# RESEARCHES CONCERNING THE INDUSTRIAL POLLUTION AND ITS INFLUENCE ON WATER, FORAGES AND HORSES IN A LIMITROPHE AREA OF A NON - FERROUS CHEMICAL UNIT

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**Summary**

In the limitrophe area of a non-ferrous ore processing unit there were harvested biological samples (organs – liver, kidney, lung, spleen, heart, hair and long bone) from dead horses, water and forage samples (hays, maize, green lucerne).

From the samples there were assessed Cd, Pb, Cu and Zn concentrations.

The method used for establishing the heavy metals content was the atomic absorption spectrophotometry.

The results interpretation was made differently, depending on sample type, conformingly to the stipulated standards. Following the researches we have reached to the conclusions presented bellow. In water, hay and cereal samples, the admitted limits for copper, lead and zinc were exceeded in the two sampling points. Also, cadmium and lead exceeded the normal values in hair samples by 5 – 14 times (hair representing a suggestive biomarker for chronic cumulative poisoning with Cd and Pb). Cd exceeded the admitted limit in bone and organ samples. Pb and Zn have also exceeded the maximum admitted limits stipulated by order 97/2005 in all organ samples, the highest value being recorded in Micasasa sampling point.

By all the obtained data it may conclude that in the area of the chemical unit evolves a chronic poisoning with heavy metals, especially with Cd, as a result of contaminated water and forages ingestion.

**Key-words:** pollution, organs, forages, water, admitted limits, poisoning, heavy-metals

Huge quantities of toxic gases, industrial residues, smoke, fertilizers and pesticides which are spread in the nature establish the pollution phenomenon and lead to some ecosystems destroying or to modifying the relation between them.

In this context, it is imposed the efficient promotion of the necessary investments starting from prevention, reducing and the integrative control of pollution.

Such a polluted area is found around a non-ferrous metal unit where are established high levels of heavy metals – cadmium, lead, zinc.

Cadmium arrives in the atmosphere, spread on soil or water after mining activity, industrial processes, charcoal and household burning. It is also a secondary product of the non-ferrous ore processing unit.

Into the organisms, it has toxic effect on liver and kidney, increasing also the arterial pressure, producing anemia, affecting reproductive system and bones. It influences the metabolism of zinc, copper and iron.

Copper is at the same time an essential and toxic element. After its absorption, it is carried by plasmatic albumins and then fixed into organs.

Zinc, a microelement which enters the organism by digestive and respiratory ways, accumulates in liver and kidney, spleen and uterus and deposits in metabolic tissues: liver, heart, but also in bones, skin and hair. It is a catalyst of the metabolism, by the 30 zinc-dependent enzymes.

It reduces the effects of the cadmium and copper excess and increases the toxic effects of lead.

Lead enters the organism by digestive and respiratory ways, where it dislocates metals from enzymes, producing their inactivation, decreases the thyroid's activity, changes the transit of neural flux and the chemical processes which depend on calcium amount.

## Material and method

Having in view the diagnosis establishing, there were sampled parts of organs (liver, kidney, lung, spleen, heart), hair and long bone.

The biologic samples were joined by forage samples from contaminated areal: hay, maize, green lucerne and water samples from the limitrophe area of the non-ferrous ore processing unit.

Based on these samples, it has been assessed the concentrations of cadmium, lead, copper and zinc.

The method used for establishing the heavy metals from all the received samples was the atomic absorption spectrophotometry (ray wavelength was 328.1 nm for cadmium; 217 nm for lead; 324.7 nm for copper and 213.9 nm for zinc).

The results interpretation was made differently depending on the sample kind: 97/2005 Order for organs, 458/2002 Law for water and for the other samples conformingly to the normal values stipulated in the special literature.

## Results and discussion

The average concentration of Cd, Pb, Cu and Zn in the water samples from wells in the influence area of a non-ferrous unit is shown in table 1.

**Table 1**

**Average concentrations of Cd, Pb, Cu and Zn in water samples**

| Sampling point | Average concentrations of carried out elements (mg/l) | | | |
|---|---|---|---|---|
| | Cd | Pb | Cu | Zn |
| Micasasa | a | 0.031 | 0.178 | 0.031 |
| Axente Sever | a | 0.1 | 0.08 | 6.0 |
| Admitted limits 458/2002 Law | 0.005 | 0.05 | 0.05 | 5.0 |

Analyzing the data in the table it can be noticed the following: cadmium was not found in any sample of the two sampling points; lead recorded an exceeding beside the norms in the water samples from Axente Sever checkpoint by 2 times; copper concentration exceeded the admitted limit in Micasasa checkpoint by 3.56 times and in Axente Serer by 1.6 times and zinc exceeded the admitted limit in Axente Sever by 1.2 times.

In table 2 there are shown the average concentrations of Cd, Pb, Cu, Zn in different forage samples (pasture hay, lucerne hay, maize, green lucerne) in two checkpoints: Micasasa and Axente Sever.

**Table 2**

**Average concentrations of Cd, Pb, Cu and Zn in forage samples**

| Sampling point | Sample | Average concentrations of carried out elements (ppm) | | | |
|---|---|---|---|---|---|
| | | Cd | Pb | Cu | Zn |
| Micasasa | Pasture hay | 13.8 | 522 | 37 | 122.5 |
| | Lucerne hay | 7.9 | 412 | 1.50 | 527 |
| | Maize | 0.16 | 0.92 | 1.4 | 49.53 |
| | Green lucerne | 6.25 | 161.6 | 15.80 | 317.8 |
| Axente Sever | Pasture hay | 0.94 | 35.7 | 15.52 | 102 |
| | Maize | 0.14 | 37.2 | 1.12 | 124 |
| | Coceni | 6.02 | 151 | 23.7 | 212 |
| Maximum admitted limits | Pasture hay | 0.6-1 | 2.5-3.9 | 5-20 | 80-100 |
| | Maize | 0.5-1 | 0.5-3.9 | | |
| | Coceni | 0.2 | 1.0 | | 15 |

Analyzing the data it can be noticed that in the hay samples there was recorded an exceeding of Cd beside the maximum admitted concentration by 8 – 14 times in Micasasa checkpoint, lead by 106 – 134 times in the same checkpoint and by 9 times in Axente Sever checkpoint, copper by almost 2 times in the hay samples in Micasasa checkpoint, but zinc by 1.23 – 5.27 times in Micasasa and 1.02 times in Axente Sever.

In maize sample, there was recorded an exceeding beside the maximum admitted concentration for lead by 9.5 times in Axente Sever checkpoint and for zinc by 49.5 times in Micasasa checkpoint and by 1.24 times in Axente Sever.

Cadmium and copper did not record any exceeding in maize sample in any checkpoint. The high values cadmium found in lucerne samples are explained by high capacity of lucerne to concentrate the cadmium.

The average values of Cd, Pb, Cu, and Zn in hair and long bones samples are shown in table 3.

**Table 3**

**Average concentrations of Cd, Pb, Cu and Zn in hair and bone**

| Sampling point | Sample | Average concentrations of carried out elements (ppm) | | | |
|---|---|---|---|---|---|
| | | Cd | Pb | Cu | Zn |
| Micasasa | Long bone | 1.4 | 38.9 | 95 | 93 |
| | Hair | 1.4 | 63 | 9.2 | 63 |
| Axente Sever | Long bone | 0.5 | 26.9 | 11.4 | 69.1 |
| | Hair | 1.1 | 47.9 | 13.6 | 47.9 |
| Normal values | Long bone | 0.1 | 8-15 | 18 | 75-95 |
| | Hair | 0.05-0.1 | 6-10 | | 170-200 |

The exceeding concentration in long bones beside the normal values was met for Cd by 44 times in Micasasa checkpoint and by 5 time in Axente Sever for Pb by 1.8 – 2.5 times. Copper and zinc recorded values within the normal limits.

Cadmium has a direct action on the bone cells or it stimulates the excessive calcium excretion by urine, producing some disorders at bone system level. Because cadmium is eliminated by excrements, urine, milk and hair, there were made assessments from hair samples in horses in the studied area.

Thus, beside the normal values, the exceeding was for Cd by 11 – 14 times, for Pb by 5 – 6.3 times, but Zn and Cu did not exceed the normal values in any sampling point.

The high values of cadmium and lead in hair samples prove that in the investigated area there is a permanent source of pollution, hair representing a suggestive biomarker for the chromic cumulative poisoning with Cd and lead.

In table 4 there are shown the concentrations of Cd, Pb, Cu, Zn in organ samples (kidney, liver, spleen, heart) from dead horses in the influence area of a non-ferrous processing unit.

**Table 4**

**Average concentrations of Cd, Pb, Cu and Zn in different horse organs**

| Sampling point | Sample | Average concentrations of carried out elements (ppm) | | | |
|---|---|---|---|---|---|
| | | Cd | Pb | Cu | Zn |
| Micasasa | Kidney | 245 | 9.2 | 12.3 | 72.8 |
| | Liver | 41.5 | 13.4 | 28.5 | 105 |
| | Spleen | 6.13 | 5.8 | 9.76 | 28.3 |
| | Lung | 0.76 | 1.7 | 7.9 | 7.1 |
| | Heart | 1.9 | 1.3 | 2.7 | 20.2 |
| Axente Sever | Kidney | 179.5 | 13.4 | 3.24 | 105.2 |
| | Liver | 82 | 20.6 | 3.96 | 216.7 |
| | Spleen | 9.59 | 5.3 | 0.67 | 33.6 |
| | Lung | 0.44 | 7 | 0.78 | 19.9 |
| | Heart | 1.89 | 5.9 | 2.29 | 23.8 |
| Admitted limits 97/2005 Order | Kidney | 1 | 0.5 | 3.0 | 50.0 |
| | Liver | 0.5 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Spleen | | | | | |
| | Lung | | | | | |
| | Heart | | | | | |

According to the data in the table. the concentration of cadmium exceeded the maximum admitted limit, conformingly to 97/2005 order, in kidney by 180 – 245 times, in liver by 83 – 144 times, in spleen by 12 – 19 times and in heart by 3,8 times.

The highest concentration of Cd was recorded in kidney followed by liver, spleen and heart. In the lungs the values were closer to the maximum admitted limit.

The storage of calcium in food increases significantly the absorption of Cd and its concentration in liver and kidney.

Lead exceeded the maximum admitted limit in kidney by 18 – 27 times, in liver by 27 – 41 times, in spleen by 10,6 – 11,6 times, in lung by 3.4 – 14 times and in heart by 2.6 – 11.8 times.

Copper concentration in organs sampled in the studied area exceeded the maximum admitted limit by 4 times in kidney, by 9.5 times in liver, 2.63 times in lungs and 3.25 times in spleen.

The exceeding was recorded in all samples from Micasasa checkpoint.

Zinc recorded an exceeding by 1.4 times in kidney samples in Micasasa and by 2.1 times in Axente Sever, by 2 times respectively by 4.3 times in liver samples, in spleen, lungs and heart there was not recorded any exceeding in any sampling point.

The excess of Cd leads to the increasing of Zn concentration in liver and kidney.

Cd, Zn and Cu govern the metallothioneins biosynthesis which could be induced by the bacterial protein and stress-caused hormones.

The high concentration of Cd and Pb in forages, correlated with the Cd and Pb concentration in organs show a chronic poisoning with Cd in the area.

Taking into consideration the large remanence of Cd and Pb, the effects are more serious, this area being continuously contaminated for years, even if in the future there will be taken several measures in order to reduce the range of pollution. Correlating the obtained data it may be noticed that in this area evolves a chronic poisoning with heavy metals, especially with Cd, with an irreversible evolution to the *exitus*; as a result of contaminated forages and water ingestion.

## Conclusions

1. In water samples, it was recorded an exceeding beside the admitted limits for lead, copper and zinc.
2. The concentration of heavy metals in hay and cereal samples exceeded the admitted limits in all samples and in the two sampling points (Cd by 8 – 14 times, Pb by 106 – 134 times, Cu by almost 2 times and Zn by 5.27 times).

3. Cadmium and lead exceeded the normal values in hair samples by 5 – 14 times, higher values being recorded by Cd.

4. The high values of Cd and Pb in hair samples show a permanent source of pollution in this area, hair representing a suggestive biomarker for chronic cumulative poisoning with Cd and Pb.

5. Cd exceeded the admitted limit in bone samples by 44 times.

6. In organ samples, cadmium exceeded the maximum admitted limit as follows (kidney by 180 – 245 times, lives 83 – 144 times, spleen 12 – 19 times and heart by almost 4 times).

7. Pb, Cd and Zn, exceeded the maximum admitted limits stipulated by order 97/2005 in all organ samples, the highest exceeding being recorded in Micasasa sampling point.

8. By all the obtained data it can be concluded that in the area of the chemical unit evolves a chronic poisoning with heavy metals, especially with Cd, as result of contaminated water and forages ingestion.

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