GOSPODARKA SUROWCAMI MINERALNYMI – MINERAL RESOURCES MANAGEMENT

2022 Volume 38 Issue 3 Pages 191–207

DOI: 10.24425/gsm.2022.143018

BEATA KLOJZY-KARCZMARCZYK[1], JAROSŁAW STASZCZAK[2]

# The pace of removing asbestos-containing products in Poland and the forecast time for the completion of this process

## Introduction

Asbestos removal in Poland is carried out based on the Program of Country Cleaning from Asbestos for the Years 2009–2032 (Program of Asbestos Removal... 2002; Program of Country Cleaning... 2009). This document specifies the tasks necessary to perform by 2032. By this time, the asbestos-containing products should be removed from the territory of the entire country. The use of asbestos-containing products ceased in 1998 pursuant to the Act on Prohibition of Asbestos Containing Products Use of 19 June 1997 (i.e. Journal of Laws, 2020, item 1680 with amendments). At the same time a widespread and long-lasting process of their removing was started. Each asbestos-containing product during the removal from a specific building automatically becomes Group 17 hazardous waste, in accordance with the waste catalogue (Journal of Laws, 2020, item 10).

✉ Corresponding Author: Beata Klojzy-Karczmarczyk; e-mail: beatakk@min-pan.krakow.pl

[1] Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Kraków, Poland; ORCID iD: 0000-0002-2003-2291; Scopus iD: 8328386000; e-mail: beatakk@min-pan.krakow.pl

2 Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Kraków, Poland; ORCID iD: 0000-0002-6157-9920 ; Scopus iD: 56814992100; e-mail: jaro@min-pan.krakow.pl

Asbestos-cement corrugated sheets or 'diamonds' type panels situated on building roofs and façades, as well as asbestos-cement water and sewerage pipes are the most frequently existing elements that contain asbestos in Poland (e.g. Urbaniak 2011; Glica and Sobczyk 2014; Wilk et al. 2015; Krówczyńska and Wilk 2018a, 2018b; Thives et al. 2022). More than 7 million Mg of such products have now been registered in the stocktaking (as of 04/29/2022), 96% of which are roofing and building facades, while 2.5% are asbestos-cement pipes and joints. The results of asbestos-cement products stocktaking and removing on a current basis are registered in the Asbestos Database, now kept by the Ministry of Development and Technology (Asbestos Database... 2022). The weight of asbestos-containing waste, specified in the Asbestos Database, is based on the determination of the area of built-in asbestos-cement products in field conditions. This database is the basic tool for monitoring the implementation of tasks resulting from the national program. This database is the source of information about the pace of the process of the removal of asbestos-containing products, and about the planning of actions, and forecasting the effects of actions in the considered field (Klojzy-Karczmarczyk et al. 2016; Krówczyńska and Wilk 2018b; Klojzy-Karczmarczyk and Staszczak 2018, 2020).

The basis for implementation of tasks resulting from the Program of Country Cleaning from Asbestos for the Years 2009–2032 consists in the performing of detailed stocktaking in field conditions and current updating of the data gathered in the Asbestos Database. The performance of repeated stocktaking studies in a specific area after a few or a dozen or so years after the original stocktaking, enables observation of the pace of asbestos-containing product removal and to forecast changes until the completion of this process. The data acquired from the Asbestos Database and from field observations show that the pace of asbestos removal in Poland is too slow and there is a risk that this process will not be finished in accordance with the document assumptions, i.e. by the end of 2032. Thus, the authors made an attempt to estimate the values illustrating the pace of asbestos-containing product removal from Poland. The obtained values will allow simulation of the time necessary to complete the process, if the current pace of removal is retained. It should be clearly emphasized that the Asbestos Database, containing the results of stocktaking, is still incomplete. Some communities have still not performed stocktaking in their areas, or the stocktaking was carried out incompletely. However, the data from individual communities were mostly entered in detail and are subject to updating on a current basis.

## 1. Methodology of analysis

The analysis of the pace of the removal of asbestos-containing products and the forecasting the time of this process completion was based on data acquired in field conditions and gathered in the Asbestos Database over many years (Asbestos Database... 2022). The stocktaking of asbestos-containing products, in accordance with the binding legislation, is the task of the building's owner. The preparation of the program for asbestos-containing-

-product removal, containing, inter alia, a summary list of asbestos-containing buildings (result of detailed stocktaking), in a system of three degrees of urgency, is the responsibility of the local government of the commune.

The stocktaking, including the assessment of the condition and possibilities of safe use of asbestos-containing products, was carried out on site, by the end of 2010, in accordance with the Regulations of the Minister of Economy, Labor, and Social Policy of 2 April 2004 on methods and conditions of the safe use and removal of asbestos-containing products (Journal of Laws, 2004, No. 71, item 649) and of 23 October 2003 on requirements in the field of asbestos use and transfer, and on using and cleaning installations or equipment in which asbestos was or is used (Journal of Laws, 2003, No. 192, item 1876). At the end of 2010, the above regulations were updated and from 2011, the work is carried out in accordance with Regulations of the Minister of Economy, Labor, and Social Policy of 13 December 2010 on methods and conditions of safe use and removal of asbestos-containing products (Journal of Laws, 2011, No. 8, item 649) and of 5 August 2010 on requirements in the field of asbestos use and transfer, and on using and cleaning installations or equipment, in which asbestos was or is used (Journal of Laws, 2010, No. 162, item 1089). The on-site stocktaking, including the assessment of the condition of asbestos-containing products, applies to all buildings with built-in asbestos-containing products, e.g. buildings of individual farms, buildings managed by communities, and buildings owned by economic operators.

The analysis of the pace of the removal of asbestos-containing products presented in the paper was performed on data which were entered onto the Asbestos Database. Twenty communities were selected, for which the original stocktaking was performed many years ago, as well as the stocktaking update, that is the secondary stocktaking. The majority of these communities are situated in the area of three provinces: Małopolska, Silesia, and Podkarpacie. Table 1 presents the list of communities for which the stocktaking data were analyzed. The communities were divided according to their nature into: urban communities (marked U, 2 communities), rural communities (marked R, 10 communities), and urban-rural communities (marked UR, 8 communities).

Table 1. List of analyzed communities

Tabela 1. Zestawienie gmin poddanych analizie

| Province | Number of analyzed communities | Community symbol* |
|---|---|---|
| Małopolska | 8 | R1, R4, R5, R7, UR1, UR3, UR5, UR7 |
| Silesia | 3 | R8, R10, UR2 |
| Podkarpacie | 4 | U1, U2, R3, UR8 |
| Other | 5 | R2, R6, R9, UR4, UR6 |
| Total | 20 | |

* U1–U2: urban communities, R1–R10: rural communities, UR1–UR8: urban-rural communities.

Basic assumptions of the analysis:

- The resources of the Asbestos Database, kept now by the Ministry of Development and Technology (Asbestos Database... 2022), are the basis of analysis.
- 20 communities were selected for the detailed analysis (2 urban communities, 10 rural communities, and 8 communities of urban-rural nature, Table 1.
- The results of original stocktaking in the twenty individual communities and the results of secondary stocktaking (stocktaking update) were analyzed.
- The assumption was made that the time of observation is the time between the original stocktaking and the stocktaking update. The observation time is variable and ranges between 5 and 12 years (Table 2). To estimate the pace of removal, the differences between figures of the original and secondary stocktaking were considered.
- In addition, the results of stocktaking for the area of the whole Poland were analyzed – these broken down to individual provinces. The results of stocktaking in the years 2018, 2019, and 2022 were analyzed. To estimate the pace of removal, a period of nearly four years, between 2018 and 2022, was considered.

Amounts estimated based on the analysis:

- The pace of removal based on twenty selected communities (Tables 2 and 5):
  - Based on the results of analysis of original stocktaking and stocktaking update for twenty communities, the pace of the removal of asbestos-containing products was determined.
  - The difference in the analyzed figures of stocktaking was calculated. The observation time was considered, which is the period between the cases of stocktaking. Values reflecting the pace of removal were estimated and converted to one resident of a specific community. In general, the calculations were made by dividing the annual amount of removal of asbestos-containing products for a specific area by the total population of the community or area.
  - The obtained figures provided the basis to estimate the mean value of the pace of removal for selected provinces, taking into account the population of individual communities (weighted mean, Table 2).
  - The obtained figures provided the basis to estimate the mean value of the pace of removal for urban areas and rural areas, taking into account the population of these areas in the analyzed communities (weighted mean, Table 3).
  - The time necessary to remove the asbestos-containing products from the area of individual communities and selected provinces was determined as was the predicted year of completion of the removal process on the assumption of maintaining the current pace of the process (Table 6 and 7).
- The pace of removal based on the data gathered in the Asbestos Database for the area of Poland (Table 4 and 5):
  - The difference in the analyzed figures of stocktaking was calculated for the area of the whole Poland and broken down into provinces.

- Close to a four-year observation time was considered, i.e. the period between stocktaking figures from 2018 and 2022. An average value of the pace was estimated for Poland, reflecting the pace of removal of asbestos-containing products converted to one resident of the country.
- The time necessary for removal of asbestos-containing products from individual provinces was estimated on the assumption of the current pace of removal being maintained (Table 4 and 8).
- The time necessary for the total removal of asbestos-containing products from the area of Poland was estimated on the assumption of the current pace of removal being maintained (Table 5 and 8).

It should be clearly emphasized that the Asbestos Database, containing the results of stocktaking, remains incomplete. Some communities have still not performed stocktaking in their areas, or the stocktaking was carried out incompletely. However, the data from individual communities were mostly entered in detail and are subject to updating on a regular basis.

## 2. Results of the performed analysis

Based on the available data on the amounts of asbestos-containing products obtained during both the first stocktaking and the stocktaking update, it was determined how much the amount of asbestos-containing products decreased in the areas of the individual twenty communities. The obtained result enabled us to determine the current pace of such materials removal from a specific area. The pace of removal in individual analyzed communities is definitely diversified (Table 2). In typically rural communities the pace of removing generally ranges from 0.81 to 6.26 kg/R/y (kg per resident per year). So high diversification is also observed for typically urban communities, where the pace of removing in one community is only 0.28, while in the second, it is as much as 5.67 kg/R/y. In urban-rural communities, the pace of removal ranges from 0.55 to 6.35 kg/R/y. It is necessary to notice that in one of rural communities, the pace of removing clearly differs from the others, reaching a high value of 36.26 kg/R/y. This is a community in the Kujawy-Pomerania Province, where during the observation time (between the cases of stocktaking), extreme atmospheric phenomena occurred, thereby causing the destruction of roofs on many buildings. A clearly increased amount of removed asbestos-containing products is undoubtedly related to that event. The total amount of asbestos-containing products removed per year in other communities can be related to the number of residents or the nature of the community.

Based on the pace of asbestos-containing products removing in the analyzed twenty communities, an average value was determined for three provinces (Table 2). The highest value illustrating the pace of removal of such products was shown for the Małopolska Province, where the averaged pace of removal is 4.02 kg/R/y. The averaged paces of removal in the Silesia and Podkarpacie Province are comparable and amount to 2.33 and 2.29 kg/R/y,

Table 2. Averaged pace of asbestos-containing products removing in the selected twenty communities and selected provinces

Tabela 2. Uśrednione tempo usuwania wyrobów zawierających azbest w wybranych 20 gminach i wybranych województwach

| Province | Community symbol | Observation period in the area of selected communities (years)* | Averaged pace of removal from the area of communities (Mg/year) | Pace of removal of asbestos-containing products in communities (kg/R/y) | Averaged pace of removal for provinces (kg/R/y)** |
|---|---|---|---|---|---|
| Lesser Poland | R1 | 9 | 8.537 | 1.55 | 4.02 |
| | R4 | 6 | 103.975 | 6.26 | |
| | R5 | 10 | 11.873 | 1.34 | |
| | R7 | 6 | 31.675 | 2.72 | |
| | UR1 | 5 | 38.205 | 6.70 | |
| | UR3 | 10 | 129.204 | 5.73 | |
| | UR5 | 11 | 180.020 | 3.70 | |
| | UR7 | 8 | 23.053 | 2.00 | |
| Silesian | R8 | 12 | 35.259 | 4.50 | 2.33 |
| | R10 | 7 | 8.571 | 2.05 | |
| | UR2 | 8 | 17.541 | 1.23 | |
| Podkarpackie | U1 | 10 | 34.388 | 5.67 | 2.29 |
| | U2 | 5 | 10.359 | 0.28 | |
| | R3 | 6 | 31.025 | 4.75 | |
| | UR8 | 9 | 58.935 | 6.35 | |
| Other | R2 | 7 | 29.226 | 3.55 | |
| | R6 | 7 | 3.812 | 0.81 | |
| | **R9** | **5** | **188.541** | **36.26** | |
| | UR4 | 8 | 16.073 | 0.55 | |
| | UR6 | 12 | 40.748 | 4.03 | |
| On average based on twenty municipalities | | | | | 3.65 |

* The time between the original stocktaking and re-stocktaking in the area of selected communities, Asbestos Database... 2022 and own data.

** Calculated as weighted average, taking into account the population of individual communities.

(kg/R/y) – kg per resident per year.

respectively. It is necessary to emphasize here that the mean values obtained from the analysis for provinces have a limited value due to a minute number of communities representing individual provinces as compared with the total.

The pace of the removal of asbestos-containing products was also calculated with consideration to the nature of communities, broken down to urban, rural, and urban-rural communities. Significant differences in this parameter are observed for the areas of urban nature and areas of rural nature, even within the same commune. Thus, the urban-rural communities were divided into areas of towns and areas of village administration units. In this way, the pace of removal was calculated for both categories of the division. In urban areas of the analyzed communities, the pace of removal is slow, on average 1.04–1.96 kg/R/y. In rural areas, the pace of removal is much faster and is about 5.70–5.75 kg/R/y. The observed substantially faster pace of removal from rural areas undoubtedly results from a clearly larger amount of this material used in buildings in these areas.

Table 3. Averaged pace of asbestos-containing products removing for communities of different nature, and for rural and urban areas on the basis of the analyzed twenty communities

Tabela 3. Uśrednione tempo usuwania wyrobów zawierających azbest dla gmin o różnym charakterze oraz dla obszarów wiejskich i miejskich na podstawie analizowanych 20 gmin

| Community/Area | Community symbol | Number of analyzed communities | Pace of asbestos-containing products removing for communities and for areas in communities of different nature (kg/R/y) |
|---|---|---|---|
| Urban communities | U1–U2 | 2 | 1.04 |
| **Rural communities** | R1–R10 | **10** | **5.70** |
| Urban-rural communities | UR1–UR8 | 8 | 3.32 |
| Urban area | – | 10 | 1.96 |
| **Rural area** | – | **18** | **5.75** |

(kg/R/y) – kg per resident per year.

The pace of the removal of asbestos-containing products was also calculated for the entire area of Poland. This parameter was analyzed by means of two methods, described in the section above, based on the analysis of data gathered in the Asbestos Database, and based on the analysis of the stocktaking performed for the twenty selected communities.

Data on the amounts of asbestos-containing products received from stocktaking in the entire area of Poland and still not disposed were collected from the Asbestos Database three times (Table 4). Overall, in the period between August 2018 and April 2022, 312,700.540 Mg of asbestos-containing products were removed and disposed of, which converted to a year, gives 85,281.966 Mg. The annual amount of removal of asbestos-containing products was

Table 4. Figures on the amounts of asbestos-containing products, received from stocktaking in the area of Poland, based on the Asbestos Database

Tabela 4. Dane o ilości wyrobów zawierających azbest, zinwentaryzowanych na obszarze Polski, na podstawie Bazy Azbestowej

| Number | Province | Amount of asbestos-containing products received from stocktaking (Mg) | | |
|---|---|---|---|---|
| | | as of 21/08/2018* | as of 06/11/2019** | as of 29/04/2022*** |
| 1 | Lower Silesia | 151,363.032 | 138,960.000 | 139,831.995 |
| 2 | Kujawy-Pomerania | 509,998.560 | 496,867.000 | 473,737.744 |
| 3 | Lublin | 1,122,324.615 | 1,128,952.000 | 1,096,607.372 |
| 4 | Lubuskie | 77,136.230 | 71,396.000 | 68,051.098 |
| 5 | Łódź | 756,816.592 | 732,811.000 | 706,890.018 |
| 6 | Małopolska | 339,550.627 | 346,586.000 | 323,707.353 |
| 7 | Mazovia | 1,411,061.669 | 1,405,483.000 | 1,379,304.724 |
| 8 | Opole | 77,516.920 | 75,108.000 | 73,527.076 |
| 9 | Podkarpacie | 300,886.729 | 299,491.000 | 285,571.940 |
| 10 | Podlasie | 543,884.365 | 516,942.000 | 509,981.102 |
| 11 | Pomerania | 234,463.465 | 224,924.000 | 226,446.643 |
| 12 | Silesia | 262,947.393 | 252,063.000 | 240,803.269 |
| 13 | Świętokrzyskie | 475,207.561 | 469,063.000 | 459,842.885 |
| 14 | Warmia-Masuria | 210,396.926 | 201,750.000 | 195,331.645 |
| 15 | Wielkopolska | 729,007.751 | 684,253.000 | 715,403.613 |
| 16 | West Pomerania | 151,145.032 | 146,920.000 | 145,968.448 |
| | Poland | 7,353,707.465 | 7,191, 569.000 | 7,041,006.925 |

* Asbestos Database... 2022 (Accessed: 2018-08-21); Klojzy-Karczmarczyk and Staszczak 2018.
** Asbestos Database... 2022 (Accessed: 2019-11-06); Klojzy-Karczmarczyk and Staszczak 2020.
*** Asbestos Database... 2022 (Accessed: 2022-04-29).

then divided by the population of the entire country (in accordance with the GUS figures, this is 38,080,411 residents, as of 31 December 2021). The calculated current pace of removal for the entire area of Poland is 2.24 kg/R/y.

In addition, the pace of removal for the area of Poland was determined based on the stocktaking and its update for twenty selected communities. The calculated averaged pace of removal on the entire country scale is 3.65 kg/R/y, based only on a study in these selected communities. After rejecting the extreme value for community R9, which substantially deviates from the others, the pace of removal on a country scale was estimated to be 3.02 kg/R/y.

Another important issue consists of showing the time necessary for the total removal of asbestos-containing products from an area. At the current stage of analysis, an unambiguous determination of this time is a difficult issue. However, these values can be estimated taking into account various methods (Table 5). The value specifying the pace of removal is important to determine at this time. For forecasting needs, an assumption was made that this value will be maintained in the future. Considering the pace of removal, based on the data gathered in the Asbestos Database, the estimated time necessary for the total removal of asbestos materials from the territory of Poland is 83 years. Assuming the pace of removal calculated on the basis of the twenty selected communities, the forecast time is definitely shorter and it is fifty years. The rejection of the extreme value for community R9 extends the predicted time to 61 years. In any case, irrespective of the applied method, the predicted time of the removal of asbestos-containing products definitely goes beyond 2032, this is the assumption made in the Program of Country Cleaning from Asbestos for the Years 2009–2032.

Table 5. Estimated time needed for the total removal of asbestos-containing products from the area of Poland – comparison

Tabela 5. Szacowany czas potrzebny na całościowe usunięcie wyrobów zawierających azbest z obszaru Polski – zestawienie

| Pace of removal/estimation method | Observation time (years) | Pace of asbestos removal (kg/R/year) | Estimated time needed for the total removal of asbestos-containing products from the area of Poland (years) |
|---|---|---|---|
| Pace of removing, based on twenty selected communities (Table 2) | 5– 12 | 3.65 | 50 |
| Pace of removing, based on nineteen selected communities (after rejection of R9) | 5– 12 | 3.02 | 61 |
| Pace of removing based on the data gathered in the Asbestos Database for the area of Poland (Table 4) | about 4 | 2.24 | 83 |

(kg/R/y) – kg per resident per year.

Within the presented analysis, it is important to draw attention to two factors which have undoubtedly shaped the obtained results. First, it should be emphasized that the stocktaking in many communities and the data update in the Asbestos Database is continuous, and the work remains ongoing. A small number of communities still do not have the detailed stocktaking of asbestos-containing products, and in many communities, the stocktaking was performed imprecisely. The updating of data in field conditions and the supplementing of database resources on a current basis will have a significant impact on the estimated values and their change. The second factor consists of a small number of communities which have been analyzed in detail under the presented work. The estimated time necessary for the total

removal of asbestos materials from the territory of the entire country, using the stocktaking of only twenty communities, should be treated with great caution. This uncertainty of the obtained values results from a small number of communities representing individual provinces. The authors had data for these twenty communities only.

Table 6. Estimated completion time of the removal of asbestos-containing products from the area of the analyzed provinces if the current pace of removal is maintained

Tabela 6. Szacowany czas zakończenia procesu usunięcia wyrobów zawierających azbest z obszaru analizowanych przy zachowaniu obecnego tempa usuwania

| Province | Community symbol | Estimated year of process completion of the removal of asbestos-containing products in communities | Time necessary to remove asbestos from the area of the commune if the current pace of removal is maintained (years) |
|---|---|---|---|
| Lesser Poland | R1 | 2152 | 130 |
| | R4 | 2041 | **19** |
| | R5 | 2205 | 183 |
| | R7 | 2077 | 55 |
| | UR1 | 2041 | **19** |
| | UR3 | 2035 | **13** |
| | UR5 | 2037 | **15** |
| | UR7 | 2042 | **20** |
| Silesian | R8 | 2057 | 35 |
| | R10 | 2035 | **13** |
| | UR2 | 2256 | 234 |
| Podkarpackie | U1 | 2042 | **20** |
| | U2 | 2091 | 69 |
| | R3 | 2074 | 52 |
| | UR8 | 2068 | 46 |
| Other | R2 | 2204 | 182 |
| | R6 | 2269 | 247 |
| | R9 | 2035 | **13** |
| | UR4 | 2068 | 46 |
| | UR6 | 2075 | 53 |

Estimated time of the process completion of the removal of asbestos-containing products exceeding one hundred years.

The main problem in the performance of tasks in the process of cleaning the country from asbestos is too slow a pace of the removal of asbestos-containing products and incomplete data in the field of stocktaking in individual communities. A similar postulate results from the work included in the NIK Information of 2016 (NIK… 2016). This document specifies that the work of asbestos removal in Poland will continue for another 196 years, if the pace of 2016 is maintained. Based on the performed analysis, it is possible to state that some of the analysed communities and provinces integrate with this value, but some communities have clearly accelerated the work.

The performed analysis has shown that none of the twenty communities will complete the process of the removal of asbestos-cement products before 2032 (Table 6 and 7, Figures 1 and 2). Among those communities, there are seven for which it is possible to think that if the current pace of removal is maintained, the process will finish within the next 20 years, that is by around 2040. For five of the analyzed communities, the estimated current pace of removal is so slow that the anticipated completion time of the removal process of asbestos-containing products will definitely exceed 100 years. In extreme cases, the analysis shows that the process of removal will only end in the years 2204–2269.

Table 7. Estimated time necessary for the total removal of asbestos-containing products from the area of selected provinces, calculated based on the performed stocktaking in the twenty analyzed communities

Tabela 7. Szacowany czas potrzebny na całościowe usunięcie wyrobów zawierających azbest z obszaru wybranych województw, obliczony na podstawie wykonanej inwentaryzacji w analizowanych 20 gminach

| Voivodeship | Population | Averaged pace of removal (kg/R/y) | Averaged pace of removal from the area of province (Mg/year) | Estimated time to remove asbestos-containing products (years) |
|---|---|---|---|---|
| Małopolska | 3,407,727 | 4.02 | 13,699.06 | 24 |
| Silesia | 4,455,877 | 2.33 | 10,382.19 | 23 |
| Podkarpacie | 2,110,694 | 2.29 | 4,833.49 | 59 |

Asbestos Database... 2022 (Access: 2006–2021) and own data.
(kg/R/y) – kg per resident per year.

Also the estimated time necessary for the total removal of asbestos-containing products from the area of Poland and from individual provinces, calculated based on the data gathered in the Asbestos Database, shows that the process of removal will not be completed before 2032. Retaining the current pace of the removal of asbestos-containing products, such products will disappear from the territory of Poland only in 2105. In individual provinces, the amounts of asbestos and the pace of removal are drastically different (Table 4 and 8). The estimated time needed to remove products with asbestos differs between provinces and ranges from 27 to 193 years. On the scale of the entire country, the time necessary to perform the

tasks was obtained as eighty-three years. In accordance with the current pace, the products will be removed fastest from provinces: Lubuskie (in 2049), Silesia (in 2062), Lower Silesia (in 2066), Kujawy-Pomerania and Warmia-Masuria (in 2070), Łódź (in 2074), Podlasie (in 2077), Podkarpacie and Opole (in 2090), and Małopolska Province (in 2097). In the remaining six provinces, the pace is now so slow that all the products will not be removed before even 2100.

Table 8. Estimated time necessary for the total removal of asbestos-containing products from the area of Poland and individual provinces, calculated based on the data gathered in the Asbestos Database

Tabela 8. Szacowany czas potrzebny na całościowe usunięcie wyrobów zawierających azbest z obszaru Polski i poszczególnych województw, obliczony na podstawie danych zgromadzonych w Bazie Azbestowej

| No. | Voivodeship | Averaged pace of removal (kg/R/y) | Averaged pace of removal from the area (Mg/year) | Estimated time to remove asbestos-containing products (years) |
|---|---|---|---|---|
| 1 | Lower Silesia | 1.09 | 3,144.828 | 44 |
| 2 | Kujawy-Pomerania | 4.83 | 9,889.313 | 48 |
| 3 | Lublin | 3.38 | 7,013.794 | 156 |
| 4 | Lubuskie | 2.48 | 2,477.763 | 27 |
| 5 | Łódź | 5.63 | 13,616.338 | 52 |
| 6 | Małopolska | 1.27 | 4,320.893 | 75 |
| 7 | Mazovia | 1.60 | 8,660.985 | 159 |
| 8 | Opole | 1.12 | 1,088.139 | 68 |
| 9 | Podkarpacie | 1.98 | 4,176.761 | 68 |
| 10 | Podlasie | 7.93 | 9,246.344 | 55 |
| 11 | Pomerania | 0.93 | 2,186.406 | 104 |
| 12 | Silesia | 1.36 | 6,039.306 | 40 |
| 13 | Świętokrzyskie | 3.46 | 4,190.366 | 110 |
| 14 | Warmia-Masuria | 2.92 | 4,108.713 | 48 |
| 15 | Wielkopolska | 1.06 | 3,710.219 | 193 |
| 16 | West Pomerania | 0.84 | 1,411.796 | 103 |
| | Poland | 2.24 | 85,281.966 | 83 |

Asbestos Database... 2022 (Accessed: 2018-08-21 and 2022-04-29).
(kg/R/y) – kg per resident per year.

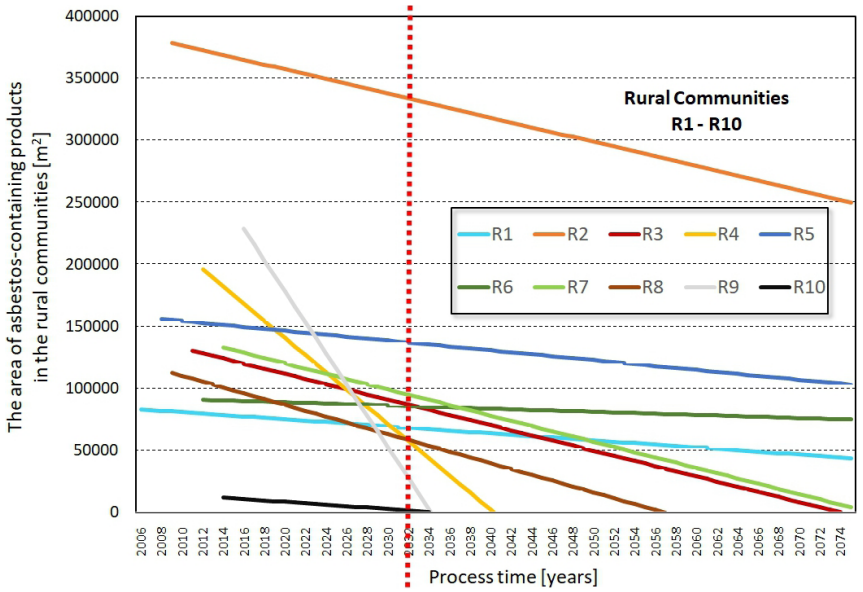


Fig. 1. The amount of asbestos-containing products used in the area of analyzed rural communities, observed and forecast in consecutive years

Rys. 1. Obserwowana i prognozowana w kolejnych latach ilość wyrobów zawierających azbest znajdujących się na obszarze analizowanych gmin wiejskich

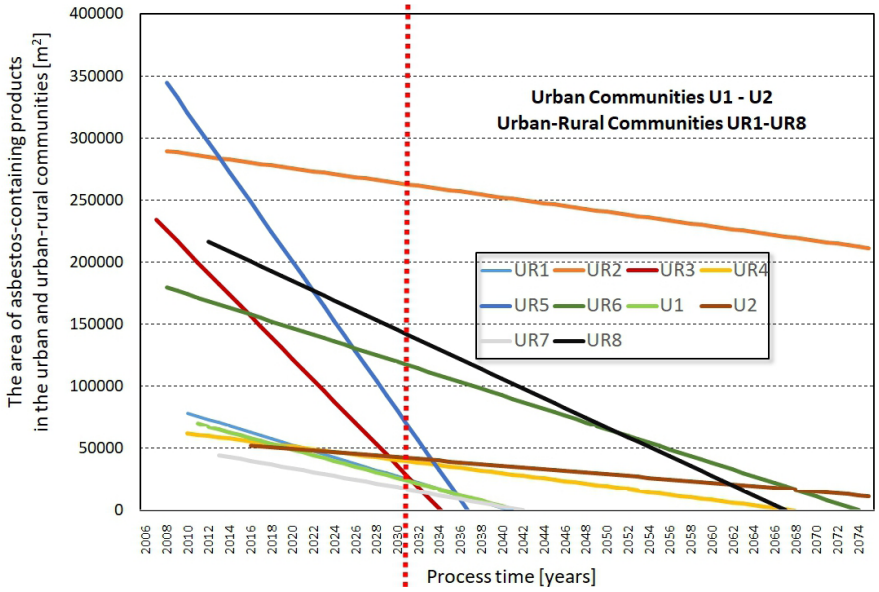


Fig. 2. The amount of asbestos-containing products used in the area of analyzed urban and urban-rural communities, observed and forecast in consecutive years

Rys. 2. Obserwowana i prognozowana w kolejnych latach ilość wyrobów zawierających azbest znajdujących się na obszarze analizowanych gmin miejskich oraz gmin miejsko-wiejskich

## Conclusions

Asbestos-cement sheets on building roofs and façades as well as asbestos-cement water and sewerage pipes are the most frequently existing elements that contain asbestos in Poland. In 1998, the use of asbestos-containing products was stopped, and their removing is performed based on the Program of Country Cleaning from Asbestos for the Years 2009–2023. This document specifies the tasks that are necessary to perform. The determination of whether the current pace of the removal of asbestos-containing products enables the completion of this process by the end of 2032 is a significant issue.

The pace of the removal of asbestos-containing products and the time necessary to conduct this process was estimated using two resources of data. The data gathered in the Asbestos Database (Asbestos Database... 2022) were analyzed and an analysis of the detailed stocktaking and its update for twenty selected communities of various nature was performed. The analysis has shown that considering the current pace of removal of asbestos-containing products, these materials will not be removed from the area of Poland by the set date (the end of 2032). Retaining the current pace of removal of asbestos-containing products, such products will disappear from Poland only within 20–200 years, depending on the province. An average pace of removal, given for the country scale, enables us to state that eighty-three years are needed for the total removal of asbestos products. The estimated time necessary to remove the asbestos materials from the territory of the entire country should be treated with great caution. The pace of removal of asbestos-containing products from the area of individual communities is diversified but falls within the same value ranges, irrespective of the nature of the given community. In general, the values obtained based on the analysis of twenty communities are accurate, but they cannot be equated with the area of the entire Poland due to a small amount of divided communities. On the entire country scale, the best results for the estimation values are provided by the analysis of Asbestos Database resources. However, in this case, it is necessary to consider that changes in the amounts received in stocktaking over the years can result not only from the process of product removal but also from feeding the database with new data for the areas where stocktaking was conducted for the first time.

The removal of asbestos-containing products that have accumulated in Poland is a huge project. The analysis of data shows that the process will not be performed according to the assumptions. Thus, to accelerate the pace of removal of asbestos-containing products, it is necessary to intensify actions. It seems necessary to start additional financial instruments. In addition, it is important to determine priority actions which would take into account the degree of harmfulness of asbestos products.

*This paper has been prepared within the framework of the statutory activity of the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences in Kraków, Poland.*

## REFERENCES


Asbestos Database... 2022 – Asbestos Database, kept now by the Ministry of Development and Technology. [Online:] http://www.bazaazbestowa.gov.pl [Accessed: 2006–2021, 2018-08-21, 2019-11-06 and 2022-04-29].

Glica, M. and Sobczyk, W. 2014. Waste containing asbestos in the Community Szczucin. *Journal of the Polish Mineral Engineering Society* 1(33), pp. 97–104.

NIK… 2016 – NIK on the implementation of the country's asbestos removal program – detailed information (*NIK o realizacji programu oczyszczania kraju z azbestu – informacje szczegółowe)*. [Online:] https://www.nik.gov.pl/aktualnosci/nik-o-realizacji-programu-oczyszczania-kraju-z-azbestu.html [Accessed: 2022-08-04] (*in Polish*).

Journal of Laws, 2003, No. 192, item 1876. Regulations of the Minister of Economy, Labour, and Social Policy of 23 October 2003 on requirements in the field of asbestos use and transfer, and on using and cleaning installations or equipment, in which asbestos was or is used *(Rozporządzenie Ministra Gospodarki, Pracy i Polityki Społecznej z dnia 23 października 2003 roku w sprawie wymagań w zakresie wykorzystywania i przemieszczania azbestu oraz wykorzystywania i oczyszczania instalacji lub urządzeń, w których był lub jest wykorzystywany azbest)* (*in Polish*).

Journal of Laws, 2004, No. 71, item 649. Regulations of the Minister of Economy, Labour, and Social Policy of 2 April 2004 on methods and conditions of safe use and removal of asbestos-containing products (*Rozporządzenie Ministra Gospodarki, Pracy i Polityki Społecznej z dnia 2 kwietnia 2004 roku w sprawie sposobów i warunków bezpiecznego użytkowania i usuwania wyrobów zawierających azbest)* (*in Polish*).

Journal of Laws, 2010, No. 162, item 1089. Regulations of the Minister of Economy, Labour, and Social Policy of 5 August 2010 on requirements in the field of asbestos use and transfer, and on using and cleaning installations or equipment, in which asbestos was or is used *(Rozporządzenie Ministra Gospodarki, Pracy i Polityki Społecznej z dnia 5 sierpnia 2010 roku w sprawie wymagań w zakresie wykorzystywania i przemieszczania azbestu oraz wykorzystywania i oczyszczania instalacji lub urządzeń, w których był lub jest wykorzystywany azbest)* (*in Polish*).

Journal of Laws, 2011, No. 8, item 649. Regulations of the Minister of Economy, Labour, and Social Policy of 13 December 2010 on methods and conditions of safe use and removal of asbestos-containing products *(Rozporządzenie Ministra Gospodarki, Pracy i Polityki Społecznej z dnia 13 grudnia 2010 roku w sprawie sposobów i warunków bezpiecznego użytkowania i usuwania wyrobów zawierających azbest)* (*in Polish*).

Journal of Laws, 2020, item 10. Regulation of the Minister of Climate of January 2, 2020 on the waste catalog *(Rozporządzenie Ministra Klimatu z dnia 2 stycznia 2020 r. w sprawie katalogu odpadów)* (*in Polish*).

Journal of Laws, 2020, item 1680 with amendments. The Act on Prohibition of Asbestos Containing Products Use of 19 June 1997 *(Ustawa o zakazie stosowania wyrobów zawierających azbest z dnia 19 czerwca 1997 roku)* (*in Polish*).

Klojzy-Karczmarczyk, B. and Staszczak, J. 2018. The Demand for Landfills for Asbestos-Containing Waste in Poland. Inżynieria Mineralna. *Journal of the Polish Mineral Engineering Society* 2(42), pp. 221–230, DOI: 10.29227/IM–2018-02-28.

Klojzy-Karczmarczyk, B. and Staszczak, J. 2020. The adopted weight of asbestos-containing products versus results of stocktaking in the area of Poland. *Journal of the Polish Mineral Engineering Society* 2(2), pp. 41–46, DOI: 10.29227/IM–2020-02-67.

Klojzy-Karczmarczyk et al. 2016 – Klojzy-Karczmarczyk, B., Makoudi, S., Mazurek, J., Staszczak, J. and Żółtek, J. 2016. An analysis of inventory results of products containing asbestos in the area of 63 communes in the period from 2005–2015 *(Analiza wyników inwentaryzacji wyrobów zawierających azbest na obszarze 63 gmin w latach 2005–2015). The Bulletin of the Mineral and Energy Economy Research Institute of the Polish Academy of Sciences* 92, pp. 211–224 *(in Polish*).

Krówczyńska, M. and Wilk, E. 2018a. Asbestos Exposure and the Mesothelioma Incidence in Poland. *International Journal of Environmental Research and Public Health.* 15(8), DOI: 10.3390/ijerph15081741.

Krówczyńska, M. and Wilk, E. 2018b. Spatial analysis of asbestos exposure and occupational health care in Poland during the period 2004–2013. *Geospatial Health* 13(2), DOI: 10.4081/gh.2018.689.

Program of Asbestos Removal... 2002 – *Program of Asbestos Removal and Asbestos Containig Products in Poland (Program usuwania azbestu i wyrobów zawierających azbest stosowanych na terytorium Polski).* Warszawa: Ministerstwo Gospodarki (*in Polish*).

Program of Country Cleaning... 2009 – *Program of Country Cleaning from Asbestos for the years 2009–2032 (Program Oczyszczania Kraju z Azbestu na lata 2009–2032).* Warszawa: Ministerstwo Gospodarki (*in Polish*).

Thives et al. 2022 – Thives, L.P., Ghisi, E., Thives Júnior, J.J. and Vieira, A.S. 2022. Is asbestos still a problem in the world? A current review. *Journal of Environmental Management* 319, DOI: 10.1016/j.jenvman.2022.115716.

Urbaniak, W. 2011. Legal requirements related to the inventory of asbestos-containing materials (*Wymogi prawne związane z ewidencją materiałów zawierających azbest*). [Online:] https://www.izolacje.com.pl/artykul/sciany-stropy/159358 [Accessed: 2022-08-04] (*in Polish*).

Wilk et al. 2015 – Wilk, E., Krówczyńska, M., Olędzka, G. and Pabjanek, P. 2015. *Asbestos landfill and transportation of asbestos-containing products (Składowanie i transport wyrobów zawierających azbest w świetle obowiązującego prawa)* [In:] *Nauka w służbie przyrodzie – wybrane zagadnienia* Olszówka, M. and Maciąg, K. eds., pp. 131–139, Lublin (*in Polish*).

## THE PACE OF REMOVING ASBESTOS-CONTAINING PRODUCTS IN POLAND AND THE FORECAST TIME FOR THE COMPLETION OF THIS PROCESS

Keywords

asbestos, asbestos-cement products, pace of removal,
estimated indices, process completion

Abstract

The asbestos removal in Poland is carried out based on the Programme of Country Cleaning from Asbestos for the Years 2009–2023. Pursuant to this document asbestos-containing materials should be removed from the territory of the whole country by the end of 2032. The pace of asbestos-containing products removal was estimated and also the time necessary to implement this process. These figures were estimated using two resources of data. The data gathered in the Asbestos Database (Asbestos Database... 2022) were analysed, and the analysis of detailed stocktaking and its update for 20 selected communes of various nature was carried out. The pace of removing in the analysed communes is definitely diversified. The obtained values generally range from 0.28 to 6.35 kg/R/y (kg per resident/year). An averaged pace of asbestos removal for the entire country is from 2.24 to 3.65 kg/R/y, depending on the adopted method of calculations. The analysis has shown that considering the current pace of asbestos-containing products removing, these materials will not be removed from the area of Poland by the set date, i.e. by the end of 2032. In individual provinces the amount of asbestos and the pace of removal are drastically different. Retaining the current pace of asbestos-containing products removing, such products will disappear from Poland only within 27–193 years, depending on the province. An average pace of removal, given for the country scale, allows to state that 83 years are needed for the total removal of asbestos products.

**TEMPO USUWANIA WYROBÓW ZAWIERAJĄCYCH AZBEST W POLSCE I PROGNOZOWANY CZAS ZAKOŃCZENIA TEGO PROCESU**

Słowa kluczowe

azbest, wyroby azbestowo-cementowe, tempo usuwania, szacowane wskaźniki, zakończenie procesu

Streszczenie

Usuwanie azbestu w Polsce realizowane jest na podstawie Programu oczyszczania kraju z azbestu na lata 2009–2032. Zgodnie z tym dokumentem materiały zawierające azbest powinny zostać usunięte z terytorium całego kraju do końca roku 2032. Oszacowano tempo usuwania wyrobów zawierających azbest oraz czas potrzebny do realizacji tego procesu. Wielkości te szacowano z wykorzystaniem dwóch zasobów danych. Przeprowadzono analizę danych zgromadzonych w Bazie Azbestowej (Asbestos Database... 2022) oraz przeprowadzono analizę szczegółowej inwentaryzacji oraz jej aktualizacji dla 20 wybranych gmin o różnym charakterze. Tempo usuwania w analizowanych gminach jest zdecydowanie zróżnicowane. Uzyskane wartości kształtują się generalnie w granicach od 0,28 do 6,35 kg/M/rok (kg/mieszkańca/rok). Uśrednione tempo usuwania azbestu dla całego kraju wynosi od 2,24 do 3,65 kg/M/rok w zależności od przyjętej metody obliczeń. Analiza wykazała, że biorąc pod uwagę obecne tempo usuwania wyrobów zawierających azbest, materiały te nie zostaną usunięte z obszaru Polski w ustalonym terminie, czyli do końca 2032 roku. W poszczególnych województwach ilość azbestu oraz tempo usuwania diametralnie się różnią. Przy zachowaniu obecnego tempa usuwania wyrobów zawierających azbest, wyroby te znikną z obszaru Polski dopiero na przestrzeni 27–193 lat, w zależności od województwa. Średnie tempo usuwania podane w skali kraju pozwala na stwierdzenie, że do całościowego usunięcia wyrobów azbestowych potrzeba 83 lat.