The Usability of Wastes in the Backfill Management

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Summary

The issue of mining wastes got into considerable attention in Slovakia. It is mainly related to the adoption of Act No. 514/2008 Coll. on treatment of waste from extractive industry and on amendment of some acts, which is an implementation of Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries. This Act regulates all the essentials related to this issue and has introduced several new measures. Their main role is to prevent negative influences of waste landfill from extraction and mineral processing on the surrounding environment. This paper is points out the possibilities of waste utilization with the aim to prevent formation of surface landfills. These landfills always represent at least aesthetically unpleasant interference in the environment. The paper is focused mainly on addressing these possibilities in magnesite mining which is one of the noted environmental burdens in Slovakia. The usability of wastes from the extraction and processing of magnesite is analyzed as well as the possibility of application of other industrial wastes for backfilling.

Keywords: mining wastes, waste treatment, utlization, magnesite

Introduction

Currently, backfilling is a very important part of environmentally friendly mining in many countries. In terms of backfilling application in various stages of the life of mining operation we distinguish two basic backfilling options of:

- backfilling in active operation: It is the backfilling resulting directly from extraction technology and thus backfilling is one of the technological processes of the mining method. It means the close relationship between the extraction and basic kind of backfill and method of its application is also creating new mining methods´ modifications.
- backfilling in process of mine liquidation: within the extraction workings liquidation, occurs the filling of open areas, which arose from the extraction of minerals. Mostly, it is about filling stope areas, arisen from extraction using the mining methods with retention of extracted open area during extraction of the extraction workings. By proper application, it is possible to achieve such liquidation, which proves the signification of using the mining methods with the backfilling on the deposit.

Backfilling prevents the:
– undesired impact of mining on the environment,
– influence of extraction other reserves on deposits,
– uprising of zones, which would mean an increased risk,
– effect of previous extraction on the mine´s technical systems, and other undesired effects of previous extraction.

The materials used in backfilling management of the mining operations are influenced to a big extent by the characteristics of the backfill. For this reason, the choice of suitable materials is one of basic conditions of the proper functioning of the backfill and the effectiveness of the putting up process. Other components are mixed to basic backfill materials if necessary (e.g. cement, plaster etc.), with their help a hardened or even a so called expansive backfill is created.

From the research of the solidity characteristics, influences of the backfill on the stability of the pillar system of the blocks, so as on the stability of the mining unit, comparison of the solidity parameters of various types and compositions of the backfill resulted in the possibilities of using a hardening one.

Considering the knowledge from the practical exploitation abroad and the results of research, there is an assumption of the development of this backfill method also in Slovakia. While besides the paste mixtures, on the basis of ashes, particularly the cemented backfill, which is especially important and in case of favorable conditions (we can look at this type of backfill as on a material with precisely defined characteristics, including significant strength at pressure and cut), could be taken into account. This type of backfill gives the project planners wider possibilities at designing new methods of mining, as it is in the case of mining with caving or using a conventional type of stone backfill. However, at the application, as it resulted from the researches, it will be necessary to solve the process automation of the managing and control of the whole technological process [1], [2], [3].

Material resources of backfilling

The sources of backfill material, we can divide into sources from mining operation and technological waste from other industries. In the mining operation it is possible to get backfill material from underground (from the stope, secondary popping etc.) or from the surface (heaps of dumps, settling pond etc.). In the underground, the backfill material is obtained in form of non-balance material, which originated in the technological processes of the mining. The material, which forms the backfill itself, is also a part of it. The material from the surface is made of non-balance material originating in the treatment process of the material in the mineral processing plant, the heaps of dumps of own or strange plants, nearby or far away quarries.

As suitable from the point of view of backfilling management, can be viewed the combination of the mining methods with the backfilling and without the backfilling, so for the needs of the backfilling management non-balance materials produced by the mining method could be used, without the backfilling. Mining methods have to be combined in such way, that the volume of the waste attained from these two methods was equal to the volume of the necessary material, applied to the backfilling room. Such combination of the mining methods has already been used in the SMZ a.s. Jelšava mine and despite of the transfer to one mining method this combination gained supporters.

As the material resources stocked in the dump heaps are being spent too, it is necessary to obtain material also from other resources, as already listed. This situation creates good conditions for the creation of the waste marketing. It is probable, that the mining plants will create agreements with other plants nearby, concerning waste disposal by its placement into underground spaces. One of the variants in that case would be the use of some types of waste in conditions of backfilling management.

Tab. 1. List of hazardous characteristics of wastes in Annex 2 to the Decree of MoESR No. 284/2001 Coll. (on Establishing the Waste Catalogue as amended by subsequent regulations) with showing acceptability for the mining environment.

Tab. 1. Lista niebezpiecznych właściwości odpadów w załączniku 2 do rozporządzenia nr 284/2001 ze zbioru ustaw Ministerstwa Edukacji i Badań Naukowych (dotyczących ustalenia Listy Odpadów Niebezpiecznych) dającego zgodę na środowiska górnicze.

Code	Hazardous characteristics	Acceptability
H1	Explosive	No
H3	Flammable liquids	No
H4.1	Flammable solids	No
H4.2	Substances or wastes liable to spontaneous combustion	No
H4.3	Substances or wastes which, in contact with water emit flammable gases	No
H5.1	Oxidizing	No
H5.2	Thermally Unstable Organic Peroxides	No
H6.1	Acute toxicity (poisonous)	No
H6.2.	Infectious substances	No
H8	Corrosives	No
H10	Ability of substances or wastes to liberate toxic gases in contact with air or water	No
H11	Chronic toxicity (poisonous) with delayed effect	No
H12	Ecotoxic	No
H13	Capable, by any means, after disposal, of yielding another material, for example leachate, which possesses any of the characteristics listed above.	No

These problems were dealt with by the researchers of the Mining and Geological Faculty of the Mining College of the Technical University in Ostrava, within the solution of the VaV 530/1/98 project „The Research and Development of Technologies for Waste Treatment Suitable for the Use in backfilling in the Deep Underground Mines". Within the duration of this project, in the years 1998-1999, 123 concrete wastes, belonging to 18 types of waste according to the Edict 337/1997 of the Statute of the Ministry of the Environment, were followed and tested subsequently. Within the solution of the grant VaV 530/1/98, 101 backfill compound mixtures were prepared in laboratory, from the wastes chosen, out of which 34 were proposed for industrial applications [4].

The basis for the choice of the waste suitable for an eventual use within the backfilling is the assessment of its hazardous characteristics. According to Annex N.2, to the Act of Decree of MoESR No 284/2001 Coll. (on establishing the Waste Catalogue as amended by subsequent regulations), the basic dangerous characteristics of the wastes are those listed in Table 1.

Even if a non-acceptability of all these characteristics for mining environment is declared in the Charter, in the last phase of the mine´s activity, it is possible to consider wastes, which have only some of the listed characteristics. Especially these characteristics are meant: Corrosives, chronic toxicity with delayed effects, ecotoxicity. A more detailed look at these characteristics and their analysis prove the logic of such an observance.

Corrosives - Waste is in relation to humans, dangerous from the point of view of its alkali effect. Acidic or base character of the waste expressed by the pH value is adjusted in the production process of the mining and construction materials. It belongs among the rigidly monitored values, since pH decisively influences the forming of insoluble salts of a whole range of dangerous metals.

Chronic toxicity with delayed effect - Waste is in relation to humans, dangerous from the point of view of its irreversible delayed effect. This effect is eliminated in the production process of the mining and construction materials by chemical reactions, where the objective is to transform the dangerous substances into insoluble salts. These are subsequently yet fixed in the process of solidification of the mining and construction mass – the backfill material. In some cases, a simple building the dangerous substance into solidified mass is enough. It is for example asbestos, which belongs to carcinogenic substances that enter the human organism via breathing. Built into mining-construction mass on the other hand, it optimizes the physical and mechanical properties (disperse concrete e.g.) and from the point of view of leaching, it is perfectly safe.

Ecotoxicity - it is a characteristic, which those wastes have, that present an acute or later danger, as a result of adverse impact on the environment by the biological accumulation or toxic effects to the biotic systems. Considering the place of storage, in the deep underground mines, out of the impact on the environment, both cited effects lose their importance [5].

As can be concluded from the following lines, it is possible to eliminate some dangerous characteristics in the production process by solidification (changing the chemical and physical properties) of the final product in relationship to the resources (wastes) entering the production, and the waste is usable within the process of backfilling, without more serious threat to the human health or environment violation.

Tab. 2. Review of wastes in terms of categorization for years 2005–2011 (source: cms.enviroportal.sk)

Tab. 2. Przegląd odpadów w odniesieniu do kategoryzacji z lat 2005–2011 (źródło: cms.enviroportal.sk)

Production of wastes (t)			
Year	**Hazardous wastes**	**Other wastes**	**Total**
2005	561 385	10 368 082	10 929 467
2006	534 565	13 966 976	14 501 541
2007	529 796	10 402 774	10 932 570
2008	529 349	10 942 667	11 472 016
2009	468 341	8 032 252	8 500 593
2010	471 408	10 283 392	10 754 800
2011	385 850	10 449 875	10 835 725

Tab. 3. Review of wastes in terms of categorization for years (source: cms.enviroportal.sk)

Tab. 3. Przegląd odpadów w odniesieniu do kategoryzacji z lat (źródło: cms.enviroportal.sk)

Production of wastes (t)					
Year	**Wastes of 1.group**	**Wastes of 10.group**	**Wastes of 17.group**	**Wastes of 19.group**	**Total**
2005	168 877	2 021 773	2 227 732	1 428 477	5 846 859
2006	295 167	3 971 902	4 371 034	977 958	9 616 061
2007	271 607	1 928 745	3 299 269	913 297	6 412 918
2008	214 969	2 978 268	2 482 546	1 030 951	6 706 734
2009	212 324	1 385 075	2 160 906	759 472	4 517 777
2010	156 183	1 519 188	2 883 752	950 238	5 509 361
2011	144 232	1 653 859	2 984 534	980 421	5 763 046
2012	292 181	1 637 890	1 616 995	968 088	4 515 154

Tab. 4. Waste production of 1st group (Wastes resulting from exploration, mining, dressing and further treatment of minerals and quarry) in year 2012 (source: cms.enviroportal.sk)

Tab. 4. Zaliczenie do pierwszej grupy produkcji odpadów (odpady wydobywcze, kopalniane, przetwórstwo mineralne i dalsze przetwórstwo minerałów i kamieni) w roku 2012 (źródło: cms.enviroportal.sk)

Waste category	**Number and name of subgroup of waste**	**Number and type of waste**	**Production in the SR (t)**
H	0103 – Wastes from physical and chemical processing of metalliferous minerals	010305 - H - other tailings containing dangerous substances	7,95
O	0101 – Wastes from mineral excavation	010101 - O - waste from mineral metalliferous excavation	20,80
		010102 - O - waste from mineral non-metalliferous excavation	111 720,00
	0103 - Wastes from physical and chemical processing of metalliferous minerals	010306 - O - tailings other than those mentioned in 01 03 04 and 01 03 05	37 858,00
	0104 – Wastes from physical and chemical processing on non-metalliferous minerals	010408 - O - waste gravel and crushed rocks other than those mentioned in 01 04 07	9 878,64
		010409 - O - waste sand and clays	2 315,30
		010410 - O - dusty and powdery waste other than those mentioned in 01 04 07	2 446,00
		010412 - O - tailings and other wastes from washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11	126 754,00
		010413 - O - waste from stone cutting and sawing other than those mentioned in 01 04 07	47,74
	0105 – Drilling muds and other drilling wastes	010508 - O - chloride-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06	1133,00

Industrial waste producion in the SR and their applicability in the backfilling

With reference to the presented ideas, it certainly will be interesting to look at the development of the waste production in the Slovak Republic in the last years. The values and the development of the waste production in the last years are in Table 2 and the graph at Figure 1.

As can be seen from this data, the waste production is quite extensive and a part of it certainly could be utilized, where the primary resource out of which it was produced, had come from, which is in the underground. This would limit the worries concerning its storage on the surface, which one way or another, was only a temporary solution.

Especially, wastes listed in the Decree of MoESR No 284/2001 Coll. (on establishing the Waste Catalogue as amended by subsequent regulations), in the following groups – 1th, 10th, 17th, 19th, could be taken into consideration. Not all wastes present in these groups, are suitable for the needs of backfilling. Only some subgroups of waste occurring in the classification into these groups can be considered.

In Table 3 is waste production in the last years from waste groups which could be used for the purposes of backfilling.

In terms of use of wastes for backfilling is the most significant 1st waste group (Group 1 - Wastes resulting from exploration, mining, dressing and further treatment of minerals and quarry). Waste production of this group divided into categories and sub-groups in the SR (year 2012) is presented in Table 4. Waste from extraction and processing of non-metalliferous minerals ("010102 - O - waste

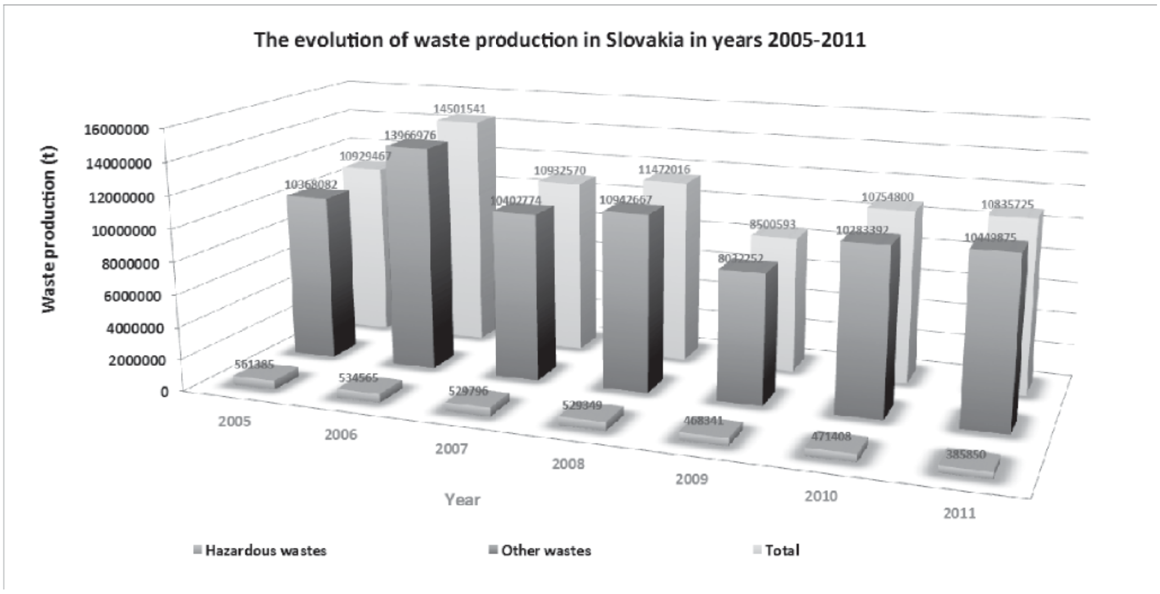


Fig. 1. Graphical representation of the evolution of waste in Slovakia in years 2005–2011 (source: cms.enviroportal.sk)

Rys. 1. Graficzna prezentacja przyrostu odpadów w Słowacji w latach 2005–2011 (źródło: cms.enviroportal.sk)

Tab. 5. The production of selected waste from 10th group (Wastes from thermal processes) in year 2012 in the SR (source: cms.enviroportal.sk)

Tab. 5. Produkcja wybranych odpadów z grupy dziesiątej (odpady w wyniku procesów termicznych) w roku 2012 w RS (źródło: cms.enviroportal.sk)

Number and name of subgroup of waste	Number and type of waste	Disposed by landfill (t)	Total (t)
1001 – Wastes from power stations and other combustion plants (except 19)	100101 - O - bottom ash, slag and boiler dust (excluding boiler dust mentioned in 10 01 04)	221 689,37	242 807,43
	100102 - O - coal fly ash	344 603,41	591 204,15
	100105 - O - calcium-based reaction waste from flue-gas desulphurisation in solid form	178 648,50	178 648,50
1002 – Wastes from the iron and steel industry	100201 - O - waste from the processing of slag	345 371,00	345 371,00
	100208 - O - solid waste from gas treatment other than those mentioned in 10 02 07	33 558,82	33 558,82

Tab. 6. The production of selected waste from 17th group - Construction and demolition wastes (including excavated soil from contaminated sites) in year 2012 in the SR

Tab. 6. Produkcja wybranych odpadów z grupy siedemnastej – Odpady budowlane i rozbiórkowe (włączając w to ziemie wykopaną z terenów zanieczyszczonych) w roku 2012 w RS

Number and name of subgroup of waste	Number and type of waste	Disposed by landfill (t)	Total (t)
1701 – Concrete, bricks, tiles and ceramics	170101 - O - concrete	63 256,99	150 308,47
	170107 - O - mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06	64 895,17	120 484,17
1703 – Bituminous mixtures, coal tar and tarred products	170302 - O - bituminous mixtures other than those mentioned in 17 03 01	27 661,02	90 957,14
1705 – Soil (including excavated soil from contaminated sites), stones and dredging spoil	170504 - O - soil and stones other than those mentioned in 17 05 03	130 790,52	182 087,52
	170506 - O - dredging spoil other than those mentioned in 17 05 05	253 047,39	495 502,89
1709 – Other construction and demolition wastes	170904 - O - mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	98 563,30	134 539,60

Tab. 7. The production of selected waste from 19th group – (Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water for human consumption and water for industrial use) in year 2012 in the SR

Tab. 7. Produkcja wybranych odpadów z grupy dziewiętnastej – (Odpady z obiektów zarządzania odpadami, zewnętrzne oczyszczalnie ścieków i przygotowanie wody pitnej i wody do użytku przemysłowego) w roku 2012 w RS

Number and name of subgroup of waste	Number and type of waste	Disposed by landfill (t)	Total (t)
1901 – Wastes from incineration or pyrolysis of waste	190112 - O - bottom ash and slag other than those mentioned in 19 01 11	51 911,74	51 918,48
1903 – Stabilised and solidified wastes	190305 - O - stabilised wastes other than those mentioned in 19 03 04	129 675,00	130 832,00

Tab. 8. Compressive strength of backfill mixture with granularity n. 1 and granularity n. 2

Tab. 8. Odporność na sprężanie mieszaniny zasypki o ziarnistości n. 1 oraz ziarnistości n. 2

Proportion sludge /cement	Compressive strength [MPa]	
	Backfill mixture - granularity n. 1	Backfill mixture - granularity n. 2
0	16,2	8,3
1/3	13,6	7,7
1/2	12,2	5,7
2/3	10,6	-
1	5	2
3/2	3,7	-
2	-	1,7
3	1,3	-

from mineral non-metalliferous excavation" and "010412 - O - tailings and other wastes from washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11") are dominant part of this waste group. These types of waste are also the most widely used by backfilling in the Slovakia.

The production of selected waste (which are produced in sufficient amount in the SR and could be used for the purposes of backfilling) from 10th group (Wastes from thermal processes) is presented in Table 5. The table shows the amount of waste disposed of by landfilling and the total amount of produced waste. The amount of waste disposed of by landfilling are particularly important in terms of their application for backfilling.

The production of selected waste from 17th group - Construction and demolition wastes (including excavated soil from contaminated sites) is presented in Table 6. Some waste of this group can also be used for backfilling with non-hardening (fragmented) backfill. E.g. waste: "170101 - O – concrete" or some waste from subgroup of "1705 – Soil (including excavated soil from contaminated sites), stones and dredging spoil".

The production of selected waste from 19th group – "Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water for human consumption and water for industrial use" is presented in Table 7.

At the potential application of technological wastes and materials, especially materials related directly to the mining industry are considered and some types of constructional wastes. The most known alternative from industrial wastes is the usage of ashes from coal burning in thermal power plants, which are viewed as a secondary resource, which enters the technological process of the plant mining process. It is based on the logical premise, that this way the non-combustible (residual) part of a natural material (coal) is returned in the underground, which was some time earlier mined from a certain depth of the Earth´s crust [2], [3], [6], [7], [8].

Safety measurements must not be forgotten though, in another case an environmental disaster could happen, which would significantly impair the surroundings, thus interfering with further activity in the mining plant. [9]

Basic conditions for the waste reuse within the backfill management are thus [10]:

1. The backfill mixture must only contain such a ratio of technological waste, which will not significantly influence the pressure resistance of the backfill mixture.
2. The ratio of technological waste must not contain harmful, toxic and hazardous substances.

Another factor, which prevents a wider use of waste for these purposes, is the presently valid legislation, which up to this time only enables the use of a very limited type of waste substances underground.

Research of the use of potentially viable materials for the needs of backfill management

The research was performed on the Faculty of Mining, Ecology, Process Control and Geotechnologies at the Technical University of Košice, and was based on the results of a research performed in the past. Since the research in the past considered mainly use of thick-grained materials and sand from the treatment plant, whereas it emerges from the analyses of the treatment procedure that the essential part of the treatment wastes is formed by the finest fractions – sludge, the research was focused just on their applicability in the backfilling mixtures.

Regarding various possibilities of application of the individual technologies of filling, mixtures of various fragmentations were mixed up: aggregate + sand + cement/sludge: for application into free mined-out area during extraction, or filling in free areas upon their extraction.

As was confirmed by further research of the strength properties of these mixtures, granular composition of the two main mentioned sorts was very significant for the strength properties of the resulting backfilling mixtures. That is why better attention has to be paid to an issue of aggregate granularity for the production of backfilling mixtures on the basis of concrete backfill.

Monitoring of the strength properties of the resulting mixtures, which can be in various forms applied to backfilling, was the most important part of the research. Regarding individual dependencies, course of decrease in the strength of the backfilling mixtures was monitored as a result of replacement of proportion of cement by fine-grained sludge (Table 7). The results (Figure 2) show that the curve of dependency has similar course at both sorts of the backfilling mixtures, while granularity no. 2 shows markedly lower compressive strength as the granularity no. 1.

It emerges from the mentioned facts that more exact dosage of the proportion of sludge/cement has to be taken into consideration at application of the mentioned backfilling mixtures, in order to obtain particularly higher strength, because each change of this proportion (and loss of cement) markedly influences the re-

Fig. 2. Graph of relation between compressive strength and proportion sludge/cement – backfilling mixture

Rys. 2. Wykres relacji pomiędzy odpornością na sprężanie a stosunkiem cementu do odpadu – mieszanina zasypki

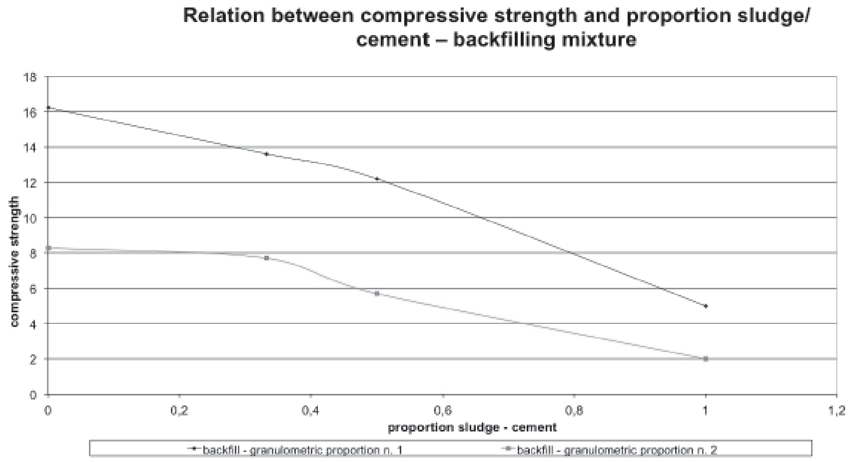
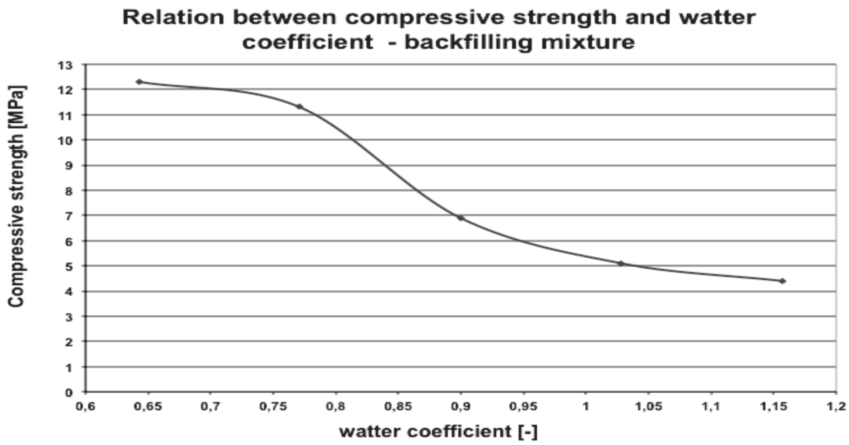


Fig. 3. Graph of relation between compressive strength and watter coefficient – backfill mixture

Rys. 3. Wykres relacji pomiędzy odpornością na sprężanie a współczynnikiem wodnym - mieszanina zasypki



sulting compressive strength of the backfilling mixture.

Initial compressive strength after 24 hours was monitored at several samples. This period had to be extended to three days at some samples, as they had not hardened completely after 24 hours, and it was impossible to withdraw them from molds. The resulting average values are stated in the Table 8. This has definitely proven that the proportion of the fine-grained sludge has a considerable influence on the period of setting of the backfilling mixtures, and the increasing proportion of sludge causes extension of the period. This fact is very unfavorable in practice, as it also extends period of backfilling till another technological operation. However, the practice with respect to factory organization and control requires this period to be the shortest possible [11].

Another important monitored dependency is relation between volume of water in the backfilling mixture, and its resulting strength. The amount of water in the backfilling mixture has actually a considerable effect on preparation, as well as period of setting and microclimatic conditions of the working place in the area of backfilling, and it increases demands for draining system of the mining factory.

It is obvious from the graphic course (Figure 3) that with increase in the water coefficient (proportion between contents of water and cement) there occurs decrease in strength of the backfilling mixtures. It is obvious particularly from level of the water coefficient at 0.75, when the curve records swifter decrease in strength. However, the water coefficient sets demands of mixture transportability, since better transportability, influenced by higher liquidity, is brought with increased wa-

Tab. 9. Initial compressive strength of backfill mixtures with granularity n.1 and granularity n.2

Tab. 9. Początkowa odproność mieszanin zasypki o ziarnistości n. 1 i ziarnistości n. 2

Proportion sludge /cement	Compressive strength [MPa]			
	Backfill mixture - granularity n. 1	Curing time	Backfill mixture - granularity n. 2	Curing time
0	-	-	1,94	24 hours
1/2	-	-	unmeasurable	24 hours
2/3	1,29	24 hours	-	-
1	0,6	24 hours	0,67	3 days
3/2	0,82	3 days	-	-
3	0,41	3 days	-	-

ter coefficient. That means that at production of backfilling mixtures, water coefficient and possibilities of the specific transportation system, are of big importance.

Temperature of the environment is naturally of big importance to individual strength characteristics, as it is possible to observe that to a certain extent the increasing temperature of the environment causes increase in the strength of the backfilling mixtures, and on the other hand, decreasing temperatures causes decrease in the mixtures strength. This phenomenon is important mainly from the point of view of the mining environment characteristics. The mentioned fact was confirmed also by this research, as with the temperature of the environment approaching the temperature of the mining environment of the magnesite mines, the increase in the period of setting of the backfilling mixtures was apparent, together with decrease in their strength. Possibility of monitoring the initial strength in such conditions was difficult even three days after mixing up the mixtures, as there was decomposition of the samples, and the strengths were not measurable with the accessible equipment. Since the underground premises of our magnesite deposits may be considered cool with the temperature ranging from 8–10ºC (46.4–50ºF), decrease in the strength at applied backfilling mixtures can be assumed in this environment. Thus it will be necessary to take this phenomenon into account also at suggesting, and further monitoring of their main properties and characteristics directly in this environment.

Conclusion

Foregoing analysis indicates the possibility of application of some types of waste for backfilling in magnesite mining. Primarily the waste directly from the extraction and processing of magnesite is considered. These wastes are also used in the current system of backfilling. In the view of the decreasing resources of materials within backfill managment the use of the waste from other industries is a real possibility in the future. It is important that this way of the use of mining waste reduces the load of surrounding environment by their storage in the forms of dumps and sludge beds.

The analyzed wastes from extraction and processing of magnesite (according to Annex 1 of the Decree of Ministry of the Environment No. 255/2010 Coll. implementing the above-mentioned Act No. 514/2008 Coll.) are regarded as inert waste. Although they do not have to fulfil all the requirements of that Act applying to storages of category A, it is always better to seek and apply other options to use instead of their surface storing. In terms of the environment and the public opinion (which currently has a significant impact on the possibility of mining activities) this procedure is certainly correct.

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Użyteczność odpadów w zarządzaniu zasypką

Sprawa odpadów kopalnianych na Słowacji doczekała się swojej uwagi. Głównie dzięki wprowadzeniu Ustawy nr 514/2008 ze zbioru ustaw dotyczących przetwarzania odpadów w przemyśle wydobywczym oraz poprawkom w kilku innych ustawach dzięki wprowadzeniu Dyrektywy 2006/21/EC przez Parlament Europejski i Radę z dnia 15 marca 2006 r. w sprawie zarządzania odpadami w przemyśle wydobywczym. Ustawa reguluje wszystkie ważne aspekty dotyczące sprawy i wprowadza kilka nowych pomiarów. Głównym jej celem jest zapobieganie negatywnego wpływu składowisk odpadów wydobywczych na procesy mineralne otaczającego je środowiska.W tej pracy znajdujemy szereg możliwości utylizacji odpadów, które mają na celu zapobiec tworzeniu się składowisk powierzchniowych. Te składowiska zawsze zapewniają co najmniej nieestetyczny wpływ na środowisko. Możliwości zawarte w tej pracy są przede wszystkim adresowane do kopalni magnezytu, która jest jedną z tych, co zauważalnie obciążają środowisko na Słowacji. Analizowana jest użyteczność odpadów uzyskanych z wydobycia i przetwarzanie magnezytu, jak również możliwość zastosowania szerszego rodzaju odpadów przemysłowych jako zasypki.

Słowa kluczowe: odpady kopalniane, przetwarzanie odpadów, utylizacja, magnezyt