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# Characterization and Treatment of Al-Menya Landfill Leachate Using Biological and Physical Methods

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## Abstract

**In this research, the leachate generated from Al-Menya sanitary landfill which is located in the southern part of the West Bank-Palestine was investigated. In this regard, the leachate physical, chemical and biological characteristics were studied using SBR and advanced membrane technology including UF and RO. The results showed that leachate generated is classified as young leachate with the possibility for biological treatment according to the BOD/COD ratio. Heavy metals concentrations varied in all samples due to incomplete waste separation stage. The concentration of Cr and Ni were the highest whereas the Ag and Pb were below the detection limit. The primary treatment and biological treatment using Sequencing Batch Reactor (SBR) showed 88%, 95%, 100% and 96% removal for COD, TSS, Ammonia nitrogen and phosphate respectively. The final stage of treatment included the advanced membrane technology (UF and RO). The treatment of SBR effluent using UF unit showed highly efficient of UF unit for TSS, Nitrate and phosphate, Al, Zn, removal with (100%), (98%), (95%), (100%), (82%), respectively. The heavy metals were partially removed, the Al was completely removed, whereas Cr concentration showed no different concentration. An efficient removal ranging between 97%-100% were observed for COD, Ammonia-Nitrogen, TSS, Al, K and Na using RO unit whereas Cr and Cd still have high concentration.**

***Keywords:*** ***Sanitary landfill; Leachate; Biological treatment; Physical treatment***

## Introduction

Landfill is a discrete area of land or excavation that receives household waste. It may also receive other types of nonhazardous wastes, such as commercial solid waste, nonhazardous sludge, conditionally exempt small quantity generator waste and industrial nonhazardous solid waste. During the operation of the landfill, leachate is formed when water passes through the waste in the landfill cells [1]. Normally the generated leachate contains large amounts of organic contaminants

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and significant concentration of heavy metals [2] and this could be a potential source of surface and groundwater contamination [3], also it may affect the hydraulic conductivity of the clay [4], by changing the structure of the clay from hexagonal to needle like crystal structure. Furthermore, health effects from leachate are not limited to drinking water but may also occur through the food chain due to the ingestion of other organisms (fish, aquatic plants) that locate in an environment contaminated by leachate [5].

Several studies concerning leachate characterizations and treatment have been carried out. The removal of organic material indicated as chemical oxygen demand COD, biological oxygen demand BOD and ammonium from leachate is the usual prerequisite before discharging leachate into the natural water [6].

Sequence batch reactor SBR is efficient method for removing pollutants from leachate, this process depends on operational parameters such as cycle time, aeration rate, volume of reactor, Hydraulic retention time HRT etc. Using SBR in a combination with the membrane reverse osmosis technique has proven to be very effective in leachate treatment [7]. It is used as reliable method and it is differentiating by the operational flexibility, easy expansion into modules and potential cost savings [8]. At 12 h cycle time, $BOD_5$, TSS and $NH_3$-N, removal was 98, 90 and 89, respectively [9]. With SRT of 10 days, system efficiency for COD, total nitrogen and phosphate removals was 91, 98 and 98, respectively [10]. When initial content of ammonia and phosphate was 900 and 90, the results showed 99.8 and 97.8 removal for nitrogen and phosphorus respectively [11].

Physical treatment included membrane technology as reverse osmosis RO seems to be one of the most promising method among the new processes for landfill leachate treatment [12,13]. Also, it has been studied on leachate treatment and the removal efficiency of contaminants COD, $NH_4^+$, electrical conductivity was exceeding 90% [14]. COD parameter and heavy metal concentrations were reduced to more than 98 and 99%, respectively [15]. UF is effective to eliminate the macromolecules and the particles, but it is strongly dependent on the type of material constituting the membrane [16]. The rate of UF depends on the area of the membrane, the concentration gradient, molecular diffusion and temperature [17]. The elimination of polluting substances not reach 100%, COD between (10% and 75%), so more recently, UF has been applied to biological post-treatment of landfill leachate.

The efficiency of Fenton's oxidation under optimum experimental conditions were pH=3, $H_2O_2/Fe^{+}_{2}$ molar ratio=3 and reaction time=150 minutes the favorable experimental conditions, maximum COD removal was 56.49% [18]. Another studied showed that that the anaerobic pond, facultative pond and maturation pond system do not meet the design criteria to discharge safely [19]. Classical processes were applied for the leachate treatment using Fenton process, the coupling coagulation-Fenton process and the adsorption on powdered activated carbon (PAC) showing reduction in chemical oxygen demand COD ranging between 85-97% [20]. Landfill leachate was pretreated by combination of chemical flocculation with polyaluminum chloride (PAC) as a flocculant and subsequently purified by the microelectrolysis-Fenton (MEF) process. The results showed a reduction in chemical oxygen demand (COD) and humic acids (HA) removal were respectively 90.27% and 93.79% [21].

The aim of this work is to determine the general characteristics of Al-Menya leachate and then to investigate the efficiency of biological treatment using SBR and physical treatment methods using UF and RO for leachate management.

## Methodology

### Study area

Al-Menya Landfill locates between 2 km-3 km to the south and western south of Al-Menya village in Bethlehem, Palestine. The landfill area is 20.5 ha (540 × 490 m). It is about 690-730 m above sea level. The average yearly rainfall about 200 mm-300 mm and average yearly temperature is 19°C-20°C. The average yearly sunrise is 189-195 Kilo Calorie/$Cm^2$ [22].

The geology of the area almost consists of gravels, deposits of clay from the mountains and hills around. Most of the well appeared that all of the contents are almost of alluvial, sand and a little of gravels. The rock caps consist of a strong and white lime (<0.5 and its maximum value 1.5 m). The lime stone reach to more than 10 m down, the ratio for preventing leakage/permeability is slim because the ability of forming another forms of stones (Chert, Flint, Marl, Marl stone and Dolomite) within forming lime stone that little in formations but large and different quantities. The landfill design access to achieve collection in lowest point, the depth of the groundwater has a big depth under the surface around 200 m, the ability of these leakages to arrive from the landfill to depth more than 10 m-20 m, is small and too far.

The waste that is received at Al-Menya landfill is municipal solid waste and the daily quantity is around 600 tons. Normally, there are specific pollutants in the textile wastewater including suspended solids, biodegradable organic matter, toxic organic compounds and heavy metals [22].

### Biological-physical treatment method

Leachate quality is quite variable from site to site and over time as a particular landfill ages. As a result, neither biological treatment nor physical/chemical treatment processes separately are able to achieve high treatment efficiencies [23,24]. A combination of both types of treatment is the most effective process for the treatment of leachate [24].

There are two main stages in Al-Menya leachate treatment, first stage started by settling the sample in a separate reactor for 2 h, then the leachate was pumped into SBR as biological treatment for about 8 h. the second stage is a physical treatment using advanced membrane technology included RO and UF.

### Optimization of SBR

In order to start up the treatment, activated sludge for SBR was brought from Oasis Hotel wastewater treatment plant in Jericho and mixed with the leachate. The efficiency of the process was tested in attempt to determine the optimum conditions and finally, treated leachate was analyzed for general characteristics. TABLES 1 and 2 summarizes the aerobic operation condition included operation condition parameters and ideal condition. These conditions were optimized according to TABLE 2 [25].

TABLE 1. **Operation conditions parameters of SBR process.**

| Condition | Aerobic |
|---|---|
| Fill | 3 L of raw leachate were pump and mixes with activated sludge in the reactor for 1 h. |
| React | Mixing occur by using electrical driving speed. Air supply was provided during the aerobic phase of react period. Biological reactions occur until the desired degree of treatment has been achieved, for 3 h. |
| Settle | Aeration is stopped. The activated sludge solids settle down to form a blanket on the base of the reactor beaker, leaving an over-layer of treated effluent, for 2 h. |
| Decant | The liquid surface which is effluent (supernatant) is removed from tank, for 1 h. |

TABLE 2. **Experiment operation conditions and optimum operation conditions for aerobic SBR operation process [25].**

| Conditions | Typical range | Aerobic (SBR) |
|---|---|---|
| HRT (day) | 0.44-12 | 1.5 |
| F/M | 0.25-0. 50 | 0.477 |
| Q (MG) | ** | $0.317 \times 10^{-4}$ |
| MLSS (ppm) | 500-24650 | 20108.4 |
| MLVSS (Ib) | ** | 0.2215 |
| Total cycle (hr) | 60-8 | 7 |
| SVI (ml/g) | 15-150 | 24.119 |
| Aeration (l/min) | 0.2-11.9 | 3 |
| React time (hr) | 3-22. 5 | 3 |
| Settle time (hr) | 0.17-2.84 | 2 |
| Decant time (hr) | 0.08-1 | 1 |
| Fill time (hr) | 0.02-3 | 1 |

**Food/microorganisms ratio F/M:** The F/M ratio as illustrated in equation (1) would simply be the digester loading divided by the concentration of volatile suspended solid (biomass) in the digester (kg-COD/kg-VSS. day). For any given loading, efficiency can be improved by lowering the F/M ratio and increasing the concentration of biomass in the digester [26]. Also, for given biomass concentration within the digester, the efficiency can be improved by decreasing the loading.

$$F / M = Organic\ loading\ rate / \ volatile\ solids \qquad (1)$$

Where,

Organic loading rate (O.L.R)=COD of the influent stream (kg-COD/L. day)
Volatile solid ($V_{ss}$)=Volatile suspended solid concentration in the reactor (kg-VSS/L).

**The hydraulic retention time (HRT):** Determination the HRT is an important process control parameter. As illustrated in equation (2), it indicates the total time required by the liquid to degrade [26].

$$HRT = COD_{in} / O.L.R \qquad (2)$$

Or, HRT=volume of aeration tank/influent flow rate
Volume is in $m^3$ and the flow rate in $m^3$/day.
HRT is expressed in days or hours.

**The flow rate:** The HRT and flow rate examine the exact influent stream from feed inlet to the outlet. Normally, flow rate is controlled by means of a peristaltic pump with corresponding tube hosing of different diameter. The flow rate is designed according to the working volume of the reactor, as described in equation (3) [26]:

$$Q=V_w/HRT \qquad (3)$$

Working volume for the reactor ($V_w$) is expressed in $m^3$, HRT is expressed in day,
Q is expressed in $m^3$/day.

## Results and Discussion

### Leachate characteristics

Al-Menya Sanitary Landfill was constructed in June 2013. The leachate samples were collected from the landfill during 2014/2015. Leachate samples were preserved at 4°C, to prevent any chemical and biological activities. TABLE 3, presents the general characteristics of the studied leachate. Comparing the analyzed characteristics with others in the literature review, the obtained results show that the leachate characteristics lies within these values. It was found that COD is more than 2000 ppm and BOD/COD>0.3, accordingly the landfill is classified as a young one (less than 5 years) [6,23]. TABLE 4 summarizes more comparison parameters for leachate classification.

TABLE 3. **General characteristics of Al-Menya landfill leachate.**

| Characteristic | Value | Standard deviation (SD) |
|---|---|---|
| PH | 6.1 | 0.3 |
| Electrical Conductivity mS/cm | 5.96 | 1.1 |
| TDS mg/l | 2000 | 550 |
| Turbidity NTU | 3000 | 5.8 |
| TSS mg/l | 2500 | 5.3 |
| COD mg/l | 11000 | 400.0 |
| BOD mg/l | 4000 | 250.0 |
| BOD/COD | 0. 36 | |
| Ammonium ($NH_4^+$) mg/l | 105.00 | 4.1 |
| Ammonia-Nitrogen : $NH_3^+$-N/$NH_4^+$/$NH_3$ mg/l | 0.48/0.62 l/0.58 | 0.1 |
| Ca mg/l | 3500 | 15 |
| Mg mg/l | 300 | 10 |
| Na mg/l | 5700 | 255 |
| K mg/l | 1000 | 57 |
| Nitrate/$NO_3$-N/$NO_3$-mg/l | 19.57/4.4 | 0.30 |
| Phosphate mg/l | 8.0 | 0.7 |
| Ag mg/l | N.D | N.D |
| Al mg/l | 3.86 | 0.55 |
| Cd mg/l | 3.66 | 0.25 |
| Cr mg/l | 5.22 | 0.37 |
| Cu mg/l | 0.64 | 0.01 |
| Ni mg/l | 5.15 | 3.40 |
| Pb mg/l | N.D | N.D |
| Zn mg/l | 3.37 | 0.31 |

TABLE 4. **Landfill leachate composition vs. landfill age [6,23].**

| | **Recent (young)** | **Intermediate** | **Old** |
|---|---|---|---|
| Age (years) | <5 | 5-10 | >10 |
| pH | 6.5 | 6.5-7.5 | >7.5 |
| COD (mg/l) | >10000 | 4000-10000 | <4000 |
| $BOD_5$/COD | >0.3 | 0.1-0.3 | <0.1 |
| Organic compounds | 80% Volatile fat acids (VFA) | 5%-30% VFA+humic and fulvic acids | Humic and fulvic acids |
| Heavy metals | Low-medium | Low-medium | Low |
| Biodegradability | High | Medium | Low |

**Biological treatment**

TABLE 5 summarizes the average physical, biological and chemical characteristics of influent and effluent after a complete cycle using SBR reactor (triplicate samples).

TABLE 5. **The average physical and chemical characteristics of influent and effluent leachate samples after completed biological treatment using SBR cycles. The total time (8 h), filling time: 1 h, reaction time: 3 h, settling time: 2 h, decantation time: 1 h and idle time: 1 h. Under HRT: 1.5 day and temperature: 25°C.**

| **Characteristics** | **Influent** | **Effluent** | **Removal %** |
|---|---|---|---|
| COD (mg/l) | 11000 ± 400.0 | 1330 ± 75 | 88% |
| TSS (mg/l) | 2500 ± 5 | 124 ± 6 | 95% |
| Ammonia-Nitrogen (mg/l): $NH_3^-$-N/$NH_4^+$/$NH_3$ | 0.48/0.62/0.58 ± 0.1 | 0.0 1 ± 0.01 | 100% |
| Nitrate: (mg/l) $NO_3$-N/$NO_3^-$ | 19.6/4.4 ± 0.2 | 13.0/3.0 ± 0.3 | 34%/32% |
| Phosphate (mg/l) | 8.00 ± 0.50 | 0.29 ± 0.10 | 96% |
| Na (mg/l) | 5700 ± 34 | 730 ± 23 | 87% |
| K (mg/l) | 1000 ± 25 | 659 ± 38 | 34% |

The results show that COD decreased from 11000 mg/l to 1330 mg/l with percentage removal 88%, TSS decreased from 2500 mg/l to 124 mg/l with removal percentage 95% for TSS. Complete removal in Ammonia-Nitrogen from the effluent was achieved. However, nitrate scored a little reduction ((34%-32%), from 19.57 mg/l as $NO_3$-N to 13 mg/l and from 4.4 mg/l as $NO_3^-$ to 3 mg/l). Phosphate decreased from 8 mg/l to 0.3 mg/l as 96% percentage removal. Also, the percentage removal of Na was 87%, it decreased from 5700 mg/l to 730 mg/l. K decreased by 34%, from 1000 mg/l to 659 mg/l. The results indicated that SBR was efficient in decreasing the organic load of raw leachate samples.

The obtained results in this research are of great importance when we compare them with others. It was found that TSS removal in biological treatment is (85%-97%) and Phosphorus removal (57%-69%) [8], however, the current research results shows removals with 95% and 96% respectively. Another study showed that the removal efficiency that has been achieved by the system were 94.9 and 55.9% for COD and Total P, respectively [27], whereas in this research, removal percentages for organic matter represented by COD concentration was (88%) and 96% for P removal.

By comparing the obtained results with the Palestinian Standards for treated wastewater, the concentration of ammonia, nitrate and phosphate are within the acceptable range and can be disposed as far as 500 m to sea water or for irrigation (dry feeds, green feeds, parks, beans, citrus trees, olive trees and almond trees) [28,29]. But according to other standards, more treatment is needed to comply with the roles and regulations [30].

**Physical treatment-ultrafiltration (UF)**

TABLE 6 summarizes the physical, biological and chemical characteristics of leachate samples after treatment using biological and UF units compared to raw leachate influent. As further and enhancement treatment stage in addition to biological treatment, this process prevents and reduce any clogging may occur before leachate reaches the RO. The treatment of SBR effluent using UF unit shows highly efficient of UF unit for TSS, Nitrate and phosphate, Al, Zn, removal with (100%), (98%), (95%), (100%), (82%), respectively. The ultrafiltration porosity prevents the suspended and large dissolved solid from passing through the membrane.

TABLE 6. **Physical and chemical characteristics of leachate effluent after treatment using biological stage and UF unit compare to raw leachate influent.**

| Characteristic | Influent | Effluent (UF) | Removal % |
|---|---|---|---|
| COD (mg/l) | 11000 ± 400 | 975 ± 20.0 | 91% |
| BOD (mg/l) | 4000 ± 250 | 280 ± 3.0 | 93% |
| TSS (mg/l) | 2500 ± 5.3 | 0.10 ± 0.01 | 100% |
| EC (mS/cm) | 5.96 ± 0.1 | 0.70 ± 0.01 | 88% |
| Turbidity (NTU) | 3000 ± 5.8 | 0.1 ± 0.1 | 100% |
| $NH_3^{+}$-N/$NH_4^{+}$/$NH_3$ (mg/l): | 0.48/0.62/0.58 ± 0.10 | 0.0 ± 0.0 | 100% |
| $NO_3$—N/$NO_3^-$(mg/l) | 19.57/4.40 ± 0.01 | 0.3/0.1 ± 0.1 | 98%/98% |
| Phosphate (mg/l) | 8.00 ± 0.01 | 0.422 ± 0.01 | 95% |
| Na (mg/l) | 5700 ± 10 | 338.68 ± 10 | 94% |
| K (mg/l) | 1000 ± 25 | 377 ± 13 | 62% |
| Al (mg/l) | 3.86 ± 0.10 | 0.53 ± 0.01 | 100% |
| Cd (mg/l) | 3.66 ± 0.01 | 3.64 ± 0.01 | 0.55% |
| Zn (mg/l) | 3.37 ± 0.10 | 0.62 ± 0.03 | 82% |
| Ag (mg/l) | N.D | N.D | |
| Cr (mg/l) | 5.22 ± 0.01 | 5.07 ± 0.01 | 3% |
| Cu (mg/l) | 0.64 ± 0.00 | 0.39 ± 0.01 | 39% |
| Ni (mg/l) | 5.15 ± 0.38 | 5.23 ± 0.50 | 0% |
| Pb (mg/l) | N.D | N.D | |

**Physical treatment-reverse osmosis (RO):**

The effluent of UF then passed through RO membrane under high pressure. TABLE 7 summarizes the variation between the raw leachate (influent) and RO effluent. It shows the physical, biological and chemical of leachate effluent after treatment using biological stage and UF unit compared to raw leachate influent.

TABLE 7. **Physical and chemical of leachate effluent after treatment using RO unit compare to raw leachate influent.**

| Characteristic | Influent | Effluent (RO) | Removal % |
|---|---|---|---|
| COD (mg/l) | 11000 ± 400 | 345 ± 24 | 97% |
| `BOD (mg/l) | 4000 ± 250 | 117 ± 2 | 97% |
| TSS (mg/l) | 2500 ± 5.3 | 0.20 ± 0.01 | 100% |
| TDS (mg/l) | 2000 ± 25 | 40 ± 1 | 98% |
| EC (mS/cm) | 5.96 ± 0.10 | 0.09 ± 0.01 | 98% |
| Turbidity (NTU) | 3000 ± 5.8 | 0.50 ± 0.01 | 100% |
| $NH_3^{\cdot}$-/$NH_4^{\cdot}$/$NH_3$(mg/l): | 0.48/0.62/0.58 ± 0.10 | 0.01 ± 0.01 | 100% |
| $NO_3$—N/$NO_3^-$(mg/l) | 19.57/4.40 ± 0.01 | 5.00/1.10 ± 0.01 | 74%/75% |
| Phosphate (mg/l) | 8.0 ± 0.5 | 0.40 ± 0.01 | 95% |
| Sodium (mg/l) | 5700 ± 10 | 136 ± 10 | 98% |
| K (mg/l) | 1000 ± 15 | 9.47 ± 0.02 | 99% |
| Al (mg/l) | 3.86 ± 0.01 | 0.01 ± 0.01 | 100% |
| Cd (mg/l) | 3.66 ± 0.01 | 3.63 ± 0.01 | 0.82% |
| Zn (mg/l) | 3.37 ± 3.10 | 1.09 ± 0.20 | 68% |
| Ag (mg/l) | N.D | N.D | |
| Cr (mg/l) | 5.22 ± 0.01 | 4.88 ± 0.01 | 7% |
| Cu (mg/l) | 0.64 ± 0.01 | 0.67 ± 0.01 | |
| Ni (mg/l) | 5.15 ± 0.38 | 4.93 ± 0.46 | 4% |
| Pb (mg/l) | N.D | N.D | |

The COD concentration of leachate influent was 11000 mg/l during all experiments and reduced to 975 mg/l with 91% removal in the UF effluent. The elimination of COD reached values within the range between 10 and 75% [31], so related to this study a clear reduction in COD was achieved. On the other hand, the effluent using RO lead to more reduction in COD to 345 mg/l with 97% removal related to experimental studies of [13,32,33], showed that RO technology elimination of COD reached 99%. The removal efficiency of some organic and inorganic pollutants exceeded 98% [34].

By comparing these results with (PSTW), the concentration of Nitrate-N concentration in UF and RO effluents recorded 0.3 mg/l and 1.1 mg/l, respectively. These concentrations are below the range 25 mg/l-50 mg/l according to Palestinian standards. Depending on this parameter, treated leachate could be applied for different uses according to the Palestinian standards except feeding aquifer by filtration. TSS in the tow effluents (RO and UF) had a complete removal, which leads to the ability to use the treated leachate for any application according to the Palestinian standards acceptable (discharge it to sea water along 500 m, feeding the aquifer by filtration, irrigate dry and green feed, irrigate garden courts, irrigate grains, irrigate forest trees, irrigate citrus fruits, irrigate olive trees and irrigate almond trees). Effluents COD concentration in UF and RO are 975 mg/l and 345 mg/l, respectively. However, Palestinian standards it should within 150 mg/l-200 mg/l and this imply that further treatment is needed to reduce organic matter more. The same results were obtained concerning BOD, where UF gave 280 mg/l and 117 mg/l using RO and the Palestinian standards for BOD is within the range 40 mg/l-60 mg/l.

$PO_4$-P concentration was 0.422 mg/l in UF effluent and 0.400 mg/l in RO effluent and these concentrations are below the Palestinian standards 5 mg/l-30 mg/l. Also, Na concentration in UF effluent is 339 mg/l and 136 mg/l for RO effluent. This concentration is a little bit higher than Palestinian standards 200 mg/l-230 mg/l. Heavy metals concentration in mg/l in the UF effluent are as the following Al, Cd, Zn, Cr, Cu and Ni, 0.531, 3.64, 0.622, 5.07, 0.393 and 5.23 respectively and the RO effluent for the same heavy metals with the same order as in UF are 0.00, 3.63, 1.09, 4.88, 0.669 and 4.93 respectively. Palestinian standards for these metals are (1-5), 0.01, (2-5), (0.05-0.1), 0.2 and 0.2 mg/l respectively. This implies that further treatment is needed for Cd, Cr, Cu and Ni [29,30]. Referring to the Australian standards for treated wastewater discharge, BOD values from UF and RO need more treatment to be reduced from 280 mg/l and 117 mg/l respectively to reach 10 mg/l. $PO_4$-P concentration is 0.422 mg/l in UF and 0.4 mg/l in RO, which need a little treatment to reach the standard 0.1 mg/l. Heavy metals concentration in mg/l in UF effluents as the following Cd, Zn, Cr, Cu and Ni, 3.64, 0.622, 5.07, 0.393 and 5.23 respectively and the RO effluents for the same heavy metals with the same order as in UF are 3.63, 1.09, 4.88, 0.669 and 4.93 respectively. Australian standards for these metals are 0.002, 0.05, 0.001, 0.01 and 0.15 mg/l respectively. All heavy metals mentioned have confirmed the potential adverse effects of UF and RO effluents and there is a necessary to treat these heavy metals to meet these standards. In general, Australian discharge standards are not compatible with the treated leachate of Al-Menya landfill, either by UF or RO [30].

$BOD_5$ effluent from UF was 280 mg/l and from RO was 116 mg/l. The permitted limit by WHO related to these values were within the range $\leq$ 240 mg/l, this range permitted irrigation of ornamental fruit trees and fodder crops. TSS effluent from UF was 0.0 mg/l and from RO was 0.0 mg/l. The permitted limit by WHO related to these values were within the range $\leq$ 140 mg/l, this range permitted irrigation of ornamental fruit trees and fodder crops, irrigation of vegetables likely to be eaten uncooked and for toilet flushing [35].

TDS effluent from UF was 350 mg/l and from RO was 40 mg/l. The restriction degree of TDS of water quality for irrigation below 450 mg/l, so there is no any restriction for this parameter on use for irrigation.

$NO_3$-N was 0.3 mg/l by UF and this value was below the standard limit which it <5 mg/l and 5.0 mg/l by RO and this value was within the standard range 5 mg/l-30 mg/l. So, UF effluent considered to be without restricted on use this treated wastewater effluent for irrigation, but there is a slight to moderate restriction on using RO effluent for irrigation. Na concentration effluent by UF was 338 mg/l and 136 mg/l by RO. The restriction degree of Na of water quality for irrigation related to these concentrations was >69 mg/l, so the restriction for this parameter on use for irrigation was slight to moderate.

Heavy metals concentration in mg/l in the UF effluent are as the following Al, Cd, Zn, Cr, Cu and Ni, 0.531, 3.64, 0.622, 5.07, 0.393 and 5.23 respectively and the RO effluent for the same heavy metals with the same order as in UF were 0.00, 3.63, 1.09, 4.88, 0.669 and 4.93 respectively. Related to FAO standards, these heavy metals concentrations as the following 5.00, 0.10, 2.00, 0.10, 0.20, 0.20 mg/l. This treated water either UF or RO effluents were inefficient as irrigated water, because these heavy metals in the leachate sample were exceeded the FAO standards [35].

## Conclusion

Al-Menya leachate was classified as young leachate according to sanitary landfill age and there physical, chemical and biological characteristics. The BOD/COD ratio shows the possibility for biological treatment. The SBR methods is an efficient method for organic matter removal, whereas advanced membrane treatment methods using UF and RO enhanced the removal efficiency. Combination the SBR with UF and RO could be an effective method for leachate treatment with addition of adsorption stage for enhancement of dissolved solid removal.

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