Waste management in the oil and gas industry in the light of the new legal regulations

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Introduction

Waste from extractive industries is defined as waste from exploration, extraction and physical and chemical processing of ores and other minerals [1], and comprise over 50% of all waste produced in Poland every year. Proper management of extractive waste, considering its properties (toxicity, carcinogenesis, mutagenicity, combustibility or explosiveness) and mass occurrence, is an important issue. Unfortunately, most of waste is not processed; is deposited in the environment or stored in special hazardous waste landfills or in non-hazardous and inert waste landfills. Until recently applicable waste management law in Poland did not exclude extractive waste as a separate kind of waste, thus the same criteria and requirements were applied to both waste from extractive industries and other industrial waste. The rise of social awareness about potential consequences of improper waste management enforced legal framework for extractive waste management both in the EU and Poland.

Legal regulations for waste from the oil and gas industry

The basic legal act on the management of waste from extractive industry is Act of 10 July 2008 on waste from extractive industry [1], which implemented to Polish law Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries (Mining Waste Directive) and amending Directive 2004/35/EC [2]. The aim of the Act on waste from extractive industry is prevention of extractive waste production in the extractive industry, reduction of its adverse environmental effect and adverse health effect. The act defines the extractive waste and non-contaminated soil management rules, waste facilities management rules and procedures connected with obtaining a licence or a permission concerning the management of waste from extractive industry as well as prevention of serious accidents at waste facilities of the category A. The act does not concern waste from exploration, recognition, extraction of minerals from the deposits, storage and processing which is not connected with this kind of activities and come from maritime area of Poland, water injection into the formation, and rock and soil mass displaced during extraction of minerals from deposits.

Within the meaning of the Act, for extractive waste there is a hierarchy of procedure for waste which tries to prevent the production of waste. It is also one of the main aims of the waste management plan which is very important statutory instrument implemented by the Act. Every waste holder should submit a plan of waste management before starting waste production or waste management. The Act defines information which should be contained in a plan as the type and the characteristic of waste. A person who holds such waste is obligated to obtain a decision which approves an extractive waste management plan, and is issued after submitting an application accompanied by a plan (a waste holder is obligated to survey his plan every five years and to inform about any changes). A waste holder running a waste facility, additionally prepare a risk estimation for the facility.

On 14 January 2013 Act of 14 November 2012 amending the act on waste from extractive industry and some other acts entered into force, which implemented changes in the Act including definitions. The new regulation adjusts wording including: waste facilities, serious accident, land reclamation and interested society, to the EU directive and implements a new term *displacement*. The Act also specifies the aims and the scope of the extractive waste management plan and rules for tailings storage facilities management.

Dating from 14 January 2013 extractive waste management plans should consider the scope and the method of monitoring of a waste facilities, a list of substances and index parameters provided for a test depending on a type and properties of stored waste. Moreover, previously plans did not specify amount of separate type of waste, but included only total amount of separate type of extractive waste estimated for the production.

A new solution is also publishing data about tests of surface water, underground water and soil, on which waste facilities may impact, especially within the scope of natural concentration of substances on a given area. Previously, it was sufficient for the extractive waste management plan to provide only test results within the scope of natural concentration occurring in soil. Moreover, the new regulation specifies Art. 9 Sec.4 with definition that extractive waste characteristic should include information concerning activities as exploration, extraction and processing of deposits for exploitation as well as description of their physical and chemical properties including their stability in atmospheric conditions and the type of mineral.

According to the new Act, waste management should be efficient not only at the post productive stage, but also during planning, that is, during the design stage. Very important in this context are methods of extraction of minerals from deposits and their processing.

The new regulations impose an obligation on every waste holder who runs a waste facility to conduct survey of classification of the facility before submitting an application for permission for closing or changing the permission for running the facility. In case of necessity of changing the classification of a waste facility, competent body obligates the holder to submit a new waste management plan. Moreover, the holder of extractive waste is obligated to reduce negative impact of extractive waste on the environment, health of people, and to prevent or minimize the possibly of broadening the scope of all adverse effects to the environment and people, produced during extractive waste management, also after closing a waste facility.

Another an important change compared to the previous Act is a new term of submitting information elicited from a waste holder running a waste facility, from The Regional Environmental Protection Inspector to The Chief Environmental Protection Inspector. According to the new guideline, deadline falls on 31 May every calendar year.

The act also changes a period of storage of reports on waste monitoring from five years until the end of the phase after closing the facility where waste was neutralized. The EU directive does not define, in this scope, time limit however, says that storage should guarantee continuity of submitting of information, especially when an operator changes. In practice it is 30 years since discontinuation of extractive waste storage.

An amendment to the Act also considers participation of the society as well as making information available to the society at the stage of licensing to running a waste facility.

Currently the act on extractive waste consists of four executive acts:

- Regulation of the Minister of Environment of 5 April 2011 on the definition of the criteria for the classification of waste facilities [3] – defining criteria for classification of classification of waste facilities as a waste facility of the category A
- Regulation of the Minister of Environment of 18 April 2011 on the management waste facilities [4] – defining the scope, time, the method and conditions for management of the waste facility of waste from extractive industries, model of monitoring report, its frequency and term of submission
- Regulation of the Minister of Environment of 15 July 2011 on the definition of the criteria the classification of waste from extractive industries as inert waste [5] defining detailed criteria for the classification of waste from extractive industries as inert waste considering their physical, chemical and biological properties
- Regulation of the Minister of Environment of 20 June 2013 on the characteristic of waste from extractive industries [6] – defining the method of collection and verification of information by which the characteristic of waste from extractive industries and the detailed scope of the characteristic of waste from extractive industries is compiled.

It should be emphasize that the acts which have been implemented so far do not exhaust the broad subject of extractive waste management.

Noxiousness of waste from the oil and gas industry

Review of legal acts on extractive waste management shows that at the moment only procedure for inert waste has been legally regulated. According to the Regulation of the Minister [5] exploratory waste cannot be considered as inert waste, if:

- is highly hydrated (highly decomposable and soluble) – together with water contained in waste, noxious substances easily get into the environment (waters, soil) an may have negative impact on the environment and/or life and health of people.
- contains over 0.1% sulfide sulphur
- is combustible and has tendency to autoignition – usually drilling waste is hydrated and contain of organic carbon does not indicate possibility of autoignition
- contains heavy metals exceeded established quality standards for soil and ground defined for group B, which defines Regulation of the Minister of Environment of 9 September 2002 on the standards for soil and ground quality [7] and vanadium quality for which maximum level has been set at 500 ppm (500 mg/kg of dry matter of extractive waste)
- contains chemical substances used to prepare and to regulate drilling fluids which during storage may pose a threat to the environment, life and health of the people.
- does not meet criteria for inert waste to be stored in the inert waste landfill which defines Regulation of the Minister of Economy of 8 January 2013 on criteria and procedures for permission to store waste in the landfill [8]. Criteria which decide about permission to store inert waste in the inert waste landfill include permissible maximum values of elution (the values are determined with liquid to solid phase proportion 10 l/kg – basic test or, when there is no other possibility, with the proportion 2 l/kg – ancillary test) which can be found in the attachment No. 2 to the regulation.

It is a well-known fact that most of waste which is produced by the oil and gas industry does not meet the criteria and cannot be considered as inert waste. Therefore, the question arises, how in current legal situation this type of waste should be treated?

It seems that the best solution is to use the guidelines for hazardous waste and non-hazardous and inert waste, included in the Regulation of the Minister [8], defining maximum levels of elution of contamination from inert waste, hazardous waste and other than inert and hazardous which are stored in a given landfill, included in the corresponding attachments. In accordance with the legal act, the scope of research of drilling waste includes determination of eluted components of waste as metals (arsenic, barium, cadmium, chromium, copper, mercury, molybdenum, nickel, lead, antimony, zinc), selenium, chloride ions, fluoride ion, sulphate ion and dissolved organic carbon (DOC) as well as total dissolved solids (TDS). Tested waste from exploration and exploitation of hydrocarbon deposits, usually including most of parameters meet criteria of storage in a landfill different than hazardous and inert (Attachment No. 3).

Exceeded maximum levels mostly concern chloride ions and total dissolved solids (TDS) which content very often exceed criteria established for hazardous waste [Attachment No. 1] [9]. The problem is difficult to avoid since high content of the substances is mostly connected with requirements of technological processes and means used during drilling.

At the same time in regard to the changing technologies used during exploration and exploitation of hydrocarbon deposits, seems necessary to consider in the procedures for waste from this works, requirements included in Regulation of the Minister of Environment of 13 May 2004 on conditions in which waste may be considered as non-hazardous [10]. In accordance with the regulation, at the first stage a list of substances should be determined which occurrence in waste may be expected (an analysis of substances used in the technological process should be conducted), then a preliminary test, which let to check whether selected substances occur in waste, and detailed test, in order to determine concentrations of occurring substances, should be conducted. This kind of procedure event thought might broaden the scope of tests necessary to properly classify waste to a proper category; however, it definitely contributes to even bigger safety of extractive waste management in the oil and gas industry.

Summary

Legal regulations implemented over the last few years definitely illustrate specificity of extractive waste in a much better way, especially their storage. The new regulations should contribute to safer waste management, maximally reduce their negative influence on the environment and life and health of people through proper planning of exploration as well as waste utilization using new environment-friendly technologies. Because waste from exploration and exploitation of hydrocarbon deposits is not usually inert, it is necessary to amend current Polish legislation with new regulations concerning procedures for hazardous, non-hazardous and inert waste.

References

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6. Rozporządzenie Ministra Środowiska z dnia 20 czerwca 2013 r. w sprawie

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9. Baza danych o odpadach wiertniczych badanych w latach 2008 do 2012, Zakład Ochrony Środowiska Instytutu Nafty i Gazu, Kraków
10. Rozporządzeniem Ministra Środowiska z dnia 13 maja 2004 r. w sprawie warunków, w których uznaje się, że odpady nie są niebezpieczne (Dz.U. z 2004 roku nr 128, poz. 1347)

Translation into English by the Author

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Z prasy światowej – innowacje: odkrycia, produkty i technologie

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Technologia cięcia laserowego

Ostatnio zauważyć można gwałtowny wzrost zainteresowania wykorzystaniem cięcia laserowego jako środka optymalizacji konstrukcji stalowych przemysłu wytwórczego. Dzieje się tak, ponieważ cięcia laserowe zapewniają lepszą jakość obróbki metali, co zmniejsza potrzebę ich wtórnego oczyszczania. Cięcie laserowe, to proces termomechaniczny. Zasada działania tego rodzaju obróbki materiału polega na ogniskowaniu wiązki laserowej na obrabianym przedmiocie, w wyniku czego materiał nagrzewa się tak bardzo, że topi się lub paruje. Odkształcenia, a także zmiany strukturalne występujące pod wpływem wysokiej temperatury powodują, że pocięty materiał może miejscowo tracić swoje właściwości mechaniczne.

Międzynarodowa grupa naukowców, na łamach czasopisma *Optics & Laser Technology,* zaprezentowała analizę naprężeń na powierzchni poddanej obróbce laserowej. Przedstawili oni oryginalną, bezdotykową i nieniszczącą metodę pozwalającą na oszacowanie naprężeń w tak obrabianym materiale. Zaproponowana metoda oceny naprężeń w materiałach poddanych działaniu wiązki laserowej zapewnia wystarczająco dużo informacji z bardzo dobrą dokładnością. Badania eksperymentalne przeprowadzono na trzech różnych materiałach: stali, aluminium i tytanie. Sprawdzenie poprawności obliczeń nastąpiło poprzez pomiar rozkładu naprężeń w pobliżu krawędzi cięcia metodą ultradźwiękową. *(kk)*

(M. Harničárová, J. Valíček, A. Öchsner, R. Grznárik, M. Kušnerová, J. Neugebauer, D. Kozak: Predicting residual and flow stresses from surface topography created by laser cutting technology, Optics & Laser Technology 52 (2013) 21–29)

Fotokatalityczne oczyszczanie wody morskiej

Przedsiębiorstwa zlokalizowane na obszarach przybrzeżnych często wykorzystują duże ilości wody morskiej. W większości przypadków, aby uniknąć problemów związanych z możliwym zanieczyszczeniem instalacji przemysłowych, woda musi zostać odkażona i oczyszczona. Naukowcy z Universidad de Cádiz w Hiszpanii proponują stosowanie do tego celu procesu fotokatalizy na powierzchniach zmodyfikowanych TiO_2. Do tej pory przeprowadzono jedynie eksperymenty w skali laboratoryjnej z użyciem pierścieniowego reaktora UV, ale otrzymane wyniki okazały się nadzwyczaj obiecujące. W porównaniu do konwencjonalnego oczyszczania z zastosowaniem promieni UV_{254}, zastosowanie fotokatalizy skutkuje szybszą kinetyką procesu: aby osiągnąć ten sam poziom dezynfekcji, wystarczy użyć od 30 do 33% mniejszej dawki promieniowania UV. Katalizator stosowany w procesie fotokatalizy wykazywał stopniowy zanik aktywności, aż do całkowitej dezaktywacji po 215 godzinach trwania procesu. Wciąż prowadzone są intensywne prace mające na celu wydłużenie czasu życia katalizatora – gdy zostanie to osiągnięte, nastąpić ma budowa instalacji pilotażowej. *(kk)*

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Biodiesel z mikroalg

Z powodu rosnących cen konwencjonalnych paliw, biopaliwa stają się coraz popularniejszą alternatywą. Badania nowych surowców i technologii nastawione są na zastąpienie paliw opartych na ropie naftowej. Przykładem może być biodiesel (ester alkilowy), który można uzyskać z tłuszczów roślinnych i zwierzęcych wykorzystując proces transestryfikacji liniowych alkoholi monohydroksylowych w obecności katalizatora. Ciekawym substratem wydają się być mikroalgi, a dokładniej pozyskiwany z nich olej. Produkcja biodieslu na bazie mikroalg ma wiele zalet w stosunku do innych roślin, m.in. szybszy wzrost i możliwość kultywacji na obszarach o małej żyzności. Niemniej jednak, zwiększenie skali ich produkcji może w niekorzystny sposób wpływać zarówno na środowisko jak i na opłacalność procesu. Dlatego też tak ważne było przeprowadzenie procesu optymalizacji produkcji mikroalg, uwzględniając identyfikację parametrów operacyjnych, kluczowych dla otrzymania produktu o wysokiej zawartości tłuszczów. Okazało się, że chociaż zastosowanie procedur flokulacji i sedymentacji obniża koszty produkcji, to jednak może być bardziej szkodliwe dla środowiska niż połączenie mikrofiltracji DCF (ang. *dynamic cross flow*) z odwirowywaniem. Chociaż bezpośrednia ekstrakcja zapewnia doskonałe wyniki ekonomiczne, to właśnie klasyczna sucha ekstrakcja jest mniej szkodliwa dla ludzi i środowiska. Okazuje się więc, że przy produkcji biodiesla aspekty ekonomiczne stoją w opozycji do względów środowiskowych, o czym należy koniecznie pamiętać podczas optymalizacji technologii jego otrzymywania. *(kk)*

(C.M. Torres, S.D. Ríos, C.Torras, J. Salvadó, J.M. Mateo-Sanz, L.Jiménez: Microalgae-based biodiesel: A multicriteria analysis of the production process using realistic scenarios, Bioresource Technology 147 (2013) 7–16)

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