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Transport and Transformation of Pb in Soil columns and Ground water

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ABSTRACT
Today, soil and water quality is affected by various pollutants. One of the important chemical pollutants are heavy metals such as Pb. Pb is a heavy metal that its non-allowable values in soil and ground water is a serious threat to human life and has some health problems such as breathing problems as well as lung and kidney cancer. Following the reports, Golestan province has unauthorized amounts of Pb in soil and ground water in some areas and according to importance of the matter, this study was conducted to evaluate the movement of Pb in soil columns and ground water of Gorgan in both horizontal and vertical dimensions with local distance of 30 cm and time interval of 3 days. For this purpose, 250 liters of distilled water containing concentrations of 0.5 and 3 ppm were prepared and injected into two pieces of selected lands in Gorgan as pilot. The results of this study showed that in both horizontal and vertical dimensions, Pb concentration will decrease within the increasing of distance and time and with respect to the rate of decrease in the concentration of Pb in the horizontal dimension, it can be said that Pb does not spread in the horizontal dimension of this area.
***Key words**: transport,soil column, ground water*

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INTRODUCTION

Pb is considered one of the least plentiful but most toxic element in the earth's crust. Pb is mobilized in the environment through natural process of weathering ,disposal of human,animal,and plant wastes, emission of volcanic ashes and fossil fuel burning. Lead is in group IV A of periodic table, and is found in both organic and inorganic form; the inorganic forms are mostly 2-atomicity while its organic forms are often 4-atomicity.Main chemical types of lead in acid soil in order of density reduction are:Pb^{+2}, organic lead complexes, $Pbso_4$, $PbHCO_3^+$; and in alkaline soil: $PbCO_3$, $PbHCO_3$, organic lead complexes,$Pb(CO_3)_2^{2-}$,$PbOH^+$.Existence of unauthorized amount of lead causes destruction of neurotic bounds in human, kidney-blood disease, belly pains, and different kinds of cancer. many geophysics-chemical processes such as absorption cause lead release from soil and precipitate in ground water [1].
Modelling of different kinds of contaminant was studied by several researchers, Nasiri [2], Hooshmand [3], Alemi,*et al* [4, 5], Hutson and Wagenet [6], Ahlrichs, Hossner [7], Mirbagheri [8-10], Copoulos,*et al*,[11], Tayfure *et al*,[12].
Regarding contaminating soil and ground waters of Golestan province to this toxic element, the purpose of this paper is to address the spatial and temporal distribution of Pb in soil column of Gorgan site.

MATERIALS AND METHODS

In this study, two plots of land with dimensions of 1.5m×2 on the site of wastewater treatment plant of Gorgan city were chosen as pilot. Then a hole was drilled to the length with the width of 1m and depth of 160cm to perform sampling and depths of 30, 60, 90, 120 and 150 cm were marked on the wall.
On the next step, two 250 liters distilled water solution containing concentrations of 0.5, 3 mg/l of Pb as Pb $(No_3)_2$ was prepared and poured on the pilots, after several hours that the solution found the opportunity to penetrate the soil and reach deep down; soil sampling was done in the vertical dimension from the surface, marked depths and bottom of the channel and at the same time in the horizontal widths of 30, 60 and 90 cm from the surface and a depth of 30 cm. Then, the samples with the label including

time and local information were transferred to the soil laboratory to determine the relative humidity of soil and prepare it for extraction involves drying, grind and sieve the soil.
In the next step in the Laboratory of Water and Wastewater, 20 g of prepared soil from each sample was mixed with 40 ml of DTPA solution and was placed on a rotary shaker at a speed of 160 rpm for 2 hours. At first the samples was passed through filter paper of 42 mm and then through a syringe filter of 0.45 micrometer to obtain a completely transparent solution for reading by atomic absorption.
All the sampling periods with time interval of 3 days on the days forth, seventh and tenth after pouring the solution, were repeated for both desired concentrations.

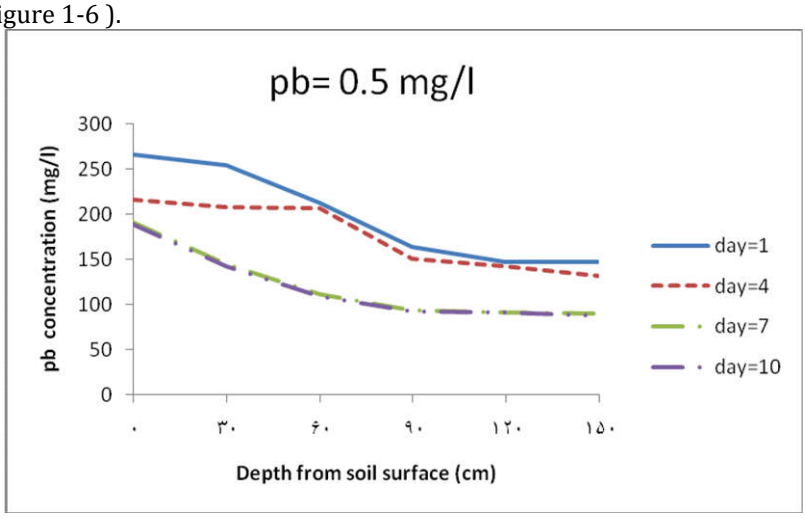
RESULTS AND DISCUSSION

In the research and before the testing and pouring the desired solution, the characteristics of the area soil and details of its texture for different depths were determined according to the following table(table 1).

Table l: The soil texture details

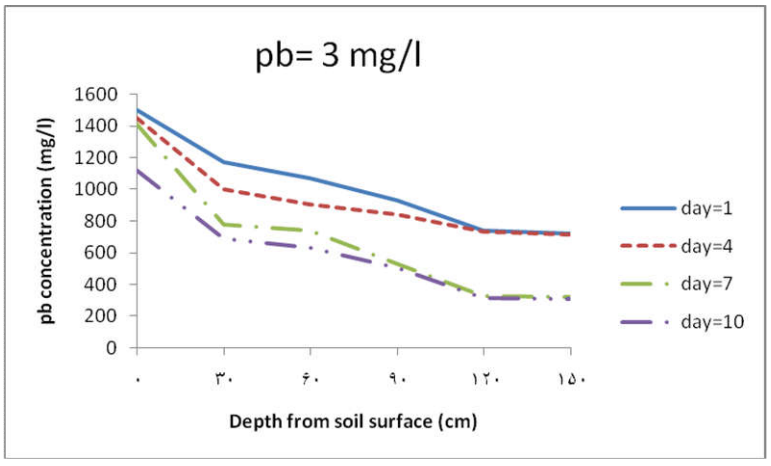
Sand%	Silt%	Clay%	Organic Carbon %	Total saturated acidity	Electric Conductivity EC*10^3
39	41	20	1.5	6.9	8.1

After determining of soil characteristics, the amounts of Pb concentration were estimated in local distance of 30cm and time interval of 3 days in both horizontal and vertical dimensions.
These results indicate that Pb concentration have been decreasing in both horizontal and vertical dimensions and on the other hand, concentration decreases at any point with time which is shown in the following diagrams(figure 1-6).



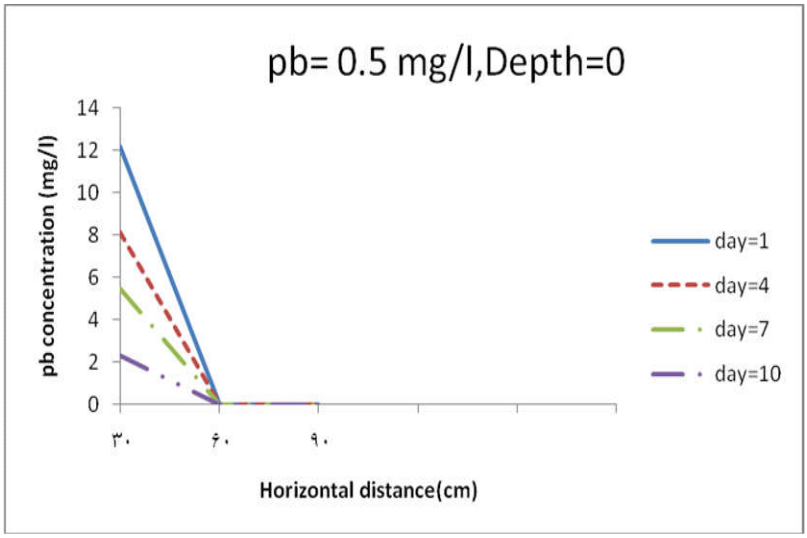
(Pb_0 =0.5 mg/l)

Figure 1- Concentration of Pb for different depths



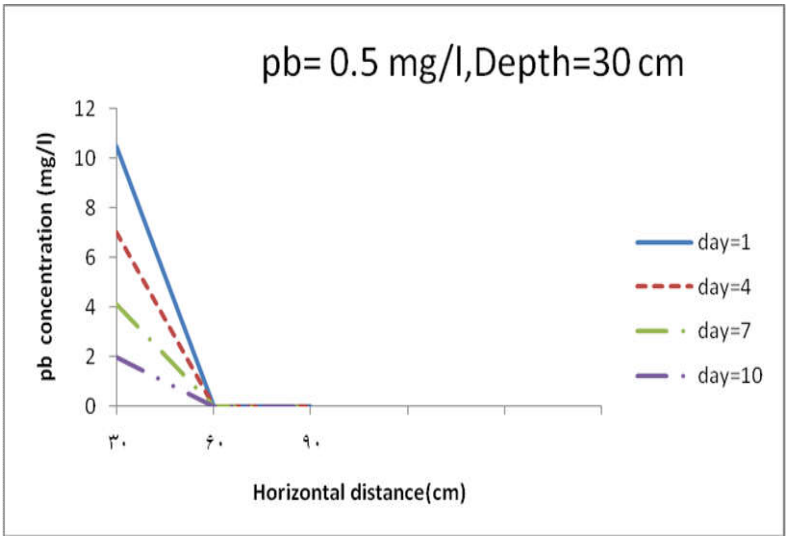
(Pb_0 =3 mg/l)

Figure 2- Concentration of Pb for different depths



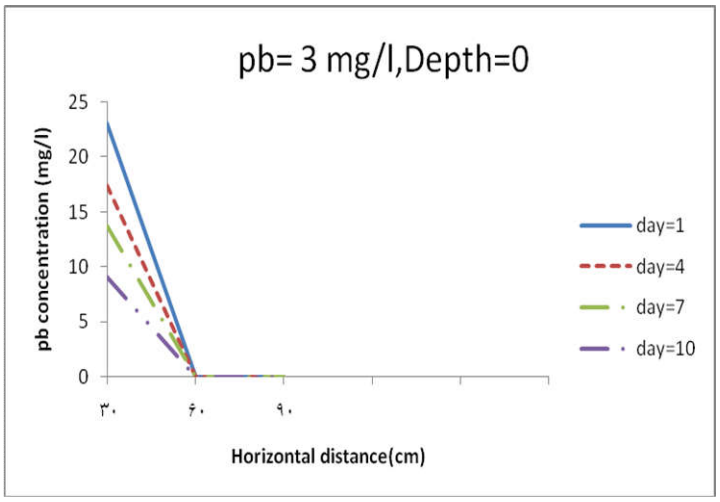
(Pb_0 =0.5 mg/l ,depth =0)

Figure 3- Concentration of Pb for different horizontal distances



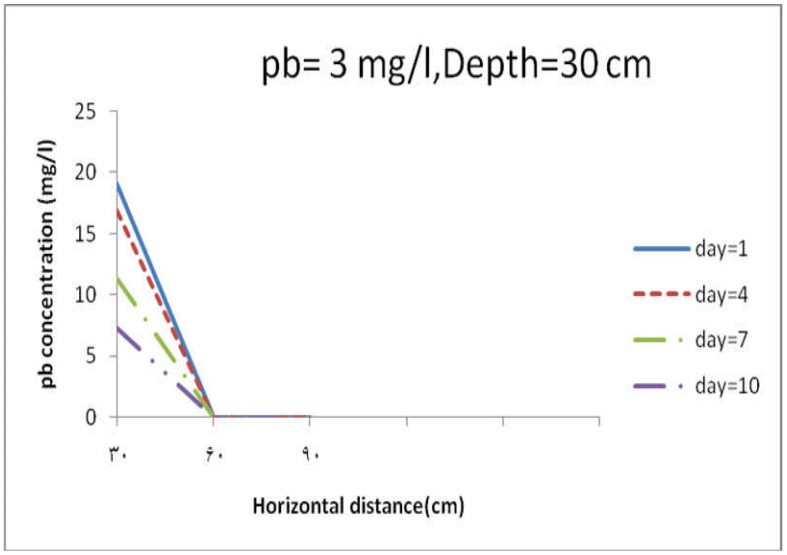
(Pb_0 =0.5 mg/l ,depth =30 cm)

Figure 4- Concentration of Pb for different horizontal distances



(Pb_0 =3 mg/l ,depth =0)

Figure 5- Concentration of Pb for different horizontal distances



(Pb_0 =3 mg/l ,depth =30cm)

Figure 6- Concentration of Pb for different horizontal distances

CONCLUSION

In this study, the motion of Pb concentration in both horizontal and vertical dimensions over time were assessed. After pouring of concentrations of 0.5 and 3 ppm of Pb solution on the pilot land, it is found that the measured concentrations on the ground on the first day and for the concentration of 0.5 was approximately equal to 530 times of input concentration and in regards to concentration of 0.4 was equal to 500 times while after 10 days, the concentrations of same points were equal to 380 and 370, respectively. Thus, according to the estimated values and the above diagrams, it was concluded that the concentration of Pb at a point decreases with increasing depth, also concentration changes decrease with time. On the other hand, the concentration decreased at a certain depth and also with increasing width distance from the desired place and reached to zero in about a half of meter which it can be concluded that Pb was not penetrated in the soil and in horizontal direction. So, one-dimensional model can be used to simulate the movement of Pb in soil column and ground water of this area.

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