DETERMINATION OF THE OPTIMUM LEVEL TO REDUCE POLLUTION AND OF THE INDICATOR OF ENVIRONMENTAL QUALITY A TECHNOLOGICAL PROCESS

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Abstract. *The deployment of anytechnologicalprocesscauseenvironmentalpollution, andthisimplies a reduction in the quality of theworkenvironmentandthe ambient environment. In theseconditions, in thispaperwasaimedtoestablishingtheoptimumpointto reduce pollutionaccordingtoexpenditure made to reduce andpreventenvironmentalpollution , but it wasdeterminedthepoint of reduction of ofpollutionbased on thecostsand social utilities. It wasalsodeterminedhowthecorrect design of a technologicalprocess or an activitywithenvironmental impact consideringenvironmental quality indicator for eachstage of it.*

Keywords: optimum level, eco-tehnological, environmental quality, technological process.

1.INTRODUCTION

Eco technology, as the science of sciences applying for the purpose of transformation of the substance in goods with a certain social utility under the conditions of sustainable development firstly requires knowledge of the entire technologic route of the substance from the natural state (rock, ore etc.) to the exploited finished product, with the following objectives:

- identify each stage of the technological process where a certain impact on the environment appears;
- identification of the moment the environmental impact occurs;
- establishment of pollution sources;
- identify the type of pollutants;
- determine the nature of pollution;
- establishment of the coefficient of pollution per stage and per total;
- determining the optimal degree of pollution reduction;
- establish ways to prevent negative environmental impact/product of respective stage at that time;
- establishing new methods of reducing environmental or pollution impact is possible.
- determining the environmental quality indicator;
- determining the balance of eco technology;
- establish criteria for conversion of an enterprise into an eco technologic unit [1, 2, 3].

For a proper design we always leave from the functional role of the product that must be *in harmony with the environment* and have the smallest impact on it. The product is the result of a technologic process, conducted in one or more locations and which initially is like a black box in which there is an output stream almost entirely leading to a greater or lesser pollution of the environment. Therefore, each stage of technological process should be very well known in the logical development of changes and stage impact on the environment, to design the eco technologic process conducted in the same locations, but with low impact or even zero impact on the environment [4, 5, 6].

2. DETERMINATION OF THE OPTIMUM LEVEL TO REDUCE POLLUTION

The total reduction in pollution is not possible either technologically or economically, because it involvesantipollutionexpenditure unbearable by any developed economy. A way to harmonize the interests of producers seeking immediate profit, to the interests of the entire society that wants to live in an unpolluted environment must be found. Thusan economic optimum is determined taking into consideration the development expenditures (Figure 1) and cleaning benefits. n_0 point is considered as optimal degree to reduce pollution, where the difference between the two curves a and b is maximum, ie where the condition:

$$tg\alpha = tg\beta \qquad (1)$$

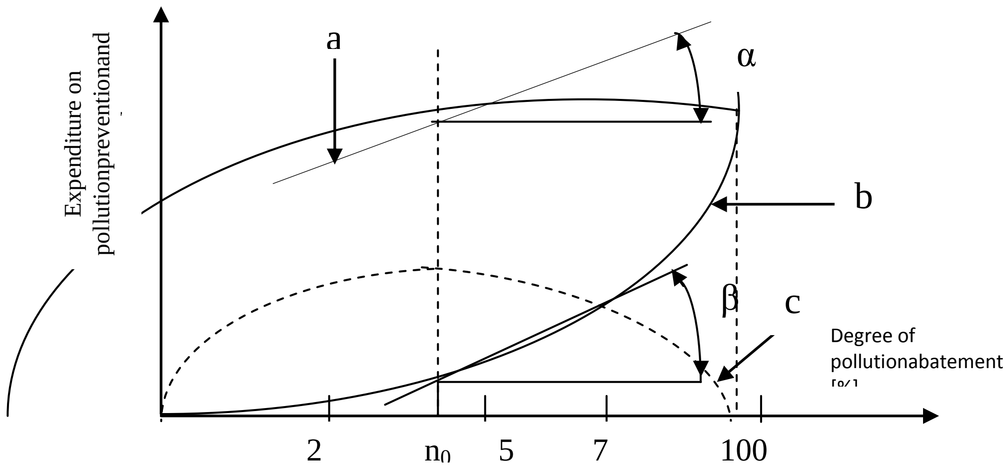

Figure 1. Determining the optimal level of pollution reduction: a - expenses incurred with remediation and pollution prevention; b-benefits of reducing pollution, c-difference between the two curves; n_0- the optimal level of pollution reduction

This analysis is not always easy because the damages caused by pollution are more difficult to quantify than the costs of introducing new production technologies, pollution prevention or reduction of pollution. However, a study of reducing pollution is easier at the level of the whole economy than at the level of an industrial plant, where an analysis of the form shown in Figure 2 can be realized. In this case, the optimal degree of pollution reduction is n_0', located at the intersection of two curves.

$n_0' = n_0$ should accomplish, but most of times it is impossible to correctly estimate the losses caused by pollution.

Closer to reality is the approach taking problem into account the degree of interest of society to pay for remediation to achieve a certain degree of purity of the environment. In order not to feel the effects of pollution, the company is willing to bear the costs of remediating C_d (Figure 3) with the advantages A_v.

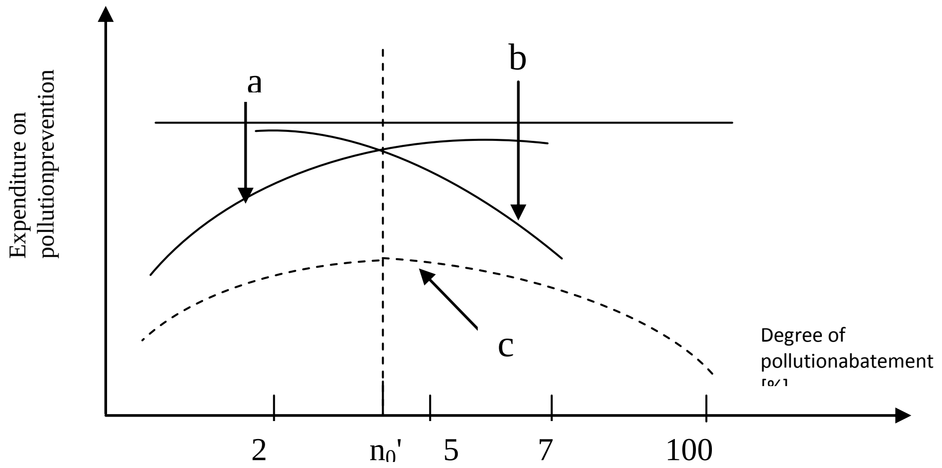

Figure 2.Determining the losses caused by pollution:
a - expenses incurred with remediation and pollution prevention; b -losses due to pollution; c -sum of the two curvesa and b; n_0' - the optimal level of pollution reduction.

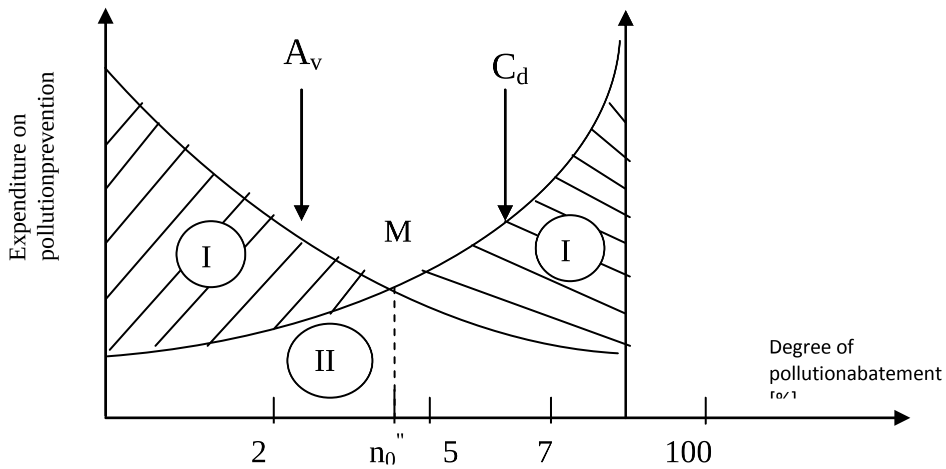

Figure 3.The degree of pollution reduction on the cost and social utility:
C_d - costs for pollution abatement; A_v - social utility/benefit of reducing pollution;
n_0'' - the optimal level of pollution reduction.

From this graph it appears that as the degree of pollution reduction increases, the benefit/social utility A_v, for which the society is willing to pay additional contributions decreases and the costs of reducing pollution C_d increase. From the analysis of areas emerging in Figure 3 the following conclusions can be drawn:

- in zone I the biggest benefits can be found because costs are much lower than the benefits and the benefits of reducing pollution can be seen;

- in zone II great losses were registered since pollution is already reduced and the costs increase in a great measure compared with the obtained benefits;

- the optimal given $n_0^{''}$ degree of pollution abatement is realized in point M.

For an optimization of the phase to fulfill the following conditionis necessary:

$$n_0 = n_0^{'} = n_0^{''} \tag{2}$$

In developed countries, investments for environmental protection have significant weights, differentiated on industrial branches.New technologies, for reducing or preventing pollution have 1,2% of GDP, and losses due to the fact that more consistent pollution abatement measures are not taken, are about 5% of GDP.

A t_{opt} time interval can be determined in order to achieve an economic optimum for reducing pollution, using a relation of the form:

$$t_{opt} = \frac{C_{am}(t) - C_{am}(t_0)}{\alpha \cdot C_{pp} - \beta C_{rp}} \quad \text{[years]} \tag{3}$$

where: C_{am} is the assimilative capacity of the environment from making expenditures to reduce existing pollution; C_{rp} - costs with existing pollution abatement at time t, C_{pp} - expenses incurred to prevent pollution and maintain them in the standard limits; α and β- coefficients expressing the increase of the capacity to assimilate, respectively to stick to standard limits, in relation the spent money unit, t_0 and t - initial time moment, respectively perspective time moment.

For a correct design of a technologic process or an activity affecting the environment is necessary to know each stage of its environmental quality indicator. This environmental quality indicator I_{cm} can be calculated at the level of each pollutant i with the relationship.

$$I_{cm_i} = \frac{CMA_i - C_{ef_i}}{C_{\max_i} - CMA_i} \quad [\%] \tag{4}$$

where: $I_{cmi}$is an indicator of environmental quality due to pollutant "i"; CMA_i - maximum admissible concentration in pollutant "i" ; C_{efi}- effective concentration, at calculation moment, in the pollutant "i", C_{max} - the maximum concentration in "i" pollutant leading to inevitable environmental degradation.

This indicator takes values between 0 (when pollution is highest and inevitable) and 1 (when the environment is clean).

Indicator of environmental quality can be calculated as the sum of all pollutants "p", in that environment, using thethe relationship:

$$I_{cm_t} = \sum_{i=1}^{p} \frac{CMA_i - C_{ef_i}}{C_{\max_i} - CMA_i} \tag{5}$$

where: I_{cmt} is an indicator of environmental quality due to all pollutants "p",existing in the environment at the time of calculation.

3. CONCLUSIONS

In conclusion we can say that the design of any ecoproduct, any ecoprocess to provide any services or any activity resulting from a technological ecoprocess should consider the following elements:

- qualityplan;
- technological route;
- technological process flow diagram;
- stages and times of environmental impact;
- sources of pollution;
- the nature of pollutants;
- mode of action of pollutants on the environment (nature of pollution);
- coefficient of pollution at each stage and the total pollution coefficient necessary to establish measures necessary for performance of established objectives, namely: changes in the technological process in order to transform it into an eco technologic process, replacement of operation or phases with high pollution;
- indicator of environmental quality;
- pollution prevention measures at each stage of development of process technology;
- measures to reduce pollution at each stage of development of process technology;
- options for replacement of hazardous pollution substances with others;
- recovery treatment and recyclingmeasures of secondary waste;
- measures for reconditioning and recycling of waste;
- measures to reintegratewaste into the environment;
- optimal level of pollution reduction;
- the cost of pollution prevention;
- eco technologic balance;
- connection of economic and legal standards and instruments (Figure 4);
- the possibility of transforming the company into one eco technologic unit.

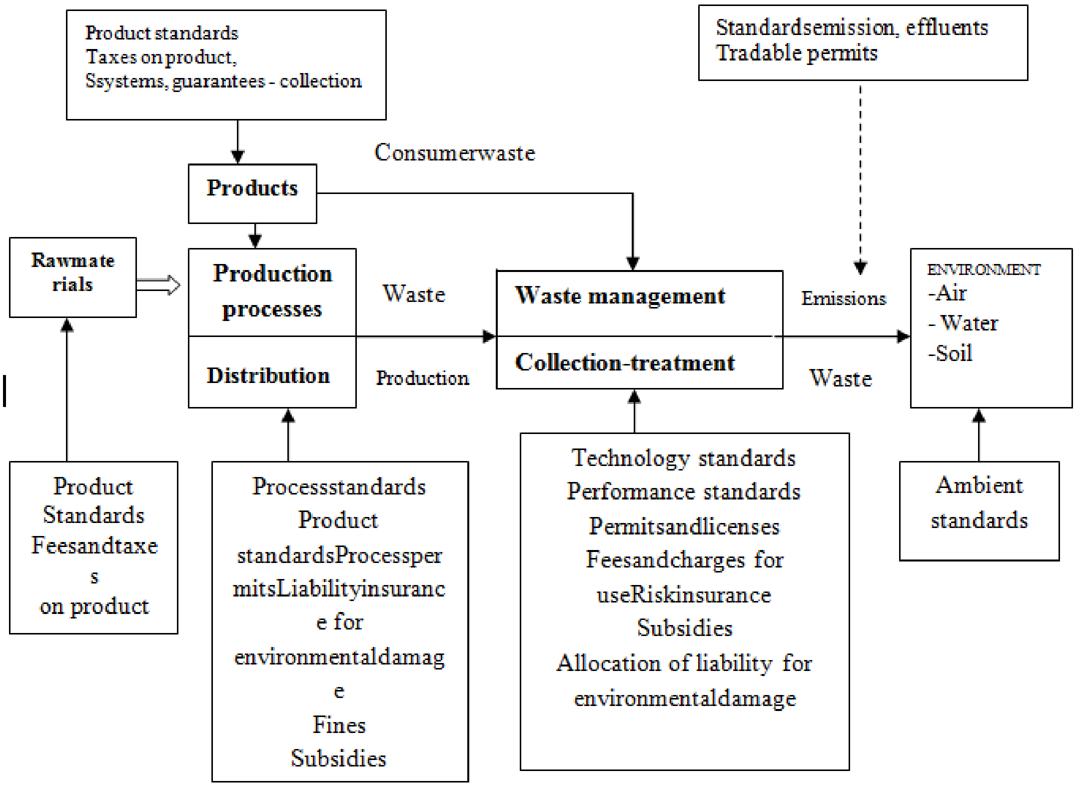

Figure 4.Connection of economic and juridical standards and instruments

Only through such an approach, the industrial-exponential consuming natural resources society and environmental pollution can thus pass from a creating exponential intelligence information society to proceed to a knowledge society and ultimately to acknowledged society.

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