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Sustainable technology as a basis of cleaner production

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Cleaner production

ABSTRACT

Purpose: The aim of the present work is characterization of the clean technology and cleaner production in relation to sustainable development and environmental requirements.
Design/methodology/approach: The paper desrcibes the general cleaner production aims, which are correspond to the prevention criteria of the IPPC-Directive. It presents cleaner production practises and technologies and examines the methods of successful application of cleaner production practises in companies, which want to realize proecological targets.
Findings: The minimization of waste and reductions in material and energy inputs are the most important environmental aims. Sustainable technological development and innovations do not automatically lead to total reduction of environmental burden of industrial production. However, technological innovation is an important factor and seems to play a central role in the long-term initiation of cleaner production.
Practical implications: Sustainable technology is usually connected with the design and analysis of complex, integrated management systems and sustainable development and it is a central target in environmental science and growth of global economies.
Originality/value: Environmental improvement of companies strategy by application the idea of cleaner production linked with sustainable technologies leads to produce environmentally friendly products and leads to increas the position of company on the market.
Keywords: Theoretical fundamentals of cleaner production; Clean technology; Sustainable development

1. Introduction

The rapid increase of human activities since the industrial revolution caused that huge quantities of resources and energy have been consumed in relatively short time. That mass consumption and the large production has significant influences on the earth's ecology, exhausting non-renewable resources and causing some environmental problems by polluting the air, water and soil [1-5].

Nevertheless, there are a lot of possibilities to reduce the environmental burden of industrial production exist. For example; optimization of the environmental performance through good housekeeping, total quality management, application of end-of-pipe techniques, recycling of wastes, non-renewable products substitution or adaptation clean technological innovations [6].

Clean technology is the most important factor for economic growth of industries and it seems to play a main role not only in the idea of cleaner production, but also in sustainable development [7].

The development of clean technology seems to be the main factor of company's strategy. Each companies, which want to reach the competitive position on the market and want to be environmental friendly should compile the strategy of technology. The risk of initiation a strategy of technology may be limited across accumulating, processing and using in decission making process information about techniques, products, machines, capital and human resources and environmental parameters [8,9].

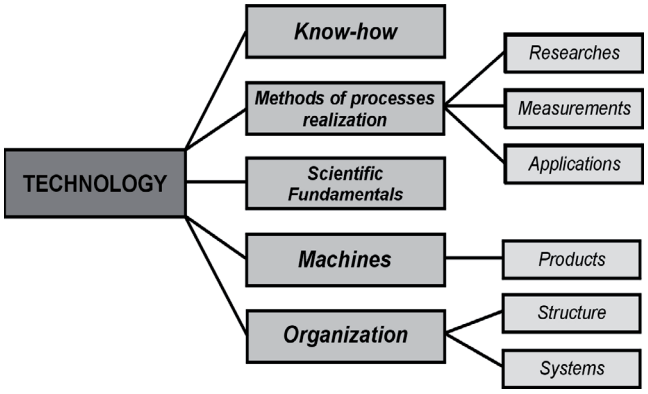

Fig. 1. Components of technology [10]

The basic actions of preparation of technology's strategy contains a recognition of all using technologies in company and an identification of all components of technology (Fig.1), which are being with object of scientific investigations. Analysing of all components of technology is very important. It helps in the selection of suitable techniques of production, which should guarantee established productivity, quality of realized processes and allows to manufacture proecological products [11].

The initiation of the new technology is very expensive process, however in long period of time, technology is one of main factors, which influences on quality of products [9].

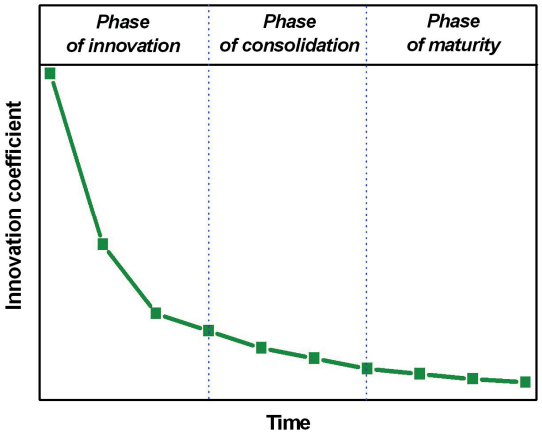

Fig. 2. Curve of technology improvement rate [10]

The better quality of products causes not only the growth of competitiveness, but what is more, it influences on the productivity of process, as a result that the modern technologies influence on shortening the duration of the production cycle and increasing the number of products [11].

Figure 2 presents the main phases of life cycle of technology illustrated by a curve of technology improvement rate. The innovation coefficient is a basic determinant of each phases. The rate of technology innovation depends on modernity of technology and it can be improves by the transfer new kinds of technologies, which is developed in recent years (Tab.1).

Table 1.
Chosen examples of new kinds of technology [10]

No.	Kind of technology	Elements
1.	Modern materials	Biomaterials, diamond coatings, modern polymers, intermetallic alloys, composite materials
2.	Numerical technology of image	Image processing, data compression, high resolution systems
3.	Modern computational methods	Modular software, computer simulation, neural networks
4.	Optoelectronics	Light pipes, lasers, optical computers
5.	Artifical intelligence	Inteligent machines, expert systems, genetic algorithms
6.	Flexible manufacturing systems	Computer integrated manufacturing (CIM), computer integrated designing (CAD)
7.	Sensor technology	Active/passive sensors, optical sesnsors
8.	Biotechnology	Bioelectronics, Genetic engineering

2. Sustainable technology and natural environment

In practice, a technology and realization of technological processes is in exact relationship from elements of working and natural environments. Steering of technological processes can not be realized without consideration of all settings in company processes and external environment (Fig.3) [12].

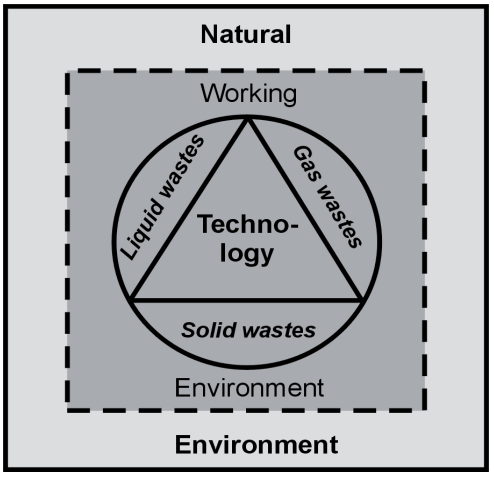

Fig. 3. Technology and natural environment [13]

Because of the fact that the process technologies should be carried out from a cleaner production point of view, the development of sustainable technology should be based on the general cleaner production aims. The technological process,

which based on clean technology should tend to reducing or minimizing the amount of [12]:

- resources consumed;
- waste and emissions generated;
- the hazards of the waste and emissions generated (mainly by usage substitution of input materials);
- the risk of accident or malfunction.

The mentioned purposes are essentially correspond to the prevention criteria of the IPPC-Directive. According to above proecological targets companies should apply as following technological innovations [14]:

- auxiliary technology, which includes all the supporting technologies to monitor and control the existing production process and all the logistics and technological infrastructure;
- end-of-pipe technology, which can be defined as all techniques added at the end of the existing processes to decrease the amount of environmentally harmful emissions;
- in-process technology, which includes improvement and application of the existing technology - changes are integrated within the process hardware of the existing production steps;
- new technology, which includes an new production process principle or a new technical plant design.

Generally, most companies, when leading changes in theirs production process, apply the first three stages of technological innovations: auxiliary technology, end-of-pipe technology or in-process technology. However, introducing a new (sustainable) technology brings the best profits. Table 2 presents some exemplary technological innovations in materials processes [15].

Table 2.
Sequences of proecological modifications in a field of materials processes [13]

No.	Stage	Contents
1.	Improvement of cleaning methods	▪ improvement of measuring methods ▪ investigation of new cleaning method
2.	Reduction of wastes stream	▪ modification of technology, production process, machines ▪ introduction of effective steering systems ▪ modification of materials ▪ reduction of water, energy and raw materials consumption
3.	Designing of proecological products	▪ planning of life cycle of products ▪ designing of products in recycling aspects
4.	Formation of new infrastructure forms	▪ modification of energy using systems ▪ modification in range of transport and communication
5.	Integration of technical sciences	▪ joining of new technical disciplines

3. Cleaner production practises and technologies

Cleaner production is definied as the continous application of an integrated preventative environmental strategy to processes and products to reduce risks to humans and the environment. For production process, cleaner production includes conserving raw materials and energy, eliminating toxic raw materials and reducing the quantity and toxicity of all wastes [16,17].

Successful application of cleaner production in companies depends on property management, maintenance, adequate infrastructure and training of people. The transfer of cleaner production practises should be realized by [16]:

- technological capacity (ability to adaptation clean technologies),
- training capacity (ability to training and education the ideas of cleaner production to various groups of people),
- institutional capacity (ability to network and co-operate among different stakeholders),
- government capacity (ability to prepare and implement policies in different policy fields).

Technological capacity is a one of the most important method to applicate the idea of cleaner production. Environmental technology is usually connected with the design and analysis of complex, integrated management systems and sustainable development (Fig.4) in the areas of [18,19]:

- role of the design in the operations of environmental technology,
- control of integrated environmental systems,
- role of computer methods in the opertaion and control of environmental systems,
- eduction and training requirements to provide efficient operation and maintenance of complex environmental systems in range of clean technology.

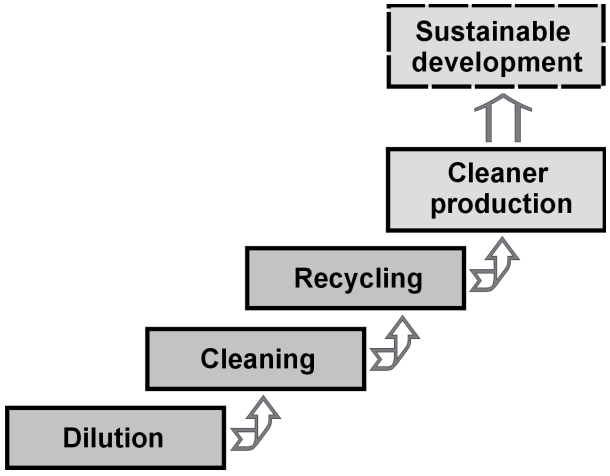

Fig. 4. Hierarchy of environmental problems solution [19-21]

The successful promotion of idea of cleaner production and environmentally sound technologies it is necessary to [20]:

- bulit business strengths of company,
- connect the business and environmental advantages of sustainable technology,

- initiate long-term investments the technology transfer and development,
- exist government assistance and support mechanisms.

However, cleaner production and sustainable technologies will not be efficient without environmental management systems, which is the framwork set by top management of company [21].

4. Conclusions

The minimization of waste and emissions and reductions in material and energy inputs are the most important environmental aims. Sustainable technological development and innovations do not automatically lead to total reduction of environmental burden of industrial production. However, technological innovation is an important factor and seems to play a central role in the long-term initiation of cleaner production.

Environmental improvement of companies strategy by application the idea of cleaner production linked with sustainable technologies leads to produce of environmentally friendly products and moreover leads to increas the company position on the market. Cleaner products must be given an essentially stronger meaning in the future because of the necessary transition to sustainable economy and development.

Sustainable development and idea of cleaner production is a central target in environmental science and plays a key role in the growth of global economies. Therefore, modern industrial and manufacturing companies should apply technologies designed to minimize pollution and use of finite resources. These technologies tend to improved the global environment and humans life.

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