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Leaching of metals from asbestos-containing products used for roofing

Introduction

The 1970s witnessed the broad use of asbestos in various technologies. Asbestos, due to its properties, was used in various sectors of industry, construction industry, power sector, and transport. The scope of application for asbestos-containing products was the subject of numerous papers (e.g. Dyczek 2000; Obmiński 2000; Pyssa and Rokita 2007). Asbestos cement corrugated sheets or 'diamond' type panels (flat sheets) 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. The use of asbestos-containing products was ceased in 1998 pursuant to the Act on Prohibition of Asbestos Containing Products Use of June 19, 1997 (unified text: Dz.U. of 2020, item 1680 with amendments). The use of the ma-

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terials was stopped due to the dangerous properties of asbestos. A widespread and long-lasting process of asbestos removal from the territory of the whole country 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 (Dz.U. of 2020, item 10).

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 be performed by 2032. The results of stocktaking and removing on a current basis are registered in the Asbestos Database, now kept by the Ministry of Development and Technology (http://www.bazaazbestowa.gov.pl). This database is one of tools for monitoring the performance of tasks resulting from the program and is a source of information in the field of this process execution pace and actions planning (Klojzy-Karczmarczyk et al. 2016; Klojzy-Karczmarczyk and Staszczak 2018, 2020; Wilk et al. 2015).

Asbestos is a general term for fibrous minerals from the amphibole and serpentines group, which are hydrated iron-magnesium aluminosilicates, sometimes containing other elements. Asbestos minerals are natural components of metamorphosed rocks, developed in limestones or magnesium-rich argillaceous rocks. Asbestos is a mineral featuring exceptional chemical and physical properties. It is resistant to high temperature, has good heat insulating and noise absorbing properties, tensile strength, flexibility, as well as it is resistant to acids, alkalis, and sea water (certain varieties) (Obmiński 2000; Szeszenia-Dąbrowska 2007; Więcek 2004; Pyssa and Rokita 2007). In world literature one can find a number of papers, which show a possibility of asbestos fibers release and their introduction to the environment. For asbestos concentrations in the air the maximum allowable concentrations (MAC) are given, expressed by the number of asbestos fibers per 1 cm^3, and by the amount of total dust in mg/m^3. In the case of asbestos concentration in soils there are no set criteria, specifying permissible pollution levels. Albeit there are studies showing the process of asbestos fibers release, but there are no studies in the literature on the metals leachability for asbestos-containing materials, and as a result – for asbestos-containing waste. So the authors made an attempt to supplement the knowledge in the considered scope.

1. Asbestos cement products and the environmental impact

Basic centers of asbestos pollution related to human activity include buildings and areas connected with the asbestos-containing waste generation and storage, unauthorized dumps of asbestos-containing waste, as well as real estate, building structures, equipment, plants or other places, where asbestos products are used, in particular during asbestos-containing products removal. In Poland, asbestos cement sheets installed on buildings roofs and façades are the most important in the overall issues of asbestos-containing products occurrence. Asbestos cement pipes are still used in water supply networks in Poland. The data on the amount and quality of asbestos-containing products are specified in the Asbestos Database of the Ministry of Development and Technology (http://www.bazaazbestowa.gov.pl) (Table 1). More than 7.1 million Mg of asbestos-containing products have been now registered in the stocktaking (as of 2021), 96% of which is roofing, while 2.5% are asbestos cement pipes and joints. 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.

Table 1. Specification of quantities and quality of asbestos-containing products registered during the stocktaking in the area of Poland

Tabela. 1. Zestawienie ilości i jakości wyrobów zawierających azbest zinwentaryzowanych na obszarze Polski

Asbestos-containing products	Total amount left for disposal (Mg)	Products characteristic (types)	Amount left for disposal, broken down by types (Mg)
Roofing, all types together	6,888,752.231	flat sheets	506,423.091
		corrugated sheets	6,382,329.140
Total asbestos cement pipes and joints	179,892.463	to remove	101,286.723
		to leave in the ground	78,605.740
Others total			37,819.168
TOTAL			7,106,463.862

Data source: Asbestos Database, Ministry of Development and Technology (https://bazaazbestowa.gov.pl), as of August 21, 2021.

Natural sources of asbestos in practice are of negligible importance due to the substantial dispersion of deposits and existence in the areas, which are relatively poorly populated, while the sources related to human activities usually exist in regions of high population density.

The environmental pollution with asbestos means contamination of the air with asbestos dusts, especially the respirable fraction, most dangerous to people, and the soil pollution, which causes re-emissions of asbestos dust. Considering the environmental pollution and the threats to human health, the emission of asbestos fibers from corroding asbestos cement products as well as asbestos fibers emission resulting from improperly carried out dismantling, transport, or storage of asbestos-containing products is the biggest problem. The main environmental hazard consists in elements of damaged structures, in particular when they are not properly removed (e.g. Więcek 2004; Jawecki 2008; Szeszenia-Dąbrowska ed. 2007; Szeszenia-Dąbrowska and Sobala 2010; Szeszenia-Dąbrowska et al. 2015; Klojzy-Karczmarczyk et al. 2016; Małuszyńska and Małuszyński 2016; Klojzy-Karczmarczyk and Staszczak 2018).

The asbestos dust in the air and its long-term inhalation are carcinogenic. The literature states that the asbestos fibers shall be considered a physical carcinogen (Szeszenia-Dąbrowska at al. 2015; Szeszenia-Dąbrowska 2007; Szeszenia-Dąbrowska and Sobala 2010). However, the involvement of other asbestos properties in the development of carcinogenic process cannot be excluded. The pollution with some metals is specified among other possible reasons (e.g. Więcek 2004; Pyssa and Rokita 2007).

The asbestos dusts released into the air have an undoubtedly negative impact on human health. The opinions on the harmful effect of asbestos cement pipes are divided. There are no studies on and evidence of harmful effects of asbestos contained in the water on human health (Klemczak and Biegańska 2009; Pyssa and Rokita 2007). Because of missing convincing evidence for harmfulness to the health of asbestos gathered in drinking water, the World Health Organization considers that this substance does not require the determination of permissible concentration in water (WHO Drinking Water Guidelines 2004). Despite the fact that asbestos is a known carcinogen, when it gets to the body via the respiratory tract, the available epidemiological studies have not confirmed a hypothesis that there is an increased risk of a pathogenic process resulting from drinking potable water containing asbestos fibers (Asbestos in Drinking-water 2003, 2020).

All the studies of the effect on human health so far were related to the asbestos fibers' importance. There are no studies on the importance of the leaching of individual components from the asbestos cement material, both from roofing as well as the water supply or sewerage system pipes.

2. Sampling and methodology

The aim of this study was to identify whether some metals can be leached from asbestos-containing waste and thus improved into the soil and water environment. Asbestos-containing wastes, randomly selected on the territory of Poland, were subject to leaching. Five samples from various locations in the area of the Lubelskie, Podkarpackie, Kujawsko-Pomorskie, Mazovian, and Lesser Poland Provinces were selected for analysis. They were marked with symbols Corrugated sheet 1–Corrugated sheet 5 (Table 3). The weight of original samples was about 0.5 kg. The materials were manual fragmented to a particle size <10 mm and homogenized. Samples weights of 100 grams were selected for testing.

The analyzed material consisted of removed asbestos cement products, deposited on the ground surface as hazardous waste. The analysis of pollutants leaching comprised so-called hard products, with a density >1000 kg/m^3. All the analyzed samples originated from the cladding sheets, widely used in the national construction industry, mainly as the roofing (popular corrugated sheets). The asbestos cement products used in the construction industry contain 10 to 15% asbestos. Asbestos cement pressure pipes (water supply and sewerage) contain a comparable amount of asbestos, of 12–15% (Więcek 2004; Indulski ed. 1990).

The leaching test was performed for all collected samples of asbestos-containing waste. In the laboratory practice a number of testing methods may be used, which allow to determine the amount of leachability in the solution (in mg/dm^3), and hence leaching from solid samples (in mg/kg DM) (e.g. Makowska et al. 2018; Mizerna and Król 2015; Rosik-Dulewska and Karwaczyńska 2008). The selection of an appropriate method for a leachability studying is a significant element of the environmental hazard assessment. The presented paper comprises laboratory tests under static conditions (1:10 test) with the use of distilled water as the leaching medium (initial pH 7.49). Aluminum, boron, barium, cadmium, chromium, copper, iron, nickel, lead, strontium, zinc, and mercury were determined in the eluate. Table 2 specifies conditions of metals leachability from the asbestos-containing waste. The leaching was carried out in accordance with the rules of standard PN EN 12457/1-4 *Characterization of waste – Leaching – Compliance test for leaching of granular waste materials and sludges*. The basic test 1:10 was carried out (solid phase S: liquid phase L). The extraction was carried out in one stage.

The pH of the solutions was determined by the potentiometric method with an Elmetron pH meter with a combination electrode.

To determine aluminum, boron, barium, cadmium, chromium, copper, iron, nickel, lead, strontium, and zinc, the atomic emission spectrometry with excitation in inductively coupled

Table 2. Parameters of the methodology applied to study metals leachability from asbestos-containing waste

Tabela. 2. Parametry zastosowanej metodyki badania wymywalności metali z odpadów zawierających azbest

Parameter	Leaching in a neutral medium (batch test)
Basic assumptions	PN-EN 12457/1-4 method
Sample weight	100 g
Material's particle size	<10 mm
L/S (liquid/solid) ratio, w in this case S means asbestos-containing waste	10/1 (1:10 test)
Leaching liquid	Distilled water – pH 7,49
Shaking method	Laboratory shaker
Shaking time	24 h ± 0.5
Type of filter	Membrane filter Pores Ø 0.45 µm
Determination of Al, B, Ba, Cd, Cr, Cu, Fe, Ni, Pb, Sr, Zn content	Inductively Coupled Plasma – Optical Emission Spectrometers, ICP-OES method (PN-EN ISO 11885:2009)
Determination of Hg content	Atomic absorption spectrometer AMA 254

Methodology adapted to the research equipment of MEERI PAS laboratory.

plasma method (ICP-OES) was used (the determination was made in an accredited laboratory, PCA accreditation No 1050). The Limit of Quantification (LOQ) for metals analysis in the liquid samples are 0.01 mg/dm^3 (Al, Ba, Cd, Cr, Fe, Pb, Zn), 0.1 mg/dm^3 (B), 0.05 mg/dm^3 (Ni), 0.2 mg/dm^3 (Sr) and 0.005 mg/dm^3 (Cu).

An Altec atomic absorption spectrometer AMA 254 was used to determine the mercury content. The applied analytical method provides the result of mercury determination as a sum of all Hg forms existing in the sample. High-temperature mineralization and the application of an appropriate catalyst allows good results for majority of mercury speciations, co-existing in environmental samples to be achieved. Two determinations of mercury content were made and the arithmetic mean was given for each case. The Limit of Quantification (LOQ) for Hg analysis in liquid samples is 0.0005 mg/dm^3. The Limit of Detection (LOD) is 0.00015 mg/dm^3.

The results of eluate analytic determinations are given in mg/dm^3 and specified in Table 3. The determined concentrations of individual components were next converted into

Table 3. Metals leaching from asbestos-containing waste (1:10 test using distilled water as the leaching medium)

Tabela 3. Wymywalność metali z odpadów zawierających azbest (test 1:10, woda destylowana jako medium ługujące)

Parameter	Unit	Sample name				
		Corrugated sheet 1	Corrugated sheet 2	Corrugated sheet 3	Corrugated sheet 4	Corrugated sheet 5
pH of the eluate	–	8.79	9.20	8.54	9.11	8.22
Al	mg/dm^3	0.613 ±0.042	1.25±0.08	3.27±0.22	0.603±0.041	1.25±0.08
B	mg/dm^3	<0.1	0.125±0.012	<0.1	<0.1	<0.1
Ba	mg/dm^3	0.377±0.044	0.019±0.002	0.132±0.015	0.419±0.049	0.263±0.031
Cd	mg/dm^3	<0.01	<0.01	<0.01	<0.01	<0.01
Cr	mg/dm^3	0.098±0.006	0.095±0.006	0.019±0.001	0.068±0.004	0.037±0.002
Cu	mg/dm^3	0.071±0.005	0.007±0.000	0.019±0.001	0.006±0.0004	0.016±0.001
Fe	mg/dm^3	0.012±0.001	0.013±0.001	<0.01	0.017±0.001	<0.01
Ni	mg/dm^3	<0.05	<0.05	<0.05	<0.05	<0.05
Pb	mg/dm^3	<0.01	<0.01	<0.01	<0.01	<0.01
Sr	mg/dm^3	4.53±0.28	0.267±0.020	2.28±0.14	1.26±0.08	1.12±0.07
Zn	mg/dm^3	<0.01	<0.01	<0.01	<0.01	<0.01
Hg	mg/dm^3	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005

The mean values ± SD.

Table 4. Mean values of metals leaching from asbestos-containing waste

Tabela 4. Uśredniona wymywalność wybranych metali z odpadów zawierających azbest

Parameter	Measured values			Limit values		
	min–max (mg/dm^3)	mean		permissible for drinking water for people* (mg/dm^3)	permissible values for industrial sewage** (mg/dm^3)	permissible values of leaching for inert waste*** (mg/kg DM)
		(mg/dm^3)	(mg/kg DM)			
Al	0.603–3.270	1.397	13.97	0.2	3.0	–
B	<0.1–0.125	<0.1	<1.0	1.0	1.0	–
Ba	0.019–0.419	0.242	2.42	–	2.0	20
Cr	0.019–0.095	0.063	0.63	0.05	0.1	0.5
Cd	<0.01	<0.01	<0.1	0.005	0.07	0.04
Cu	0.006–0.019	0.024	0.24	2.0	0.5	2
Fe	<0.01–0.017	0.012	0.12	0.2	–	–
Ni	<0.05	<0.05	<0.5	0.02	0.1	0.4
Pb	<0.01	<0.01	<0.1	0.01	0.1	0.5
Sr	0.267–4.530	1.891	18.91	–	–	–
Zn	<0.01	<0.01	<0.1	–	2.0	4.0
Hg	<0.0005	<0.0005	<0.005	0.001	0.03	0.01

* Regulation of the Minister of Health of December 7, 2017 on the quality of drinking water for people (Dz.U. of 2017, item 229).

** Regulation of the Minister of Maritime Economy and Inland Navigation of July 12, 2019 on substances especially hazardous to the water environment and conditions to be met when introducing sewage to waters or ground, and also at discharging rainwater or thaw water to waters or water equipment (Dz.U. of 2019, item 1311).

*** Regulation of the Minister of Economy of July 16, 2015 on allowing the waste to be landfilled (Dz.U. of 2015, item 1277).

– No determined limit values.

The gray fields – above the limit values.

the released amount of the pollutant in relation to the dry weight of the sample and also provided in mg/kg DM. The obtained results are specified in Table 4.

3. Results and discussion

The presented paper contains an analysis of leaching tests results for 5 samples of asbestos-containing waste of corrugated sheet type, previously used as roofing. In the process of leaching with distilled water (pursuant to the rules of the PN-EN 12457/2 method), after the experiment performance and stabilization of conditions (after approx. 24 hours), for the obtained solutions pH ranged from 8.22 to 9.20 (Table 3 and 4). So the alkalinity of eluates increased with respect to the leaching medium pH (7.49).

In general, low leachability of individual metals under the planned and determined conditions was observed (Table 3 and 4, Figure 1). Metals such as cadmium, nickel, lead, and zinc were not observed in the solution. Boron was observed only for one sample. The leachability for mercury was not observed or was found at the Limit of Detection level. The obtained results of Hg content in previous studies for other environmental samples, including the groups of mineral wastes were higher (Klojzy-Karczmarczyk and Mazurek 2019, 2021).

The other analyzed metals were observed in eluates, but their concentrations were usually low (Figure 1). The low leachability was found for barium (0.019 to 0.419 mg/dm^3), chromium (0.019 to 0.095 mg/dm^3), copper (0.006 to 0.019 mg/dm^3), and iron (<0.01 to 0.017 mg/dm^3).

The highest leachability values were found for strontium and aluminum. The leachability of strontium ranged from 0.267 to 4.530 mg/dm^3, at a mean value of approx. 1.891 mg/dm^3. However, strontium is not a parameter, for which the permissible limit values are set for drinking waters, industrial sewage or leachate, determining the possibility of storage for landfills of a specific type. The presence of strontium compounds and their leachability

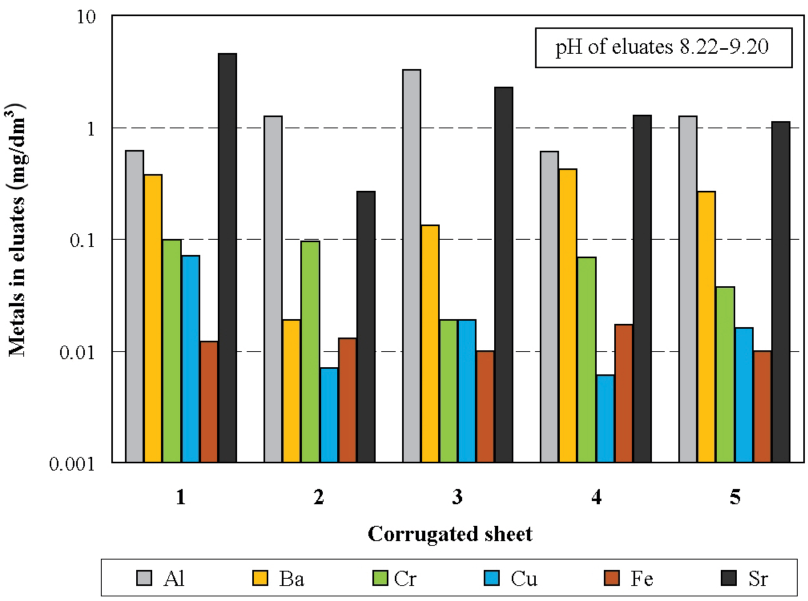

Fig. 1. Specification of metals leaching from samples of asbestos-containing waste, of corrugated sheet type (1:10 test)

Rys. 1. Zestawienie wymywalności metali z próbek odpadów zawierających azbest, typu płyta falista (test 1:10) from asbestos cement waste may have been the result of cement existence in the material. Strontium compounds were widely used in the second half of the 20th century, also in the production of ceramics (Uliasz-Misiak 2016).

The higher leachability values were obtained for aluminum too. The leachability of aluminum ranged from 0.603 to 3.270 mg/dm^3, at a mean value of approx. 1.397 mg/dm^3. Asbestos cement materials feature a high degree of firmness, obtained due to a substantial share of a binder (most often being Portland cement). They also feature a low asbestos percentage in flat and corrugated asbestos cement sheets (10–15%). As a result it is possible to presume that pollutants characteristic of cement will be mainly present in products of leaching. In accordance with the widely available information (e.g. https://www.sanier.pl/chemia-budowlana-cement-portlandzki/) Portland cement is obtained through the combination of ground clinker with gypsum. Cement clinker is obtained by firing a mixture of ground raw materials, containing mainly limestone and aluminosilicates at a high temperature. So aluminum in the eluate most likely results from this element leaching from cement, being the basic component of the asbestos cement material.

Taking permissible metal contents, determined for drinking water, pursuant to the Regulation of the Minister of Health of 7 December 2017 *on the quality of drinking water for people* (Dz.U. of 2017, item 229) into account, eluates obtained in tests did not meet the requirements in terms of aluminum content. Permissible values have been exceeded many times. The aluminum content in eluates also exceeded the limit values set for the industrial sewage pursuant to the Regulation of the Minister of Maritime Economy and Inland Navigation of July 12. 2019 *on substances especially hazardous to the water environment and conditions to be met when introducing sewage to waters or ground, and also at discharging rainwater or thaw water to waters or water equipment* (Dz.U. of 2019, item 1311).

The obtained results of individual elements leaching from the waste material provide the basic criterion for the determination of possibilities to landfill specific waste on specific type landfills. In accordance with requirements specified in the Regulation of the Minister of Economy of July 16, 2015 o*n allowing the waste to be landfilled* (Dz.U. of 2015, item 1277), the results of analyzed metals leaching, obtained in the study, allow to classify the asbestos cement waste as an inert waste group. Only the chromium content, in three samples, exceeded the permissible values for inert waste and fell within the limits set for the waste other than hazardous and inert.

It is difficult to compare leachability (amount of leaching) for individual metals from asbestos-containing waste of corrugated sheet type with studies of other authors due to the lack of studies on leaching from the waste material of such characteristic available in the literature. However, the total content and leaching tests are the subject of study by various authors for other waste groups generated in Poland (including Bożym 2017, 2019; Bożym and Klojzy-Karczmarczyk 2020, 2021; Kicińska and Caba 2021; Kicińska 2021; Kosa-Burda and Kicińska 2016; Król et al. 2020; Szlugaj 2020). The leaching of metals from asbestos containing wastes is lower than other mineral wastes. The total metal content of the sample has not been tested at the study and it will be comparative studies in the future.

On the other hand, the results of the study of leachability from asbestos-cement waste can be compared with the results of leachability from cement or concrete (Kalarus et al. 2016a, 2016b). The results of leachability of heavy metals from cement show a low level of leaching. The exceptions are strontium, barium and chromium. The leachability of these elements from cement is many times higher than their leachability from asbestos – cement waste. The study of leachable of metals from concrete was given a lower emission than leachable from cement. It can be concluded that the results of the leachability of chromium, cadmium, copper and nickel obtained in the paper are at a very low level, similar that that of concrete. The leachability of lead is slightly higher than that of concrete, and the leachability of strontium is 2 to 5 times higher than in concretes. It increases with the time of storage in water.

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. The use of asbestos-containing products was stopped in 1998 and each asbestos--containing product during the removal from a specific building automatically becomes group 17 hazardous waste.

All the studies on the impact of asbestos dust presence in the air and water on human health so far were related to the asbestos fibers importance. In the literature there are no studies on the importance of leaching of individual components from asbestos cement materials, both from roofing as well as from water supply or sewerage system pipes. In the presented paper asbestos-containing waste, randomly selected in the area of Poland, was subject to leaching. Five samples from various locations were selected for analysis. The analyzed material consisted of removed asbestos cement products (used for roofing) and deposited on the ground surface, as the hazardous waste of low asbestos content, of approx. 10–15%. The leaching was carried out under neutral conditions, using the distilled water as the leaching medium.

After the experiment performance and conditions stabilization for the obtained solutions, the pH increased to 9.2. In general, the metals as cadmium, nickel, lead, zinc and mercury were not observed in the solutions. The low leachability was found for barium (on average 0.242 mg/dm^3), chromium (on average 0.095 mg/dm^3), copper (on average 0.019 mg/dm^3), and iron (on average 0.012 mg/dm^3). Increased leachability values were found only for strontium and aluminum. On average the leachability for strontium was 1.891 mg/dm^3, while for aluminum – 1.397 mg/dm^3. It is possible to presume that products of leaching contain mainly pollutants characteristic of cement (aluminum, strontium, and iron).

Approx. 6.9 million Mg of asbestos-containing products, used for roofing, remained to be removed and disposed by landfilling in the territory of Poland. Taking into consideration the carried out studies on metals leachability, one can consider that the landfilling of this material will be environmentally safe in this respect. An additional advantage, protecting against the possibility of pollutants migration to the soil and water environment from a landfill body, consists in the landfilling of such waste in additional protective packaging (big bags).

Moreover, there are 0.2 million Mg of asbestos cement pipes and joints to be disposed, still used in the water supply and sewerage systems. Leachability studies on such waste material have not been carried out. However, based on the results obtained for asbestos cement waste of roofing corrugated sheet type, one can think that the introduction of metals to the water supply network is of marginal importance. The only concern is raised by aluminum, which, as shown by the tests, may be introduced to the water supply network, and its excessive amount is not favorable for the quality of drinking water.

It is difficult to compare the amount of leaching for individual metals from asbestos-containing waste of corrugated sheet type with studies of other authors due to the lack of similar studies available in the literature. The authors will continue the laboratory studies undertaken on the presented subject.

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LEACHING OF METALS FROM ASBESTOS-CONTAINING PRODUCTS USED FOR ROOFING

Keywords

asbestos, asbestos cement products, asbestos-containing waste, leaching test, metals

Abstract

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. During removal from a specific building such a material automatically becomes hazardous waste. The presented paper covers studies carried out on leachability of pollutants from asbestos-containing waste, previously used for roofing. Laboratory tests under static conditions were carried out (1:10 test, pursuant to rules of the PN-EN 12457/1-4 standard) using distilled water as the leaching medium. Aluminium, boron, barium, cadmium, chromium, copper, iron, nickel, lead, strontium, zinc, and mercury were determined in the eluate. Low leachability of individual metals under the planned conditions was observed. In general, such metals as cadmium, nickel, lead, zinc, boron and mercury were not observed in solutions. The other analysed metals were observed in eluates, but their concentrations were usually low. The low leachability was found for barium (0.019 to 0.419 mg/dm^3), chromium (0.019 to 0.095 mg/dm^3), copper (0.006 to 0.019 mg/dm^3), and iron (<0.01 to 0.017 mg/dm^3). Increased leachability values were found only for strontium, between 0.267 and 4.530 mg/dm^3, and aluminium, ranging from 0.603 to 3.270 mg/dm^3. The analysed asbestos and cement materials feature a low percentage content of asbestos in flat and corrugated asbestos cement sheets (10–15%). Because of that it is possible to presume that pollutants characteristic of cement will be mainly present in products of leaching.

WYMYWALNOŚĆ METALI Z WYROBÓW ZAWIERAJĄCYCH AZBEST, STOSOWANYCH JAKO POKRYCIA DACHOWE

Słowa kluczowe

azbest, wyroby azbestowo-cementowe, odpady zawierające azbest, test wymywalności, metale

Streszczenie

W Polsce, najczęściej występującym elementem zawierającym azbest są płyty azbestowo-cementowe na dachach obiektów i elewacjach oraz rury azbestowo-cementowe wodociągowe i kanalizacyjne. W trakcie usuwania z konkretnego obiektu, materiał taki staje się automatycznie odpadem niebezpiecznym. W ramach prezentowanej pracy przeprowadzono badania wymywalności zanieczyszczeń z odpadów zawierających azbest, stosowanych wcześniej jako pokrycia dachowe. W warunkach statycznych (test 1:10, zgodnie z zasadami normy PN EN 12457/1-4) przeprowadzono badania laboratoryjne, stosując jako medium ługujące wodę destylowaną. W eluatach oznaczano glin, bor, bar, kadm, chrom, miedź, żelazo, nikiel, ołów, stront, cynk oraz rtęć. Obserwowana jest niska wymywalność poszczególnych metali w założonych warunkach. Generalnie nie obserwuje się w roztworach metali takich jak kadm, nikiel, ołów, nikiel, cynk, bor oraz rtęć. Pozostałe analizowane metale są obserwowane w eluatach, jednak ich koncentracje są zazwyczaj niskie. Stwierdzono niską wymywalność dla baru (0,019–0,419 mg/dm^3), chromu (0,019–0,095 mg/dm^3), miedzi (0,006–0,019 mg/dm^3) i żelaza (<0,01–0,017 mg/dm^3). Podwyższone wartości wymywalności stwierdzono jedynie dla strontu, w granicach 0,267–4,530 mg/dm^3 oraz dla glinu, w granicach 0,603–3,270 mg/dm^3. Analizowane materiały azbestowo-cementowe charakteryzują się niską procentową zawartością azbestu w płytach płaskich i falistych azbestowo-cementowych (10–15%). W związku z tym można przypuszczać, że w produktach wymywania będą obecne głównie zanieczyszczenia charakterystyczne dla cementu.