THE IMPACT IN ENVIRONMENT BY PRESENCE IN SOIL OF CHROME IONS

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Soil pollution is increasing day by day resulting in poor crop stand along with health hazards of human beings and animals. Major sources of soil pollution are: industrial effluents, sewage sludge, fertilizers and pesticides application, etc. Agricultural recycling of waste is growing too, and can be very worthwhile in both economic and agronomic terms, but it is crucial to minimize its environmental impact. In effect, it can cause contamination. Various pollutants are involved, including heavy metals (HMs) such as cadmium (Cd), chromium (Cr), mercury (Hg), lead (Pb), copper (Cu), nickel (Ni) and zinc (Zn), which need to be studied closely, since they are generally toxic to animals and plants. The purpose of this paper was to analyze soil samples from industrial area and observe if heavy metals ions as chromium can influence the environmental components. Six soil samples from 5 and 30 cm deep were analyzed in order to estimate the impact and risk for environment. The values of impact induced on soil (samples 3 and 4) underlay the fact that the environment is highly modified by the presence of chromium ions, causing a degraded environment, not proper for life forms (ecosystems). Mainly, the impact on soil is induced by the presence of chromium [VI]. The associated risk shows that all activities which involve uses of heavy metals should be stopped.

***Key words**: environment, heavy metals, industrial processes, pollution, impact and risk.*

Soil is the most valuable and non-renewable resource. It is the basic medium of life support for human beings, animals, flora, fauna and many other organisms. Thus, soil is the infinite life. In this context, thousands and thousands years back, it is mentioned in *Veda* that "upon this handful of soil our survival depends. Husband it and it will grow our food, fuel and our shelter and surround us with beauty. Abuse it, the soil will collapse and die taking away with it". So by any means we will not allow our precious soil to be polluted. A polluted soil will be a curse to our nation. There are various means of soil pollution. Soil pollution is increasing day by day resulting in poor crop stand along with health hazards of human beings and animals. Major sources of soil pollution are: industrial effluents, sewage sludge, fertilizers and pesticides application, etc.

Agricultural recycling of waste is growing too, and can be very worthwhile in both economic and agronomic terms, but it is crucial to minimize its environmental impact. In effect, it can cause contamination. Various pollutants are involved, including heavy metals (HMs) such as cadmium (Cd), chromium (Cr), mercury (Hg), lead (Pb), copper (Cu), nickel (Ni) and zinc (Zn), which need to be studied closely, since they are generally toxic to animals and plants. The main risk is contamination of the water supply or food chain via crops.

The steel and allied industries, dispose huge amounts of basic slag. Similar to lime sludge, basic slag has ameliorative properties of acid soils, but high contents of iron and manganese in it will be additive to the iron rich acid soils. Moreover the slag is very hard to crush for use. Deposits of by-product, if remains unused, may be a source of soil pollution. These emissions can contribute to a significant air, water and soil pollution, on large or small area, depending on qualitative and quantitative characteristics of emissions. The auxiliary activities involved in producing and selling of tubes, lines and different metallic products are activities which could have a negative impact on the environment for short or long time.

The purpose of this paper was to analyze soil samples from industrial area and observe if heavy metals ions as chromium can influence the environmental components. The chemicals used in various industrial processes, based on heavy metals have a high degree of toxicity, and it is a big interest in pollution prevention so that the impact on human health, animals can be reduced. Six soil samples from 5 and 30 cm deep were analyzed in order to estimate the impact and risk for environment.

MATHERIAL AND METHOD

The new method applied to evaluate the environmental impact and risk is based on an algorithm developed as software, designed as ***SAB***, and it automatically quantifies the environmental impacts and risks that arise from an evaluated activity, considering the measured concentration, levels of quality indicators [2, 4].

This new method for environmental impact and risk assessment (***EIRA***) was applied considering in the assessment process environmental component *soil.* The evaluation of environmental impacts was done using a matrix in order to calculate the "significance" of this environmental component - soil, potentially affected by the evaluated activity. The significance parameter can take values between 0 and 1; value 1 represents the most important environmental component, in this case the soil. These values are assigned by the evaluator (*table 1, table 2*).

Table 1

The calculation of importance units for environmental components

Environmental component	Surface water (l)	Ground water (m)	Soil (n)	Air (o)
Surface water (l)	l = 0.00	(1/m)	(l/n)	(l/o)
Ground water (m)	m = 0.0	(m/m)	(m/l)	(m/o)
Soil (n)	n = 1.0	(n/m)	(n/n)	(n/o)
Air (o)	o = 0.00	(o/m)	(o/n)	(o/o)

l – importance value for surface water, m – importance value for ground water,
n – importance value for soil, o – importance value for air

Table 2

Importance units obtained by solving the matrix from Table 1

Environmental component	Normalized weights (NW)	Significance units (SU = NWx1000)
Surface water	0	0
Ground water	0.0	0
Soil	0.99	999
Air	0	0

The impact on environmental component (*EI*) directly depends on measured concentration of pollutants, and it is expressed as the ratio between significance units (*IU*) and quality of environmental component (*EQ*), defined as follows (*eq. 1*):

$$EI = \frac{SU}{EQ} \tag{1}$$

The parameter *quality of environmental component* (EQ) is defined as follows (*eq.2*):

$$EQ = \frac{MAC}{MC} \tag{2}$$

where:

MAC – maximum allowed concentration of quality indicators;
MC – measured concentration of quality indicators.

After the calculation of importance units, the next step was to calculate the quality of environmental component defined above. If the quality parameter of environmental component is equal with 0, it results that the environmental quality is very poor (this means that the measured concentration of pollutant is very high); if *EQ* value is close to 1, or higher than 1, then the quality of environmental component is good or very good [1].

The impact induced on *soil* is (*eq.3, 4*):

$$EI_s = \frac{\sum_{i=1}^{n} EI_{(s)i}}{n} \tag{3}$$

$$EI_{s_i} = \frac{SU_s}{EQ_{s_i}} \tag{4}$$

$EQ_{(s)i}$ – quality of environmental component *soil*, considering the quality indicator *i*;
SU_s – importance units obtained by *soil*.

This way the impacts for environmental components considered the most representative for the evaluated situation were calculated. The next step was to quantify the risks that arise, in the view of the results for environmental impacts. The risks are calculated as follows (*eq.5*):

$$ER_j = EI_j \cdot P_j \tag{5}$$

ER_j – environmental risk for environmental component *j*;
EI_j – environmental impact on environmental component *j*;
P_j – probability of impact occurrence on environmental component *j*.

The probability of impact occurrence was calculated using the same matrix as described above (*table 1*) to calculate the importance units. The normalized weights are presented in table 3. The evaluator has to give values between 0 and 1 for probability (*table 4*), which is detailed in table 5 [3].

Table 3

The calculation of *probability*

Environmental component	Surface water	Ground water	Soil	Air
Surface water	0.00	0.00	0.00	0.00
Ground water	0.00	0.00	000	0.00
Soil	0.80	800.00	1.00	800.00
Air	0.00	0.00	0.00	0.00

Table 4

Normalized weights obtained by solving the matrix from Table 3

Environmental component	Normalized weights (NW)	Probability units (P)
Surface water	0.00	0.00
Ground water	0.00	0.00
Soil	0.53	0.53
Air	0.00	0.00

Table 5

Description of probability

Probability	Description
0.91-1.0 (Almost certain)	Is expected to occur in most circumstances (99%)
0.61-0.9 (Likely)	Will probably occur in most circumstances (90%)
0.31-0.6 (Possible)	Might occur at some times (50%)
0.05-0.3 (Unlikely)	Could occur at some times (10%)
<0.05 (Rare)	May occur only in exceptional circumstances (1%)

Considering the fact that the measured concentrations of main pollutants analyzed in soil samples are close to maximum allowed concentrations (MAC), likely probability was accorded or, in some situations it was considered that environmental impact might occur at some times. It should be mentioned here that the maximum allowed concentrations were considered in accordance with Romanian legislation (Order 756/1997).

RESULTS AND DISCUSSIONS

The soft *SAB* designed for integrated impact and risk quantification, described above was applied for quantification of heavy metals presence in soil such as chromium ions (total chromium and chromium [VI]). The impact and associated risk induced in environment directly depend on concentration of pollutants analyzed.

It has to be emphasized that if the impact and risk have very high values, then the impact induced by the considered activities in the environment is great and the environmental risks are at an unacceptable level. High values for environmental impacts and risks underlay the presence of pollutants in environment in very high concentrations, because impact directly depends on the measured concentration of pollutants. Considering the impact classification from method of global pollution index, a classification of impacts and risks is proposed *(table 6*).

Table 6

Classification of environmental impact and risk

Impact Scale	Description	Risk Scale	Description
<100	Natural environment, not affected by industrial/human activities	<100	Negligible/insignificant risks
100-350	Environment modified by industrial activities within admissible limits	100-200	Minor risks, monitoring actions are required
350-500	Environment modified by industrial activities causing discomfort conditions	200-350	Moderate risk at an acceptable level, monitoring and prevention actions are required
500-700	Environment modified by industrial activities causing distress to life forms	350-700	Moderate risks at an unacceptable level, control and prevention measures are needed
700-1000	Environment modified by industrial activities, dangerous for life forms	700-1000	Major risks, remediation, control and prevention measures are needed
>1000	Degraded environment, not proper for life forms	>1000	Catastrophic risks, all activities should be stopped

From the evaluated site, 6 soil samples from 5 and 30 cm deep were analyzed. Each soil samples were taken from different depth (5 and 30 cm), so that the transfer of pollutants from surface to the depth, and finally to the ground water is analyzed.

The main pollutants that influence the soil quality are shown in *figure 1,* and in *figure 2* the environmental impact and risk induced on soil are shown.

It can be observed from figure 1 the fact that the main pollutant of soil is the chromium ion [VI], which could be transferred from polluted soil to the aquatic systems. So that, it is necessary to apply the control and bioremediation measures for polluted soil with heavy metals (chromium ions found in high concentration in soil ecosystem).

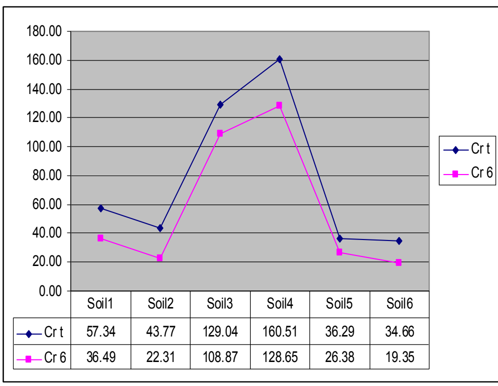

Figure 1 **Dynamic of main pollutants**

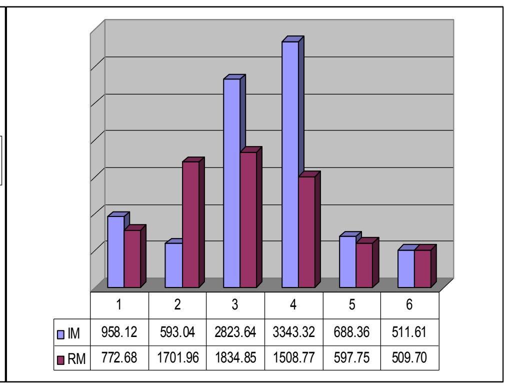

Figure 2 **Environmental impact and risk**

CONCLUSIONS

The purpose of this paper was to analyze soil samples from industrial area and observe if the heavy metals can influence the environmental components, directly exposed to the uses of these. Thus, from the evaluated site, 6 soil samples from 5 and 30 cm deep were analyzed. Each soil samples were taken from different depth (5 and 30 cm), so that the transfer of pollutants from surface to the depth, and finally to the ground water is analyzed.

The values of impact induced on soil (samples 3 and 4) underlay the fact that the environment is highly modified by the presence of chromium ions, causing a degraded environment, not proper for life forms (ecosystems). Mainly, the impact on soil is induced by the presence of chromium [VI]. The associated risk shows that all activities which involve uses of heavy metals should be stopped.

Considering these facts, it is recommended to avoid the use of chemical compounds with high degrees of toxicity or with heavy metals that can influence the quality of soil.

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