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The Metallic Charge of the Leachates of the Public Discharge of Sefrou' City. (Middle Atlas, MOROCCO)

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ABSTRACT

The leachates are the main transport vector for metallic pollution from waste storage sites. The main objective of this study is to evaluate the metallic charge of the leachates of the discharge public of Sefrou's city and draw its impact on the natural environment. The characterization of leachates of five studied stations revealed the presence of the metallic elements (Fe, Cr, Cu, Nor, Zn, Cd and Pb) which present nuisances for health and environment

The analysis of our results shows that the decreasing order according to the metals most found in the leachate studied is as follows: Fe, Cr, Pb, Zn, Cu, Ni, Cd therefore the leachate generated by the municipal discharge of Sefrou (Middle Atlas, Morocco) are percolates transiting a metallic charge of which Iron and Chromium are the most abundant, which is in agreement with the results of characterization of other discharges of domestic waste. This characterization has also allowed us to show that the metallic composition of the leachate from this discharge is typical of a dominant domestic discharge and that it is essential to treat this highly polluted discharge in order to avoid any risk of contamination of water resources and the natural environment.

KEYWORDS

leachates, heavy metals, discharge, Sefrou Morocco.

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1 INTRODUCTION

The landfill constituted the most used technique of elimination of waste in the world, easy to operate and relatively inexpensive[1] .Several authors showed that in Morocco, the great majority of the public landfill has a fatal effect on the components of the receiving environment, in particular the groundwater[2345] . One of the major problems associated to this landfill is the production of liquid effluents called leachates or commonly "discharge juice". They result from the percolation of rainwater through the deposits and the water contained in the waste and those of their degradation [6] . Indeed, from the phase of deposits, waste is

submitted to processes of degradation related to complex biological and physico-chemical reactions. The water infiltrates there and produces leachates full of organic matters, bacteria, mineral compounds and in heavy metals essentially.

The leachates which constitute the main vector of transport of the metallic pollution resulting from the sites of storage of waste present a very random composition and varies in function of the type of waste, the age of the landfill, the technique of exploitation and climatic conditions. In spite of its complexity, four groups of pollutants (dissolved organic matter, anthropic organic compounds, major mineral compounds and heavy metals in small quantities characterize the leachate[7 8]. Our study consists of a characterization and analysis of the metallic charge of leachate from the landfill of Sefrou city. To do campaigns, samplings and analyses were performed on these leachates. These samples covered the following metals: Fe, Cr, Cu, Ni, Zn, Cd and Pb

2 MATERIALS AND METHODS

2.1 Study Area

The town of Sefrou is located at 28 km from the South-east of Fès on the Regional Road 503 (RR503) [9] and at the bottom of the mountainous chain of the Middle Atlas with an average of 850m of altitude. The Surface of the urban perimeter of the east city is about 1050 Hectares.

Figure 1: situation geographies of Sefrou

The population of Sefrou city counted in 2004, 64 006 inhabitants [10]. It is now approximately 80 000 inhabitants [11] and the waste produced daily by this city is about 54 tons[12] . They are deposited in a wild and uncontrolled discharge (former quarry), without any environmental management control and health monitoring.

The following figure presents the location of the landfill and the sampling sites.

Figure 2: Map of location of the landfill and the sampling sites.

2.2 Methods Of Study

The Sampling of leachate is performed on 5 stations, these samples are taken during one year from January to December 2013.

250 ml of leachate was collected and placed in polyethylene bottles washed with hydrochloric acid (10 %) and rinsed with distilled water. During transport to the laboratory, these samples were placed in a cooler. In the laboratory, these samples were stored at -4°C. The analyses of trace elements (Fe, Cr, Cu, Ni, Zn, Cd and Pb) are realized by Atomic Emission spectrometry with Inductively Coupled Plasma (ICP-AES) in the dissolved phase of the sample.

3 RESULTS AND DISCUSSION

Generally, in urban areas, waste and its mode of elimination are activities that also produce large amounts of metal pollutants. Most of the components of municipal waste contain heavy metals such as batteries (Hg, Zn, Pb, Cd), paints (Cr, Cd, Pb), plastics (Cd, Ni), cardboard paper (Pb)…. etc.

The metallic pollution of landfill waste is a long-term problem that raises many concerns. The metal concentrations measured in the leachates are, however, weak and the majority of heavy metals, mainly copper, nickel, lead, iron, zinc and cadmium in fact remain trapped within the waste mass. Baccini and al (1987) estimate that more than 99.9% of the heavy metals are still trapped in the discharge after about 30 years[13] .

The leachate examined contains considerable levels for heavy metals and the comparison of the levels revealed in the five stations studied show that the highest values are recorded at stations S3 and S5 (Figures 3,4,5,6,7,8,9). this can be explained by the presence of releases from tanneries in these two sites. (Figure 10 and Figure 11).

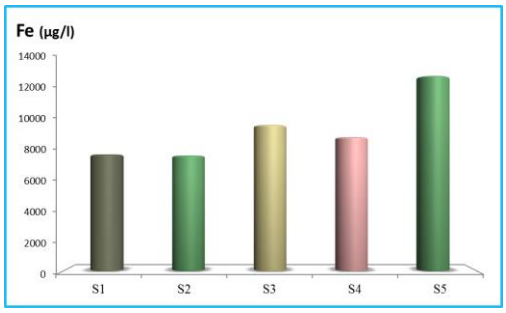

Figure 3: concentrations of iron at five sampling stations.

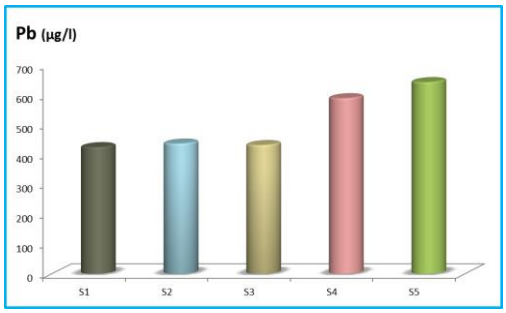

Figure 4: concentrations of Lead at five sampling stations.

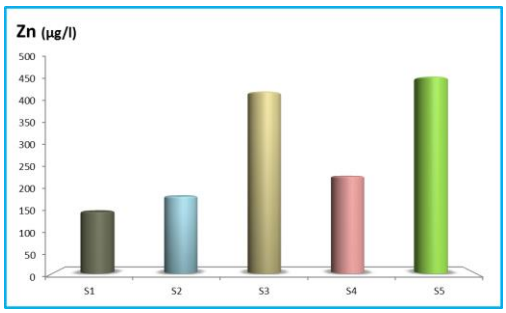

Figure 5: concentrations of Zinc at five sampling stations.

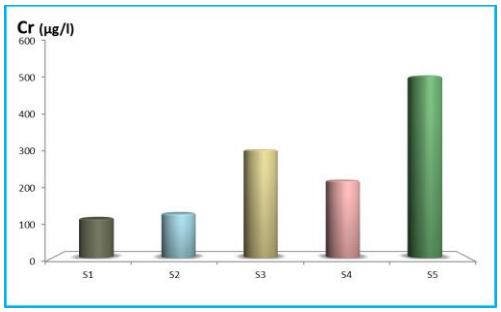

Figure 6: concentrations of Chromium at five sampling stations.

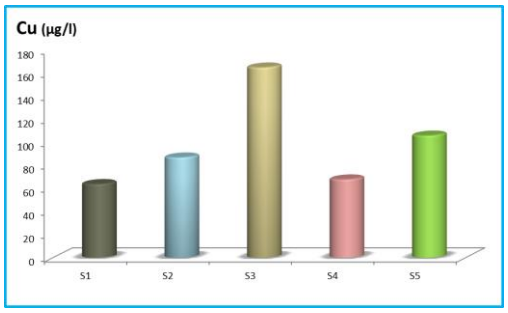

Figure 7: concentrations of Copper at five sampling stations.

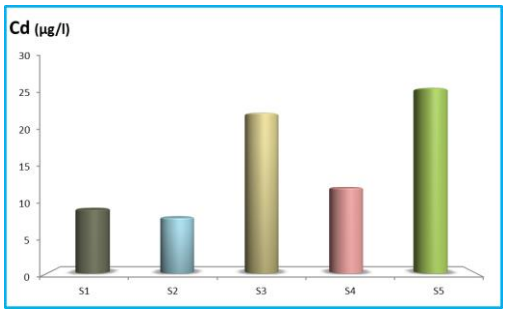

Figure 8: concentrations of Cadmium at five sampling stations.

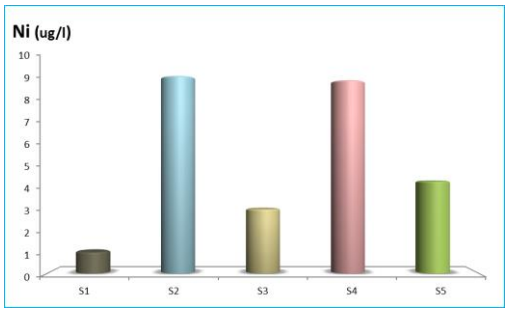

Figure 9: concentrations of Nickel at five sampling stations.

Figure 10: sampling station 5 contains tannery waste (S3).

Figure 11: sampling station 5 contains tannery waste (S5).

The analysis of our results shows that, for all the sampling stations, iron is the metal present in greater quantity in the leachate studied with an average concentration of about (9354µg / l), followed by the Lead, the Zinc and the Chromium which exceed the criteria for discharge to surface water.

The other metals like Copper, Nickel and Cadmium have various averages respectively (98 µg/l), (5,3 µg/l), (15,46 µg/l). That does not exceed the permitted norms[14], and remain in the range of concentrations revealed in several regions of Morocco and elsewhere (Table 1).

Concentration s (µg/l)	Décharge de Séfrou	Décharge de Rabat (Maroc) [15]	Décharge d'El Jadida (Maroc) [16]	Décharge d'Alger	Décharge de Tizgat [17]	Décharge d'Etueffont [18]	Décharge de Méknès [19]	Critère de rejet direct
Fe	**9354**	23 000	24 000	12 300	–	2 630	–	**3000**
Cr	**253,4**	517	156,33	500	300	270	107,2	**2 00**
Zn	**288,2**	-	747,2	700	500	740	78,3	**5000**
Cu	**98**	118	157,8	450	_	270	113,7	**500**
Ni	**5,3**	133,6	133,8	250	670	210	64	**500**
Cd	**15,46**	8,38	34	_	_	10		**200**
Pb	**505,2**	_	_	_	_	100		**500**

Table 1: Comparison of average heavy metal contents in domestic landfill leachates

Heavy metals, whose contents even if they do not exceed the permitted limits, may constitute a danger to health. Indeed, the metallic elements by bioaccumulation and bioamplification can be found at toxic doses at a certain level of the trophic chain, especially in the presence of grazing livestock and olive crops in the region near the discharge. Indeed, heavy metals, more particularly the Lead, the Zinc and the Copper, are a part of cases of pollution representing a major environmental problem. They can migrate into groundwater and accumulate in the food chain and present risks to human health.

4 CONCLUSION

The physicochemical characterization of leachate generated by the landfill of Sefrou city (Middle Atlas, Morocco) showed that this leachate transiting a metallic charge which the iron and the chromium are the most abundant, that is in agreement with the results of characterization of other domestic discharges. The highest concentrations of the majority of the analyzed elements are observed at the station 3 and the station 5. This characterization allowed us to show that the metallic composition of the landfill leachate is typical of a discharge with dominant domestic character.

The heavy metal toxicity, even at low concentrations, and also the cumulative effect of these trace elements present nuisances and very negative impacts on the human health and on the environment surrounding in general. Therefore, the leachates by their liquid nature constitute a concentrated source of pollutants and the greatest risk of these effluents is the contamination of water resources.

Hence, leachate from the landfill of the city of Sefrou plays a harmful role on the environment and on the quality of life of people in the area. This alarming situation pushes us to propose a way of treatment of the uncontrolled leachate (current) and the installation and implementation of a system of collection and treatment of these effluents to the controlled landfill (future discharge).

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