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Leaching Mathematical Modeling for Two Zones of North Khuzestan Province

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Abstract: The main aims of present study are evaluation desalinization and desodification mathematical modeling in two zones of Northeast of Khuzestan province in Southwest of Iran with and without emendator material (Sulfuric acid). To reach the aims, the experiment was done in two zones with four treatments; 25, 50, 75 and 100 cm of water irrigation and four iterations in each plot (1*1 m) from surface to 150 cm of soil depth. Data that have used in this paper were Electrical Conductivity (EC) and Exchange Sodium Percentage (ESP). Data obtained from experimental results and with SPSS12.0 software eleven mathematic models have extracted. Results show that in zone one with and without acid Cubic equation for Electrical Conductivity and Exchange Sodium Percentage have the most and S, Logic equations have the least coefficient of determination. In addition, in zone two with and without acid for Electrical Conductivity Component, Growth and Power equations have the most and S, Logic equations have the least coefficient of determination. In zone two, the results of Exchange Sodium Percentage are similar to zone one.

Key words: Leaching, desalinization, desodification, emendator material, Khuzestan

INTRODUCTION

Decreasing soil salinity and increasing potential of production may be possible with desalinization. The best method for desalinization and desodification is leaching soil by water with or without emendator material. Put water on soil for some time until water infiltrate to soil and transform drain water to drainage or bottom layer of soil. The first proceedings for utilization of saline and alkalis soil are investigations about improvement, adjustment soil and study about leaching for determination water requirement (Consulting Engineering Tak Sabz, 2007).

In studying project evaluation the possibility of reclamation saline and alkaline soils and determination water requirement for leaching with field-testing has recommended. With these, testing can obtained imperial and theoretical models, desalinization and desodification curve.

Imperial models are type of mathematic equation that are obtained from measured and observation data. Therefore, these models do not have any mathematic or physics presuppositions but have some limitation (can use them for special location and problem) and blow advantages:

- Application imperial model in approximate estimation.
- Imperial models can be part of numerical complex model
- Imperials models have some limitation but in practical applications, these models are better than theoretical models (Water Resources Management of Iran, 2006)

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In a review, Reeve *et al*. (1955) and Reeve (1957) showed that leaching curve had general special shape. They did some investigations with theses situation; soil texture was silt clay loam and initial Electrical Conductivity on 0-30 cm depth of soil was 40 dS m^{-1} with continued leaching and obtained inverse imperial equation below:

$$\frac{D_W}{D_S} = \frac{1}{5(\frac{EC_f}{EC_i})} + 0.15 = \frac{1}{5}(\frac{EC_i}{EC_f}) + 0.15 \quad (1)$$

Where:
D_W = Depth of application water (cm)
D_S = Soil depth (cm)
EC_i = Electrical conductivity before leaching
EC_f = Electrical conductivity after leaching

According to investigation and field testing in Hansa-Hariana In India, Leffelaar and Sharma (1977) represented that results of Reeve's model gave the depth of leaching water for light soil (sandy loam to silt loam) more than requirement amount. They did continued and alternate experiment leaching in soil with initial Electrical Conductivity 30 dS m^{-1} and obtained inverse imperial equation below:

$$\frac{EC_f - EC_e}{EC_i - EC_e} = \frac{0.062}{\frac{D_{lw}}{D_s}} + 0.034 \quad (2)$$

Hoffman (1980) by using data that had obtained from the field in USA and some country represented equation below:

$$\frac{D_W}{D_S} = K\frac{EC_i - EC_{eq}}{EC_f - EC_{eq}} \quad (3)$$

Where:
D_W = Depth of application water (cm)
D_S = Soil depth (cm)
EC_i = Electrical conductivity before leaching
EC_f = Electrical conductivity after leaching
EC_{eq} = Equivalent electrical conductivity
K = Dimensionless imperial coefficient

Pazira and Kawachi (1981) according to study and experiments that did during several years in central part of Khuzestan for silt clay to clay silt soil with Electrical Conductivity equivalent to 65-80 dS m^{-1} from surface to 150 cm of soil depth represented inverse and imperial equation below:

$$\frac{EC_f - EC_e}{EC_i - EC_e} = \frac{0.070}{\frac{D_{lw}}{D_s}} + 0.023 \quad (4)$$

The variables have defined and D_{lw} is net of irrigation water (cm).

Verma and Gupta (1989) two model for continued and alternate leaching represented.
For continued leaching

$$\frac{EC_f - EC_e}{EC_i - EC_e} = 0.099\left(\frac{D_{lw}}{D_s}\right)^{-1.27} \quad (5)$$

For alternate leaching

$$\frac{EC_f - EC_e}{EC_i - EC_e} = 0.09\left(\frac{D_{lw}}{D_s}\right)^{-1.63} \quad (6)$$

Pazira *et al*. (1998) did field experiment on saline and sodic soil of southeast Khuzestan province in Iran. The experiments were done on clay loam to silt clay with initial Electrical Conductivity 38.2-46.5 dS m^{-1} from surface to 1 m depth of soil. They obtained for alternate leaching below equation:

$$\frac{EC_f - EC_e}{Ec_i - EC_e} = 0.0764\left(\frac{D_{lw}}{D_s}\right)^{-0.864} \quad (7)$$

The variables have defined before.

Generally, can be classified exiting imperial models by mathematic method. The imperial models of Reeve (1957), Leffelaar and Sharma (1977), Hoffman (1980) and Pazira and Kawachi (1981) are as inverse equation and the imperial model of Pazira *et al*. (1998) is as Power and the imperial models of Dieleman (1963) is Semi Logarithm equation.

In this study with field data, mathematic models have obtained and finally, the best model for study area has suggested.

MATERIALS AND METHODS

Experiment Site

For evaluation leaching mathematical modeling a research has done in Shavoor plain one of the Khuzestan plains. The area of study region is 77706 ha and locates in 40 km North of Ahwaz in Ahwaz-Hafttapeh road. This area from south terminates in Tavana canal in south to Elhaee village, from north to Shavoor village, from east to Tehran-Ahwaz railway and from west to Karkheh River. The field study was done on March 2007 at Shavoor plain that has located between 48° 15' to 48° 40' 40" Eastern longitude and 31° 37' 30" to 32° 3' 30" Northern latitude.

Average of annnal temperature and rainfall are, respectively 25.6^{oc} and 233.7 mm. According to the Amberzheh climoscope study area is medium hot desert. Thermal regime of soil is Hypertermic and humidity regime is Ustic and Aquic.

The Method of Experiment

For these current study two zones of Shavoor plain was selected. General characteristic of these areas has shown in Table 1(Consulting Engineering Tak Sabz, 2007).

Zone number one locates near Seyed Ghazban village and zone number two locates on the North of Mazraeh village. For know information about chemical and physical characteristics of soil on two zones and water that applied for leaching, chemical and physical parameters of soil and water before leaching were measured. The results have represented on Table 2-6 (Consulting Engineering Tak Sabz, 2007).

Table 1: General characteristics of study zones

Zone	Class before/ after leaching	Soil texture	Infiltration rate (cm h^{-1})	Hydraulic conductivity (m day^{-1})	Impermeable layer depth (m)	Water table depth (m)
1	S_4A_2/S_3A_1	Silt loam and silt clay loam	6.55	1.30	>3.00	2.85
2	S_4A_3/S_2A_2	Silt clay loam	0.87	2.77	>3.00	1.14

Table 2: Soil chemical quality before leaching on zone No. 1

Soil depth (cm)	ECe (dS m^{-1})	pH	Gypsum (meq/100 g soil)	CEC (meq/100 g soil)	EX. Na (cmol/ kg soil)	SAR	ESP*	ESP**
0-25	56.84	7.73	25.3	14.4	3.01	19.05	20.90	21.16
25-50	29.68	7.77	18.2	15.3	2.33	13.65	15.23	15.88
50-75	10.18	7.70	9.1	15.4	1.06	5.13	6.88	5.93
75-100	6.87	7.56	8.2	15.6	0.96	4.55	6.15	5.17
100-150	4.57	7.63	7.8	15.7	0.43	1.09	2.74	0.35

$$*ESP = \frac{Ex \cdot Na}{CEC} \times 100,\quad **ESP = \frac{100(-0.0126 + 0.01475SAR)}{1 + (-0.0126 + 0.01475SAR)}$$

Table 3: Soil chemical quality before leaching on zone No. 2

Soil depth (cm)	ECe (dS m^{-1})	pH	Gypsum (meq/100 g soil)	CEC (meq/100 g soil)	EX. Na (coml/ kg soil)	SAR	ESP*	ESP**
0-25	64.44	7.78	36.8	15.1	5.08	31.99	33.64	31.47
25-50	28.60	7.77	29.1	15.4	4.90	29.98	31.82	30.05
50-75	14.81	7.88	11.2	15.8	3.67	21.78	23.23	23.59
75-100	10.54	7.80	9.3	15.7	3.33	20.35	21.21	22.33
100-150	9.72	7.96	7.1	15.6	3.08	18.88	19.74	21.00

$$*ESP = \frac{Ex \cdot Na}{CEC} \times 100,\quad **ESP = \frac{100(-0.0126 + 0.01475SAR)}{1 + (-0.0126 + 0.01475SAR)}$$

Table 4: Soil physical characteristics (definite moisture in soil layers on zone No. 1)

Soil depth (cm)	Layer depth (cm)	Percentage weight moisture θ_{mc}	θ_{mFC}	pd (g cm^{-3})	*Deficit moisture (cm)	Totally
0-25	25	18.60	19.85	1.42	0.44	0.44
25-50	25	20.20	21.43	1.46	0.45	0.89
50-75	25	20.45	21.87	1.48	0.53	1.42
75-100	25	21.90	22.00	1.49	0.04	1.46
100-150	25	22.10	22.32	1.51	0.00	1.46

$$*d = \frac{(\theta_{mc} - \theta_{mFC}) \times \rho_d \times D}{100}$$

Table 5: Soil physical characteristics (definite moisture in soil layers on zone No. 2)

Soil depth (cm)	Layer depth (cm)	Percentage weight moisture θ_{mc}	θ_{mFC}	pd (g cm^{-3})	*Deficit moisture (cm)	Totally
0-25	25	14.75	21.61	1.50	2.57	2.57
25-50	25	21.12	21.93	1.51	0.31	2.88
50-75	25	21.27	23.02	1.54	0.67	3.55
75-100	25	21.52	22.71	1.53	0.46	4.01
100-150	25	20.13	22.63	1.53	1.78	5.79

$$*d = \frac{(\theta_{mc} - \theta_{mFC}) \times \rho_d \times D}{100}$$

Table 6: Characteristics of water irrigation quality

Date sampling Year	Month	Day	EC (µmohs cm^{-1})	pH	Ca^{2+}+Mg^{2+} (meq L^{-1})	Na^{1+} (meq L^{-1})	SAR
2007	04	08	898	7.40	4.8	4.9	3.16

After that in each zone eight plots with 1*1 m size have created. In four plots before leaching, 0.27 L Sulfuric acid was mixed with soil. The whole water that applied in all plots in each frequency was 100 cm and after, increases 25 cm of water the samples of soil was provide.

In first round, 25 cm or 250 L water increased to each plot and iteration. Then, one plot was selected. After to exit gravity water, from 0-25 cm depth of soil was provided samples and continued experiment on remaining plots. Twenty five centimeter water has increased to remain plots and after to exit gravity water from 25-50 cm of soil depth was sampled. This method was repeated for 75, 100, 125 and 150 cm of soil depth, 75 and 100 cm of water. After collection samples EC_e, pH, CEC, ESP, $CaSO_4$, Anions and Cations have measured in laboratory. Also, after fourth round of leaching from depth 0-5 cm of soil was sampled for measurement equivalently Electrical Conductivity (EC) and Exchange Sodium Percentage.

To obtain mathematical models were used SPSS12.0 software. The ratio net depth of irrigation to soil depth as independent variable (X) and ratio difference between final Electrical Conductivity and equivalent Electrical Conductivity to difference between initial Electrical Conductivity and equivalent Electrical Conductivity as dependent variable (Y) were used as input of SPSS. Then 11 mathematical models were obtained. Similar these methods were done for zone 2 and Exchange Sodium Percentage.

RESULTS AND DISCUSSION

According to Table 4 and 5, 100 cm water that were given to soil as irrigation water and the total definite of moisture from surface to 150 cm depth in zone one and two respectively were 1.46 and 5.79 cm. So, depth of irrigation water that leached soil, respectively is 98.54 and 94.21 cm.

Results showed that in zone one with application acid before leaching maximum of Electrical Conductivity in depth 0-25 cm was 56.84 dS m^{-1} and after leaching has become 18.07 dS m^{-1}. In 150 cm depth of soil with using 100 cm irrigation water average of Electrical Conductivity from 32.63 to 18.99 dS m^{-1} decrease. In addition, results in this zone showed that average of Exchange Sodium Percentage decrease from 14.05 to 10.98.

In zone one without application acid before leaching maximum of Electrical Conductivity in depth 0-25 cm was 56.84 dS m^{-1} that after leaching has become 23.22 dS m^{-1}. Also, in 150 cm depth with using 100 cm irrigation water average of Electrical Conductivity from 32.63 to 26.29 dS m^{-1} decrease. Results showed that average of Exchange Sodium Percentage decrease from 14.05 to 9.89.

In zone two with application acid before leaching maximum of Electrical Conductivity in depth 0-25 cm was 64.44 dS m^{-1} that after leaching has become 14.96 dS m^{-1}. In 150 cm depth with using 100 cm irrigation water average of Electrical Conductivity from 37.07 to 16.89 dS m^{-1} decrease also, Exchange Sodium Percentage decrease from 28.86 to 20.07.

In addition, in zone two without application acid before leaching maximum of Electrical Conductivity in depth 0-25 cm was 64.44 dS m^{-1} that after leaching has become 13.95 dS m^{-1}. In 150 cm depth with using 100 cm irrigation water average of Electrical Conductivity from 37.07 to 16.36 dS m^{-1} decrease also, Exchange Sodium Percentage decrease from 28.86 to 20.02.

Generally, in zone one with application acid Electrical Conductivity 13.64 dS m^{-1} and without acid Electrical Conductivity 6.34 dS m^{-1} decreases. Also, in this area Exchange Sodium Percentage decreases 3.07 and 4.16 under similar situation. In zone two with application acid Electrical Conductivity 20.18 dS m^{-1} and without acid EC 20.71 dS m^{-1} decrease. Also, Exchange Sodium Percentage decreases 8.79 and 8.84 under similar situation.

In study areas (zone one and two) equivalents Electrical Conductivity of soil with application acid 3.85 and 7.61 dS m^{-1} and without application acid 6.13 and 6.34 has obtained. If equivalent Electrical Conductivity in this situation is compared with water Electrical Conductivity (898 micromohs cm^{-1}) would show that the salinity of soil can not decreased more than these amount. Because of equivalent Electrical Conductivity of soil is approximately 1.5-2 multiple of water Electrical Conductivity (Mohsenifar *et al*., 2006).

Table 7: The data of desalinization and desodification on zone No. 1 (With application acid)

Thickness of soil layer (cm)	(X,Y)	Irrigation water depth (cm) 25	50	75	100
0-25	Dl_w/D_s	0.982	1.982	2.982	3.982
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.936	0.262	0.355	0.060
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.009	0.450	0.599	0.187
25-50	Dl_w/D_s	0.482	0.982	1.482	1.982
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.158	0.362	0.385	0.112
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.116	0.622	0.624	0.205
50-75	Dl_w/D_s	0.314	0.648	0.981	1.314
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.271	0.523	0.500	0.184
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.200	0.844	0.840	0.402
75-100	Dl_w/D_s	0.235	0.485	0.735	0.985
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.316	0.681	0.723	0.327
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.240	0.953	0.970	0.582
100-125	Dl_w/D_s	0.188	0.388	0.588	0.788
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.445	0.846	0.983	0.589
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.342	1.168	1.206	0.810
125-150	Dl_w/D_s	0.157	0.324	0.490	0.657
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.332	0.825	0.946	0.676
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.252	1.161	1.200	0.890

Table 8: The data of desalinization and desodification on zone No. 1(Without application acid)

Thickness of soil layer (cm)	(X,Y)	Irrigation water depth (cm) 25	50	75	100
0-25	Dl_w/D_s	0.982	1.982	2.982	3.982
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.819	0.636	0.501	0.146
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.704	0.694	0.694	0.374
25-50	Dl_w/D_s	0.482	0.982	1.482	1.982
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.026	0.849	0.656	0.321
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.777	0.771	0.762	0.436
50-75	Dl_w/D_s	0.314	0.648	0.981	1.314
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.170	1.071	0.874	0.502
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.893	0.914	0.881	0.532
75-100	Dl_w/D_s	0.235	0.485	0.735	0.985
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.226	1.188	0.972	0.706
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.964	1.001	0.951	0.689
100-125	Dl_w/D_s	0.188	0.388	0.588	0.788
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.428	1.414	1.127	0.987
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.132	1.183	1.061	0.893
125-150	Dl_w/D_s	0.157	0.324	0.490	0.657
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	1.307	1.317	1.043	0.941
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.057	1.156	0.984	0.872

The main aim of present study was to obtain desalinization and desodification mathematic models. So, the data of Table 7-10 have used. These equations have represented in Table 11-14. Equations were represented consist of Linear, Logarithmic, Inverse, Quadratic, Cubic, Power, Compound, S, Logistic, Growth, Exponential and for choose the best equation coefficient of determination of each equation also has obtained.

According to Table 11 for Electrical Conductivity Cubic equation with coefficient of determination equivalent 83% has the most correlation and Logistic equation with coefficient of determination equivalent 43.2% has the least correlation. Also, for Exchange Sodium Percentage Cubic equation with coefficient of determination equivalent 85.3% has the most correlation and S equation with coefficient of determination equivalent 42.8% has the least correlation.

In zone one without application acid according to Table 12 for Electrical Conductivity Cubic equation with coefficient of determination equivalent 91.3% has the most correlation and S equation with coefficient of determination equivalent 41.5% has the least correlation. For Exchange Sodium

Table 9: The data of desalinization and desodification on zone No. 2 (With application acid)

Thickness of soil layer (cm)	(X,Y)	Irrigation water depth (cm) 25	50	75	100
0-25	DI_w/D_s	0.897	1.897	2.897	3.897
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.584	0.322	0.229	0.141
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.841	0.729	0.606	0.473
25-50	DI_w/D_s	0.442	0.942	1.442	1.942
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.704	0.526	0.449	0.302
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.886	0.807	0.670	0.521
50-75	DI_w/D_s	0.286	0.619	0.953	1.286
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.736	0.683	0.621	0.407
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.902	0.881	0.766	0.643
75-100	DI_w/D_s	0.210	0.460	0.710	0.960
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.746	0.719	0.724	0.454
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.906	0.925	0.826	0.716
100-125	DI_w/D_s	0.161	0.361	0.561	0.761
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.816	0.845	0.832	0.516
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.930	0.975	0.882	0.779
125-150	DI_w/D_s	0.128	0.295	0.461	0.628
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.756	0.829	0.808	0.498
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.907	0.965	0.889	0.795

Table 10: The data of desalinization and desodification on zone No. 2 (Without application acid)

Thickness of soil layer (cm)	(X,Y)	Irrigation water depth (cm) 25	50	75	100
0-25	DI_w/D_s	0.897	1.897	2.897	3.897
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.534	0.356	0.304	0.142
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.937	0.676	0.577	0.419
25-50	DI_w/D_s	0.442	0.942	1.442	1.942
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.709	0.574	0.480	0.310
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.944	0.699	0.600	0.447
50-75	DI_w/D_s	0.286	0.619	0.953	1.286
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.747	0.714	0.648	0.389
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	0.991	0.816	0.741	0.596
75-100	DI_w/D_s	0.210	0.460	0.710	0.960
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.768	0.740	0.711	0.481
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.003	0.852	0.792	0.643
100-125	DI_w/D_s	0.161	0.361	0.561	0.761
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.836	0.807	0.777	0.554
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.041	0.914	0.856	0.718
125-150	DI_w/D_s	0.128	0.295	0.461	0.628
	$(EC_f-EC_{eq})/(EC_i-EC_{eq})$	0.789	0.763	0.736	0.546
	$(ESP_f-ESP_{eq})/(ESP_i-ESP_{eq})$	1.021	0.903	0.861	0.750

Table 11: Imperial desalinization and desodification models on zone No 1 (With application acid)

Model	Desalinization formula	R^2	Desodification formula	R^2
Linear	$Y=-0.3285X+1.0302$	0.548	$Y=-0.3042X+1.1756$	0.675
Logarithmic	$Y=-0.4410LnX+0.5554$	0.798	$Y=-0.3710LnX+0.7481$	0.812
Inverse	$Y=0.2217/X+0.2800$	0.720	$Y=0.1666/X+0.5540$	0.585
Quadratic	$Y=0.1755X^2-0.9760X+1.3600$	0.758	$Y=0.1232X^2-0.7586X+1.4070$	0.824
Cubic	$Y=-0.1062X^3+0.7893X^2-1.8512X+1.6334$	0.830	$Y=-0.0568X^3+0.4512X^2-1.2264X+1.5531$	0.853
Power	$Y=0.4173X^{-0.8477}$	0.754	$Y=0.6502X^{-0.5496}$	0.711
Compound	$Y=1.1704*0.4726^X$	0.730	$Y=1.2837*0.6080^X$	0.721
S	$Y=e^{(0.3656/X-1.2889)}$	0.502	$Y=e^{(0.2255/X-0.6778)}$	0.428
Logistic	$Y=1/((1/1.446)+0.1398*4.3846^{X)})$	0.432	$Y=1/((1/1.343)+0.0724*3.8627^{X)})$	0.464
Growth	$Y=e^{(-0.7496X+0.1574)}$	0.730	$Y=e^{(-0.4975X+0.2498)}$	0.721
Exponential	$Y=1.1704e^{-0.7496X}$	0.730	$Y=1.2837e^{-0.4975X}$	0.721

Percentage in this zone Cubic equation with coefficient of determination equivalent 73.9% has the most correlation and Logistic equation with coefficient of determination equivalent 31.5% has the least correlation.

Table 12: Imperial desalinization and desodification models on zone No. 1 (Without application acid)

Model	Desalinization formula	R^2	Desodification formula	R^2
Linear	$Y = -0.3257X+1.2536$	0.784	$Y = -0.1840X+1.0340$	0.628
Logarithmic	$Y = -0.3829LnX+0.8007$	0.876	$Y = -0.2149LnX+0.7786$	0.693
Inverse	$Y = 0.1685/X+0.6069$	0.606	$Y = 0.0931/X+0.6726$	0.465
Quadratic	$Y = 0.1014X^2-0.6997X+1.4441$	0.887	$Y = 0.0559X^2-0.3903X+1.1390$	0.706
Cubic	$Y = -0.0529X^3+0.4070X^2-1.1355X+1.5802$	0.913	$Y = -0.0372X^3+0.2708X^2-0.6967X+1.2348$	0.739
Power	$Y = 0.7013X^{-0.5453}$	0.749	$Y = 0.7449X^{-0.2870}$	0.665
Compound	$Y = 1.4267*0.5894X$	0.871	$Y = 1.0636*0.7704^X$	0.680
S	$Y = e^{(0.2147/X-0.5830)}$	0.415	$Y = e(0.1183/X-0.4247)$	0.404
Logistic	$Y = 1/((1/1.429)+0.0621*4.0827^{X)})$	0.470	$Y = 1/((1/1.184)+0.0849*2.6470^{X)})$	0.315
Growth	$Y = e^{(-0.5286X+0.3554)}$	0.871	$Y = e^{(-0.2608X+0.0617)}$	0.680
Exponential	$Y = 1.4267e^{-0.52866X}$	0.871	$Y = 1.0636e^{-0.2608X}$	0.680

Table 13: Imperial desalinization and desodification models on zone No. 2 (With application acid)

Model	Desalinization formula	R^2	Desodification formula	R^2
Linear	$Y = -0.2042X+0.7910$	0.802	$Y = -0.1350X+0.9314$	0.800
Logarithmic	$Y = -0.2119LnX+0.5111$	0.789	$Y = -0.1392LnX+0.7466$	0.778
Inverse	$Y = 0.0717/X+0.4437$	0.427	$Y = 0.0468/X+0.7031$	0.415
Quadratic	$Y = 0.0542X^2-0.3984X+0.8852$	0.876	$Y = 0.0327X^2-0.2521X+0.9881$	0.826
Cubic	$Y = -0.0021X^3+0.0659X^2-0.4145X+0.8900$	0.876	$Y = -0.0087X^3+0.0814X^2-0.3190X+1.0078$	0.866
Power	$Y = 0.4572X^{-0.4594}$	0.758	$Y = 0.7315X-0.1906$	0.748
Compound	$Y = 0.8754*0.6145^X$	0.931	$Y = 0.9485*0.8254^X$	0.829
S	$Y = e^{(0.1444/X-0.9053)}$	0.353	$Y = e^{(0.0622/X-0.3682)}$	0.376
Logistic	$Y = 1/((1/0.846)+0.0718*4.3179^{X)})$	0.503	$Y = 1/((1/0.976)+0.0519*2.8454^{X)})$	0.419
Growth	$Y = e^{(-0.4869X-0.1331)}$	0.931	$Y = e^{(-0.1919X-0.0529)}$	0.829
Exponential	$Y = 0.8754e^{-0.4869X}$	0.931	$Y = 2.8454e^{-0.0519X}$	0.829

Table 14: Imperial desalinization and desodification models on zone No. 1 (Without application acid)

Model	Desalinization formula	R^2	Desodification formula	R^2
Linear	$Y = -0.7872X+0.1931$	0.838	$Y = -0.1634X+0.9411$	0.708
Logarithmic	$Y = -0.2020LnX+0.5219$	0.838	$Y = -0.1868LnX+0.7104$	0.847
Inverse	$Y = 0.0707/X+0.4529$	0.485	$Y = 0.0728/X+0.6310$	0.608
Quadratic	$Y = 0.0481X^2-0.3655X+0.8709$	0.906	$Y = 0.0600X^2-0.3781X+1.0453$	0.833
Cubic	$Y = -0.0123X^3+0.1174X^2-0.4606X+0.8989$	0.910	$Y = -0.0327X^3+0.2437X^2-0.6306X+1.1196$	0.867
Power	$Y = 0.4746X^{-0.4253}$	0.758	$Y = 0.6892X^{-0.2576}$	0.812
Compound	$Y = 0.8653*0.6377^X$	0.928	$Y = 0.9596*0.7877^X$	0.762
S	$Y = e^{(0.1366/X-0.8649)}$	0.369	$Y = e^{(0.0951/X-0.4705)}$	0.522
Logistic	$Y = 1/((1/0.837)+0.0790*4.0405^{X)})$	0.567	$Y = 1/((1/1.042)+0.0715*2.9875^{X)})$	0.398
Growth	$Y = e^{(-0.4498X-0.1447)}$	0.928	$Y = e^{(-0.2386X-0.0412)}$	0.762
Exponential	$Y = 0.8653e^{-0.4498X}$	0.928	$Y = 0.9596e^{-0.2386X}$	0.762

Also, for Electrical Conductivity in zone two against of zone one Component, Growth and Exponential equation with coefficient of determination equivalent 91.3% has the most correlation and S equation with coefficient of determination equivalent 35.3% has the least correlation. The results of Exchange Sodium Percentage were similar to zone one. Cubic equation with coefficient of determination equivalent 86.6% has the most correlation and S equation with coefficient of determination equivalent 37.6% has the least correlation (Table 13).

Finally, according to Table 14 the results of Electrical Conductivity in zone two without application acid were similar to this zone with application acid. Component, Growth and Exponential equation with coefficient of determination equivalent 92.8% has the most correlation and S equation with coefficient of determination equivalent 36.9% has the least correlation. Also, for Exchange Sodium Percentage Cubic equation with coefficient of determination equivalent 86.7% has the most correlation and Logistic equation with coefficient of determination equivalent 39.8% has the least correlation.

CONCLUSION

For leaching salt of soil is necessary to add water on soil dependent on situation with or without emendator material. If amount of addition water is low, it will not solve salt. Also, if apply water more than requirement cost will increase. In this investigation results show that in zone one application emendator material (sulfuric acid) causes more decrease on Electrical Conductivity but in zone two are showed that with and without application acid approximately similar results.

In zone one leach of salt with application acid is more effective than when has used water without acid. Because of water table in zone one is low level and soil texture is lighter than zone two. Therefore, Exited salt from soil profile is easily. In addition, hydraulic conductivity is low in this zone. Therefore, emendator material has enough time to combination with the cations (especially Calcium and Magnesium) of soil. In the sequel, exited salt of soil is increased. In this area, concentrations of Sulfate and Sodium in saturation emulsion of soil after leaching (with acid) have increased. Increasing of these ions cause Sodium replacement to Calcium and decrease Exchange Sodium Percentage.

In zone two because of soil has heavy texture and infiltration is low water have enough time to leach soil. So, application of emendator material is not necessary. This case causes decreasing Electrical Conductivity and Exchange Sodium Percentage with and without acid become similar.

Results of correlation mathematic models represent that in zone one with and without acid Cubic equation have the most and S and Logistic equation have the least coefficient of determination. In zone two with and without acid Component, Growth and Exponential equation have the most and S and Logistic equation have the least coefficient of determination for Electrical Conductivity. For Exchange Sodium Percentage in zone two results similar to zone one.

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