ESTIMATION THE EFFECT OF RAIN WATERS IN CONTAMINATED SOIL BY USING MATHEMATICAL METHOD AND ITS APPLICATION IN BAGHDAD

L.N.M. Tawfiq   M.A. Hasan

ABSTRACT

The aim of this paper is to design a Simulink model which can estimate the effect of rainwaters in the contaminated soil by heavy metal. The paper suggests design of Simulink model to estimate concentration of heavy metals in soil depending on the given data. Then compared the results with laboratory inspecting to estimate the accuracy of suggested technique. Where the sample data selected from different zone in Baghdad difference land   (Commercial, Industrial, Residential, Roadside) before and after the rain to determine its effect. Then to test the efficiency of suggested method we applied the study in Baghdad city and compared with the laboratory results to illustrate the accuracy The practical results show the efficiency of suggested technique.

INTRODUCTION

Mathematical Models are simplified representations of some real world entity can be in equations or computer code are intended to mimic essential features while leaving out inessentials, that is, models describe our beliefs about how the world functions. Mathematical modeling aims to describe the different aspects of the real world, their interaction, and their dynamics through mathematics (3).

Generally, nutritional metals do occur naturally in fruits and vegetables as essential trace elements needed for good health, but they could be toxic when their concentrations exceed limits of safe exposure; sixteen chemical elements are known to be important to a plant's growth and survival [2]. The sixteen chemical elements are divided into two main groups: non mineral and mineral. The non-mineral nutrients are Hydrogen (H), Oxygen (O), and   Carbon (C), these nutrients are found in the air and water. The 13 mineral nutrients, which come from the soil, are dissolved in water and absorbed through a plant's roots. Heavy metals are that elements having specific gravity that is at least five times the specific gravity of water which is expressed as 1 at 4°C and refers to metallic elements with an atomic weight greater than Iron (55.8 g/mol) [4]. Several workers have they already investigated the mobility of heavy metal in the soil amended with sewage sludge and concluded that only relatively small amount of metal were available for transport in the soil water immediately after sludge application (4). Giordano and Mortvedt (5) show that under excessive leaching condition, movement of heavy metal in soil is somewhat greater from inorganic than from complexes sources found in sewage sludge. Other works study the effect of rainwaters in soil depending This research work, therefore aimed at design a mathematical model equation that estimate the concentration of heavy metals in the soil, then we compare the results before and after the rain to estimate the effect of rain in soil on laboratory testing for many samples of soil before and after the rain such (1)[6-7]

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*College of Education for Pure Science Ibn Al-Haitham, Baghdad University, Baghdad, Iraq.

METRICAL AND METHODS

model equation was which design a can estimate the effect of rain waters in the contaminated soil by heavy metals such as: Lead (Pb), Nickel (Ni), Cadmium (Cd), Copper (Cu), Iron (Fe), Zinc (Zn), Chrome (Cr), and Manages (Mn). This aim can be achieved through the realization of the following objectives:

a- Collection of data showing the concentration of heavy metals at different percentage of the soil with respect to distance and time.

b- Design mathematical model equations for the concentration of heavy metals in the soil.

c- Simulation of the model equation using computer software programmed, Math Lab 2015 professional. Compare the simulated result with the experimental data to determine the accuracy of suggested technique.

the model that xdot and x are both outputs and inputs of the model. Therefore, we need to use a feedback loop for each of these signals. Before running the model is sure to include a Scope block for viewing the results. Now that the model is complete, we are ready to run the simulation and look at the results.

Running Simulation and Analyzing data

Having completed the Simulink Models systems, it is now run a simulation to get the results.

Double-click on the Integrator block and set the initial data measured in laboratory dispersion test as given in Table 1. Then, double click on the Gain block and open the Step block. Now, run the simulation and open the Scope block. Hence we get the result that is the value of dispersion parameter (D_L) and close to 0.5. Then, get the concentration of heavy metals. Then compared with the standard universal value for concentration of heavy metals to determine the rate of contamination in the soil

Table 1: The results of laboratory tests of soil samples concentration unit PPm

No	Site	PH	Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1	Mohammed Al- Kasim highway before rain	8.34	0.85	37.26	26.16	2998.41	581.32	155.76	400.60	149.74
-	Mohammed Al- Kasim highway after rain	6.89	ND	8.58	7.30	1013.13	79.00	39.20	25.34	13.70
2	Bab Al- Muadham before ain	8.34	0.80	44.55	26.14	2977.93	541.17	136.50	450.60	78.00
-	Bab Al- Muadham l after rain	6.89	ND	11.04	9.30	1011.54	89.18	39.18	25.34	15.78
3	Kadhimiya before rain	8.30	1.00	39.76	27.28	2681.04	589.76	112.2	512.71	243.98
-	Kadhimiya after rain	6.89	0.03	8.23	12.72	884.73	153.26	36.09	27.27	18.94
4	Al Karada before rain	8.22	0.90	49.14	37.45	2884.73	470.60	110.15	682.71	101.60
-	Al Karada after rain	6.92	ND	10.40	11.36	1305.81	100.60	36.09	37.32	22.87
5	Al-Taji control before rain	8.31	1.86	54.18	47.25	3133.44	759.76	140.20	600.60	388.38
-	Al-Taji control after rain	6.78	0.05	20.38	14.29	1422.56	98.92	38.09	26.13	41.00
6	Al-Durah before rain	8.21	1.96	62.72	54.25	2233.43	659.00	139.18	690.60	213.00
-	Al-Durah after rain	6.67	0.04	21.98	13.25	1327.50	86.54	63.34	32.34	38.00

Application of the Mathematical Model

The study area is Baghdad city, the data and information on soil is selected from 48 stations located on different parts of the Baghdad city for the purpose of

collecting samples of soil have been distributed on a regular basis so as to cover most areas of the city, with a focus on the type of each area as residential, commercial, agricultural, main roads and industrial; as illustrated in Figure 1. 148 soil samples were selected from residential, commercial and industrial land which represent the initial data for suggested design, collected at a range of depth (0 - 20) cm. Samples

Building Model

To model the system to estimate the concentration of heavy metals in the contaminated soil we start by looking at the terms in the bracket. There are three input signal lines: t, y, and x, we also notice that both t and y are multiplied by constants, as in the case of the first- model; this can be done in Simulink by using a Gain block. The signals are then summed together as in Figure 1, below.

Figure 1: The model of the system to estimate the concentration of heavy metals in the soil

were preserved in cleaned polyethylene bags and finally transported directly to the laboratory. The laboratory results are given in Table (1).

Figure 1: Locations of samples Sites in Baghdad city

Now used the laboratory results in the suggested design as input, i.e., initial data, to get the concentration of heavy metals: Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn, for any depth and in any time. The results of suggested method are given in Figure (2)
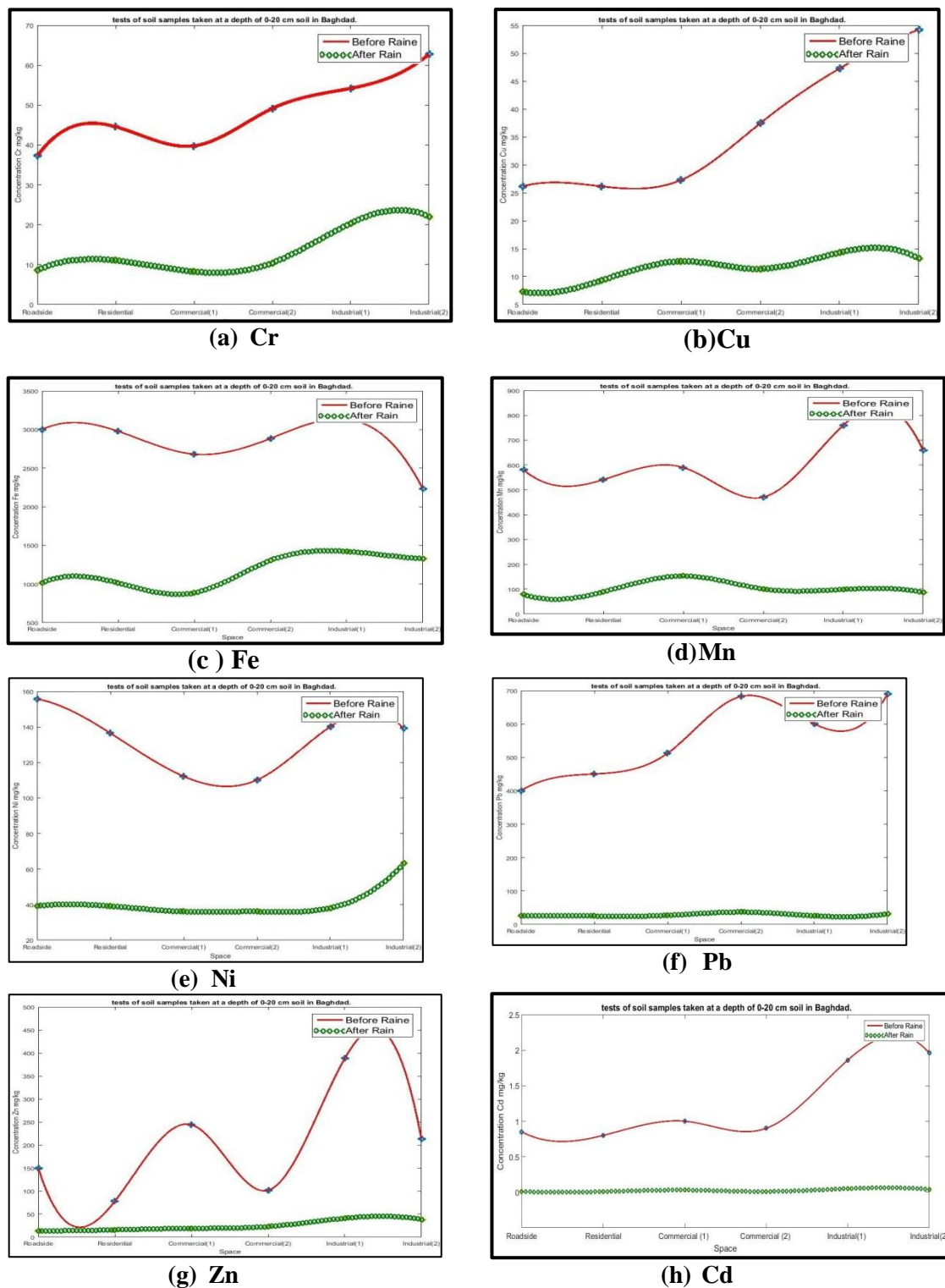

(a) Cr

(b)Cu

(c) Fe

(d)Mn

(e) Ni

(f) Pb

(g) Zn

(h) Cd

Figure 2: Results of suggested method for concentrations of heavy metals

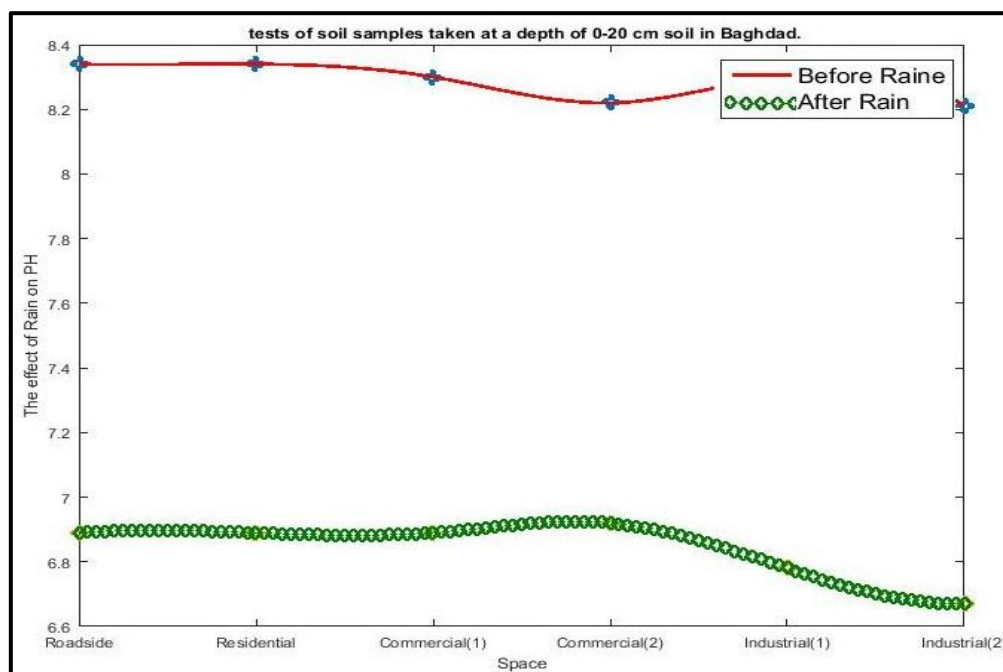**Also, we used the suggested method to estimate PH for soil sample and the results illustrated in figure (3)**

Figure 3: Estimate the pH by suggested method

Conclusions

The analysis of the results shows that there are a very good level of agreement between the experimental and simulated results obtained. This can also be confirmed by the numerical analysis of the result by using interpolation. the model can be considered to be a good representation of the estimating the concentrations of heavy metals in the soil.

Results and Discussion

The practical results show the effect of the rains on the soil. The results of the analysis of lead in soil in Baghdad city, show that the concentrations of this element has exceeded the permissible limits in some regions is due to the impact of divorced and industrial plants such as brick factories and smelters as well as the impact of divorced vehicles due to combustion. Also, observed by measuring the concentrations of Ni and Cd it had exceeded the permissible limits, which indicates the existence of these elements in the soil of this city, and the reason for the increase in the concentrations of these elements is due to several reasons including the impact of industrial activities, but by less than before rain due to suspension of many of these actors to work due to war conditions experienced by the country as well as the impact of adsorption by clay minerals and the presence of organic matter in the soil that play an important role in increasing concentrations of these elements as well as the weathering and irrigation and drainage show on table(1) and figure(2).

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تخمين تأثير مياه الامطار في التربة الملوثة باستخدام طرق رياضية و تطبيقها في محافظة بغداد

لمى ناجي محمد توفيق   محمد عبد الحسين حسن

المخلص

الهدف من البحث هو تخمين تأثير مياه الامطار في التربة الملوثة بالمعادن الثقيلة باستخدام طرق رياضية في محافظة بغداد. العمل تم من خلال تحديد تراكيز المعادن الثقيلة في التربة ضمن منطقة الدراسة وبمناطق مختلفة (الزراعية والصناعية والتجارية والسكنية والطرق العامة) من خلال الفحوص المختبرية قبل هطول الامطار، ثم اعادة اخد العينات وفحصها من المنطقة نفسها لكن بعد هطول الامطار ومقارنة قيم التراكيز قبل وبعد الامطار لمعرفة مدى التأثير وثم استخدام تلك العينات لتصميم انموذج رياضي يتم من خلاله تحديد قيم تراكيز المعادن الثقيلة في تلك التربة او أية عينة اخرى و في أي وقت واي عمق في التربة لتحديد مدى تلوث التربة بتلك المعادن دون استخدام الفحوص المختبرية التي تعد مكلفة وكانت النتائج عالية الدقة.

كلية التربية للعلوم الصرفة ابن الهيثم، جامعة بغداد، بغداد، العراق.