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FACTORS INFLUENCING THE INCREASE IN THE EFFICIENCY OF MANAGING GENERATED INDUSTRIAL WASTES IN THE ASPECT OF APPLICABLE LEGAL REQUIREMENTS

Key words

Industrial, waste management, efficiency increase.

Summary

The amount of currently generated wastes originating from different branches of industry, in accordance with the requirements of the applicable national legislation, shall be successively reduced. The properly made analysis of the possibilities for reusing wastes generated during the course of the production cycle, coupled simultaneously with the analysis of the generated waste management procedures, provides a real possibility of reducing their quantities, which may additionally be significantly reflected in the reduction of the enterprise running costs. Upon implementing new technologies for handling the generated wastes – as a recognized by-product – the appropriate waste management method may contribute to the improvement of the plant's viability and profit. The implementation of new activities and procedures concerning the organization of the waste handling method, planned to this end, should be coupled with the simultaneous review and analysis of available technologies that

assure the utilization of the waste as a by-product, directly at its source. In the light of the foregoing, the knowledge of the main factors having an effect on the increase in waste management efficiency, while taking account of the applicable environmental requirements and standards, becomes a basis for achieving the ecological effect and the resultant financial effect.

Introduction

The dynamic growth of the consumption of goods observed since the second half of the 20th century up to the present time, being a driving force for economic growth and the resulting increase in industrial production is becoming at the same time the main cause of the increase in the amount of generated wastes. In accordance with the applicable national and EU legal acts, the quantity of both industrially generated wastes and municipal wastes shall be gradually reduced. This objective may be achieved, inter alia, based on the clean production strategy, whose main concept is to implement activities aimed at the proper management of wastes as “by-product” either directly at the source of their generation or in external installations technologically not associated with the conducted industrial production. A properly performed analysis of the possibilities of reusing wastes generated in the production cycle, combined simultaneously with the analysis of the feasibility of implementing or improving waste management procedures, provides a real capability to reduce the amount of wastes and, in addition to meeting the administrative law requirements, it may contribute to increasing the enterprise's viability and profit.

1. Basic principles of waste management in the light of applicable legal requirements related to industrial process by-products

The main legal act that constitutively regulates the issues related to the rules of waste generation and management in the territory of the Republic of Poland is the Act of 14 December 2012 on wastes (Dz. U. of 2012, Item 21). In accordance with the provisions of the Act, a waste generator is any entity whose activity or living causes the generation of waste (the so called primary waste generator), and any entity who conducts pre-processing, mixing or any other activities resulting in a change to the nature or composition of that waste (the so called secondary waste generator). Compared to the Act of 27 April 2001 (official codification, Dz. U. of 2010, No. 185, Item 1243, with subsequent amendments) applicable until recently, the new Act introduces a number of changes to facilitate the procedure of handling substances formed as a result of the conducted production cycle, which until recently, might have been regarded solely as wastes, and currently may be regarded as a by-product. This by-product may constitute a commercial product being either a finished product or a component to be used directly in the conducted production cycle. In

accordance with Article 10 of the new Act on „wastes,” an article or a substance generated as a result of the production process whose main aim is not their production may be considered a by-product not being waste.

In accordance with Article 11 of the Act on „wastes,” the manufacturer of an article or a substance constituting a by-product shall be required to submit the application for recognition as a by-product to the Marshal of the Voivodeship relevant to the place of their generation. This application should include, inter alia, the specification of the place of manufacture of the article or substance intended to be recognized as a by-product, an indication of the article or substance intended to be recognized as a by-product and their mass, a description of the manufacturing process whereby the article or substance is produced, and the process in which they will be used. The recognition of the article or substance as a by-product will take place if the Marshal of the Voivodeship does not express the objection by a decision within 3 months from the day of receiving the application for recognizing the article or substance as a by-product. When determining whether a given substance or article is „produced as an integral part of the manufacturing process” or not, the competent authorities may take into account the following considerations:

- The nature and scope of tasks necessary for preparing the material for being directly reused;
- The determination of the degree of connection of the tasks with the main manufacturing process;
- The determination of whether the tasks are undertaken within the „normal industrial practice”; and,
- The determination of whether the tasks related to the material preparation are also an „integral part of the manufacturing process” or not.
- The authority may also take into consideration the relevant BAT reference document [1].

An essential aspect of the enterprise's activity that may contribute to increasing the effectiveness of conducted waste management can be subjecting the wastes to the processes of recovery and recycling directly in the location of their generation. In order to determine if the types of wastes that result from the performed recovery and recycling processes will cease to be wastes, in Article 14, the legislator prescribes the requirement of meeting jointly the following conditions:

- 1) The article or substance is widely used for specific purposes.
- 2) There is a market for such articles or substances or demand for them.
- 3) The article or substance meets the technical requirements for use to specific purposes and the requirements specified in regulations and standards applicable to the product.
- 4) The use of the article or substance will not lead to any adverse effects on human life or health or the environment.

Moreover, the article or substance shall meet the requirements prescribed by the European Union regulations. In addition, in this case, the article or substance that no longer meets the above-mentioned conditions becomes again a waste. It should be noted here that the law clearly prohibits the joint storage of wastes and an article or substance that has lost the status of a waste, as well as the storage of an article or substance that has lost the status of a waste in areas designated for the storage of wastes.

In order to define the proper waste handling priorities, Article 17 of the Act specifies the following order of activities: 1) preventing waste generation; 2) preparing for reuse; 3) recycling; 4) other recovery processes; 5) waste disposal.

The text of the aforementioned provisions of the Act on „wastes” implies definite requirements for implementing new directions and procedures in the waste management of an enterprise. Those procedures should also take into account the need for developing and implementing new waste processing technologies and allow for introducing any possible changes to the conducted production processes.

2. Review of waste management procedures

The process of managing wastes generated within the framework of conducted business activity primarily involves the implementation of an appropriate environmental policy in the enterprise, which should be largely based on the reduction of the quantities of wastes by using materials of an extended life cycle or materials and technologies that provide the capabilities for them to be reused.

The waste management functions involve the following [2]:

- Waste management monitoring;
- The organization and distribution of recovered resources;
- The managing the storages of resources that lend themselves to be reused;
- Releasing information about wastes, their properties and production volume; and,
- Registering waste disposal sites along with the level and method of their protection.

The extent of the environmental impact of an enterprise is largely tied to the method of its management. Therefore, the rules of comprehensive quality management provided the basis for developing the concept of the environmental management system set out in the ISO 14000 standards. The ISO 14000 standard series may be implemented in any enterprise, regardless of its size and the sector in which it is active. The objective of the ISO 14000 standard is the continuous improvement aimed at the maximum possible mitigation of a company's adverse environmental impact, chiefly by preventing pollutants from being generated. The system considers and regulates the entire area of environmental enterprise

activity and management, which encompasses planning, system implementation, production, verification and correction, marketing, and product and waste management. The implementation of ISO 14000 brings about advantages resulting from the reduction of production costs due to conducting the rational raw materials, energy and waste management, and the reduction of charges due to the use of the environment. The ISO 14000 standard also imposes the obligation to train employees, raise their awareness, and to define the environmental policy appropriate to the nature and scale of the enterprise's activities. According to the above-mentioned standard, the environmental policy should be documented, implemented, and made publicly available.

3. Example methods of handling wastes and by-products having an effect on improving the effectiveness of conducted commercial activity

The rationally maintained management of generated waste includes the following activities: proper waste classification, segregation, possible waste processing, and the sale or reuse in production processes. Wastes and by-products generated in an enterprise can be managed through direct use in primary technological processes (e.g. dust recycling), through the following:

- Use in incidental production processes (e.g. production of gold from silver electrode-position products in a separate technological process),
- The sale or free transfer outside the plant without enrichment,
- use in the installations of the cooperating plants (e.g. production of rhenium by the KGHM copper metallurgy group in a separate KGHM affiliate company),
- Use for manufacturing products not manufactured so far in the enterprise (e.g. production of window framing from polyester-glass laminate waste),
- Use as an energy source (e.g. a raw material for production of alternative fuels).

Among the above-mentioned methods of utilizing industrial wastes constituting a recognized by-product, the most important from the worldwide materials management point of view seem to be the methods of recovering and using „critical metals,” or the metals that have no new resources in nature. In view of the above, the only sources of their acquisition are currently industrial processes in which these metals constitute a by-product of the main production. An example of this type of activities could be the above-mentioned production of rhenium in copper metallurgy, conducted by a separate KGHM spin-off company, Ecoren S.A., which started up the production of ammonium perrhenate on the „Głogów” Copper Smelter (Huta Miedzi) site in 2006. Rhenium is a very rare element, whose content in the earth's crust is estimated at $10^{-7}\%$. It occurs exclusively in a dispersed state, chiefly as an admixture in molybdenum and tantalum ores, copper-bearing shale, and native platinum. It is used mainly for the manufacture of metal products resistant to very high temperatures.

Another example illustrating the possibility of the practical use of a recognized by-product can be the utilization of ashes, slags, and ash-slag mixtures formed in power plants and thermal-electric power stations during the generation of electric and thermal energy. These products are a residue from the process of combustion of hard and brown coals, whose 2008 production in Europe amounted to 56 m tons, and in Poland – nearly 16 m tons [3]. These ashes make a valuable material that contains chiefly aluminosilicates, and calcium, iron and magnesium oxides. They can be used in the production of mixtures for road construction purposes and in the production of building materials. They can also be used as a fill material to stabilize soil, as a cement substitute in concrete production, and as an additive in pavement block or brick manufacturing technologies. An example of these applications could be the activity of the Renevis company, who utilizes combustion by-products (CBP) originating from the Wrocław and Czechnica combined heat and power plants owned by the company KOGENERACJA S.A. Silicate and geotechnical aggregate offered as a commercial product is approx. 10% cheaper than natural aggregates. This aggregate was used, inter alia, for the construction of the traffic embankments of the Oleśnica ring road, in the construction of the Łany-Kamieniec Wrocławski stretch, in the construction of the A1-A4 Sośnica motorway interchange, and in the reconstruction of the Kosmonautów and Lotnicza streets in Wrocław [3].

A noteworthy, although slightly different in its nature, example of generated waste management could be the reuse of the waste fraction of polyester-glass laminates (formed, for instance, in the shipbuilding, aircraft and automotive industries, railway and building engineering, and the chemical, food and petroleum industries) for manufacturing new usable products. Due to the method of their generation and the fact that they are not to be used directly without further processing other than regular industrial practice, these wastes may not be recognized as a by-product. In the 1990s, the view was held that hardening plastics were not recyclable, because they are chemically cross-linked and contain large quantities of fillers. Laminate wastes were disposed of onto neutral waste disposal sites, where – due to a considerable space that they occupy – they pose a major problem. At the Industrial Chemistry Research Institute in Warsaw, a methodology for the utilization of waste polyester-glass laminates has been developed, which has been implemented in the company OK–Team Sp. z o.o. in Warsaw, who specialize in the manufacture of window and door framing from polyester sections by the pultrusion process that is run by reversing the well-known extrusion process to change it into stretching. Two full-value products are obtained in the process, namely: resin powder and fibrous filler, which can be added at 20–40% to the manufacture of another product of plastics. The resin powder can also be used as a substitute of mineral fillers without changing the strength properties of the plastics. In the installed test plant, up to 50 million grams of product can be utilized per year [4].

4. Summary and conclusions

In order to improve the effectiveness of the management of wastes generated in an enterprise, an analysis of the main factors having an immediate influence on the method of handling them needs to be carried out in the light of applicable standards and legal requirements and the technological requirements of the conducted production. The analysis of those factors should include:

- The determination of the current direction of the enterprise's production in the aspect of any possible prospects for the growth in related directions;
- A review of the applied production technologies, while taking into account the locations and types of generated wastes;
- A review of the currently used rules, practices and procedures of environmental management in the enterprises, with particular emphasis on the management of generated wastes;
- A financial analysis of the currently used technological solutions, including those related to the enterprise's waste management;
- The determination of the possibilities of introducing the trends of changes in the production technology in the enterprise, and the selection of new solutions to improve it;
- The development of new rules and procedures of environmental management in the enterprise, which will take into account the introduced changes to the production technology and waste management and their compliance with the legal requirements; and,
- A financial analysis of the technological solutions planned to be implemented.

After carrying out the analysis encompassing the above-mentioned factors and implementing technological solutions and management procedures selected on its basis, it will be necessary to maintain continuous supervision on the activities conducted to this end and to determine their financial and ecological effects.

The proper approach to the issues of waste management maintained in the enterprise, allowing for cooperation between functional units responsible for management, technological supervision, financial supervision, and environmental protection, may result in a total change in the waste policy and the resulting change of the qualification of the waste generator into an incidental product manufacturer. The use of the enterprise's assets in the form of its location, existing infrastructure, utility connections, licences and concessions and environmental permits held, with the simultaneous introduction of new technology directions for „incidental production” including the recovery of generated wastes at their source, as demonstrated by the examples given, might result in an improvement in the plant's viability and profitability growth. An added effect of the activities implemented in the enterprise, as discussed above, will also be a greater stabilization of its position in the production market, resulting from extending the scope of its business activity.

References

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Czynniki wpływające na wzrost efektywności gospodarowania wytwarzanymi odpadami przemysłowymi w aspekcie obowiązujących wymogów prawnych

Słowa kluczowe

Przemysł, gospodarka odpadami, efektywność.

Streszczenie

Ilość wytwarzanych obecnie odpadów pochodzących z różnych gałęzi przemysłu zgodnie z wymogami obowiązującego prawa krajowego w tej materii winna być sukcesywnie ograniczana. Odpowiednio przeprowadzona analiza możliwości dalszego wykorzystania powstających w trakcie cyklu produkcyjnego odpadów, połączona jednocześnie z analizą procedur zarządzania wytwarzanymi odpadami daje realną możliwość ograniczenia ich ilości, co dodatkowo w sposób znaczący może znaleźć odzwierciedlenie w obniżeniu kosztów funkcjonowania przedsiębiorstwa. Po wprowadzeniu nowych technologii w zakresie postępowania z wytwarzanymi odpadami jako uznanym produktem ubocznym, odpowiedni sposób gospodarki odpadowej może przyczynić się do poprawy wzrostu rentowności i zysku zakładu. Planowane w tym celu wdrożenie przez zakład nowych działań i procedur dotyczących organizacji sposobu postępowania z odpadami, winno być połączone z jednoczesnym przeglądem i analizą dostępnych technologii gwarantujących wykorzystanie odpadu jako produktu ubocznego bezpośrednio w miejscu jego powstawania. W świetle powyższego znajomość głównych czynników mających wpływ na wzrost efektywności gospodarowania odpadami przy jednoczesnym uwzględnieniu obowiązujących wymogów i norm środowiskowych, staje się podstawą osiągnięcia efektu ekologicznego i wynikającego z niego efektu finansowego.