South Ahmadi Land Fill Monitoring Cleaning and Management

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Abstract: *South Al Ahmadi land fill (previously called Kabad land fill) located 35 km west of Kuwait City, is one of the largest land fill occupying an area of 4,214,609 mq2 and with waste as high as 40 m. The environmental impact of the landfill on the surrounding soil and ground water was evaluated in 2016. Ground water and soil analysis proved heavy contamination. A recent monitoring study was conducted in the landfill area using a similar procedure with the amount of ground water samples and soil samples in the surface and subsurface. These samples were under-went physical and chemical analyses resulted in the large pollution of these elements. Rapid population growth and lifestyle changes have increased the generation of waste. This study emphasises on the importance of solid waste management in south Al-Ahmadi land fill. The municipal or residential wastes generated in city areas are mostly solid. Safe and cost effective-waste management disposal is a significant challenge for modern society of Kuwait. Increase waste generation adversely impacts the environmental, financial, and social situations. Most of the waste in such landfill is dumped in an uncontrolled manner. Landfills occupy extensive land area. In small countries such as Kuwait, the scarcity of land is a challenge. This is the main objective for this study. To overcome the problem, a method must be implemented to minimize and properly segregate solid waste in Kuwait. A successful integrated solid waste management plan will result in safer and cleaner environment for future generations.*

Keywords: environment, Kuwait, management, segregation, solid, waste

1. Introduction

Waste generation is increasing dramatically in Kuwait most of the waste is dumped in sanitary landfills [1].

Figure 1(A)

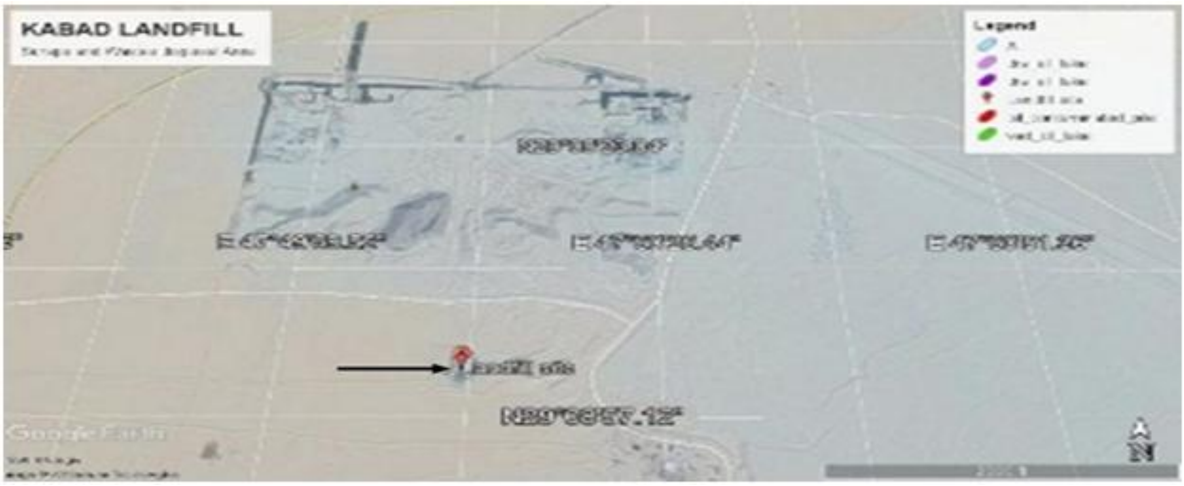

Figure 1(B): Location map of the south Al Ahmadi landfill

Some of these landfills were closed and few are still operated among these is south Al-Ahmadi landfill (Figure1, a, b)This landfill started operating in 1999 closed in 2001 and then reopened at 2011 for different solid household

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waste (Kuwait municipal official site). Land waste disposal is a common challenge in most developing countries. While several solutions have been pilot-tested, these operate mostly in isolated stages, which decrease their effectiveness. Effective and sustainable waste management requires seamless transition and handoffs across all stages—from generation and collection to , treatment, and reuse [2], integrated waste management enterprises address the challenges posed by waste left unattended by public authorities, which may result in several environmental, and health issues. Specific sections of society face serious health risks including waste workers and people residing near dump yards. Poor health directly effects their livelihood and productivity. One of the major factors to deals with waste management is addressing the informal activities that occur in the collection, segregation and disposal by various stakeholders (i.e. waste pickers and middlemen). These activities perpetuate the lack of awareness related to safe waste management practices in most developing countries. Unregulated and illegal dumpsites serve about 4 billion people and hold over 40- % of the world's waste [2] Inefficiencies creep in when different players manage different components of the waste value chain. Poor transition and handoffs happen at each stage because of the limited interaction and engagement between stakeholders. Waste generators dump unsegregated waste at street corners or open dumps which public waste management authorities are then expected to take over. In the absence of an adequate public waste management infrastructure, the waste remains in these areas before it is collected by informal waste pickers, who do preliminary sorting, and take only what they find of value. The waste pickers sell the saleable items to informal recyclers and dump the rest in the landfills without appropriate treatment. Integrated waste management will solve this issue with a continuous formalized process flow, free of inefficiencies [1]

2. Materials and Methods

The materials and analysis method used in this monitoring process are the same as those used the primary study [3] A total of 60 soil surface and subsurface (at depth of 40cm) samples were collected from south Al Ahmadi land fill area. 5 ground water samples were collected from water wells around the land fill site (Figure 2.A,B). Waste types, depth, and compaction were considered to explain the result and recommended cleanup remedy.

The soil samples analyzed geochemically in Kuwait institute for scientific research (KISR). For the heavy metals (lead, nickel, aluminum, cadmium, organic concentration)Using absorption method for this compound. Ground water samples analyzed geochemically by extraction of the total dissolved solids (chloride sulfate, nitrite calcium, magnesium, sodium, potassium and heavy meatless).

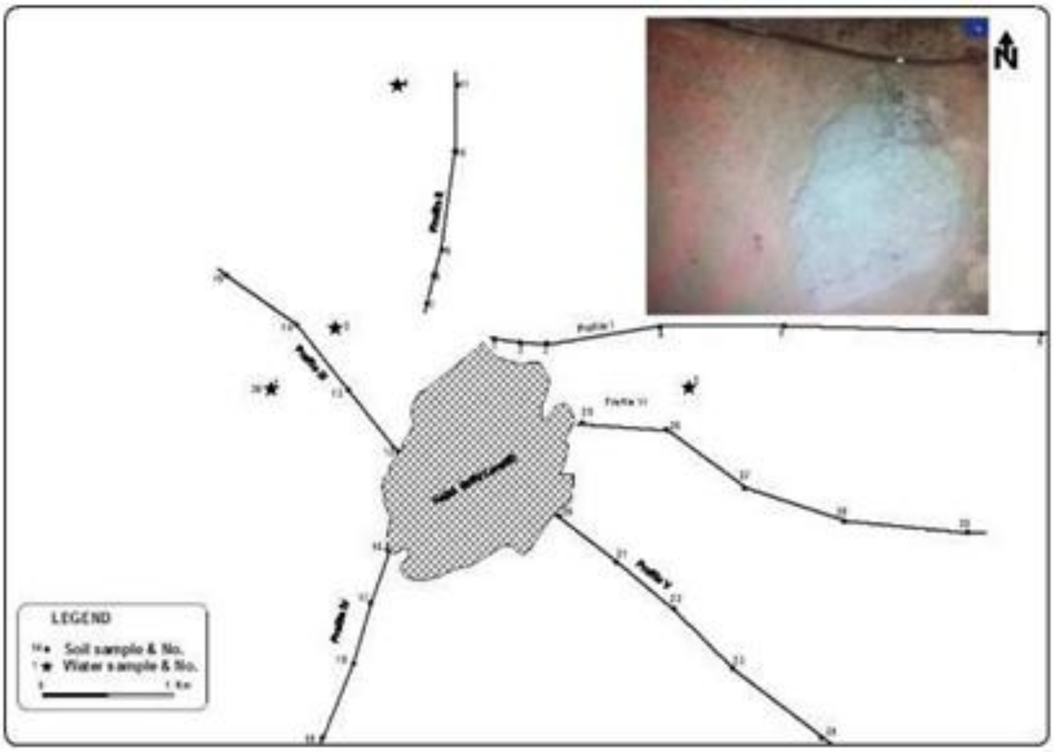

Figure 2 (A): Sampling location of ground water and soil in south Al Ahmadi area

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Figure 2 (B): Sampling location of ground water and soil in south Al Ahmadi area

3. Results and Discussion

1-Ground water: the ground water analyses for solids are presented in (Table 2).The table shows that the concentration of the total dissolved solids (TDS) is very high for the parameter of chloride and sodium. The lowest concentration was given by Potassium, and the highest was given by chloride. If these data are compared with a study made for south Al Ahmadi landfill (Tabl,1) [3].

Table 1: Chemical analyses of groundwater samples (mg/L) from and around the study area

Test	Test Method		1	2	3	4	5	WHO standards		
Parameter										for groundwater
TDS				9820	10420	9930	12530	12740		500 mg/L or less
Chloride	BS1377 1990	Part3	3191.40	3468	4139	4012	4246	250 mg/L or less		
Sulfate	BS1377 1990	Part3	2332.00	2478	2520	2645	2670	400 less	mg/L or	
Nitrate	BS1377 1990	Part3	43	43	44	42	42	50 less	mg/L or	
Calcium	ASTM		D 511	828.40	831.20	833.30	845.20	849.30		75 mg/L or less
Magnesium	ASTM		D 511	303.42	309.22	311.02	324.22	330.02		100 mg/L or less
Sodium	Flame Photometric		4100.00	4280.50	4290.20	4320.50	4327.20	35 less	mg/L or	
Potassium	Flame Photometric		32.00	33.00	33.70	34.40	36.50	2 less	mg/L or	
Iron	ASTM		D 1068	<0.10	<0.10	<0.10	<0.10	<0.10		0.3 mg/L
Cadmium	APHA3120		0.007	0.006	0.006	0.005	0.005	0.003 mg/L or less		
Chromium	APHA3120		0.539	0.538	0.536	0.534	0.530	0.05 mg/L or less		
Vanadium	APHA3120		0.36	0.41	0.40	0.36	0.33	40 less	mg/L or	
Copper	Nano Photometric		0.17	0.17	0.16	0.13	0.11	7 less	mg/L or	
Nickel	Nano Photometric		0.52	0.52	0.51	0.49	0.48	1.3		mg/L or less
Zinc	Nano Photometric		0.64	0.68	0.63	0.60	0.59	20		mg/L or less
Aluminum	APHA3120		0.28	0.27	0.25	0.23	0.20	5 less	mg/L or	
Lithium	APHA3120		0.24	0.24	0.23	0.21	0.19	50 less	mg/L or	
Boron	APHA3120		0.02	0.02	0.02	0.01	0.01	1 mg/L or less		
Fluoride	APHA3120		1.1	1.05	1.09	0.95	0.90	0.8 less	mg/L or	

Table 2 clearly shows an increase in the total dissolved solids of all elements measured. In the previous study the average was 12,171.22 mg/l Potassium have 32mg/l (the minimum concentration) and 4245mg/l for chloride(the maximum concentration). This means 100% between both studies done for the land fill.

Table 2: Total Dissolved Solids of Ground Water Samples (Mg/L) from and around the Study Area.(Brofile 1)

Test	1	2	3	4	5	WHO standards
Parameter						for groundwater
TDS	10,830.22	11,442.92	12.171.22	12,223.32	12,501	500 mg/L or less
Chloride	3191.4	3468	4139	4012	4246	250 mg/L or less
Sulfate	2332	2478	2520	2645	2670	400 mg/L or less
Nitrate	43	43	44	46	52	50 mg/L or less
Calcium	828.4	831.2	833.3	845.2	849.3	75 mg/L or less
Magnesium	303.42	309.22	311.02	324.22	330.02	100 mg/L or less

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Sodium	4100	4280.5	4290.2	4320.5	4327.2	35 mg/L or less
Potassium	32	33	33.7	34.4	36.5	2 mg/L or less

The explanation for this would be the lack of water recharge from the surface (rainwater), given that such recharge can lower the salinity of the ground water. All readings of the total dissolved solids exceeded the limits (table,2) by the world health organization for water quality (salts limits in water).The nitrate concentration increased from 43mg/L to 52 mg/L(82%).As for heavy metals, cadmium(Cd), chromium(Cr), vanadium(V) and fluoride(F) concentration had the same path as the total dissolve solids zinc (Zn) had the highest reading (in the new study, table 3) 0.74mg/l compared with 0.69 mg/L from the previous study[3]. Cadmium was the lowest with 0.015mg/L as an average in the new monitoring compared with 0.007mg/l from the old one. Nickel (Ni), aluminum(Al),boron (B) lithium(Li), and Iron (Fe) show slight variations in reference to the preliminary study [3], table (3,4).

Table 3: Chemical Composition of Heavy Metals in Ground Water Samples after Monitoring (Mg/L) from and around the Study Area. (Brofile 2,3)

Iron	<0.60	<0.60	<0.60	<0.60	<0.60	0.3 mg/L			
Cadmium	0.017	0.016	0.016	0.015	0.015	0.003 mg/L less	or		
Chromium	0.639	0.638	0.636	0.634	0.63	0.05 mg/L less	or		
Vanadium	0.56	0.61	0.6	0.56	0.53	40 mg/L or less			
Copper	0.27	0.27	0.26	0.23	0.21	7 mg/L or less			
Nickel	0.57	0.67	0.66	0.64	0.63	1.3		mg/L less	or
Zinc	0.74	0.78	0.73	0.7	0.69	20		mg/L less	or
Aluminum	0.38	0.37	0.35	0.33	0.3	5 mg/L or less			
Lithium	0.44	0.44	0.43	0.41	0.39	50 mg/L or less			
Boron	0.22	0.22	0.22	0.21	0.21	1 mg/L or less			
Fluoride	1.3	1.25	1.29	1.15	1.1	0.8 mg/L or less			

Table 4: Chemical Composition of Heavy Metals in Ground Water Samples (Mg/L) from and Around the Study Area. (Brpfile 4,5)

Iron	<0.10	<0.10	<0.10	<0.10	<0.10	0.3 mg/L			
Cadmium	0.007	0.006	0.006	0.005	0.005	0.003 mg/L less	or		
Chromium	0.539	0.538	0.536	0.534	0.53	0.05 mg/L less	or		
Vanadium	0.36	0.41	0.4	0.36	0.33	40 mg/L or less			
Copper	0.17	0.17	0.16	0.13	0.11	7 mg/L or less			
Nickel	0.52	0.52	0.51	0.49	0.48	1.3		mg/L less	or
Zinc	0.64	0.68	0.63	0.6	0.59	20		mg/L less	or
Aluminum	0.28	0.27	0.25	0.23	0.2	5 mg/L or less			
Lithium	0.24	0.24	0.23	0.21	0.19	50 mg/L or less			
Boron	0.02	0.02	0.02	0.01	0.01	1 mg/L or less			
Fluoride	1.1	1.05	1.09	0.95	0.9	0.8 mg/L or less			

Given the continuous dumping operations in the south Ahmadi land fill since the 2018 study, the concentration of heavy metals under investigation are clearly increasing in the ground water around the land fill and some distance from the land fill if leaching from the topsoil is going on. Leaching is caused by traditional dumping which is simply waste disposal in the old south Al Ahmadi quarry (between 5-18m deep) with no process for the wastes, expect to cover these with sand sheet.

2-Soil samples: Soil samples were collected from either the surface or subsurface, where heavy have a high tendency to concentration as result of the comparison between the 2018 and resent study in 2019 (Table5, 6, figures 3 and 4 respectively) for the heavy metals.

The sanitary landfill receives 2000 tons of house solid waste daily (Kuwait municipality official site).This huge amount of dumping material puts pressure on the soil of the landfill. More products will produced from the reaction amongst unclassified wastes in the dumpster and polluted the soil. In the second stage, the products it will leach out to the subsurface soil and the groundwater.

4. Landfill Cleaning

This present monitoring study of the landfill indicates a high transmission of the heavy metals as a result of the large mass of soil waste that puts pressure on the on the landfill on a daily basis. The Soil and ground water are under danger of severe pollution. Wind -blowing dust develops in the land fill area and is loaded with heavy metals can be distributed in the open desert environment or the residential suburbs around the land fill or away from it. Given such serious conditions, an immediate action plan should be implemented to eliminate or stop exposing- cariogenic- elements exposure to the environment in a steady basis. The cleaning producer is as flows:

1) The municipality of Kuwait should assign anew, healthy landfill location to replace the present landfill in south Al ahmadi [4]
2) Dumping must stop in the landfill at once.
3) The removal plan should start soon after closing the facility.
4) Wastes in this step will be classified into reusable materials for useful purposes, as well as recyclable and non-recyclables materials [1].

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ISSN: 2319-7064
SJIF (2019): 7.583

Table 5: Chemical Analysis of Soil Samples after Monitoring (Mg/Kg) of the South Al-Ahmadi ,Landfill

Profile	Sample	Sample	Soil		Chemical analyze samples(mg/Kg)			
No.	No.	Status	Cd	Pb	Ni	Fe	Al	Organics
	1	surface	0.15	2.976	5.89	2609.283	2620.314	0.062
		subsurface	0.201	1.633	9.105	2436.394	1925.894	0.054
	2	surface	0.154	2.966	5.86	2604.1	2616.2	0.061
		subsurface	0.203	1.632	9.211	2433.25	1923.19	0.213
	3	surface	0.151	2.946	5.66	2601.7	2611.5	0.059
I		subsurface	0.191	1.833	9.118	2419.21	1911.61	0.049
	4	surface	0.149	2.926	5.36	2581.1	2603.2	0.052
		subsurface	0.137	2.136	9.061	2363.152	1896.02	0.041
	5	surface	0.147	2.9	5.11	2561.2	2593.4	0.048
		subsurface	0.122	2.331	8.443	2313.21	1868.22	0.037
	6	surface	0.13	2.876	4.96	2531.3	2575.7	0.039
		subsurface	0.1079	2.973	8.043	2280.05	1854.34	0.03
	7	surface	0.351	3.311	9.24	2440.22	1933.05	0.062
		subsurface	0.273	2.937	24.2	5747.142	4444.021	0.052
	8	surface	0.344	3.28	9.15	2436.394	1925.894	0.056
		subsurface	0.268	2.917	24.07	5735.178	4427.069	0.05
II	9	surface	0.344	3.28	9.15	2436.394	1925.894	0.056
		subsurface	0.241	2.902	23.85	5724.126	4407.213	0.046
	10	surface	0.336	3.201	8.99	2424.11	1905.31	0.046
		subsurface	0.223	2.885	23.46	5704.111	4397.122	0.041
	11	surface	0.321	3.181	8.82	2411.17	1891.15	0.039
		subsurface	0.194	2.872	23.05	5694.421	4384.231	0.038
	12	surface	0.366	3.425	9.35	2453.236	1944.52	0.073
		subsurface	0.294	2.952	25.02	5756.113	4455.211	0.063
	13	surface	0.359	3.319	9.29	2444.33	1937.62	0.068
III		subsurface	0.281	2.943	24.66	5751.261	4451.102	0.059
	14	surface	0.351	3.311	9.24	2440.22	1933.05	0.062
		subsurface	0.273	2.937	24.2	5747.142	4444.021	0.052
	15	surface	0.344	3.28	9.15	2436.394	1925.894	0.056
		subsurface	0.268	2.917	24.07	5735.178	4427.069	0.05
	16	surface	0.366	3.425	9.35	2453.236	1944.52	0.073
		subsurface	0.294	2.952	25.02	5756.113	4455.211	0.063
	17	surface	0.374	3.431	9.39	2461.263	1953.23	0.081
IV		subsurface	0.305	2.962	25.71	5761.612	4461.241	0.076
	18	surface	0.382	3.442	9.45	2465.215	1960.21	0.089
		subsurface	0.312	2.979	26.08	5770.126	4467.321	0.089
	19	surface	0.391	3.451	9.52	2473.256	1967.32	0.095
		subsurface	0.321	2.985	26.41	5774.611	4473.521	0.098
	20	surface	0.366	3.425	9.35	2453.236	1944.52	0.073
		subsurface	0.294	2.952	25.02	5756.113	4455.211	0.063
	21	surface	0.374	3.431	9.39	2461.263	1953.23	0.081
		subsurface	0.305	2.962	25.71	5761.612	4461.241	0.076
V	22	surface	0.382	3.442	9.45	2465.215	1960.21	0.089
		subsurface	0.312	2.979	26.08	5770.126	4467.321	0.089
	23	surface	0.391	3.451	9.52	2473.256	1967.32	0.095
		subsurface	0.321	2.985	26.41	5774.611	4473.521	0.098
	24	surface	0.405	3.46	9.66	2478.261	1972.32	0.105
		subsurface	0.366	3.002	26.74	5783.23	4482.214	0.103
	25	surface	0.366	3.425	9.35	2453.236	1944.52	0.073
		subsurface	0.294	2.952	25.02	5756.113	4455.211	0.063
	26	surface	0.374	3.431	9.39	2461.263	1953.23	0.081
		subsurface	0.305	2.962	25.71	5761.612	4461.241	0.076
VI	27	surface	0.382	3.442	9.45	2465.215	1960.21	0.089
		subsurface	0.312	2.979	26.08	5770.126	4467.321	0.089
	28	surface	0.391	3.451	9.52	2473.256	1967.32	0.095
		subsurface	0.321	2.985	26.41	5774.611	4473.521	0.098
	29	surface	0.405	3.46	9.66	2478.261	1972.32	0.105
		subsurface	0.366	3.002	26.74	5783.23	4482.214	0.103
Sample	30	surface	0.017	1.502	16.29	4472.107	3561.259	0.092
	WHO Standard Values	3 mg/Kg	100.2	50.1	50002			
	in sample solution	or less	mg/Kg	mg/Kg or less	mg/Kg or less	less		

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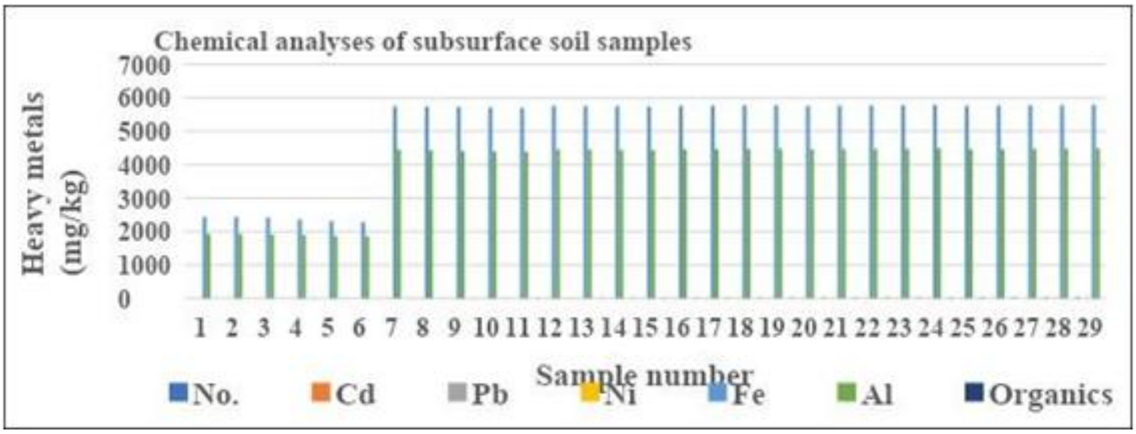

Figure 3: Chemical analysis of soil samples after monitoring (mg/Kg) of the south AL -Ahmadi Landfill

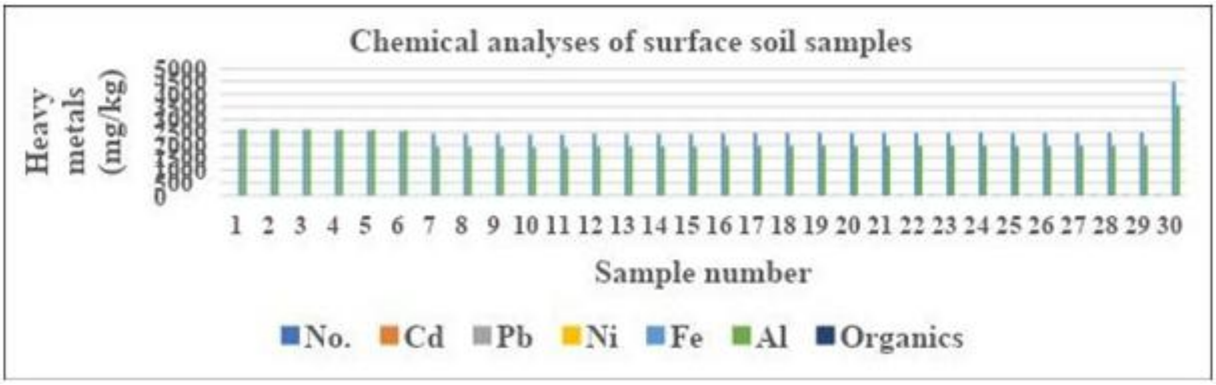

Figure 4: Chemical analysis of soil samples after monitoring (mg/Kg) of the south Ahmadi Landfill

In contract to with the first study undertaken in 2016(Al-Rashed 2016), the concentration with heavy metals increased in the study (Table 5). As a result of continuous dumping in the site.

5) In this step recyclable waste (only solid in this land fill), will be categorized into plastics, paper, metal, glass, organic, garbage, expired food and vegetables.
6) From the statistics released by [5] household solid waste is increasing annually (Figure 5).A total 50% of household solid waste is organic followed by papers (21%) plastics (13%),and finally other waste like glass, textiles and metals (13%).
7) In this step: all solid waste classified from the previous step can be easily recycled for instance, organic waste can be used as fertilizer [6], papers can be reproduced into new paper products,. Plastics can be melted, and different plastics can be produced from items such as trash bags, colored pens, panties and cover boxes and glass metals and textiles can be used as raw materials for disposable solid waste.
8) With the high standard of solid waste: recycling plans and government management. The south Ahmadi landfill will no longer become series threat to the environment.

Table 6: Chemical Analysis of Soil Samples (Mg/Kg) South Ahmadilandfill (After Alrashed 2016)

Profile Sample Sample (mg/Kg)								Chemical Analysis of soil samples
No.	No.	Status	Cd	Pb	Ni	Fe	Al	Organics
	1	surface	0.14	2.776	5.79	2607.28	2618.31	0.042
		subsurface	0.191	1.433	9.005	2434.39	1923.89	0.034
	2	surface	0.144	2.766	5.76	2602.1	2614.2	0.041
		subsurface	0.193	1.432	9.111	2431.25	1921.19	0.193
	3	surface	0.141	2.746	5.56	2599.7	2609.5	0.039
I		subsurface	0.181	1.633	9.018	2417.21	1909.61	0.029
	4	surface	0.139	2.726	5.26	2579.1	2601.2	0.032
		subsurface	0.127	1.936	8.961	2361.15	1894.02	0.021
	5	surface	0.137	2.7	5.01	2559.2	2591.4	0.028
		subsurface	0.112	2.131	8.343	2311.21	1866.22	0.017
	6	surface	0.12	2.676	4.86	2529.3	2573.7	0.019
		subsurface	0.0979	2.773	7.943	2278.05	1852.34	0.01
	7	surface	0.341	3.111	9.14	2438.22	1931.05	0.042
		subsurface	0.263	2.737	24.1	5745.14	4442.02	0.032
	8	surface	0.334	3.08	9.05	2434.39	1923.89	0.036
		subsurface	0.258	2.717	23.97	5733.18	4425.07	0.03

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II	9	surface	0.334	3.08	9.05	2434.39	1923.89	0.036
		subsurface	0.231	2.702	23.75	5722.13	4405.21	0.026
	10	surface	0.326	3.001	8.89	2422.11	1903.31	0.026
		subsurface	0.213	2.685	23.36	5702.11	4395.12	0.021
	11	surface	0.311	2.981	8.72	2409.17	1889.15	0.019
		subsurface	0.184	2.672	22.95	5692.42	4382.23	0.018
	12	**surface**	**0.356**	**3.225**	**9.25**	**2451.24**	**1942.52**	**0.053**
		subsurface	**0.284**	**2.752**	**24.92**	**5754.11**	**4453.21**	**0.043**
	13	surface	0.349	3.119	9.19	2442.33	1935.62	0.048
III		subsurface	0.271	2.743	24.56	5749.26	4449.1	0.039
	14	surface	.341	3. 111	9.14	2438.22	1931.05	0.042
		subsurface	0.263	2. 737	24..1	5745.14	4442.02	0.032
	15	surface	0.334	3.08	9.05	2434.39	1923.89	0.036
		subsurface	0.258	2.717	23.97	5733.18	4425.07	0.03
	16	surface	0.356	3.225	9.25	2451.24	1942.52	0.053
		subsurface	0.284	2.752	24.92	5754.11	4453.21	0.043
	17	surface	0.364	3.231	9.29	2459.26	1951.23	0.061
IV		subsurface	0.295	2.762	25.61	5759.61	4459.24	0.056
	18	surface	0.372	3.242	9.35	2463.22	1958.21	0.069
		subsurface	0.302	2.779	25.98	5798.13	4465.32	0.069
	19	surface	0.381	3.251	9.42	2471.26	1965.32	0.075
		subsurface	0.311	2.785	26.31	5772.61	4471.52	0.078
	20	surface	0.356	3.225	9.25	2451.24	1942.52	0.053
		subsurface	0.284	2.752	24.92	5754.11	4453.21	0.043
	21	surface	0.364	3.231	9.29	2459.26	1951.23	0.061
		subsurface	0.295	2.762	25.61	5759.61	4459.24	0.056
V	22	surface	0.372	3.242	9.35	2463.22	1958.21	0.069
		subsurface	0.302	2.779	25.98	5768.13	4465.32	0.069
	23	surface	0.381	3.251	9.42	2471.26	1965.32	0.075
		subsurface	0.311	2.785	26.31	5772.61	4471.52	0.078
	24	surface	0.395	3.26	9.56	2476.26	1970.32	0.085
		subsurface	0.356	2.802	26.64	5781.23	4480.21	0.083
	25	surface	0.356	3.225	9.25	2451.24	1942.52	0.053
		subsurface	0.284	2.752	24.92	5754.11	4453.21	0.043
	26	surface	0.364	3.242	9.29	2459.26	1951.23	0.061
		subsurface	0.295	2.779	25.61	5759.61	4459.24	0.056
VI	27	surface	0.372	3.251	9.35	2463.22	1958.21	0.069
		subsurface	0.302	2.785	25.98	5768.13	4465.32	0.069
	28	surface	0.381	3.26	9.42	2471.26	1965.32	0.075
		subsurface	0.311	2.802	26.31	5772.61	4471.52	0.078
	29	surface	0.395	3.225	9.56	2476.26	1970.32	0.085
		subsurface	0.356	2.802	26.64	5781.23	4480.21	0.083
Sample	30	surface	0.007	1.302	16.19	4470.11	3559.26	0.072
	WHO Standard Values	3 mg/Kg	100	50	50000			
	in sample solution	or less	mg/Kg	mg/Kg or less	mg/Kg or less	less		

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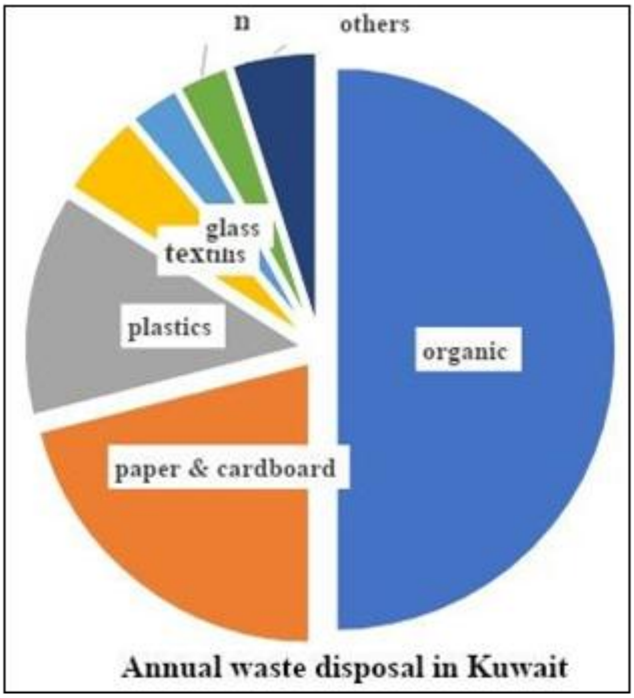

Figure 5: Quantitative waste disposal in Kuwait (annually)

5. Conclusion

The monitoring study of south Al Ahamdi landfill (previously called Kabad) in kuwait showed that the country is still suffering from large amount of waste that requires disposal. The High numbers of the TDS and heavy metals in the chemical composition of ground water and soil of the urban suburbs south Al-Ahmadi exceeded the limits of the World Health Organization. The recorded of total dissolve solids in the ground water in and around the area and heavy metals in soil after more than two years since the first study rings the bill regarding the danger of such waste on the environment .A healthy landfill, clean-up- action from the government of Kuwait and application of high quality standards will help the south Al-Ahmadi and its surrounding areas and the ground water recover.

References

[1] A.Alsulaili, B.Alsager B, Albanwan, A. Almeer , L. AlEssa, "An integration soil waste Management system in Kuwait".5th international Conference on environmental science and technology,V69 pp.: 54-59, 2014.
[2] H. Alhasawi, "Investigation of Municipal Solid Waste Management in GCC States, Kuwait", 1999.
[3] A. Alrashed, "The Environmental impact of Kabad Land fill on the soil and ground water In Kuwait: A case study",international Journal of Geosciences v:9,pp: 255-271, (2018).
[4] X. Qian, R. Koerner, D. Gray, "Geotechnical aspects of Landfill design and Construction", New Kuwait Municipal Statistical Department Annual statistical report, 2019.
[5] Kuwait municipality official site, https//www.baladia.gov.ku, (2019)
[6] Office of environmental health and safety Kuwait, Non- recyclable material list, Online. http://lausdoehs.org/docs/Recycling/Non_Recyclable_ List.pdf (2014)
[7] KEPA ambient air quality standards (Decree No.8/2017 issued under Article 48 of Law no.42/2014).
[8] KEPA noise quality standards (Decree No.8/2017 issued under Article 48 of Law no.42/2014).
[9] ISO 14001, 2015 (Environmental management system).
[10] IFC standards, ENVIRONMENTAL, HEALTH, AND SAFETY GUIDELINES PORTS, HARBORS, AND TERMINALS February 2, 2017.
[11] Chua TE (1995a) A collective responsibility. Asian Energy Year Book. Petroleum Economists Ltd., London, pp 114–115.
[12] Chua TE (1995b) Marine pollution: development since UNCLOS III and prospects for regional cooperation. In: Koh KL.
[13] Beckman RC, Chia LS (eds) SEAPOL Singapore conference on sustainable development of coastal and ocean areas, past rio perspectives. South East Asia Programme in Ocean Law and Management, Singapore, pp 144–176.
[14] Chua TE, Ross AR (1998) Pollution prevention and management in the east Asian Seas, a paradigm shift in concept, approach and methodology. International maritime organization regional
[15] Programme for the prevention and management of marine pollution in the east Asian Seas, Quezon City, MPP-EAS Technical Report 15, 45.

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