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ENVIRONMENTAL IMPACT ASSESSEMENT RELATED TO METALLURGICAL INDUSTRY ACTIVITIES

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In this work is presented the impact assess of metallurgical specific activities on the environment through global pollution index calculation. The pollution index value calculated for environmental components: air, water, soil, vegetation, noise, waste, population health status indicated an environment subject to human effect within acceptable limits.

Keywords: metallurgy, industry, environmental impact, pollutants in water, pollutants in area

INTRODUCTION

The metallurgical activities involve melting processes, development of alloys and casting in different forms depending on the request. Basically, extraction of the ore, flotation and training material to storage dumps is an alteration of the natural environment involving changes in ecosystems and dynamic balance that have serious consequences on their durability. In the process of cast obtaining meet technological stages that are great generators of pollution, namely: preparation core training, development, casting and ingots, pieces debate, parts cleaning and reshuffling. Melters induce soil, vegetation, air and water pollution with metals [1,2]. Training materials are landfilled after use which most often are not waterproofed, and are sources of pollution to groundwater or are improperly designed and that why appear lateral leaks which induce soil and vegetation pollution in the surrounding area. Wind is a good vehicle for fine particles from waste dumps and disseminate them over larger surface producing pollution that harms plants and enter in the food chain.

Physics pollution of soil is done both by stockpiling waste and through forms that are no longer used and are not melted [3,4].

The environmental impact of metallurgical industry causes a deterioration of environment quality and produces imbalances of the natural ecosystems with serious consequences on their durability. Basic attributes of the environmental impact assessment are the same with the attributes of environment modern politics. Environmental assesment is a process:

- as anticipating because it follows that the environmental issues are considered early stage start-up of new objectives and major activities impacting the environment;
- as integrator because it integrates environmental consideration in the stage projects, contributing to compliance with the requirements of sustainable development;
- technical and participative because it combines collection, analysis and use of scientific and technical data with public and protecting environmental authorities [5,6].

MATERIALS

Sources of pollution from metallurgical activities are:

- ferrous industry that generates pollutants such as: mineral compounds, coal, ash, cyanides, phenols, acids waters;
- non-ferrous industry through activities for obtain copper, zinc, aluminum generators cyanides, acids, heavy minerals, chlorine.

The main types of pollution from the foundry industry are: pollution by excavation works: mining, gravel pits and quarries, pollution by covering the soil dumps, tailings ponds, waste facilities, pollution with sewage and inorganic waste, metals, salts, basic acids, pollution with airborne substances. Soil pollution is mainly due to waste and second products. Waste that can affect most the soil is dross.

Steel industry wastewater containing the entire range of organic and inorganic waste products, specifics for production units. In Table 1 are presented the sources of pollution and pollutants in wastewater from the steelworks.

Water discharged from coke-chemical plants are of two categories, according to their origin and content of contaminants:

- phenol ammonia water containing phenols, ammonia, tars, oils, organic substances;

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Table 1 **Sources of pollution and pollutants in water coming from steel mills**

Section name	Wastewater pollutant
Furnace coke plant	Heat, ammonia, phenols, cyanides
Furnce	Heat, suspended solids, cyanide, sulfur compounds
Steelworks	Heat, suspended solids, lime, oil, dust, iron carbonates and bicarbonates dissolving of fluxes used in smelting
Hot rolling	Heat oil, iron oxide and petroleum products
Cold rolling	Oil emulsion, heat
Finishing Processes	Alkali, emulsions, acids, iron salts, phenols, fats, solids
Power plants	Heat, boiler purges

- phenolic waters contaminated with phenols, ammonia, benzene, sulphide hydrogen, cyanide, tars, oils, organic substances.

The content of contaminants present in these two categories of sewage waters highlights the risk they pose to the natural receptor.

Technological processes which contribute to getting parts through metal casting, releasing a large amount and variety of pollutants that we meet in air, water, soil. From this we includes:

- dust – dust particles that forms the dispersed phase and air gas that forms air dispersion medium phase. Powders sizes between 0,01 - 10 microns.
- the smoke resulting from the melting of metal and metal oxide consist of solid particles sized less than 1 micron;
- fog formed of fine liquid particles.

The powders produced by the steel works can be in amounts of up to 80 % of iron oxides (red powder), and optionally manganese, and the iron and steel foundries containing oxides of silicon, aluminum, calcium, zinc, etc. A particular aspect of these powders could be high absorbency capacity of pollutant particulate categories on it can be absorbed irritating gases (SO_2, NO_x), thereby increasing their adverse effectes on health.

RESULTS AND DISCUSIONS

The environmental impact assessment was carried out using a complex matrix method based on cause-effect relationship (Rojanschi Matrix) and the calculation of the overall pollution. In the method, each medium separately, each type of source and each pollutant fall on a scale of creditworthiness expressed through grades 1 to 10, wherein 10 - is the natural state unaffected by anthropic activity and 1 - is a situation irreversible damage of the environmental factor analyzed. Depending on the obtained marks, it can assess the degree of damage for each environmental factor taken into account. For the calculation of the global pollution index (GPI) the marks for each component of the environment, are transposed on a scale of separate creditworthiness, which is divided into 6 classes with values between 1 and 6 in which: class 1 - is the natural environment unaffected by human activity and class 6 - is degraded environment, improper forms of life. To simulate the synergistic effect it builds a chart: the ideal state is represented graphically by a regular geometric shape (geometric shape is based on environmental factors considered, rays and equal to each side having 10 units of creditworthiness).

Table 2 **Matrix assessment of global pollution index in the area of the site**

Environmental components	Cause: Pollutants emissions Effects: Notes on creditworthiness scale						NC
Air	SO_2						8
	NO_2						7,5
	CO						8
	powders						7,5
	VOCs						8
	aldehydes						8
	Metals						7
Water		pH					8
		Ether extractable oil					7,5
		Materials in suspen- sion					7,5
		BOD_5					8
		COD					8
		Deter-gents					8
		Ammonia nitrogen					8
		Sulphi-des					8
Soil-vegetation			SO_4^{2-}				9
			N				9
			Metals				9
			VOCs				9
Noise							8
Waste							7,5
Population							8
Total	7,8	7,9	8,5	8	7,5	8	7,84

By representing notes of creditworthiness (NC) it is obtained a geometric figure of the actual state (irregular geometric shape). State of global pollution index consists of ratio of ideal surface S_i and the surface representing real state, S_r. It was established a rating scale for the global pollution index (GPI) values from it is resulting the environmental impact or effect of human activities on the environment. The pollution index value was calculated for environmental components: air, water, soil, vegetation, noise, waste, population health status.

Table 2 shows the matrix global pollution index assessment, the component environment, in the site area of non-ferrous metal foundries. Simulation synergistic effect of environmental factors taken for analysis is shown in Figure 1.

In the given situation (I), the ideal state is represented by a regular hexagon with S_i area. To calculate the ideal surface it was applied formula (1) for calculating the area of a polygon:

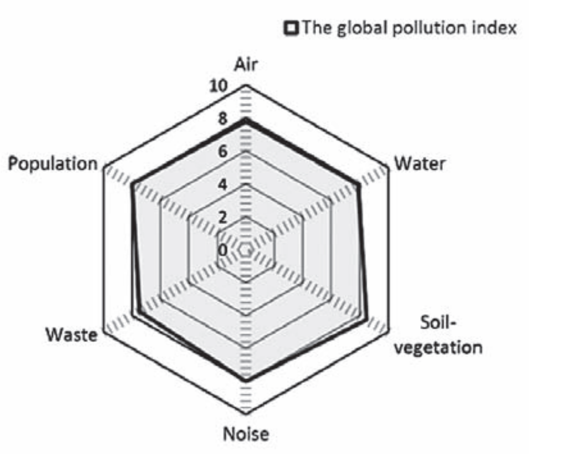

Figure 1 Graphical representation of global pollution index (I)

$$S_n = \frac{1}{2} \cdot \sin\frac{360}{n} \cdot \left(l_n \cdot l_1 + \sum_{i=1}^{i=n-1}(l_i \cdot l_{i+1})\right) \quad (1)$$

where: n is the number of sides of the polygon.

If regular hexagon, l = NC = 10;

the regular hexagon is reached by calculating the formula (2) and (3):

$$S_i = \frac{1}{2} \cdot n \cdot \sin\frac{360}{n} \cdot l^2, \; l^2 = 10 \quad (2)$$

$$S_i = \frac{1}{2} \cdot 6 \cdot \sin\frac{360}{6} \cdot l^2 = 259,8076 \quad (3)$$

The real state is represented by an irregular hexagon with sides: l_1= NC= 7,8; l_2= NC= 7,9; l_3= NC= 8,5; l_4= NC= 8,0; l_5= NC= 7,5;

l_6= NC= 8,0

whose area is given by relation (4):

$$S_r = \frac{1}{2} \cdot \sin\frac{360}{6} \cdot \left(l_n \cdot l_1 + \sum_{i=1}^{i=n-1}(l_i \cdot l_{i+1})\right) \quad (4)$$

$$S_r = 138,2046$$

Global pollution index was estimated by comparing the areas of two polygons represented in Figure 1, GPI = S_i/S_r = 259,8076 / 138,2046 = 1,879.

According to the scale of the impact assessment, the value GPI is a Class 1 - 2 and indicates an environment subjected to human effect within acceptable limits.

Table 3 shows the evaluation matrix of global pollution index, on environmental component, in the protected area at a distance of 1000 m from the lens (II). It was calculated a value GPI = 1,38 and illustrated in Figure 2. The value GPI is a Class 1 - 2, which indicates an environment subject to the human effect within acceptable limits.

Table 4 shows the assessment matrix of global pollution index, on environmental component, in the protected area at a distance of 200 - 500 m from the lens. Value GPI is 1,50 and falls in Class 1 - 2, which indicates an environment subject to the human effect within acceptable limits. In Figure 3 is represented the global pollution index at distances of 200 - 500 m objective (III).

Table 3 **Matrix assessment of global pollution index at 1 000 m distance of the lens**

Environmental components	Cause: Pollutants emissions Effects: Notes on creditworthiness scale				NC
Air	SO_2				8
	NO_2				8
	CO				8
	Powders				8
	VOCs				8
	aldehydes				8
	Metals				8
Soil-vegetation		SO_4^{2-}			9
		N			9
		Metals			9
		VOCs			9
Noise					9
Population					8,5
Total	8,0	9,0	9,0	8,5	8,62

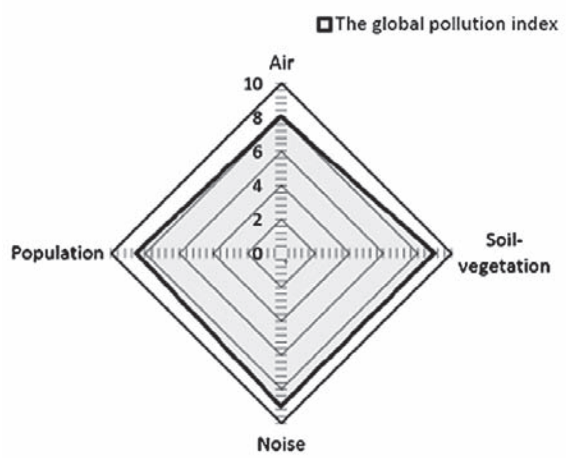

Figure 2 Graphical representation of global pollution index (II)

Table 4 **Matrix assessment of global pollution index at distances of 200 – 500 m objective**

Environmental components	Cause: Pollutants emissions Effects: Notes on creditworthiness scale				NC
Air	SO_2				8
	NO_2				8
	CO				8
	Powder				8
	VOCs				8
	Aldehydes				8
	Metals				8
Soil-vegetation		SO_4^{2-}			9
		N			9
		Metals			9
		VOCs			9
Noise					9
Population					8
Total	8,0	9,0	9,0	8,0	8,5

CONCLUSIONS

Linking specific activities of metal industry with with the natural environment is one of the key elements in estimating the effects that they perform on ecosys-

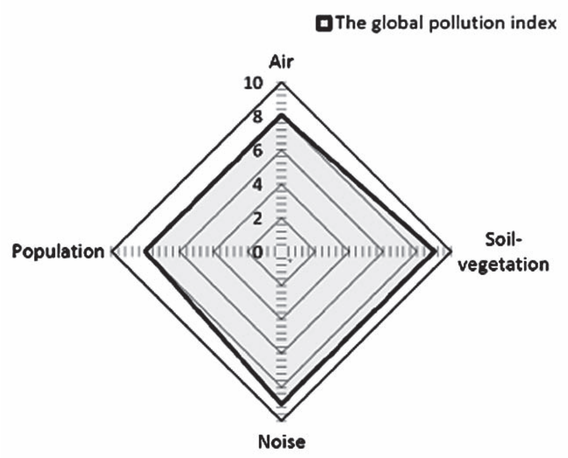

Figure 3 Graphical representation of global pollution index (III)

tems and the quality of the environment. Starting from these considerations, and having regard to current legislation, at this type of activity is recommended industial environmental impact assessment in order to determine appropriate measures for protecting the environment. At the same time, environmental impact assessment underpinning the development and selection the methods of remediation characteristic of the metallurgical processes generating pollutants.

Method impact assessment trough the complex matrix is based on method cause-effect relationship. Index pollution calculation given by metallurgical specific activities, for the environmental components: air, water, soil, vegetation, waste, noise and population health status indicates an environment subject to human effect within acceptable limits.

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Note: The responsable translator for English language is Budianu Marcu Alina Viorica, Targu Jiu, Romania