of cleaning any area from asbestos. The asbestos removal in Poland from the area of individual municipalities is carried out based on the Programme of Country Cleaning from Asbestos for the years 2009–2023 (Programme of Asbestos Removal... 2002, Programme of Country Cleaning... 2009). This document determines tasks necessary to perform by 2032 and the basis of actions consists of carrying out detailed stocktaking in field conditions.

The results of stocktaking on a current basis are registered in the Asbestos Database kept by the Ministry of Economic Development, Labour and Technology (<http://www.bazaazbestowa.gov.pl>). This database is one of tools for monitoring the performance of tasks resulting from the programme and is a source of information in the field of this process execution pace and actions planning (Kłojzy-Karczmarczyk et al. 2016, Kłojzy-Karczmarczyk and Staszczak 2018, Wilk et al. 2015). The main elements related to asbestos-containing products occurrence in Poland are objects and sites, where such products are used. The corrugated asbestos cement sheets or 'diamond type panels situated on building roofs and façades

as well as asbestos cement pipes are the most frequently existing elements. Each asbestos-containing product during the removal from a specific building becomes automatically group 17 hazardous waste. Such classification results from the provisions of the Act on Prohibition of Asbestos-Containing Products Use of 19 June 1997 (i.e. Dz.U. of 2020, item 1680 with amendments). A widespread and long-lasting process of asbestos removal from the territory of the whole country was started. The main environmental hazard consists in elements of damaged structure, in particular when they are not properly removed (e.g. Jawecki 2008; Szeszenia-Dąbrowska 2007; Szeszenia-Dąbrowska and Sobala 2010; Szeszenia-Dąbrowska et al. 2015, Kłojzy-Karczmarczyk et al. 2016; Małuszyńska and Małuszyński 2016; Kłojzy-Karczmarczyk and Staszczak 2018).

More than 7 million Mg of asbestos-containing products have been registered now and not disposal yet (as of 2019 end). The weight of asbestos-containing waste, specified in the Asbestos Database, is based on the determination of the area of built-in asbestos-containing products in field conditions. The adopted weight of asbestos-containing panel was changing over the years. It was not related to a change of those products conditions, but resulted from the analysis of data from various environments. Undoubtedly, a change of the adopted weight (in Mg) for 1 m² of panels affects the specified weight

Tab. 1. The amount of asbestos-containing products in accordance with the results of stocktaking carried out in the area of Poland and the forecast asbestos-containing waste generation based on indices estimated by the authors own elaboration

Tab. 1. Ilość wyrobów zawierających azbest zgodnie z wynikami inwentaryzacji przeprowadzonej na obszarze Polski oraz prognozowane wytwarzanie odpadów zawierających azbest na podstawie wskaźników szacowanych przez autorów

No	Voivodeship	Registered stock of asbestos-containing products (and not disposed yet) based on the Asbestos Database *		Forecast generation of asbestos-containing waste **	
		weight [Mg]	area [m ²]	weight [Mg]	area [m ²]
1	Lower Silesian	138,960	9,263,992	340,340	22,689,364
2	Kuyavian-Pomeranian	496,867	33,124,442	301,373	20,091,545
3	Lublin	1,128,952	75,263,480	386,382	25,758,818
4	Lubuskie	71,396	4,759,729	130,702	8,713,455
5	Łódź	732,811	48,854,091	333,660	22,244,000
6	Lesser Poland	346,586	23,105,703	598,497	39,899,818
7	Mazovian	1,405,483	93,698,861	700,758	46,717,182
8	Opole	75,108	5,007,167	161,875	10,791,636
9	Podkarpackie	299,491	19,966,053	419,681	27,978,727
10	Podlaskie	516,942	34,462,826	166,525	11,101,636
11	Pomeranian	224,924	14,994,942	305,422	20,361,455
12	Silesian	252,063	16,804,169	426,965	28,464,364
13	Świętokrzyskie	469,063	31,270,900	233,611	15,574,091
14	Warmian-Masurian	201,750	13,449,995	208,564	13,904,273
15	Greater Poland	684,253	45,616,864	552,657	36,843,818
16	West Pomeranian	146,920	9,794,659	200,805	13,387,000
	POLAND	7,191,568	479,437,873	5,467,818	364,521,182

* – The registered stock of asbestos-containing products based on the Asbestos Database, as on 6 November 2019 (<http://www.bazaazbestowa.gov.pl>), assuming 1m² = 0.015 Mg (15 kg)

** – Forecast generation of asbestos-containing waste estimated based on indices presented in the paper by B. Kłojzy-Karczmarczyk et al. (2016) with the weight converted according to the assumption of 1m² = 0.015 Mg (15 kg)

of those products or waste in general. In 2018, the authors in a previous paper (Kłojzy-Karczmarczyk and Staszczak 2018) provided the total weight of registered products lower by nearly 2 million Mg. However, it is necessary to emphasise, that during processing the data in previous years a definitely lower weight of 1 m² of asbestos-containing materials was adopted. The paper shows the changes of the weight adopted for 1 m² of asbestos-containing panels over the years and proves the impact of such a change on the results obtained during the stocktaking in the area of Polish municipalities.

The stocktaking and generation of asbestos-containing waste

The performance of detailed stocktaking, including the assessment of the quality condition of asbestos-containing products is the basic action carried out in the process of country cleaning from asbestos. The results of stocktaking carried out on site in municipalities are on a current basis presented in the Asbestos Database kept by the Ministry of Economic Development, Labour and Technology (formerly Ministry of Development, Ministry of Entrepreneurship and Technology, and beforehand by the Ministry of Development and Ministry of Economy) (<http://www.bazaazbestowa.gov.pl>). The data gathered in the Asbestos Database allow to obtain a real and not presumed amount of materials accumulated in the area of Poland. At present (as on 6 November 2019) the amount of asbestos-containing products registered during the stocktaking (and not disposed yet) is 7,191,568 Mg (Table 1). This stocktaking is still incomplete and requires continuation but it is more and more precision. Not all municipalities carried out detailed stocktaking in their area yet. Certain municipalities performed it fragmentarily or entered only the products, which they intended to remove in a specific year based on

residents declaration. However, it should be emphasised, that the share of municipalities having a programme of asbestos-containing products removal from their own area, and hence detailed stocktaking, exceeds already 60%. Instead, the total number of municipalities covered by full or only partial stocktaking is estimated at more than 95%. So the figures given in Table 1 will be increased once full stocktaking is completed throughout the country, but at the same time decreased by landfilled values. The 2018 paper (Kłojzy-Karczmarczyk and Staszczak 2018) provided the registered amount of approx. 5,392,718 Mg (as on 21 August 2018). An increase over a year is significant, but it does not result from the increase in the amount of registered products in the area of consecutive municipalities in Poland. Such an increase results from the applied conversion factor from the amount given in units of area to the amount given in units of weight.

The programme of asbestos and asbestos-containing products removing from the territory of Poland (Programme of Asbestos Removal... 2002) specifies that the weight of 1 square metre of an asbestos cement panel is 11 kg (0.011 Mg). While in accordance with the data gathered by the paper authors from various asbestos-containing waste landfills, the weight of 1 m² of asbestos cement panel is on average 14 kg (0.014 Mg). This very value was taken in the 2011 paper to estimate indices for generation and calculation of waste weight potentially generated by one resident (Kłojzy-Karczmarczyk and Makoudi 2011). In turn, in accordance with the Asbestos Database, from 1 July 2019 the weight of 1 m² of asbestos cement panel is 15 kg (0.015 Mg). Till 30 June 2019 the conversion factor used in the database was 11 kg (0.011 Mg) per 1 m², in accordance with the 2002 programme. The weight of 11 kg per 1 m² was adopted during the results processing

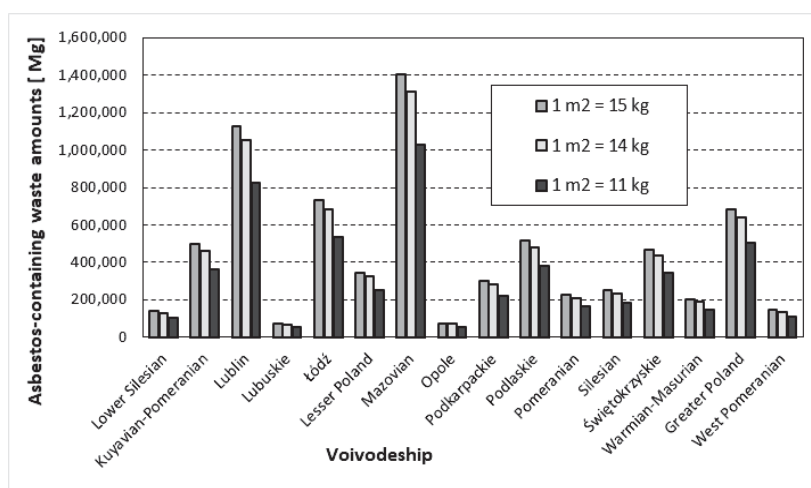


Fig. 1. The amount of asbestos-containing waste registered during the stocktaking in [Mg] assuming three different conversion factors of product [m²] to weight [kg] (based on <http://www.bazaazbestowa.gov.pl>)

Rys. 1. Wielkość zinventaryzowanych wyrobów zawierających azbest w [Mg] przy założeniu trzech różnych przeliczników [m²] wyrobu na masę [kg] (na podstawie <http://www.bazaazbestowa.gov.pl>)

and estimating the indices in the 2015 and 2016 papers (Klojzy-Karczmarczyk et al. 2015; 2016).

The estimation of possible generation of asbestos-containing waste based on indices of generation by residents is a separate issue in the process of analysis. This parameter value varies over time and results from delivering newer and newer stocktaking data, which at the same time feed the Asbestos Database. The paper authors participated in numerous stocktaking operations, which results allowed to produce indices for asbestos-containing waste generation by residents. Because of conditions in the urban and rural areas it is necessary to estimate separately waste generation indices for those areas (Klojzy-Karczmarczyk and Makoudi 2011, Klojzy-Karczmarczyk et al. 2016). Those indices were also used in this paper, but they were corrected due to a change of estimated weight of 1 m² of asbestos cement panel. In July 2019 the hitherto conversion factor from a square metre to kilogrammes was changed in the Asbestos Database. The previous value was 11 kg, while from July 2019 this value is 15 kg. Therefore indices calculated in 2016 were recalculated. The generation index provided in m² did not change, but the total weight of products forecast to generate was changed. Also the stocktaking results gathered in the Asbestos Database so far and converted to weight were automatically recalculated taking into account the weight of asbestos cement panel equal to 15 kg. Table 1 specifies the registered amount of asbestos-containing products with forecast generation of asbestos-containing waste in Poland estimated based on indices in a voivodeship arrangement. In the calculations the waste generation index (based on products accumulation) was taken for rural areas as 21 m²/per capita (0.315 Mg/per capita). Instead, the estimated index for waste generation in urban areas is 1.8 m²/per capita (0.027 Mg/per capita).

On the entire country scale the amount of material registered in the stocktaking is definitely higher than that forecast based on indices. The analysis carried out in the voivodeship arrangement shows those figure depending on the area. In the Warmian-Masurian voivodeship the amount registered in the stocktaking corresponds to the forecast one. In 8 voivodeships (Lower Silesian, Lubuskie, Lesser Poland, Opole, Pod-

karpackie, Pomeranian, Silesian, West Pomeranian) the forecast amount is higher than the registered one. In the other voivodeships the forecast amounts are lower than those registered in stocktaking. Voivodeships with high accumulation of asbestos-containing products comprise mainly the area of central and eastern Poland. However, in the process of index estimation, this area – due to the sequence of tasks performance – was represented only by single municipalities. To determine an index reliable for the entire area of Poland in each voivodeship it is necessary to carry out stocktaking in the same or similar number of municipalities with different types of development. The asbestos-containing waste generation index per 1 resident is definitely lower in urban than in rural municipalities, which results from the nature of development.

The amount of asbestos-containing products registered in the Asbestos Database is presented below (Fig. 1). Values obtained during stocktaking in field conditions in units of area [m²] were converted according to 3 different weight conversion factors, used over the years, i.e. 11, 14, and 15 kg per 1 m². The presented graphs show that in the Mazovian and Lublin voivodeships there are now more than million Mg of asbestos-containing products, which should be disposed by 2032. The results, specified in Mg, reflect the problem irrespective of the applied conversion factor of the registered area to weight, although the values applied now taking into account those used in the Asbestos Database give obviously the highest values.

The ensuring of capacity for asbestos-containing waste landfilling

There are many methods for effective and safe disposal of asbestos-containing waste (e.g. Makoudi 2007; Pawluk 2010; Wilk et al. 2015). The basic method consists in landfilling the asbestos-containing waste in places especially designed for this purpose. In the area of Poland there is a number of landfills or landfill sections designed and adapted to landfill such waste. There are also plans to expand such facilities or to build new ones. In almost every voivodeship there is a landfill for asbestos-containing waste or another landfill with a separate

Tab. 2. Available capacity of landfills for asbestos-containing products disposal by voivodeships
 Tab. 2. Dostępna pojemność składowisk do unieszkodliwiania wyrobów zawierających azbest z podziałem na województwa

No	voivodship	Number of generally accessible landfills*	Free capacity of generally accessible landfills [m ³]*
1	Lower Silesian	2	3,800
2	Kuyavian-Pomeranian	2	65,250
3	Lublin	3	171,198
4	Lubuskie	1	38,806
5	Łódź	2	8,957
6	Lesser Poland	3	40,207
7	Mazovian	1	33,918
8	Opole	-	-
9	Podkarpackie	4	9,101
10	Podlaskie	2	144,233
11	Pomeranian	4	202,939
12	Silesian	4	323,186
13	Świętokrzyskie	1	1,460,000
14	Warmian-Masurian	1	12,193
15	Greater Poland	1	53,000
16	West Pomeranian	2	95,325
total	POLAND	33	2,662,113

* - based on the Asbestos Database, as on 6 November 2019 (<http://www.bazaazbestowa.gov.pl>)

section for asbestos-containing waste landfilling. The Opole voivodeship is an exception, where there is no such landfill at all. Perhaps this results from the fact that the Opole voivodeship belongs to those with the smallest amounts of asbestos-containing products, which ultimately will become waste. Moreover, in the neighbouring Silesian voivodeship there are as many as 4 plants for this hazardous waste landfilling.

Overall, in the territory of Poland there are 33 landfills, where asbestos-containing products can be subject to disposal. The biggest number, 4 facilities, are situated in Podkarpackie, Pomeranian, and Silesian voivodeships, while 3 facilities in each of Lublin and Lesser Poland voivodeships. The specification of free capacity to landfill asbestos-containing waste (Table 2) shows that in many voivodeships there is a situation, that the amount of landfill capacity slowly becomes scarce. Acc. to the data registered in the Asbestos Database in total the free landfilling capacity (as on 6 November 2019) amounts to 2,662,113 m³, where in the Lower Silesia only 3,800 m³ left to fill, in the Łódź voivodeship 8,957 m³ left, while in the Podkarpackie voivodeship (despite 4 operating landfills) only 9,101 m³ left. Taking into account the fact that the data in the database cannot be updated on a current basis, the size of landfill sections left to fill for asbestos containing waste may be even smaller. So it is necessity to build new landfills or to transport asbestos-containing waste to other voivodeships. In the 2018 paper (Klojzy-Karczmarczyk and Staszczak 2018) the available landfilling capacity was shown as 2,679,409 m³ (as on 21 August 2018). The decrease in the free landfilling capacity on a year scale is not significant and results from the volume of landfilled waste. At the same time also sections for landfilling were expanded. The change of waste conversion factor from the area to weight does not affect the estimated landfilling capacity.

Conclusions

In 1998 a broad and long-lasting process of asbestos removal from the territory of the entire country was started in Poland, which at the same time resulted in the generation of group 17 hazardous waste. The grounds to analyse results

of stocktaking of built-in asbestos-containing products and monitoring of the removal process and determination of demand for the next landfills or landfill sections consist of the data and information gathered in the Asbestos Database (<http://www.bazaazbestowa.gov.pl>) as well as of the data obtained during the own work by the authors.

At present more than 480 million m² of asbestos-containing products were registered in the territory of Poland, which makes 7.2 million Mg. More than 1 million Mg exist only in the Mazovian and Lublin voivodeships. In 2018 the amount registered in the stocktaking was 490 million m² and the weight of registered products amounted to 5.4 million Mg. Such an increase in weight over 1 year results only from the applied conversion factor of area to weight. At the same time a part of asbestos-containing materials was removed from the area of real estates and disposed and the process of removal is visible via reduction of the area of accumulated materials expressed in m².

The paper presents the amount of asbestos-containing products registered in the Asbestos Database of the Ministry of Economic Development, Labour and Technology (and before Ministry of Development). Values obtained during stocktaking in field conditions in units of area [m²] were converted according to 3 different weight conversion factors, used over the years, i.e. 11, 14, and 15 kg per 1 m². Potential accumulation and thereby generation of asbestos-containing waste may be estimated also based on the indices of generation by residents. Because of conditions in the urban and rural areas it is necessary to estimate separately waste generation indices for those areas. Moreover, individual voivodeships feature a specific nature and each of them should be considered on an individual basis.

On the entire country scale the deficit of landfilling capacity is now approx. 2,664,974 m³. After the carried out planned expansion of the landfilling base the shortages will decrease to 1,420,004 m³. The change of asbestos cement panel weight and the related change of conversion factor for the waste quantity from the area to weight does not affect the estimation of demand for landfills. The decrease in the free landfilling capacity

in the years 2018-2019 is not significant and results from the volume of landfilled waste. On a year scale the total available landfilling capacity went down by 17,296 m³.

Taking into account the results of carried out analysis in the field of asbestos-containing products stocktaking and estimating the available waste landfilling capacity it is necessary to emphasise that these values should be referred to a unit of area or a unit of volume. Indices of those products accumulation and thereby generation indices given in units

of area [m²] remain topical. While the indices given in units of weight lose their importance and depend on the applied conversion factor. The only deviation from this observation consists in the fact of possible specification of accumulated products (waste) in weight units measured in real terms.

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Przyjmowana waga wyrobów zawierających azbest a wyniki inwentaryzacji na obszarze Polski
Podstawowym działaniem, realizowanym w procesie oczyszczania obszaru z azbestu, jest przeprowadzenie szczegółowej inwentaryzacji wyrobów zawierających azbest wraz z oceną ich jakości. Usuwanie azbestu w Polsce, z terenu poszczególnych gmin, realizowane jest na podstawie Programu oczyszczania kraju z azbestu na lata 2009–2032. Dokument ten określa zadania niezbędne do realizacji do 2032 roku, a podstawą działań jest przeprowadzenie szczegółowej inwentaryzacji w warunkach terenowych. Wyniki procesu inwentaryzacji są na bieżąco zamieszczane w Bazie Azbestowej prowadzonej przez Ministerstwo Rozwoju, Pracy i Technologii (wcześniej Ministerstwo Rozwoju) (<http://www.bazaazbestowa.gov.pl>). Wartości pozyskane w trakcie inwentaryzacji w warunkach terenowych w jednostkach powierzchni [m^2] przeliczono zgodnie z 3 różnymi przelicznikami wagowymi, stosowanymi na przestrzeni lat, czyli 11, 14 oraz 15 kg na 1 m^2 . Potencjalne nagromadzenie a tym samym wytwarzanie odpadów zawierających azbest może być też szacowane na podstawie wskaźników wytwarzania przez mieszkańców. Ze względu na uwarunkowania obszarów miejskich oraz wiejskich, konieczne jest oddzielne szacowanie wskaźników wytwarzania odpadów dla tych obszarów. Poza tym poszczególne województwa wykazują specyficzny charakter i każde z nich należy traktować indywidualnie. Na chwilę obecną, na terytorium Polski, zinwentaryzowanych zostało ponad 480 mln m^2 wyrobów zawierających azbest, co stanowi 7,2 mln Mg. Wielkości te pozyskano stosując przelicznik powierzchni na masę na poziomie 15 kg. Największe nagromadzenie obserwowane jest w województwie mazowieckim oraz lubelskim. W skali całego kraju istnieje obecnie niedobór miejsca do składowania na poziomie 2 664 974 m^3 . Zmiana masy płyty azbestowo-cementowej i związana z tym zmiana przelicznika ilości odpadów z powierzchni na masę nie ma wpływu na szacowanie zapotrzebowania na dodatkowe pojemności składowiska. Należy wyraźnie zauważyć, że ilość nagromadzonych wyrobów zawierających azbest a tym samym wytwarzanie odpadów podawane powinno być w jednostkach powierzchni [m^2]. Wartości podawane w jednostkach masy są uzależnione od zastosowanego przelicznika.

Słowa kluczowe: odpady, azbest, inwentaryzacja, wskaźnik wytwarzania, pojemność składowania, Baza Azbestowa