

# CONCEPT OF ECODESIGN APPLIED TO THE DESIGN AND PROCESSES EQUIPMENT MANUFACTURING

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**Rezumat:** *Conceptul de Ecodesign presupune integrarea în activitatea de concepție a produsului a componentei de protecție a mediului, care este integrată alături de alte componente ca: gestiunea costurilor, performanța tehnică, cerințele clientilor. Condițiile de protecție a mediului trebuie aplicate pe ansamblul tuturor fazelor ciclului de viață a produsului (concepție, proiectare, fabricație, transport, utilizare și eliminare), pe produs sau pe serviciu, pe ambalaj. Lucrarea de față tratează problematica aplicării conceptului de Ecodesign la concepția și proiectarea proceselor și echipamentelor tehnologice de fabricație din domeniul construcției de mașini.*

**Abstract:** *The Ecodesign concept involves the integration of product design in the work of the environmental component that is integrated with other components such as: management costs, technical performance, customer requirements. Environmental conditions must be applied throughout all phases of product life cycle (conception, design, manufacturing, transportation, use and disposal), the product or service on the packaging. This paper deals with the issue of applying the concept of Ecodesign in the design process and equipment design and manufacturing technology in the field of machine building.*

## 1. Introduction

According to the principles of sustainable development, the environment must be protected so that, in conditions in which the renewable resources are increasingly scarce, the rate of natural resources-consumption does not lead for long-term to their decrease and to permit their saving in order to satisfy the aspirations of the present and next generations.

But any industrial product do not go through its life cycle without eating (consumption of natural resources and energy) or polluting (every product is at the origin of freeing various substances in the atmosphere, water or soil, respectively: waste water, exhaust, emissions of gas or vapour).

All these are actually sources of impact on environment which, through the attention accorded in the design phase of products, can be considerably improved.

The concept integrates in the product design activity the following new component: the environmental protection, component that is integrated with others such as: management costs, technical performance, customer requirements.

The environmental protection conditions must be applied throughout all phases of the product life cycle (conception, design, manufacturing, transportation, use and disposal), on product or service, on packs, etc.

This present paper treats the problems concerning the application of the concept of Ecodesign in the design of the manufacturing processes and equipment from the field of machine building.

## **2. Waste and pollution sources of waste generated by manufacturing or operating processes of technological equipment manufacturing**

The main groups of waste and pollutants, which result from the manufacturing processes and technological equipment that operates in the field of machine building, can be grouped as follows:

- metallic scraps, ferrous and nonferrous, as: metallic chips, scrapped parts, heads, rods, worn tools and parts etc.
- non-metallic wastes, as: lubricants, oils, solvents with tricolor or hydrocarbons used to washing operations, carpal used to clean structures or hands, which are impregnated with oil, dust, etc.
- air polluted with different particles, such: oil, combustion gas, coolant mist, dust, etc.

The main sources of pollution with wastes or other pollutants caused by the manufacturing, operating and maintenance phases of the manufacturing technologic equipment are as follows:

- working processes and operations of the parts that compose the processing equipment or of parts that are manufactured on the technologic equipment, from which the metallic scraps result;
- washing operations of the structure or of its components, operations of oil changing from different mechanisms, etc.
- operating, maintenance and repairing operations of the equipment, etc.

The amount of waste resulted from the manufacturing processes or from the operating of manufacturing technologic equipment depends, generally, on the following factors: type of working operations of the component parts, machining character (roughing, finishing, super finishing), working parameters and conditions established by the technologic design and production size, shape complexity of component parts, correct design of the equipment construction and of the technologic process, human resources qualification etc.

### **3. Objectives of the concept of Ecodesign in technological processes and equipment**

The main objective of the Ecodesign concept is to minimize the environmental impact of products and services in order to improve the quality of life for present and future.

Other important objectives of the concept are as follows: application of the best solutions of quality utilization that must take into account the environment; redefinition of business strategy of the enterprises by taking into account the environmental issues which may create opportunities for innovation, for a new offering and for conception of functional, economic, sustainable products that must respond to users requirements and creates a competitive advantage on the products market.

The effective environmental impacts which may have the technologic equipment and manufacturing processes and which must be considered in implementing the Ecodesign concept in their design are as follows:

- materials consumption in the manufacturing of technologic equipment and in the frame of manufacturing processes developed on such equipment;
- consumption of oil, water, solvents and other fluids that can pollute the environment;
- energy consumption;
- pollution with noises, smells etc;
- polluting generated, directly or indirectly, immediately or in the future (at the end of life of the technologic equipment), wastes, etc.

The general directions for action in order to improve the impact of technologic equipment and manufacturing processes on the environment are as follows:

- inputs into the system: water consumption, energy, materials and supplies;
- outputs from the system: air emissions, wastes, noises, waste parts, scraps, etc.

The following indicators can be used for measuring the environmental impact of various activities that use the manufacturing processes and equipment: consumption of non-renewable natural resources; consumption of renewable resources; power consumption needed in the technologic equipment manufacturing; energy consumption needed for the use of technologic equipment or total power consumption; indicators of transport, such: number of miles of the enterprise vehicles for purchase raw materials and materials needed for equipment distribution), percentage of waste that presents the danger of pollution.

#### 4. Principles and strategies that follow to be applied according to Ecodesign concept in the conception of the manufacturing processes and equipment

**Table 1.** Principles and strategies that follow to be applied according to Ecodesign concept in the conception of the manufacturing processes and equipment

<p>The basic principles that must be applied in the conception of the technologic processes and equipment according to ecodesign concept are as follows:</p>	<ul style="list-style-type: none"> <li>▪ the consideration of the life cycle of the manufacturing technologic process and equipment, principle that consists into considering all the stages of the life cycle and of their impact on environment;</li> <li>▪ the consideration of the manufacturing process and equipment like a system with multiple components (equipment, envelopes, consumables etc.);</li> <li>▪ the consideration of the exigencies on the manufacturing process and equipment concerning the environment (regulations, brand image etc.);</li> <li>▪ the consideration of the consequences created on environment by the achievement of manufacturing process and equipment (resources consumption, atmospheric emission, wastes, rejects, valorisation at the end of equipment life cycle etc.);</li> <li>▪ the analysis of the exigencies and consequences on the entire life cycle of the manufacturing process and equipment;</li> <li>▪ application of a multi-criteria system that includes the assembly of the environment parameters as: raw material and power consumptions on the assembly of the life cycle of manufacturing process and equipment and their components, environment polluting with wastes generated by the manufacturing process and equipment – on their entire life cycle; transformation of the natural environment of the life frame.</li> </ul>
<p>The main strategies that must be applied in the conception of the technologic processes and equipment according to Ecodesign concept are as follows:</p>	<ul style="list-style-type: none"> <li>▪ selection of materials with low impact on environment, selection of renewable materials and reduction of the material consumption;</li> <li>▪ reduction of the impact on environment in the phase of utilization of the manufacturing process and equipment;</li> <li>▪ improvement of the rules of utilization of the manufacturing process and equipment;</li> <li>▪ increase of the period of utilization of the manufacturing process and equipment;</li> <li>▪ prevention of the polluting, optimization of wastes collection and creation of the system of wastes recycling;</li> <li>▪ diminishing of the natural resources consumption, diminishing of the power consumption and utilization of non-polluting energies;</li> <li>▪ reduction of wastes quantity by reducing the weight, volume and dimensions of the technologic equipment by using recyclable and recycled materials, by repairing and reusing of the worn equipment;</li> <li>▪ design and achievement of an easier assembling of the technologic equipment etc.</li> </ul>
<p>The main errors that must be avoided at the application of the strategies or of the Ecodesign concept are as follows:</p>	<ul style="list-style-type: none"> <li>▪ selection of materials without evaluation of their impact on environment,</li> <li>▪ focusing on only one phase of the life cycle of technologic processes and equipment;</li> <li>▪ focusing on reduction of the minor impacts and not on the processes that have an important impact on the environment.</li> </ul>

### 5. Technical solutions, methods and recommendations for the application of the Ecodesign concept in the conception of manufacturing processes and equipment

The conception and achievement of the manufacturing processes and equipment based on the Ecodesign concept must includes all the phases of their life cycle. The main technical solutions and recommendations that are specifically to the environment problems and are applicable in each phase of the life cycle of manufacturing processes and equipment are presented in table 2. [1], [2]

**Table 2.** Solutions and recommendations

Selective selection of materials	<ul style="list-style-type: none"> <li>▪ Avoiding or reduction of the utilization of toxic materials on the entire assembly of the life cycle of technologic process and equipment, either by the reason of health protection but also by the reason of environment protection.</li> <li>▪ Preferable utilization of the renewing materials, that has as effect the elimination of wastes and an optimum management of the resources; preferable selection of recyclable materials whose quality after recycling are specifically to secondary raw material.</li> <li>▪ Avoiding of irreversible associations of materials; for example, the recyclable materials can create some problems in the case when must be associated by different reasons (rigidity, mechanical strength etc.) with other materials.</li> <li>▪ Avoiding of raw materials and parts whose origin create environmental problems.</li> </ul>
Economy of raw materials	<ul style="list-style-type: none"> <li>▪ Preferable utilization of recyclable materials that will permit the reduction of needed raw materials and the decrease of the wastes volume.</li> <li>▪ Preferable utilization of mono-materials or reduction of the number of distinct materials.</li> <li>▪ Reduction and economy of the quantity of needed materials by an optimization of the mechanical strength – with condition to maintain the exigencies concerning the mechanical strength.</li> <li>▪ Reduction of the quantity of needed materials by an integration of the functions.</li> </ul>
Optimization of the process and equipment functionality	<ul style="list-style-type: none"> <li>▪ Guaranty of a high reliability that is important not only for the fact that permits to increase the life and the utilization of the process or equipment but also by the point of view of environment protection.</li> <li>▪ Guaranty of the quality of the process or equipment operating and the diminishing of the perturbations; adoption of a simple operating principle. Providing further opportunites for regulation and adjustment</li> <li>▪ Prevision of technological processes or equipment; develop multifunctional products.</li> </ul>
Guaranty of an increased safety of the environment protection	<ul style="list-style-type: none"> <li>▪ Reduction of the risk to affect the environment during the utilization of the process or equipment.</li> <li>▪ Indication of the nature and quantity of dangerous materials used in the process or in fabrication of the technologic equipment.</li> </ul>
Increase of the product life	<ul style="list-style-type: none"> <li>▪ Achievement of a design that will contribute to a long utilization of the process or equipment.</li> <li>▪ Achievement of an appreciated product that will ensure an increase of its life to product user; dimensioning of the product for a long life cycle.</li> <li>▪ Achievement of a product robustness, that will confer to product a high strength to specific load, an increase of the product life, an efficient utilization of resources and an increased potential of the product to be reused after its renewing.</li> <li>▪ Conception of outer surfaces having a good strength to wear or corrosion that will have an important influence on the product life; Harmonization of the life of different components.</li> </ul>

## Conclusions

The conditions of environmental protection, the characteristics concerning environment protection of the equipment or processes and the needs to ensure an adequate microclimate in the working space, requires that in the designing stage of the equipment and its manufacturing processes and technological processes carried out on such equipment to be taken into account all aspects concerning the generation of polluting elements and the elimination of their adverse effects. In this respect, it is recommended that the designer of the technologic equipment and processes to implement or to suggest technical solutions and data concerning the reduction of environmental pollution with residues resulted from manufacturing and operating processes.

The design and achievement of the technologic processes and equipment based on the Ecodesign concept must be made in all phases of the product life cycle.

The basic steps needed by designer to solve the environmental problems in the design of technologic equipment and process are as follows: analysis of technologic equipment concerning the environmental problems; the setting of environmental characteristics of the equipment or process; the design of equipment and processes according to environment requirements; the checking of properties and environmental characteristics of the equipment or process.

## REFERENCES

- [1] Brabie G., *Optimal design of mechanical structures. Concepts applied in the design/manufacturing*, Ed. Junimea, Iași, **2009**.
- [2] Brabie, G., Samachiș, I., *Machine Tools. Basics optimize design solutions*, Ed. Junimea, Iași, **1995**.
- [3] Mohora C., *Remanufacturing machine tools*, Ed. AGIR, Bucharest, **2003**.
- [4] \*\*\* *Conception de produits et environnement - ADEME* - [http:// www.ademe.fr](http://www.ademe.fr).
- [5] \*\*\* *Ecoconception* - <http://www.eco-conception.fr>.