Industrial landfill source of air pollution in Mitrovica

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Abstract: The town of Mitrovica is one of the cities with the highest air pollution, in particular with heavy metals. Source of air pollution are industrial dumps generated during metallurgical mining activities, chemical, and finalization of raw materials. In this context are explored the features of air pollution case suspended particles, chemical composition and their distribution. Monitoring of air pollutants with particles is conducted in different parts of the city, respectively, in urban and industrial zones. From the values obtained besed on chemical analysis of dust in the air, it follows that the presence of suspended particles containing heavy metals exceed the permitted values. In certain places even double then allowed values, 246,752 $\mu g/m^3$. While the source of pollution in known, the amount of these pollutants reaches into millions of tons, it is urgend needed to prepare a strategic plan for rehabilitation and elimination of these landfills.

Key-words: air pollution, tailing, heavy metals, total suspended particulate matter.

1. Introduction

Industrial landfills are sources of air, water and land pollution in the town of Mitrovica. The city of Mitrovica is surrounded with industrial waste. In the town itself is a dump Mitrovica Industrial Park (MIP) containing residues of neutral last processing stage of zinc, pyrite, and other ferric minerals. In Figure 1.1 is presented a landfill in MIP. This landfill is located in area of 35 hectares, while the total mass of these residues is 1500 000 tones. These residues include: iron, lead, zinc, cadmium and other associated metals arsenic, antimony, indium and silver. Other landfill that "contributes" to the pollution of environment in region Mitrovica is the Industrial Park in Zvecan (IPZ), which is spread in the area of 50 hectares. This dump contains about 12 million tons of waste from the flotation process and 2.5 million tons of waste from the metallurgical process of lead. Another landfill is Kelmendi that contains waste from flotation process; it is estimated about 9 million tons waste. This landfill as well as that of Zvecan contains iron, lead, zinc, cadmium and other associated elements in smaller quantities. In Figure 2.2 is presented the view of Mitrovica city, surrounded by industrial landfill

Figure 1.1. View of the dump of MIP

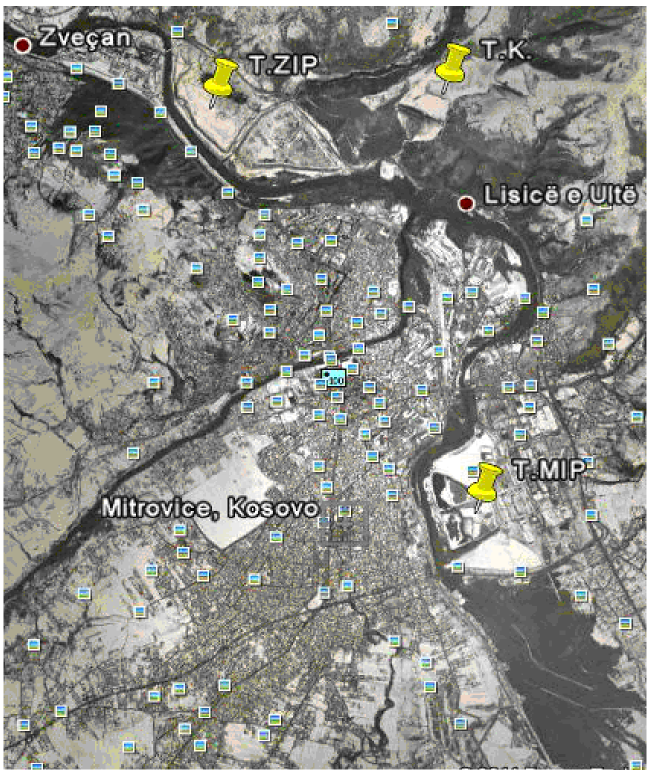

Figure 1.2. View of the Mitrovica city and landfills; Tailing in MIP; Tailing in ZIP and tailing in Kelmend (TK)

Further, the air pollution can occur until now from windblown dusts accumulated at the smelter facilities as well as from wind erosion of fine particulates from uncovered tailings/processing residues present at the respective sites, i.e. from the Mitrovica Industrial Park waste deposits, the Zvecan smelter waste piles or also from uncovered dry mine tailings [9].

Atmospheric transport leads to serious heavy metal pollution of a waste area. The citizens of Mitrovica and surroundings experience airborne lead concentrations at or near the EU limit value of 0,5 $\mu g/m^3$, coming from the Trepca Industrial Complex. Although the plant does not operate currently, the waste is piled up in the open air and due to a lack of street cleaning equipment dust with a high lead concentration keeps circulating [3]. Soils within a radius of at least 10 kilometers from the stacks are heavily polluted mostly for highly toxic elements such as lead and cadmium [1]. The deposition of lead contaminated dust is of much greater concern for the community, especially near the centre of town, where road dust is mobilized by heavy traffic [2].

Moreover, during the summer and winter in urban areas, present the case of smog, which leads to a greater deterioration of air quality. However, the investigate hot spot represents also an immediate health risks to the adjacent residential areas through uncontrolled emissions of airborne dust containing heavy and toxic metals [11].

The study of Shllaku (1992) cited in Klitgaard et al. (2004) showed that blood lead concentrations in inhabitants of Mitrovica were several times higher than in the inhabitants of Pristina. In 12% of the children living in Mitrovica, the blood lead levels exceeded 70 µg/dL and in 35 % lead concentrations were 50-69 µg/dL. It was estimated that about 9 000 children in Mitrovice might have blood lead concentrations above 40 µg/dL. It was also found that lead blood levels in pregnant women were more than three times higher in Mitrovica than in Pristina. For comparison, severe lead poisoning, at levels exceeding 70 µg/dl of blood can lead to encephalopathy and death. A dose of 30 µg/dL is currently regarded as elevated and levels of 10 µg/dl and over potentially harmful, especially during development [10]. Therefore, heavy metals content

in the air which surrounds Mitrovica cause many environmental problems associated with human health and economic losses.

Dust emissions containing toxic elements are a further source for contaminant disposition in the region. Mitrovica city, and its south-east part in particular, has a high level of pollution with the dust particles, where the maximum value reaches 5560.8 $mg/m^2/day$, which exceeds WHO recommended values for 20 times. It can be seen that in the area of $1m^2$, the level of pollution is 542.3 mg per day, where the population of the region is exposed to this pollution during the entire day. These data originate form study on Spatial Distribution of Settled Air Pollution in Mitrovica, Comparison between Seasons 2006-2007 [4]. Exposure to fine fractions of particulate matter and toxic metals should be an issue of concern for the future investigation of the area. The investigation should focus on the long-term measurement of the airborne dust concentration in the air and also on the analyses of a broader range of toxic metals content in the airborne dust. Also monitoring the air quality in the region is very important. The air quality monitoring continuous monitoring of weather parameters like wind direction, wind velocity, ambient air temperature, precipitation, concentration of dust particles, monthly collection of fugitive dust particles and laboratory analyzes focused on assaying the concentration of Cd, Cu, Pb, Sr and Zn [5]. The effects of these powders determined by the total content of dust in the air, i.e. the dust content of air, physical and chemical characteristics of its environment as well as subject to the action of dust.

2. Methods

It was realized close to potentially exposed recipients in the surroundings of the tailings impoundment during weather conditions with high potential for wind erosion of tailings materials; measurement of airborne dust concentration was carried out with portable light scattering particle analyzer (optical particle sampler) for monitoring of total suspended particles, PM_{10} particles, $PM_{2,5}$ particles with incorporated membrane filter for gravimetric determination and subsequent chemical and mineralogical analyses of the selected samples for dust source apportionment. Measurement campaign of suspended particles consisted from the following phases:

- On site sampling of fugitive dust
- Gravimetric determination of concentration of fugitive dust in controlled conditions
- Chemical analyses of collected samples and determination of concentration of heavy metals.

Measurements are conducted on four sides of in different area in Mitrovica which are presented below:

- MIP - Faculty of Mining and Metallurgy
- Square “Adem Jashari”
- Primary School “Muharrem Bekteshi”
- Bair, Greek Camp of KFOR

Aims of these measurements are determination of:

1. Concentration of suspended particles in the air with diameter less than 10 and 2.5 micrometers (PM_{10} and $PM_{2.5}$).
2. Content of certain heavy metals in the collected particles.
3. Obtaining information about the level of pollution in the ambient air in Mitrovica by evaluating the results for concentration of particulate matter (fugitive dust) and their content of heavy metals.

Technical details

For sampling of fugitive dust was used the following equipment:

- Adapter with PUF for PM_{10} and $PM_{2,5}$ and sampling cassettes (Cassela)
- Low volume sampling pump (Allegro A100)
- Flow meter (Cole Palmer)
- Quartz filter 37mm (Millipore), switcher
- Stand and plastic tubes 5 mm.

Figure 2.1. Allegro A100 Pump

For gravimetric analysis was used the following equipment:

- Thermo reactor (Binder ED),
- Desiccators and microbalance with resolution 0,001 mg.

The methodology of the dust samples collection is done as follows.

Preparation: Quartz filters (37 mm diameter) were prepared for sampling in laboratory conditions. Filters were dried at 105 °C temperature in Thermo reactor and then cooled and kept in desiccator in order to prevent from absorption of humidity on them. The prepared filters were weighed on microbalance in room with the controlled and stable conditions (RH=50% and 200C).

2.1 On site sampling

PUF adapters for filters were used to collect aerosol particles in $PM_{2.5}$ and PM_{10} size fraction. The equipment was installed at height of 5m above ground level. It was connected to the low volume air sampling pump Allegro A100. The air flow was limited to 5l/min by a flow meter Cole Palmer with range (4 – 30 l/min). After the collection, filter samples were stored in plastic and sealed cassettes and kept in safe box.

2.2 Gravimetric determination

Particle mass was gravimetrically determined in horizontal position and afterwards transported to the laboratory. Weighing the filters with samples, after 48 hours conditioning in a desiccator, in clean and conditioned room, (T=20°C, RH around 50%).

For a quality assurance of the procedure, two blank filters were also prepared and carried on with other filters.

2.3 Chemical analyses of dust particles

The collected samples were analyzed for heavy metals concerning the objectives of the project "Environmental Assessment and Remedial Action Plan for Mitrovica Industrial Park".

The elements of interest are as follows:

- HM – heavy metals: Cd, Pb, Zn
- Other metals: Mn

The filters were placed in laboratory glass beakers (100 ml) and diluted in 2 portions of 10 ml nitric acid (1:1). After evaporating to dryness the filters were washed with doubly distilled water and the residues were transferred into 5 ml volumetric glass flasks and fill to the mark with redistilled water. For determination of heavy metals a Thermo Model Solar 2 flame atomic absorption spectrometer with air/acetylene flame was used. Instrumental parameters are optimized according to the Manual. A Varian SpectrAA 640 Z Zeeman electro thermal atomic absorption spectrometer with a Varian PSD-100 Autosampler was used. Hollow cathode lamps were used as a source.

3. Results

Measurements were made in urban areas, the square "Adem Jashari" Elementary School "Muharrem Bekteshi" and quarter Bair where is situated the Greek battalion of KFOR, and in the industrial area of Mitrovica Industrial Park respectively in the Faculty of Mining and Metallurgy. Table 3.1 presents the results obtained during the measurement, i.e. the measure of total suspended particulate material, fractions of particles with aerodynamic diameter of 10 μm and 2.5 μm, as well as the limited European values. While Table 3.2 presents the results of chemical analysis of dust for the respective places, the concentration of cadmium, lead and zinc in μg/m3 in 24 hours.

Table 3.1. Results from gravimetric of fugitive dust PM_{10} and $PM_{2.5}$

Measurements points	TSP (μg/m^3)	Size fraction	Mass of collected dust (μg/m^3)	European Guidelines (μg/m^3)
MIP – Faculty of Mining and Metallurgy	126.709	$PM_{2.5}$	26.532	25
		PM_{10}	59.235	50
Squer "Adem Jashari"	246.752	$PM_{2.5}$	16.753	25
		PM_{10}	127.369	50
Primary Schhool "Muharrem Bekteshi"	127.424	$PM_{2.5}$	9.16	25
		PM_{10}	60.027	50
Bair, Camp i KFOR-it Greek	144.045	$PM_{2.5}$	13.123	25
		PM_{10}	54.571	50

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Table 3.2. Results from chemical analyses of collected dust

Measurements points	Cd (μg/m^3)	Pb (μg/m^3)	Zn (μg/m^3)
MIP - Faculty of Mining and Metallurgy	0.01266	1.196	1.116
Squer “Adem Jashari”	0.0034	0.373	0.0207
Primary School “Muharrem Bekteshi”	0.00866	0.7145	0.067
Bair, Camp i KFOR-it Greek	0.003	0.78	0.0437

4. Discussion

The limit of values recommended by World Health Organization (WHO) were used for the evaluation. A primary pathway for the human health exposure to heavy metals is inhalation of the air particles containing heavy metals. Results of chemical analyses of the dust particles are mentioned in the tables 3.1 and 3.2. The dust particles show high content of Cd, Zn and Pb in comparison with the guideline values for concentration in air for heavy metals [6] and [7]. The obtained results shows that in all points of measurement, the overall amount of total suspended particulate material in the air exceed the value limit allowed by the EU for 24 hours, 120 μg/m^3 [8]. These results show that the most polluted place is square "Adem Jashari, TSP concentration has the value 246.752 μg/m^3 achievements, so double the allowed value. Also, the concentration of particles with 10 μm aerodynamic diameter exceeds the limited value of allowed by the EU for 24 hours, 50 μg/m^3 at all measured points [8]. Also in the square "Adem Jashari" concentration of these particles exceeds twice the limit allowed value. While the concentration of suspended particles with aerodynamic diameter 2.5 μm is below the value allowed by the EU 25 μg/m^3, the exception is at the measurement place in the Faculty of Mining and Metallurgy. It is characteristic the ratio between 10 μm diameter particles to those with diameter 2.5 μm. In the square "Adem Jashari" PM_{10}=127.369 μg/m^3 related to $PM_{2.5}$=16.753 μg/m^3.

In Table 3.2 in which are presented the concentrations of investigated metals in the dust, it is seen that the values exceed the allowed limits. Comparing the obtained values we can conclude that the concentration of particles smaller than 2.5 μm is quite high. For the high presence of these particles a good "contribution" gives also vehicles that circulate in this area and streets dust which is not cleaned properly.

As is known such dust it is difficult to deposit. These particles can stay for days suspended in the air. So these kinds of particles "contribute" to air pollution and damaging the health by the residents.

5. Conclusion

The air pollution in Mitrovica exceeds the limit of allowed values, comparing with the norms of the European Union, doubtless this zone is classified as injurious for health of the people. Concern grows even more when it is known that pollutants are heavy metals and their impact on human health is known. The first step which should be undertaken, for improvement of air quality, is the elimination of the pollution source. Although we are dealing with millions of tons of waste and for elimination of this pollution sources are needed a financial resources to prepare a strategic action plan for these residues, for temporary coverage, or adjustment of drainage channels for water, or reprocessing because these residue have an economic value. It is to undertake regular cleaning of roads, regular monitoring of air because the air around Trepca currently is not monitored.

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