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Estimation of Cationic Content of Surrounding Groundwater in Al-Bassa Waste Dump – Lattakia – Syria

Hajar Nasser*, Saleem Mohammad Ahmad

Department of Chemistry, Faculty of Science, Tishreen University, Lattakia, Syria
*Corresponding author email:mostafaisbera@gmail.com

Abstract The study included conducting periodic laboratory analyzes of the groundwater around the waste dump located in al-Bassa area in Lattakia, Syria, by choosing 10 wells surrounding the landfill area (B1→B5) located in the current landfill area (B6→B10) located in the old landfill area, which were sampled over a year**.** The study included measurement of the concentrations of the following cations: (K^+, Na^+, Ca^{2+}, Mg^{2+}). In this study, the IC device was used.

The results showed that the values of all cations in the wells surrounding the current site were higher than those in the wells surrounding the old site. This indicates the large pollution in the present landfill resulting from the leachate resulting from the solid wastes in the landfill which leaks to the groundwater sources. The highest values for magnesium, calcium, sodium and potassium cations in the winter were estimated respectively: 68.91 (mg/l) for well (B5), 111.96 (mg/l) for well (B1), 88.91 (mg/l) for well (B2) 15.52 (mg/l) of well (B1). The sodium values of the well water studied were within the permissible limits according to the Syrian standard of drinking water.

Keywords groundwater, Al-Bassa, leachate, dumps of solid wate, Magnesium, Calcium, Sodium, Potassium

Introduction

Water is considered one of the most important wealth and natural resources which must be developed, saved, and used by high efficient. It isn't only used for drink and agriculture; also it is used for industry and different uses, which is reflected positively on society [1].

Groundwater is fed by irrigation systems in agricultural lands, natural rain showers, and industrial surface water for example rivers, fountains [2]. Ground water contains dissolved materials , during the passage of water in several layers of ground it dissolves materials which are different according to the type of rocks that form the layers of ground ,define the concentration and type of those dissolved materials and the validity of water for drinking and other uses. Groundwater in Limestone in the areas of distribution tends to be very hard with high concentration of Calcium and Magnesium cations. Groundwater in Granite and Basalt rocks has high concentration of Sodium, Potassium and Fluorine generally. When water passes through saline layers groundwater becomes salty [3].

World Health Organization (WHO) defined water pollution as any change in the element involved in its composition directly or indirectly, which makes water less suitable for intended uses [4].

Groundwater sources are exposed to different types of pollutants, mainly waste water, water of industrial processes, pesticides and chemical fertilizers, waste and solid waste remains of olive presses.

The major danger of accumulated waste in waste dump is the leachate which is defined as the leaked liquid of solid waste, and it caused by the decomposition of these waste and humidity that already exists, rain showers water, as well as external water that leaks in some way into landfills.

Chemical elements vary and their concentration varies in leachate within a wide range. Waste composition, landfill age and climate are the basic factors that cause that [5].

The composition of many of rocks and soils have Sodium compounds , these compounds dissolve easily in winter, whereas all kinds of surface and ground water have Sodium which is a basic element for human, animal and plant health [6].

Sodium keeps the normal liquids system equal in the human body, in addition human body needs Sodium to complete the functions of muscles and nerves , but Sodium overdose affects kidneys , increases blood pressure and heart issues [7,8].

Calcium is one of the most important elements that exist in body, blood and tissues. It has an important role in biological processes for example: (muscles constriction, nerve impulses, efficacy of heart function, blood clotting process. Calcium exists in bones which are considered as stores of Calcium when body needs it. The rest of it cycles inside body freely to enter the different processes [9].

Magnesium is defined as one of the most important element, because of its importance for human body and other beings. It was found that there is a relation between vascular diseases and the amount of Magnesium in water [10].

Potassium ranked seventh due to its existence, so that the concentration of Potassium in groundwater is groundwater is less than concentration of Sodium because it dissolves less in water and it exists in sedimentary and igneous rocks. Potassium has an important role in endocrine functions and the composition of Fibrinogen which is responsible for blood clotting, also the increase of the concentration of Potassium leads to increase the liquidity of blood [11].

The importance of this research is that it's an application to the sustainable development program of water resources to conduct periodic monitoring and evaluate the quality of the groundwater that surrounds the waste dump especially it irrigates most of the agricultural areas there, as well as drinking water and other uses.

The aim of this research is to Study changes in the concentration of some cations that exist in groundwater in these selected areas over a year. For example (K^+, Na^+, Ca^{2+}, Mg^{2+}).

The Area of Study

Al bassa Waste Dump

Figure 1: A space photograph of Al-bassa waste dump

Al bassa waste dump is located 30 km southeast of Lattakia along the Mediterranean sea with a length of 5 km between Al-Kabeer AL-Shemali and Al- Sanobar rivers. It occupies an area of 110 hectares on the seafront directly in a location with disabled tourist benefits. The waste of both Lattakia and its three cities includes Jableh, Hafeh and Qardaha. This waste dump is the main one in Lattakia city. This waste dump has been used since 1970, where the waste was being dumped without covering it with soil, and without any organized work by the municipality of the area, and that increases the pollution issue in waste dump area [12].

Stages of the Work on Al bassa Waste Dump

Working at Al bassa waste dump has begun since 2003, before that it was a random dump where waste is dumped as agreed, then work has been done to activate the waste dump and this is done in two stages: It became two parts and the distance between them 1 km.

First Stage: (the old waste dump):

It was under the supervision of the city council (2003-2006) with an area of 18 hectares and then moved to the directorate of technical services that rehabilitated this part, finished the final layer , after that closed this waste dump. Wells (B6→B10) exist in this part of the waste dump.

Second Stage: (the present waste dump)

It is under the supervision of the directorate of technical services in Lattakia_ stretched out between (2006_2009)_ with an area of 24 hectares according to the study of Japanese agency for international cooperation (JICA). However, the lack of receipt of the new site _in Qasia_ and the lack of alternative one after closing the place, which made the stage open to this day. Wells (B1→B5) exist in this part of the waste dump.

Devices and materials used

Ion chromatograph device for measuring the concentration of Magnesium, Potassium, Calcium and Sodium cations. Glass wares. Standard solution. Dual distillation water.

Sampling

Water samples were collected from groundwater wells located in the old landfill areas wells (B6→B10) and current landfill wells(B1→B5) once a month from June 2017 to May 2018. The samples were collected in high density polypropylene containers with a capacity of 1 liter after washing the container with the sample water several times then closed tightly with a sticky tape written on it (sample number , well number , waste dump area , Date of sampling), then The samples were transferred to the laboratory for analysis.

Results and Discussion

1) Magnesium cation Mg^{2+}

Table (1) shows the results of the measurement of magnesium cation in water samples from wells. The results in the table are also shown in Figs (2) (3):

Table 1: Mean change of Magnesium values (mg/l) for well water studied.

Well number										The Month	
10	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
46.67	47.37	45.26	42.70	44.40	50.59	47.11	49.58	49.49	48.85	**June**	**2017**
43.30	44.16	42.53	41.71	42.16	49.83	46.06	47.91	47.65	46.44	**July**	
43.66	45.47	44.98	45.02	43.82	44.15	49.66	46.53	47.54	48.51	**August**	
48.50	49.11	48.59	48.22	49.12	51.11	50.70	51.73	49.85	51.15	**September**	
49.38	49.66	48.98	49.72	48.90	54.06	50.51	50.70	51.69	52.40	**October**	
48.45	51.22	49.28	50.11	48.89	54.48	52.02	50.13	52.15	52.53	**November**	
57.62	54.19	59.35	58.21	57.42	59.65	60.58	60.51	63.63	64.91	**December**	
58.18	53.13	58.17	55.80	55.36	63.42	64.51	58.04	61.35	61.76	**January**	**2018**
53.21	57.18	62.02	55.05	58.11	68.91	63.53	61.70	60.40	65.63	**February**	
49.05	50.13	49.72	49.44	51.31	56.96	50.51	55.17	59.93	58.25	**March**	
42.55	45.80	48.35	42.11	50.19	59.28	58.62	53.68	57.11	56.47	**April**	
49.21	49.82	47.16	50.69	52.66	54.02	49.26	50.71	51.90	52.62	**May**	
49.148	49.77	50.366	49.065	50.195	55.538	53.589	53.033	54.391	54.96	$\bar{X}$	

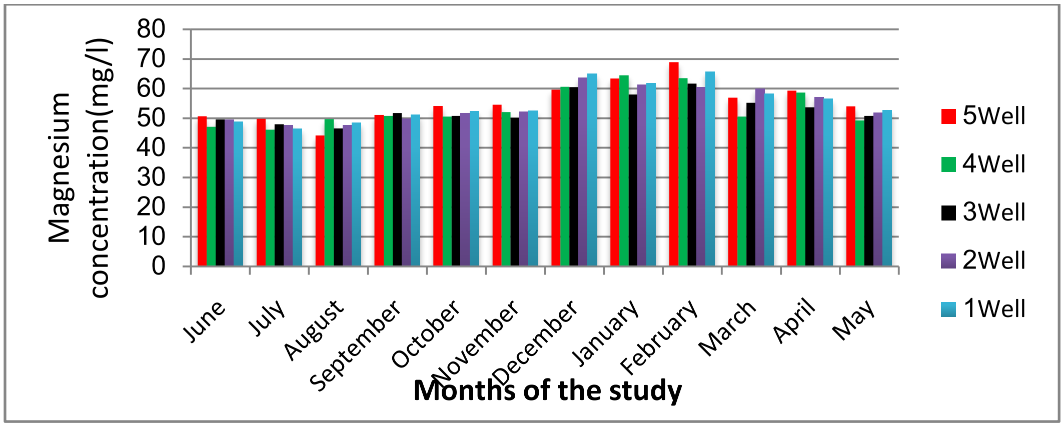

Figure 2: Change in the values of magnesium in well water studied around the present landfill during the months of the study

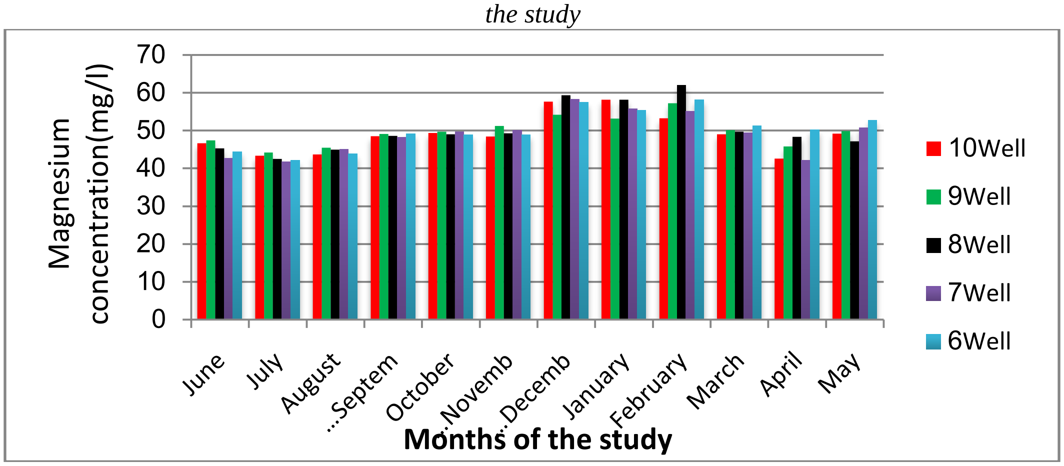

Figure 3: Changes in the values of magnesium in well water studied around the old landfill during the months of the study

2) Cation Calcium Ca^{2+}

Table (2) shows the results of calcium cation in water samples from wells, and the results are shown in the table in Figs. (4) (5):

Table 2: Mean change in the values of the calcium (mg/l) for the well water studied

Well number										The Month	
10	9	8	7	6	5	4	3	2	1		
55.77	52.30	53.58	51.65	49.20	66.90	63.88	67.58	62.91	66.16	**June**	**2017**
56.96	56.38	58.85	54.44	49.11	70.63	60.09	67.91	68.44	67.17	**July**	
53.51	54.52	52.41	50.05	52.91	69.71	60.49	65.10	67.03	65.36	**August**	
80.12	82.52	81.27	80.16	80.50	91.31	90.62	88.31	92.04	86.31	**September**	
81.31	83.53	82.72	79.51	81.88	92.95	89.94	88.08	89.66	84.35	**October**	
84.84	87.46	84.14	84.34	83.79	92.78	90.78	93.13	95.11	92.21	**November**	
99.12	98.60	100.13	100.48	102.54	106.98	109.11	109.22	103.12	107.31	**December**	
98.30	96.66	99.10	97.14	100.62	105.13	107.57	109.13	110.10	111.96	**January**	**2018**
96.05	99.55	97.13	98.81	100.25	109.50	106.11	107.48	108.8	106.21	**February**	
71.96	79.67	77.19	74.85	76.28	91.06	89.26	90.30	81.76	79.67	**March**	
73.66	73.66	79.63	71.96	80.91	88.08	87.19	87.19	82.15	83.14	**April**	
76.47	71.19	76.66	75.76	75.71	82.63	85.60	88.23	82.16	80.13	**May**	
77.339	78.003	78.568	76.596	77.808	88.972	86.72	88.472	86.94	85.832	$\bar{X}$	

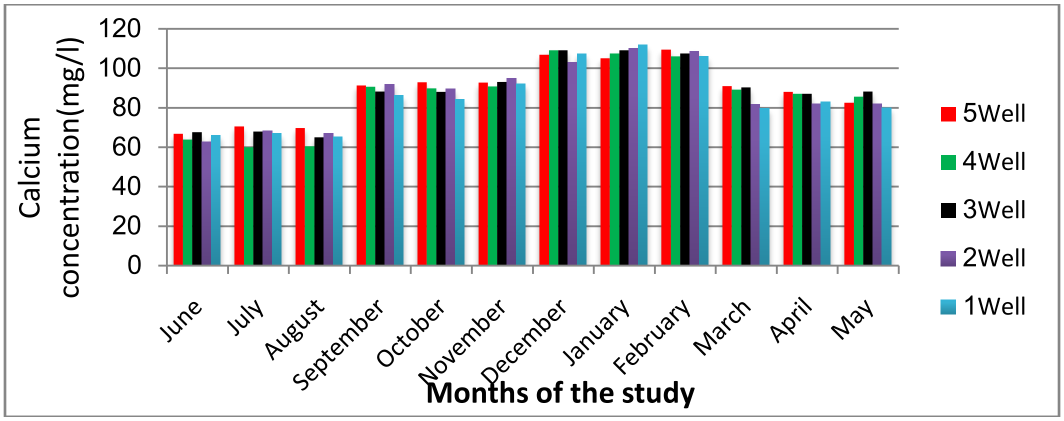

Figure 4: Change the values of calcium in well water studied around the present landfill during the months of the study

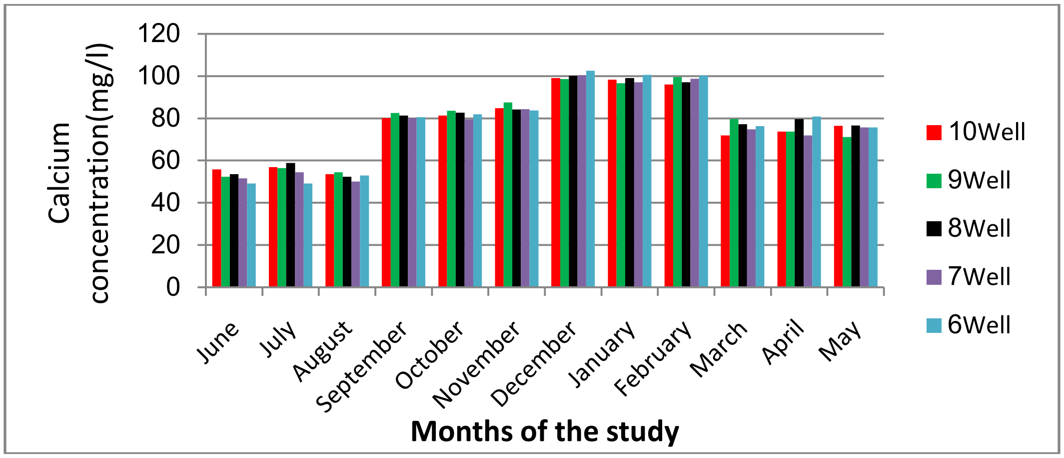

Figure 5: Change the values of calcium in well water studied around the old landfill during the months of the study

3) Sodium cation Na^+

Table (3) shows the results of sodium cation in the water samples from the wells. The results are also shown in the table in Figs (6) (7).

Table 3: Mean change in the values of sodium (mg/l) for well water studied

Well number										The Month	
10	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
39.22	37.10	41.16	37.91	40.32	48.60	41.12	40.42	49.83	46.12	**June**	**2017**
41.12	35.18	33.96	41.46	40.30	40.24	42.11	48.82	51.18	50.89	**July**	
37.62	39.16	40.61	39.65	36.13	47.44	49.21	51.73	46.19	44.23	**August**	
48.31	51.14	51.16	52.31	52.79	55.63	57.75	59.01	56.15	54.95	**September**	
53.02	49.91	52.13	54.06	51.55	52.67	57.88	56.93	58.23	56.51	**October**	
54.98	50.79	53.15	51.74	53.58	54.73	59.32	55.36	56.01	52.84	**November**	
57.21	53.21	56.47	57.77	61.39	75.11	69.13	78.01	73.12	71.31	**December**	
51.01	48.41	59.91	62.12	53.87	73.17	70.71	78.19	88.91	83.04	**January**	**2018**
57.42	62.14	65.99	59.19	43.12	74.61	81.36	71.02	76.07	70.63	**February**	
49.62	50.41	51.11	55.91	56.21	61.16	60.81	63.16	57.91	58.06	**March**	
51.19	50.63	49.19	50.96	51.21	61.50	55.02	55.47	60.42	59.83	**April**	
45.95	47.73	49.84	50.35	47.08	55.74	58.22	58.15	56.65	55.03	**May**	
48.889	47.984	50.39	51.119	48.963	58.383	58.553	59.689	60.889	58.62	$\bar{X}$	

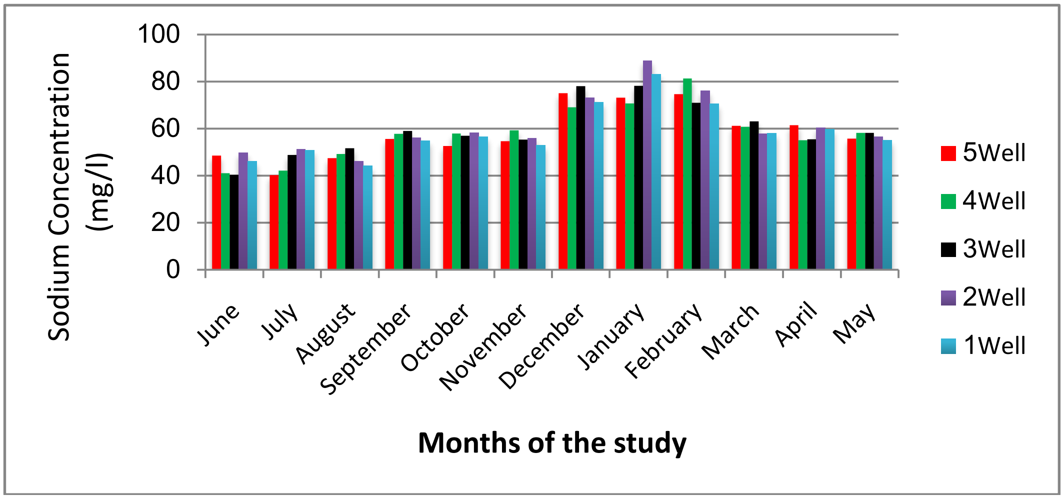

Figure 6: Change the values of sodium in well water studied around the present landfill during the months of the study

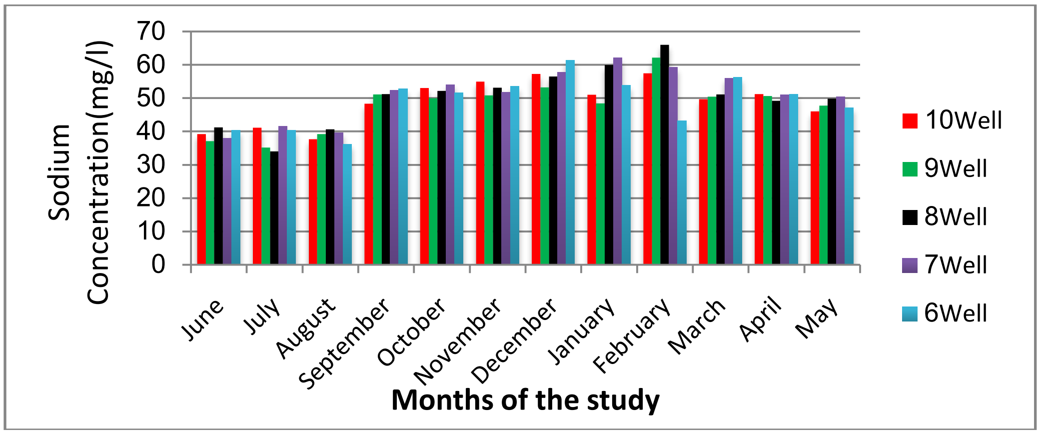

Figure 7: Change in the values of sodium in well water studied in the old landfill during the months of the study

4) Potassium cation K^+

Table (4) shows the results of the measurement of potassium cation in the water samples from the wells. The results are also shown in the table in Figs (8) (9):

Table 4: Mean change in the values of potassium (mg/l) for well water studied

Well number										The Month	
10	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
4.33	5.94	4.73	4.52	5.38	6.88	7.17	7.38	6.63	6.78	**June**	**2017**
4.12	4.51	5.21	5.38	4.12	5.98	7.47	6.55	6.12	7.15	**July**	
5.63	4.47	5.49	4.43	4.47	7.13	5.51	6.05	5.52	7.55	**August**	
7.68	6.89	8.83	8.64	7.69	9.47	9.22	9.35	10.24	9.56	**September**	
8.09	8.16	7.04	8.56	8.02	9.44	9.59	10.76	9.43	9.12	**October**	
7.58	9.65	9.27	9.98	8.99	10.25	11.05	10.78	9.78	10.09	**November**	
9.82	10.42	13.19	11.86	10.63	14.22	15.06	13.76	9.98	11.12	**December**	
10.12	8.14	9.91	10.56	7.35	9.64	10.98	11.13	14.11	13.96	**January**	**2018**
8.22	7.14	11.75	8.69	9.42	11.06	15.21	13.13	12.51	15.52	**February**	
7.96	9.11	8.17	7.04	6.15	9.05	12.11	8.41	9.65	11.15	**March**	
8.02	8.75	7.34	8.87	8.86	10.13	9.01	11.53	12.50	10.50	**April**	
9.14	7.13	8.28	8.01	7.56	11.14	10.08	11.36	9.15	9.24	**May**	
7.5592	7.5258	8.2675	8.045	7.3867	9.5325	10.205	10.016	9.635	10.145	$\bar{X}$	

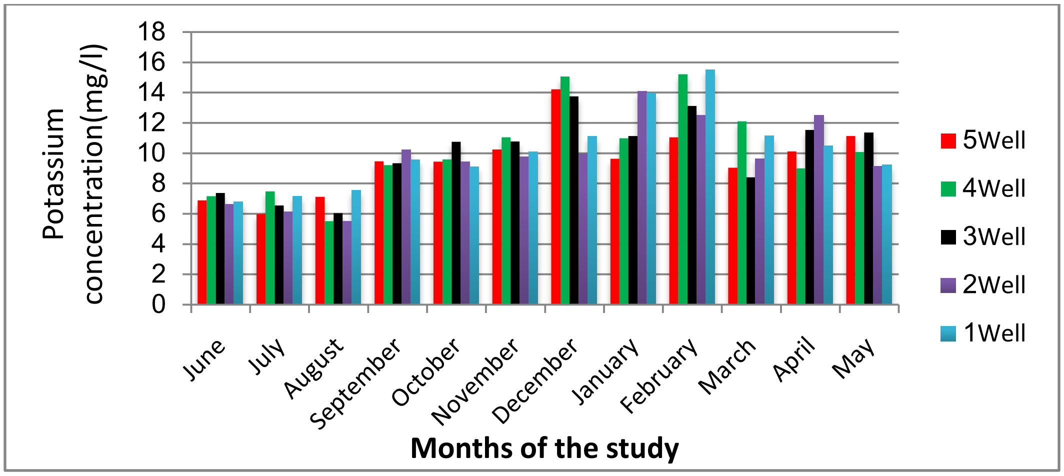

Figure 8: Change in the values of potassium in well water studied around the present landfill during the months of the study

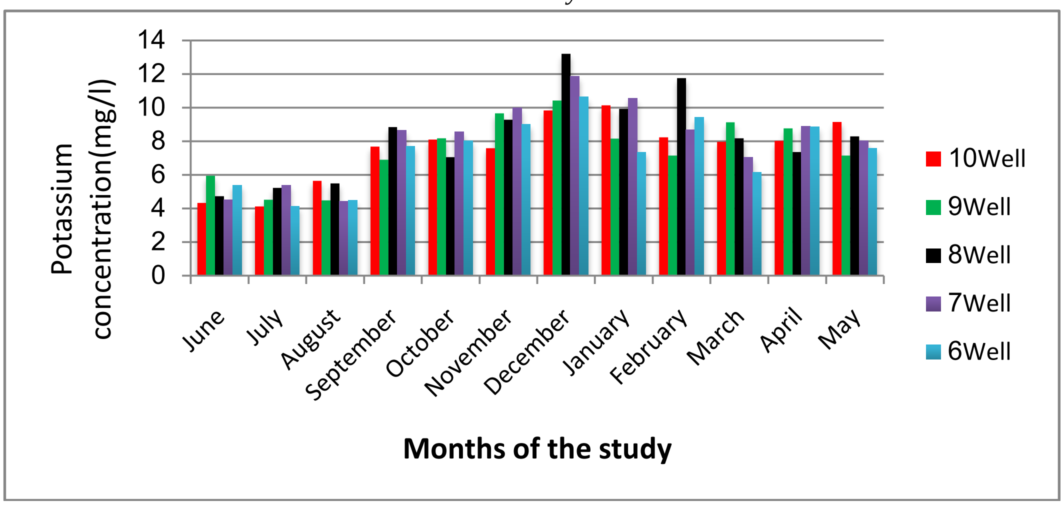

Figure 9: Change in the values of potassium in the water of the studied wells around the old landfill during the months of the study

We can notice from the presented results in tables (1-2-3-4) and shapes (2-3-4-5-6-7-8-9):

- Average monthly values of the concentration of Magnesium (49.065_55.538), Calcium (76.596_88.972), Sodium (47.984_60.889), Potassium (7.386_10.205).
- The highest value of all cations were in winter while the lowest ones were in summer and that's due to the heavy rain showers that carry the leachate that comes from waste dump , in addition rain showers wash salts of cations that exist in soil to wells.
- The highest values of cation concentrations were in the well water surrounding the current dump in comparison with the values of wells surrounding the old one, This serious pollution returns to the leachate that caused by solid wate of waste dump which arrives to groundwater sources.
- Sodium values of the water of wells didn't exceed the limits allowed within the Syrian standards of drinking water [13].

Conclusions

- Sodium values of the water of all wells are verified by the Syrian specifications in terms of their validity of drinking water, where the permissible limits according to the Syrian standards are 200mg/l.
- the concentration values of all measured cations of wells surrounding the current waste dump higher than their values of the wells surrounding the old waste dump because of the serious pollution in the waste dump

area which returns to the leachate of solid waste that arrives to groundwater in addition to rain showers that wash the effects of cations from soil and move them to groundwater sources.

- The highest values of all cations were in winter, whereas the lowest ones were in summer.

Recommendations:

- Directing agricultural land owners to moderate the use of pesticides and fertilizers.
- Establish a monitoring system for groundwater quality in the region through conducting periodic analyzes of the water of wells.
- Work on closing the waste dump and rehabilitate the area environmentally.

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