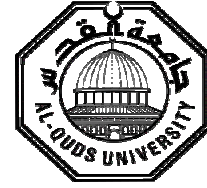


**Deanship of Graduate Studies
Al- Quds University**



**Small Scale Waste Water Treatment Plants in West
Bank: Comparative Study**

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Small Scale Waste Water Treatment Plants in West Bank: Comparative Study

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Thesis Approval

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Al- Quds - Palestine

2012

Dedication:

"To Our Profit Mohammad
(Peace be upon him)".

"To My Family and Friends".

Declaration

I certify that this thesis submitted for the degree of Master is the result of my own research, except where otherwise acknowledged, and that this thesis (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed: 

Majdi Shaker Shaheen

Date: 10/12/2012

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List of abbreviations	
AS	Activated Sludge
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
EC	Electrical Conductivity
FC	Fecal Coliform
KHP	Potassium Hydrogen Phthalate
MBR	Membrane Bio Reactor
MCM	Million Cubic Meter
MoA	Ministry of Agriculture
MOU	Memorandum of Understanding
pH	Power of Hydrogen
PMD	Palestinian Metrological Department
PWA	Palestinian Water Authority
RO	Reverse Osmosis
TC	Total Coliform
TDS	Total Dissolved Solids
TOD	Total Oxygen Demand
TOC	Total Organic Carbon
TPC	Total Plate Count
TS	Total Solids
TSS	Total Suspended Solids
UASB	Up flow Anaerobic Sludge Blanket
UV	Ultra Violet
WHO	World Health Organization
WWTP	Waste Water Treatment Plant

Abstract:

In this work, a comprehensive contrast between small scale waste water treatment plants (WWTPs) that are located in deferent regions in Palestine utilizing different technologies is presented. During this investigation, eleven WWTPs have been visited. Two of these plants were found not functioning, four were found in bad conditions, and five plants were found functioning properly. Wastewater grab samples from the influent and effluent were taken from the selected plants once every month during the experimental period from January 2010 to December 2011.

Two kinds of analysis were carried out on these samples. The first analysis was carried out immediately once the sample has reached the lab. These include pH, Electrical conductance (EC), total plate count (TPC), total coliform (TC), fecal coliform (FC) and biological oxygen demand (BOD). The second group of analysis was measured in later stage. These include total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), ionsand chemical oxygen demand (COD).

The efficiency of studied plants were calculating by considering the effectiveness of reducing COD, BOD₅, TS, TDS, and TSS of the final effluent from each plant. In Al Quds University WWTP the average reduction in TDS, TSS, TS, BOD₅ and COD are 99 %, 99 %, 99%, 95 % and 95%, respectively. For Nahaline the average reduction in TDS, TSS, TS, BOD₅, and COD are 52 %, 81 %, 58 %, 57 % and 57 %, respectively. For Nuba the average reduction in TDS, TSS, TS, BOD₅, and COD are 22 %, 35 %, 22 %, 54 % and 24 %, respectively. For Al Aroub WWTP the average reduction in TDS, TSS, TS, BOD₅, and COD are 15 %, 45 %, 18 %, 42 % and 33%, respectively. For the Inter Continental Hotel In Jericho WWTP the average reduction in TDS, TSS, TS, BOD₅, and COD are 48 %, 96 %, 56 %, 59 % and 40 %, respectively.

Upon comparing the efficiency of all the studies plants, it can be concludes that membrane technology coupled with activated sludge process was found to give the best removal efficiency for all the studies quality parameters. Furthermore, upon comparing the actual cost of treatment of one cubic meter for each plant together with the removal efficiency, activated sludge technology is found to give the most economical technology. However, parallel to the actual cost, the sustainability of reuse and environmental cost should be addressed for future discussion in the adaptation of any treatment technology in Palestine by the decision makers.

Chapter One

Introduction

1. Introduction

1.1 Water Supply

Water supply and sanitation in the Palestinian territories is characterized by severe water shortage, which is exacerbated by the effects of Israeli occupation. According to the WASH Monitoring Program, Israelis use 85% of the water available from the mountain aquifer in the West Bank, and 82% of the water from the coastal aquifer under Gaza (Wikipedia, 2009). Israel denies the Palestinian rights to share and use water from Jordan River. The Palestinian Water Authority (PWA) was established after Oslo agreement (1995) to monitor, develop and distribute the limited drinking water supply allocated to it by the Israeli's Authority (UNEP, 2003).

The unfair distribution of water resources and the denials of the full control of the Palestinians over their natural water reservoirs make most of the Palestinian municipalities and villages to suffer from the shortages in fresh water supply especially in summer (Palestinian Media Center, 2003).

1.2 Water Resources

At an average sustainable rate, the amount of renewable shared freshwater available throughout the entire Jordan Valley from rivers and renewable aquifers is roughly 2700 million cubic meters per year (MCM/yr), out of which 1400 MCM/yr comes from groundwater and 1300 MCM/yr from surface water (Palestinian Media Center, 2003). The main sources of water available to Israelis and Palestinians are the Jordan River and groundwater underlying the West Bank and coastal areas. Israel has denied Palestinians access to the entire Lower Jordan River since 1967. After the start of Israel's military occupation in 1967, Israel declared the West Bank land adjacent to the Jordan River a closed military zone, to which only Israeli settler farmers have been permitted access (Palestinian Media Center, 2003). Groundwater is the major source of fresh water supply in Palestine. Currently, more than 85% of the Palestinian water from the West Bank aquifers is taken by Israel, accounting for 25% of Israel's water needs. The groundwater resources underlying the Palestinian Territories are the Mountain Aquifer (West Bank) and the Coastal Aquifer Basin (Gaza Strip). The Mountain Aquifer is replenished by the winter

rains which mainly fall on the West Bank territory. A major quantity of this water flows underground outside of the West Bank, and moves gradually towards the slopes of the hills mainly within Israeli territory (Tamkeen, 2005)

The level of development in water infrastructure and services is far less in the Palestine Territories compared with Israel. After transfer of certain responsibilities and authorities by the Israelis to the PA and especially after the establishment of PWA in 1995, many projects have been implemented to construct new water networks or to rehabilitate existing ones. This is considered to be a time consuming task that requires commitments from the Palestinians and Israelis supported by the international community. The average water supply to the Palestinian communities of the Occupied Territories is about (63 Lc /day) in the West Bank and (140 Lc/day) in the Gaza Strip. However, water supply significantly varies throughout the Territories. In (7 %) of the Palestinian communities, is less than or equal to (30 Lc/day), in (36 %) of them it is between (30- 50 Lc/day), in (41 %) of them it is between (50 – 100 Lc/day), and finally, only in (16%) of them is (100 Lc/day), which is the minimum amount recommended by the World Health Organization. (Murad, 2005).

1.3 Water Quality

The quality issue is the second dimension of the water crisis. Quality is a primary concern, especially in the Gaza Strip, where over extraction (the extraction of water in quantities outrunning the recharging capacity of the aquifers) leads to the seepage of saltwater from the Mediterranean Sea into the underground aquifer and to the increase of brackish water from the deeper layers (AlSa'ed, 2000). However, the situation is also difficult in the West Bank as all of the Palestinian Territories are characterized by an extensive and inappropriate use of pesticides and fertilizers in the agricultural sector and by the absence and inadequacy of the sewage infrastructure. Today only (7%) of water in the Gaza Strip meets the World Health Organization's standards. Diseases registered in the hospitals include cholera, dysentery, hepatitis, and yellow fever (WHO, 1996).

1.4 Rainfall Distribution

The large variations in rainfall and limited surface resources have led to widespread scarcity of the fresh water resources in the region, resulting in a heavy reliance on groundwater as the major source for various uses.

The contribution of surface water to the overall water balance is limited and marginal. The sources of water in the WB are those renewable waters of the Mountain aquifer that rises and outcrops in the WB but extends across and below the territories of Israel. The main recharge acceptance area is located in the core of the WB where water originating in altitudes higher than 400 meters feed the major aquifers in the area. The ground water recharge in the WB is the direct infiltration of rainwater through fractured, karstic rocks and porous soils. The overall balance in the West Bank is estimated to be 679 MCM/ yr, while in Gaza it is estimated at 45 MCM/ yr (Arij, 1998).

1.5 Water Abstraction

Table 1.1 shows the amount of water abstract from the aquifer in West Bank by the Palestinian and Israel, the amount of water that abstract by the Palestinian in the range is about 113 MCM – 138 MCM, or about (17-20%) of the estimated potential, and an Israeli over extraction of 389 MCM (80%) of the estimated potential.

Table (1.1): Water abstraction by Palestinian and Israeli from the Aquifer. (PWA, 2009).

Aquifer	Estimated potential MCM	Abstractions			Excess over Article 40 allocation		
		Total Palestinian	Total Israeli	Total Abstracted	Palestinian	Israeli	Total over extraction
Western	362.0	29.4	591.6	621.0	7.4	251.6	259.0
North Eastern	145.0	36.9	147.1	184.0	(5.1)	44.1	39.0
Eastern	172.0	71.9	132.9	204.8	(2.6)	92.9	90.3
Total	679.0	138.2	871.6	1,009.8	(0.3)	388.6	388.3

Palestinian abstractions have actually declined over the last ten years. Contrary to expectations under Oslo II, the water actually abstracted by Palestinians in the West Bank