BENEFITS AND LIMITATIONS RELATED TO THE APPLICATION OF THE REACH REGULATION FOR MINING EXPLOSIVES

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Abstract

The article outlines practical implications associated with the development and implementation of the REACH regulation. Following the introduction of this legal act, the system for managing the safety of chemical substances throughout the European Union has been harmonised and based on the principles of registration, evaluation and authorisation. These rules apply to all types of substances, preparations and products available on the market. Their importance in reducing the environmental impact of hazardous substances, including explosives, should be considered particularly important. The study inter alia analyses the advantages of applying the REACH system to mining explosives (dynamites and emulsion explosives), including in particular a comprehensive analysis of the environmental effects of the use of this type of substances, carried out according to unified criteria specified in the provisions of the regulation. On the other hand, the major drawback of the adopted regulations is the failure to take into account the conditions associated with the safety of the working environment in the discussed legal act.

Keywords: REACH system, environmental management, explosives

1. Introduction

An inherent consequence of the development of civilization is undoubtedly the degradation of the natural environment. The increased ecological awareness has resulted in the importance of broadly understood environmental protection in the current EU regulations, which is reflected in the provisions of the Maastricht Treaty of February 7, 1992, where the basic objectives of activities in the field of environmental protection were formulated (Article 21(2)). They include the following (Treaty on European Union, 1992):

- preserving, protecting and improving the quality of the natural environment,

DOI: 10.5604/01.3001.0053.9111
Received: 04.08.2023 Revised: 31.08.2023 Accepted: 03.09.2023

- protection of human health,
- prudent and rational use of natural resources.

The importance attached to environmental protection in the EU legal regulations has been reflected in the adoption of the REACH Regulation on December 18, 2006 (Regulation (EC) No 1907/2006), which is generally considered to be one of the most important and far-reaching legal acts aimed at protecting the environment against the harmful effect of chemicals. The regulation can be regarded as an integrated environmental management system, which regulates the issue of chemicals in a comprehensive way. With the implementation of REACH, a unique and valuable body of physicochemical, environmental fate and (eco)toxicity data has been compiled (Fantke et al., 2020). The tool for applying the provisions of the Regulation is IUCLID (International Uniform Chemical Information Database). IUCLID has been specifically developed for compiling and exchanging information on chemicals between industry and regulatory authorities (Khans et al., 2019b). Also of great importance is the regulation of 16 December 2008 on classification, labelling and packaging of substances and mixtures (CLP - Classification, Labelling and Packaging) (Regulation (EC) No 1272/2008). Its adoption is a step towards global harmonization of the rules for the classification of chemical substances. Such a solution should be considered appropriate as effective environmental protection will require actions going beyond the borders of the European Union due to the extensive international trade. Classification and labelling is an important indicator for downstream users to alert them of the presence of dangerous chemicals in their products (Woutersen et al., 2019).

The REACH Regulation, applying to all chemical substances, is particularly stringent in relation to hazardous substances, which require authorization in order to be placed on the market. The division of hazardous substances into classes is comprised by the CLP Regulation, which in this respect supplements the REACH provisions. This regulation distinguishes a total of several groups of dangerous substances. The division criteria include those listed in the subsequent parts of the above-mentioned legal act, i.e. physical hazards as well as threats to health, the environment and so-called additional risks.

The aim of this paper is to analyse the advantages and limitations of REACH application in the case of one of the substances listed by the CLP regulation in the group of physical hazards - mining explosives, which include dynamites and emulsion explosives. The obligation imposed by the REACH regulation on manufacturers and importers of substances requiring these entities to conduct comprehensive tests of substances on the basis of criteria set out in REACH is of extreme importance. It allows the environmental effects of a substance to be analysed on the basis of harmonised criteria regarding their physicochemical, toxicological and ecotoxicological properties. The literature highlights that chemical substitution efforts supported by regulations such as REACH are leading to a change of chemicals used in industry (Sackmann et al., 2018; Sobanska et al., 2017). In the case of mining explosives, the rules of registration, evaluation and authorization adopted by the REACH regulation will undoubtedly result in limiting the use of nitroglycerin and nitroglycol, i.e. compounds used in the technological process of dynamite production.

Despite the undeniable importance of the REACH regulation, it would appear that current analyses of the assessment of the safety of the use of substances (preparations and products), which are based solely on the criteria indicated by REACH, should be considered insufficient. Based on analyses carried out in this work, it will be demonstrated that direct adoption of such criteria in the case of mining explosives will, among others, cause the omission of issues related to work safety. Given the fact that this concerns the legal act that is fully and directly applicable throughout the European Union, taking actions aimed at supplementing the requirements of the REACH regulation with the specific effects of a particular substance (preparation, product) is important and fully justified.

2. REACH regulation

Regulation No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 is based on three basic principles, which include: registration, evaluation and granting of authorizations, as well as, in justified cases, restrictions on the production, marketing and use of certain substances. Pursuant to the general REACH regulation, the provisions contained therein apply to substances produced in their natural form as well as to components of preparations or products and to their marketing. The scope of the regulation is extremely extensive. Its provisions apply not only to raw materials, but also to products made of them. According to REACH, responsibility for the latter in terms of control and environmental impact assessment is transferred onto their producers.

The obligation to register substances contained in a preparation is in principle imposed on its manufacturer or importer. Registrants must evaluate reliability as well as relevance when assessing the adequacy of studies (Ingre-Khans et al., 2019a). All required data are submitted by the obligated entities electronically to the European Chemicals Agency (ECHA). Registration is done by completing the form available on the Agency's website. All substances produced or imported into the European Union in quantities of minimum 1 Mg per year are subject to registration. The importance that REACH attaches to the registration of chemical substances and preparations is clearly demonstrated by the provision contained in Art. 5 of the regulation, which states that "substances in their natural form, in preparations or in products shall not be manufactured or placed on the market in the Community unless they have been registered (...)". There is no doubt that such a categorical regulation means adopting the "no registration – no trading" principle. The REACH registration database provides a wealth of information on chemicals put on the European market (Ingre-Khans et al. 2016). However, concerns have been raised regarding the extent to which information is reported as well as the quality of the information provided by industry (Ingre-Khans et al. 2019c; Maxim, Berger, 2020). The REACH regulation itself contemplates the possibility of resorting to tabulated data from handbooks and other sources (Garralga et al., 2022). It is the data obtained in the registration process that provides a basis for their assessment in terms of a potentially negative impact on living organisms and the natural environment. Once a chemical substance has been registered, it is given a number by which it can be identified. When fulfilling the registration obligation, manufacturers or importers are required to submit information on the physicochemical, toxicological and ecotoxicological properties of substances (preparations and products). The scope of required data has been specified in annexes VII - X REACH. The analysis of data contained in the annexes clearly indicates that the regulation made the amount of requested data dependent on the tonnage of the substance manufactured or imported. It has been assumed that the potential danger to human health and the environment associated with the use of a substance placed on the market increases with its increased amount on the market, which is presented in Table 1.

Table 1. Scope of data necessary for the registration of a specific substance (preparation, product) (Regulation (EC) No 1907/2006 REACH)

Turnover range	Attachment VII	Attachment VIII	Attachment IX	Attachment X
1-10 Mg/year	+			
10-100 Mg/year	+	+		
100-1000 Mg/year	+	+	+	
≥1000 Mg/year	+	+	+	+

It is worth emphasizing that registration was a long-term process. Provisions of the REACH regulation defined long transitional periods, the scope of which depended on the quantity of the substance produced or imported and on its specific properties. As a result, the first part of provisions contained in the regulation came into force on 1 June 2008, while the last transitional period for registration was set for 31 May 2018. Such a long period of *vacatio legis* that was applied to some provisions, unprecedented in others legal acts, can only be explained by the complexity of provisions contained in the regulation and the need to adapt to the regulations in question by the addressees of the said provisions. Deadlines for the registration of substances in accordance with the requirements of the Regulation are presented in Figure 1.

A key criterion for evaluating substances placed on the market as required by the Regulation will be the identification of compounds that pose the greatest risk to human health and life, which should be subjected to further detailed testing. These activities will also be supported by an assessment of the technical documentation

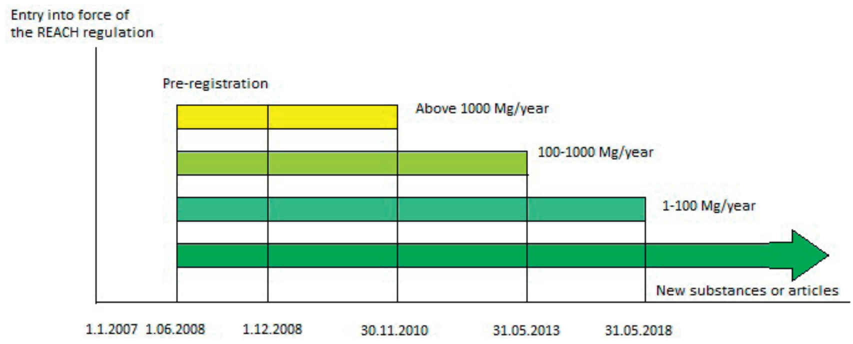

Figure 1. Deadlines for registration of substances specified by the REACH regulation

held by ECHA, relating to a specific substance, as well as the exchange of information contained therein. This will help reduce the number and scope of tests to be carried out by individual manufacturers (Gaedicke, Ehlers, 2007).

The principle of granting authorizations applies to substances classified as compounds having a negative impact on health or the environment. Their placement on the market requires a special permit issued by the European Commission. This rule will applies to the majority of dangerous substances on the market. Whereas a decision on authorisation is binding for the authorisation holder only, a decision on restriction applies to all companies (i.e. producers, manufacturers, downstream users, retailers) of EU member states (Gabbert, Hilber, 2020).

3. Mining explosives

The mining industry consumes the largest amount of explosives of any industry – almost 99% of all explosives used for civilian purposes. In terms of assortment consumption in equal groups of materials, the distinction between dynamites and emulsion explosives is of the greatest importance in the context of environmental impact and performance parameters.

The production of a dynamite-type material is based on proper preparation, with the use of the processes of grinding, drying and sieving, and next mixing the ingredients to create the so-called dynamite mass, which, as a result of coagulation, turns into a semi-solid state - gel. Table 2 shows the percentage content of the dynamite mass compounds.

The technological process of dynamite production is finalized by the so-called loading of the manufactured explosive.

The production of dynamites has a significant adverse impact on the environment, stemming from air pollution, generation of waste and the necessity for discharging wastewater. Due to high pressure vapours, nitroglycerin and nitroglycol, which are half-products in the dynamite production process, are extremely burdensome for health. According to Senczuk, the effects of such

Table 2. Percentage of ingredients used in the production of dynamite (Bieganska, Harat, 2013)

No.	Raw material	Dynamite composition [%]
1	Ammonium nitrate (V)	53.8 – 73.1
2	Sodium nitrate (V)	2 – 10
3	Nitroglycerin	5.0 – 20.4
4	Nitroglycol	5.2 – 20
5	Nitrocellulose	0.3 – 1.6
6	Dinitrotoluene	3.0 – 5.0
7	Wood flour	0.6 – 2.5
8	Barium sulphate	3.0 – 5.0
9	Guar gum	0.5 – 1.0
10	Dye	0.01 – 0.1

impact may include severe headaches in humans, and even loss of consciousness or collapse leading to death (Senczuk, 2002).

A further negative impact of the described process is generation of wastewater with low pH and a high content of nitrates. In their production process, the source of wastewater is the neutralization of nitroesters. Post-production wastewater, cooling wastewater and contaminated centrifuge rinsing water are generated. Nitration and denitration installations are also a major source of air pollution related to the technological process. These are primarily sulphur and nitrogen dioxides as well as carbon monoxide. Pollution – particulate matter is also produced by dynamite mass mixing plants.

On the other hand, emulsion explosives (EE) can be considered the latest achievement in the production of this type of substance (Zhao et al., 2021). Since emulsion explosives started to be produced on a mass scale, various industries, including mining, have had access to explosives that do not contain toxic components (e.g. nitroglycerin), which makes them much safer in production. The technology of emulsion explosives production is much more complicated than in the case of classical explosives. The process of producing emulsion explosives requires the use of specialized mixers and strict adherence to the technological regime. Substances needed for the production of emulsion explosives are listed in the table 3.

In the emulsion explosives production process the main emphasis is placed on the proper preparation of ingredients (emulsifier, organic phase and nitrate solution). Each of the above-mentioned raw materials is prepared separately in specially designed installations. The next stage of the technological process is the production of emulsion. For this purpose, previously prepared compounds are mixed – a saltpetre solution with oil mixtures. Care should be taken to make sure

Table 3. Percentage share of ingredients used in the production of emulsion explosives (Bieganska, Harat, 2013)

No.	Raw material	Emulsion explosives composition [%]
1	Ammonium nitrate (V)	51.24–70
2	Sodium nitrate (V)	8.5–13.9
3	Water	6–10.5
4	Wax	0.7–0.75
5	Paraffin	0.65–0.7
6	Oil	1.5–6.0
7	Emulsifier	1.2–1.5
8	Microballoons	1.5–2.6
9	Aluminium	3.4–4.8

that during the emulsification process the temperature is 87-93°C and the matrix pressure does not exceed 250 kPa. Microballoons, aluminium and ammonium nitrate are also added to the matrix prepared in this way. The emulsion produced is then subjected to either a cooling process - in which case we obtain the so-called bulk emulsion or to moulding into a cartridge shape, in which case the technological process ends with the packaging and transport of the finished product to the warehouse.

In the described process, a water-in-oil (W/O) emulsion explosive is produced, in which the dispersed, oxidizing phase is a solution of inorganic nitrates, whereas the fuel, hydrocarbon phase is a combustible substance. The durability of such a system of immiscible liquids is ensured by adding an emulsifier to the mixture, i.e. a chemical compound that enables the emulsion formation (Xuguang, 1994).

A very important advantage of emulsion explosives is the minimized impact of their production on the environment. Compared to the production of typical mining explosives, the production of emulsion explosives is completely safe and practically waste-free. All heating and cooling agents remain in a closed circuit (Maranda, 2010). Consequently, the production process does not result in the emission of pollutants into the atmosphere or the necessity for discharging wastewater (Al-Sabagh et al., 2017). Even the used cooling water, which is replaced with fresh water after approximately a month, is used to produce solutions for mobile production. The subject literature emphasises that the only waste generated in the production process includes: cardboard and foil packaging of raw materials, used oil from machine gears and pumps and materials for cleaning machines and production equipment. Spilled granular or porous ammonium nitrate is also considered waste. It is collected in containers and afterwards resold for agricultural purposes (Maranda et al., 2008).

Another aspect that makes it possible to analyse different types of explosives is a comparison of the so-called functional properties. The latter include, for example, measured detonation velocity for a given diameter of the explosive charge (DEC), explosion heat and energy concentration, which illustrate the energy efficiency of the detonation process. Table 4 presents the functional properties of selected dynamites and emulsion explosives.

Table 4. Functional properties of selected dynamites and emulsion explosives (Nitroerg Technical Data 1a, 1b, 1c)

Type of explosive	Functional properties		
	Explosion heat [kJ/kg]	Energy concentration [kJ/dm^3]	Detonation speed [m/s] DEC [mm]
ERG 22 E (dynamite)	3763	5260	5500 (32)
ERG 31 E (dynamite)	4027	5648	5500 (32)
ERG 35 E (dynamite)	4296	6014	6000 (32)
EMU 2 (EE)	3364	4036	4700 (40)
EMU ST (EE)	3093	4820	5500 (40)
EMU GM 1 (EE)	3762	4514	4000 (32)

Data presented in the table clearly indicate that emulsion explosives differ, as a matter of principle, from traditional nitroester explosives in terms of their functional properties. An example could be the energy of concentration, which in the case of dynamites reaches values significantly above 5000 kJ/dm^3, while in the case of emulsion explosives they are 1000 kJ/dm^3 lower.

In order to optimize the functional parameters of emulsion explosives, it was proposed to modify their composition by adding penthrite (PETN) to the emulsion matrix (Harat, 2019). Various compositions of the developed mixture with contents ranging from 30 to 50% were also subjected to tests. Table 5 presents selected functional properties of the obtained material.

Table 5. Functional properties of the obtained compositions of emulsion explosives with the addition of PETN

Type of material	Functional properties		
	Explosion heat [kJ/kg]	Energy concentration [kJ/dm^3]	Detonation speed [m/s] DEC [mm]
30% PETN	4144	5801	5800 (32)
40% PETN	4377	6128	6400 (32)
50% PETN	4761	6665	6700 (32)

The result was a material with very good functional properties - comparable to or even better than currently produced dynamites. However, it should be emphasized that the resulting composition is not free of defects. The major disadvantage is clearly the lack of the possibility to mechanically load the blast holes. Such a possibility depends on the resistance to impact, which, according to the PN-EN 13631-4 standard, should reach a value above 30 J (PN-EN 13631–4:2004). In the experimental tests of the produced compositions, the values of 23.5 and 19.6 J were obtained. Values required by the standard are met only by emulsion explosives.

4. Advantages of applying the REACH Regulation

The advantages of applying the REACH Regulation may be divided into two groups. One of them refers to the legal nature of the discussed legal standard, whereas the other one - to the practical consequences related to the entry into force of the Regulation, which undoubtedly includes the establishment of a harmonised database pertaining to the properties of substances (preparations, products).

A drawback of EU legal regulations related to the management of chemical substances prior to the REACH Regulation lays in the fact that the Community regulations in this area were based on directives. This type of regulation is a specific source of European law - it is not applied directly, and its binding nature applies only to the objectives that should be achieved. In order to put the provisions contained therein in practice, a Member State has to carry out the so-called implementation, which can be defined as "transferring" the solutions contained in the directive into the internal law of a specific state. This is most frequently done by issuing a generally applicable legal act, which is commonly a law.

Prior to the introduction of the REACH regulation, the discussed issues were regulated by Council Directive 67/548/EEC of 27 June 1967 on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances, which was subsequently significantly modified by the amending directive of 19 September 1979. Regulation 67/548/EEC can be regarded as the first Community legal act, the introduction of which was aimed at protecting health and the environment against the potential harmful effects of chemical substances. The classification of substances was based on the available data concerning their properties. The literature emphasizes that due to the fact that the system in force at that time was based solely on available data, the manufacturers frequently failed to carry out research on the potentially dangerous properties of substances (Ruden, Hansson, 2007). The amendment of the above directive of September 19, 1979 introduced a previously unknown division of chemical substances into the so-called existing substances, listed in the European Inventory of Existing Commercial Chemical Substances (EINECS), and new substances listed in the European Index of New Notified Substances

(ELINCS). The solution adopted at that time led to the diversification of the scope of assessment of a given substance in terms of its environmental impact since its introduction into the European Community. Exemption from this requirement applied to the so-called existing substances, i.e. substances placed on the market in the period from 1 January 1971 to September 1981. Other solutions were adopted for new substances, which had to be subjected to a harmonised testing procedure throughout the EC in order to be approved for sale. The conducted tests were mainly intended to determine the carcinogenic and mutagenic properties of these substances. The analysis of the state of chemical safety undertaken by the European Commission revealed huge gaps in the available data. It is emphasised in the subject literature that only 14% of the substances produced in the European Community in large quantities (above 1000 Mg/year) had complete data required by the applicable regulations relating to "new" substances. The data for 65% of substances were incomplete, while 21% of the substances were defined as substances "without" data, i.e. their impact on health and the environment was unknown (European Commission, 1999).

REACH as a Community regulation is a binding legal act applicable directly on the entire territory of the European Union, without the need of implementing its provisions. It is estimated that the entry into force of the Regulation resulted in the invalidation of approximately 40 Community legal acts relating to chemicals (European Parliament, 2023). A major change to these old regulations is that REACH places greater responsibility on manufactures, importers and downstream users to ensure that they manufacture, place on the market or use substances in such a way that they do not adversely affect human heath (Schenk, Antonsson, 2015). In many ways, REACH represents a global paradigm shift in chemical regulation, and it has introduced a new, complex regulatory process to which chemical producers and users throughout supply chains must adapt (Scruggs et al., 2015; Beal, Deschamps, 2016).

Another very important advantage of using REACH is the establishment of a harmonised database regarding the properties of substances (preparations, products). This is a consequence of the registration principle obliging manufacturers or importers to send strictly defined information on the physicochemical, toxicological and ecotoxicological properties of manufactured or imported substances to ECHA. Importantly, the REACH regulation embraces the precautionary principle and as a result information must be compiled on the potential hazards of a substance before it may be allowed to be sold in the marketplace (Spencer Wiliams et al., 2009). In contrast, the historical EU chemical programs generally operated under the presumption that chemical substances are safe unless new data demonstrate otherwise (Steinway, Seitz, 2008).

The primary objective of the REACH regulation is to protect life, health and the environment against the harmful effects of toxic substances as it is this type of substances that the REACH regulations on registration, evaluation and authorization shall fully apply to. The dynamites and emulsion explosives (EE) discussed in this paper differ fundamentally in terms of the toxicity of their components. The most arduous substances in dynamites are nitroglycerin and nitroglycol, while emulsion explosives contain no toxic substances. In order to optimize the operational parameters of emulsion explosives, penthrite can be added to the emulsion matrix. Therefore, it seems reasonable to compare the selected properties of nitroglycerin, nitroglycol and penthrite, presented in Table 6, according to the criteria specified in the REACH regulation.

Table 6. Selected physicochemical, toxicological and ecotoxicological properties of substances

No.	Property	Nitroglycerin	Nitroglycol	Penthrite
1.	State of matter	Liquid	liquid	Solid
2.	Melting point	13.5°C (US National Center, 2023a)	- 22°C (US National Center 2023b)	140°C (US National Center 2023c)
3.	Flashpoint	218°C (US National Center, 2023a)	114°C (US National Center 2023b)	205-215°C (Lewis, 2004)
4.	Impact on living organisms	Toxic effect on eyes, skin and respiratory tract (Vincoli, 1997)	Highly toxic to skin and respiratory tract (Vincoli, 1997)	Toxic effects not found (US EPA, 1992)
5.	Toxicokinetics	**Absorption**: through the skin, lungs and respiratory tract. Blood pressure decreases after absorption. **Distribution:** immediately absorbed in the blood. **Excretion**: metabolised in the blood and liver, and, next, excreted in urine and respiratory tract. Toxic effect (US EPA, 1992; Yinon, 1990)	**Absorption:** through the skin and lungs. Particularly toxic absorption through the skin – toxic doses above 0.75 mg. **Distribution:** immediately absorbed in the blood, max level after 30 min. **Excretion:** decomposed to inorganic nitrates after 4 hours, excreted in urine. Strong toxic effect (US EPA, 1992; Yinon, 1990)	**Absorption:** through the skin and respiratory tract. Minimal – low vapour pressure of the substance. **Distribution:** the compound and its metabolites circulate in the blood throughout the body. **Excretion:** decomposed in the blood, liver and kidneys, excreted in urine. Toxic effects not found (US EPA, 1992; Yinon, 1990)

table 6 cont.

No.	Property	Nitroglycerin	Nitroglycol	Penthrite
6.	Behaviour in the environment	Soluble in water. In the atmosphere occurs in the aerosol form. Gravitational deposition on the earth surface (Vincoli, 1997)	Not subject to sorption in the soil environment. In the atmosphere, the half-life is 22 days (Vincoli, 1997).	Does not exist in the form of vapours in the air. Substance insoluble in water (Huber, Mross, 2001)
7.	Aquatic toxicity	Highly toxic to aquatic organisms - algae and fish (Yost, 2004)	Half-life over 200 days. No data on the impact on the aquatic environment (Vincoli, 1997)	No toxic effect (US EPA, 1992)

The presented data clearly indicates that nitroglycerin and nitroglycol should be considered as dangerous substances, the use of which should be limited due to their properties. Such a conclusion stems from Art. 55 of REACH, in which it is emphasized that supervision over hazardous substances should result in their gradual replacement with alternative substances. In order to achieve this goal, producers, importers and downstream users have been obliged to conduct analyses of the availability of "environmentally friendly" alternative solutions and apply them if possible from the economic and technological point of view.

5. Restrictions on the application of the regulation provisions

The disadvantage of provisions of the REACH regulation lies in the fact that this piece of legislation does not take into account the criterion of the influence of properties of a given substance on occupational safety. In the case of explosive materials, dynamites and emulsion explosives should be considered opposite in this respect. Therefore, a list of their properties will provide a basis for considerations regarding the safety of using the mixture developed for the purposes of this article.

The technological process in which such explosives are produced is considered to be very burdensome for the environment. This is mainly due to the use of nitroglycerin and nitroglycol as components of this type of explosives, i.e. substances with toxic properties, which generate a large amount of energy, thus initiating an explosive transformation and, consequently, detonation of the remaining components. Their production and use involve a number of risks, including: the risk of an uncontrolled explosive reaction due to the high sensitivity of ingredients to stimuli (nitroglycerin, nitroglycol), and wastewater from the production process. In addition, there is a need to maintain stocks of explosives in production plants.

The necessity of manufacturing ready-made explosives in the production plant is also troublesome. As a result, this substance is present on a continuous basis, from the moment of its production to the time of consumption, which has been shown in Fig. 2. The red colour in the figure indicates a hazard caused by the presence of an explosive.

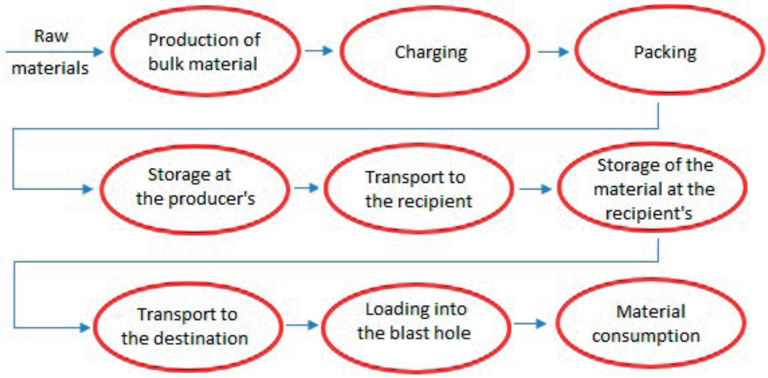

Figure 2. Diagram of production and trade in dynamite-type explosives

The presence of explosives involves the risk of transporting these substances on public roads, which exposes the substance to the risk of explosion or the risk of theft and misuse. Due to the existing hazards, the transport of this type of materials needs to be escorted.

Due to the above described hazards, dynamites are being replaced with materials of a new generation - emulsion explosives. A proper explosive material can be produced in this case by the stationary method in a production plant or at the place of its final usage with the use of a loading hose, or in a blast hole. It appears that the safest and most beneficial system for environmental management is one in which the matrix is produced in a stationary plant, and its sensitization is carried out at the place of its usage (Fig. 3).

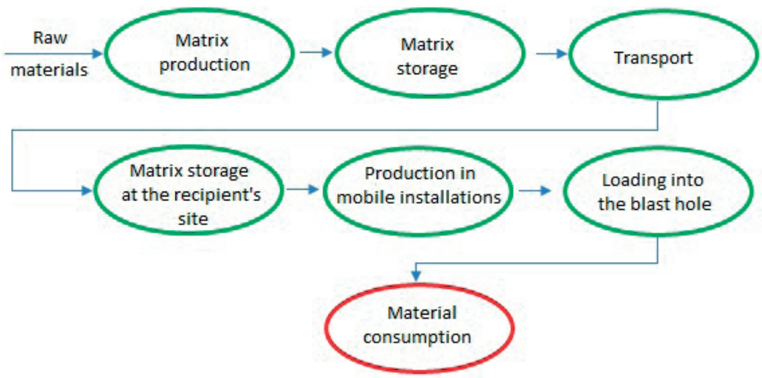

Figure 3. Diagram of production and trade in emulsion explosives

Red colour indicates a hazard caused by the presence of an explosive. There is no doubt that the process of emulsion explosives production is less burdensome for the environment, and the risk to safety is significantly reduced.

6. Conclusions

The article analyses the REACH regulation in terms of its application to mining explosives, including dynamites and emulsion explosives. Based on the example of the indicated substances, it has been demonstrated that the application of the REACH regulation has numerous advantages. The obligation imposed on manufacturers and importers to conduct comprehensive tests of substances, which are carried out according to harmonised criteria throughout the European Union, should be considered extremely important. It enables comparing the properties of substances with similar applications. This type of analysis of mining explosives has clearly shown the highly onerous properties of nitroglycerin and nitroglycol, which are contained in dynamites. These compounds should be considered highly toxic. Therefore, their replacement with alternative substances should be regarded crucial for ensuring a high level of protection of health and the environment, which is very strongly emphasized by the REACH regulation. In the case of mining explosives, emulsion explosives are an excellent example of this type of compounds as they do not contain any substances recognized as toxic. On the other hand, very good operational parameters (explosion heat, energy concentration), the values of which exceed those obtained for emulsion explosives, should be considered as a certain advantage of dynamites. In order to obtain emulsion explosives with similar parameters, it was proposed to modify their composition by adding penthrite to the emulsion matrix. The assessment of the environmental effects of this type of activity carried out in this work on the basis of criteria specified by the REACH regulation has confirmed that the adverse environmental impact of the substance used is much lower than that of nitroglycerin and nitroglycol.

There is no doubt that REACH is of great practical significance. However, it should be emphasized that the substance evaluation rules specified by REACH, which are focused on environmental factors, cannot be the only source of information on the safety of substance use. Such a conclusion is clearly justified by the analyses of dynamites and emulsion explosives conducted in this article. A significant limitation of the effectiveness of REACH is the failure to take into account the conditions related to work safety, which are extremely important, especially in the case of dynamites. Therefore, it seems justified to postulate the need for supplementing the provisions of the REACH regulation with specific features of a given substance (preparation, product), which have a significant impact on the safety of its use at all stages of its life cycle. It seems that this information should be submitted by manufacturers or importers already at the stage of substance registration. Such a modification would certainly contribute to strengthening the level of protection of life and health against the harmful effects of all kinds of chemical substances.

Acknowledgements

Temat zaprezentowany podczas II Konferencji Naukowo-Technicznej „Nauka-Technologia-Środowisko" w dniach 27–29 września 2023 r. w Wiśle. Konferencja finansowana przez Ministra Edukacji i Nauki w ramach programu „Doskonała nauka" – moduł „Wsparcie konferencji naukowych"
(projekt nr DNK/SP/546599/2022).

Doskonała Nauka

The topic was presented during the 2nd Scientific and Technical Conference "Science-Technology-Environment" on September 27–29, 2023 in Wisla.
The conference is financed by the Minister of Education and Science as part of the „Excellent Science" program - the "Support for scientific conferences" module (project no. DNK/SP/546599/2022).

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KORZYŚCI I OGRANICZENIA ZWIĄZANE Z ZASTOSOWANIEM ROZPORZĄDZENIA REACH DLA GÓRNICZYCH MATERIAŁÓW WYBUCHOWYCH

Abstrakt

W artykule przedstawiono praktyczne konsekwencje związane z opracowaniem i wdrożeniem regulacji rozporządzenia REACH. W następstwie wprowadzenia tego aktu prawnego nastąpiło ujednolicenie systemu zarządzania bezpieczeństwem substancji chemicznych na obszarze całej Unii Europejskiej i oparcie go na zasadach rejestracji, oceny i udzielania zezwoleń. Zasady te odnoszą się do wszelkiego rodzaju substancji, preparatów i wyrobów znajdujących się w obrocie handlowym. Za szczególnie istotne należy uznać ich znaczenie w zakresie ograniczenia środowiskowych oddziaływań substancji niebezpiecznych, do których zalicza się materiały wybuchowe. W ramach rozważań podjętych w pracy analizie poddano zalety zastosowania systemu REACH względem górniczych materiałów wybuchowych (dynamitów i materiałów wybuchowych emulsyjnych), do których zaliczyć należy w szczególności kompleksową analizę skutków środowiskowych zastosowania tego rodzaju substancji prowadzoną wedle ujednoliconych kryteriów ustalonych poprzez przepisy rozporządzenia. Z kolei na najistotniejszą wadę przyjętych regulacji uznać należy nie uwzględnienie w ramach omawianego aktu prawnego uwarunkowań związanych z bezpieczeństwem środowiska pracy.

Słowa kluczowe: system REACH, zarządzanie środowiskiem, materiały wybuchowe