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CLEANER PRODUCTION STRATEGY AS POSSIBILITY OF WASTE REDUCTION IN WOOD SAWING

STRATEGIA CZYSTSZEJ PRODUKCJI MOŻLIWOŚCIĄ REDUKCJI ODPADÓW PRZY PRZECIERANIU DREWNA

Abstract

Cleaner production is a management strategy aimed at reducing the losses associated with waste of energy and raw materials which focuses on waste prevention and not the way of its utilization. Cleaner Production can also reduce company's costs incurred during the processes taking place within the organization. In the case of companies involved in wood processing (sawmills, carpenters, etc.) a lot of waste in the form of sawdust, shavings or edgings is created. These are materials that can be used as an alternative fuel for firing furnaces and boilers. Good sales management of this type of waste after production allows companies to obtain additional income and minimize environmental risks.

Keywords: clean production, pellet production, protection of the environment

Streszczenie

Czystsza produkcja jest to strategia zarządzania przedsiębiorstwem mająca na celu ograniczenie strat związanych z marnotrawstwem energii i surowców, skupiająca się na zapobieganiu powstawania odpadów, a nie sposobów ich utylizacji. Czystsza Produkcja pozwala też na redukcję kosztów przedsiębiorstwa ponoszonych podczas procesów zachodzących wewnątrz organizacji. W przypadku przedsiębiorstw zajmujących się obróbką drewna (tartaki, stolarnie itp.) powstaje bardzo dużo odpadów w postaci trocin, wiór czy też zrżyn. Są to materiały, które można wykorzystać jako paliwa alternatywne do opalania pieców i kotłów grzewczych. Dobre zarządzanie sprzedażą tego typu odpadami poprodukcyjnymi pozwala przedsiębiorstwom na uzyskanie dodatkowych dochodów i zminimalizowanie zagrożeń dla środowiska naturalnego.

Słowa kluczowe: czystsza produkcja, produkcja pelletu, ochrona środowiska

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1. Introduction

Cleaner Production (CP) is a continuous use of processes and products integrated into a preventive environmental strategy to reduce the risk to humans and the environment. Cleaner Production uses a system which, when appropriate procedures are used, becomes a voluntary and not formalized environmental management system. UNEP defines Cleaner Production as follows: Cleaner Production is a strategy for environmental protection involving a continuous, integrated, preventive action in relation to processes, products and services, aimed at increasing the efficiency of production and services, and reduce the risk to humans and the environment [1]. Fig. 1 shows the use of Cleaner Production in practice.



Fig. 1. Use of Cleaner Production in practice

Cleaner Production program is achieved by technical and organizational measures aimed at eliminating or reducing the short-term and long-term adverse impacts of production processes and products on people and the environment. Cleaner production process refers to both manufacturing processes and the environmental characteristics of an article throughout its life cycle. With regard to the course of manufacturing process, this means the elimination of harmful materials and emissions and rational use of living labor, materials and energy [2]. In the Cleaner Production program, we can distinguish four main principles [3]:

- the precautionary principle – advocates the necessity of proving a potential poisoner that its activities or products will bring harm to the environment, shifting the burden of proof to the manufacturer instead of the local community which had already existed to

prove damages. The rejection of this approach is the use of quantitative computed degree of risk as the sole factor in deciding whether to use a chemical or the introduction of new technology. In this case, science is not ignored, but notes that if industrial production is also a huge social influence besides scientists, also other people should have influence over those decisions;

- the preventive approach – the process of preventing damage to the environment is cheaper and more effective than trying to “heal” the same environment after its destruction. Prevention requires going “against the tide” of the production process to remove the source and cause of the problems, instead of trying to control the outcome or damage. Pollution prevention should replace preventive pollution control. For example, prevention requires changes in the production process, allowing to stop a huge waste stream, while the lack of a “precautionary approach” produces more and more sophisticated models of incinerators. The increase in energy efficiency should suppress the appetite to consume fossil energy sources;
- democratic control – clean production involves all the affected by industrial activity, and thus workers, consumers and local communities. The information available on the production and involvement in decision-making supports democratic control. The community must have information concerning production company and minimum access to information on industrial emissions, pollution registers and plans for the reduction of toxic substances in the course of production as well as data on the composition of products;
- the integrated and holistic approach – people need to adopt an integrated approach for the use of natural resources and consumption. Ignorance of contemporary approach, interrelationships and dependence of the production allows for the movement of pollutants between air, water and soil. Reducing the resulting emissions associated with the production does not lead by itself to reducing harmfulness of the product. Minimization of risks can be obtained by taking into account the entire product life cycle, paying attention to the materials used, the flow of water and energy and economic impact of switching to cleaner production. Life Cycle Analysis is one of the tools in maintaining a holistic, comprehensive approach [4].

2. Characteristics of waste produced in wood sawing

During the process of wood sawing, a large amount of waste in the form bark, sawdust, edgings, blocks manipulation, etc. is produced. This amount of wastes needs a lot of space for warehousing or storage. In the case of sawdust shavings, you often need extra space or storage in the form of silos. Storage of such waste is associated with many risks for humans and the environment. There is a danger of spontaneous combustion of wood waste, if there is no control of the temperature and density of biomass. Sparks, heating of the machines working on these landfills, lightnings and biochemical processes can also cause biological hazards (viral and fungal diseases). They can cause skin and respiratory diseases. Because of the way these wastes are stored, disease can spread through the air and wild animals, birds and rodents. In the case of transport of sawdust and wood dust, explosions can occur

mixing the waste with atmospheric air, which can become an ignition source. In storage areas waste, wood can acidify the soil. Inadequate protection of sawdust stored in dumps may cause its spread to the surrounding areas under the influence of winds. These dumps can become habitat for rodents and wild animals.

3. Characteristics of pellets

In the analyzed company waste from primary production (sawing of wood raw material), pellets are partially processed in plants and sold to contracted customers. Bark is sold to companies engaged in the horticultural industry. Shavings and sawdust are used for firing furnaces in plants and sold to biomass power plants. With shavings, also wood pellets are produced. Edgings from production lines are crushed in special machines adapted to this (wood chippers), processed and used for the production of wood pellets.

Wood pellets organic fuel is produced from the sawmill wood and intended for heat generation in boilers allocated to combustion of the pellets used to produce heat. Pellet can be used for heating purposes in houses, hotels, industrial buildings, warehouses, public buildings, and wherever there is a demand for heat. Fig. 2 shows wood pellets.



Fig. 2. Wood pellets with 6 mm in diameter

Characteristics – pellet has high energy properties and low moisture content. 1 ton of pellets is created after burning up to 3 kg of organic ash, which can be used as a natural garden fertilizer. It is environmentally friendly-production of pellets does not cause any additional cutting of trees in the forest. Its use gives comfort, cleanliness and comfort during transportation and handling. Low CO₂ emissions during combustion. Pellet is a renewable energy source. Combustion may be in a maintenance-free boiler. Availability of purchase and ease of transport. It is not harmful to humans and does not cause allergies.

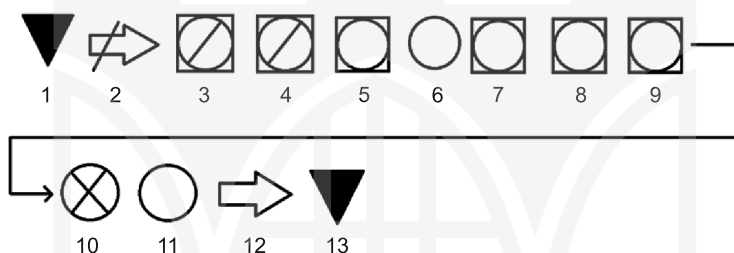
Specifications: 6 mm diameter [+/-1 mm]; length 3.15–12 mm; humidity 10%; ash content 0.7%; caloric content in the range 14–19 GJ/Mg; bulk density above 600 kg/m³.

Packaging – pellets are packed in bags of 15 kg or big-bag packagings of 1000 kg or 1200 kg. Pellets can also be stored in bulk, but you should fulfill the following conditions: storage - pellets should be stored dry, free from moisture and condensed from the roof surface without insulation. Wood material is characterized by high absorption of moisture from the air. Therefore, you should pay special attention to whether pellets are stored in conditions of low natural humidity.

Transport – pellets must be transported by cars having tarpaulins or be otherwise protected against the weather. Pellets should be protected against humidity and protected during transport to prevent overturning pallets. Pellets transported in bulk must also be protected by tarpaulin or otherwise. Due to their shape and construction, they can also be transported in bulk tankers suitable for transport in a loose and granulated form.

4. The pellet manufacturing process in terms of technology

Pellet is produced from the sawmilling waste. It is processed in a number of operations before it can be packaged and sent to the recipient. Production is continuous stoppages during the production process due to failure or planned review. The manufacturing process in terms of technology is a description of all the operations occurring in the pellet production process represented by the specific symbols (Fig. 3).



Legend:

1. Storage – raw material for the production of pellets in the form of shavings and waste after production from sawmill is stored in a designated and prepared place on a raw material storage yard.
2. Transport – is done using a wheel loader.
3. Drying the sawdust - using a belt dryer equipped with heat exchangers which generate the appropriate drying temperature. Sawdust humidity after drying should be less than 10%.
4. Purification – involves the removal of foreign bodies from the shavings, such as sand and metals using a solenoid mounted on the belt and screens.
5. Milling – is the process of homogenization of sawdust pieces, which takes place in hammer mills equipped with the ankle to shredding material.
6. Filtering – in this phase of the production process dust resulting from the previous grinding operation is removed and retained in filter bags.
7. Pressing – at this stage raw materials are added 1 to 2% of water in the form vapor, dust is heated to the temperature of 70°C for easier formation of granules and then compressed by a piston through a die.
8. Granulation – a process in which the raw material is subjected to high pressure and molded into granules of a fixed size depending on the diameter of the holes in the die and is cut off to the desired length using a knife.
9. Cooling – the process of cooling pellets to ambient temperature takes place in a cooling device which uses compressed air to enhance the stability of granules.
10. Dust removal – is done by means of screens on which there are separated dust and small particles from the finished product. The waste from this operation is returned to the beginning of the recyclable production process.
11. Packaging – this process takes place on the automated line where pellet is packed and weighed.
12. Transport – transport of pellets into a warehouse for finished products.
13. Storage – finished product packed in bags is stored in the warehouse or in the open air under the protection foil so that moisture does not get into it. Pellet is stored in bulk in large siloses at 15 to 30°C and proper humidity.

Fig. 3. The wood pellets manufacturing process in terms of technology

5. Conclusion

Pellet production is a very good ecological solution, which allows companies to minimize the risks arising from the storage of wood biomass. This is due to processing of waste heat in the pellets production process which minimizes biological hazards. Storage space is reduced by compacting waste pellets and protecting the surrounding area against pollution resulting from the conditions in which the pellets are stored. Apart from minimizing fire hazards, there are also financial benefits for businesses arising from processing wood waste in the main production of pellets. Pellet is a solid fuel alternative to coal and is quite popular fuel compared to sawdust or edgings. Additional costs associated with the pellets production are compensated by their price and revenues they bring.

References

- [1] Nowak Z., *Polski ruch czystszej produkcji – wczoraj, dziś, jutro*, Czysta Produkcja i Eko-Zarządzanie, maj 2015, nr 1–2, 2015 [in Polish].
- [2] Adamczyk W., *Ekologia wyrobów – jakość, cykl życia, projektowanie*, PWE, Warszawa 2004 [in Polish].
- [3] Nowak Z., *Zarządzanie środowiskiem, cz. II*, Wydawnictwo Politechniki Śląskiej, Gliwice 2001 [in Polish].
- [4] Kruszevska I., Thorpe B., *Strategies to Promote Clean Production*, Briefing, Greenpeace International, 1995.