An-Najah National University
Faculty of Graduate Studies

Impacts of Biodegradable Organics on Soils and Groundwater In West Bank

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Dedication

TO

MY DEAR FATHER AND MOTHER FOR THEIR SUPPORT, TO MY BROTHERS AND SISTERS, AND TO MY WIFE, WITH LOVE AND RESPECT.

Acknowledgment

Praise be to Allah, the most merciful, the most graceful for granting me the power and courage to finish this work.

I would like to express my great thanks and gratitude to Dr. Shehdeh Jodeh and Prof. Marwan Haddad for their supervision, encouragement and guidance throughout this study.

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الإقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل عنوان:

Impacts of Biodegradable Organics on Soils and Groundwater In West Bank

تأثيرات المركبات العضوية التي تتحلل حيويا على التربة والمياه والجوفية في الضفة الغربية

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Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification

Student's name: **اسم الطالب:**

Signature : **التوقيع:**

Date: **التاريخ:**

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List of Symbols

WHO: World Health Organization.

BOD: Biological Oxygen Demand.

COD: Chemical Oxygen Demand.

DO: Dissolves Oxygen.

TDS: Total Dissolves Solid.

TN: Total Nitrogen Percent.

TP: Total Phosphorus Percent.

M: Molar Concentration.

Wt: Weight of Soil Sample.

MN: Molar Mass of N grams.

a.: For Soils Columns Short I Year Effect.

b.: For Soils Columns Short 10 Years Effect.

c.: For Soils Columns Short 25 Years Effect.

EC: Electrical Conductivity.

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Abstract

The purpose of this study was to investigate the impact of biological oxygen demand (BOD) on soil and drinking water in WestBank. This study will give us a conclusion about ground water contamination of waste from solid waste and sewage water.

The study was performed on two soil samples brought from Jericho and Tulkarm. The physical and chemical properties of the two soil samples were analyzed. The study was conducted between April and May, 2009. The concentration of BOD in the leachate was found to increase with time in both types of soil, in April the BOD concentration was higher in the leachate from Jericho soil than Tulkarm soil, but in May the BOD concentration was higher in Tulkarm soil than Jericho soil.

The concentration of BOD in the leachate collected from blank column was decreasing with time, the dissolved oxygen (DO) was decreasing with increasing BOD concentration in both soil.

The total dissolved solids (TDS) concentration in the leachate was decreasing in both soil with time .

The BOD concentration was increasing in the soil layers from top to the bottom in both soils (Tulkarm, Jericho), but BOD was higher in Tulkarm soil in each layer compared with that in Jericho soil layers.

The TDS level in Tulkarm soil layers was higher than in Jericho soil layers.

The total nitrogen (TN) concentration in soil layers increases with depth and with time during water addition in the blank column but decreases in the soil layers in the columns where BOD was added.

Chapter One

Introduction

1.0 Introduction

During the last decade, there has been a growing concern about the decrease in usable water resources. Currently, the world is moving towards water crisis; water shortage is an important concern in arid areas such as Africa, southern Asia, and the middle east and in some other parts of the world, which it may lead to a war crisis (Jaafar Zadeh,1996). Palestine is not like other countries, it has its special situation because of the Israeli occupation.

Palestinians are forbidden to look or dig for underground water, even inside his/her own land. Not only did the Israelis occupy Palestinian land, but they also controled its natural resources of water. Palestinian natural sources of ground water and rainwater replenish the ground water. The occupiers (Israelis) control the amount of consumption for each citizen i.e., the occupiers consume 80% of natural water leaving Palestinians with 20%. On the other hand, continued population growth has increased per capital water consumption and increased water requirements, for different uses, although the West Bank in Palestine is a special case [1] .

The Palestinian citizen can not travel freely from one place to another. Most Palestinians depend on agriculture. Agriculture needs fertile soil and enough pure water, moreover this water is required by both humans and animals to drink.

So, we must protect the ground water from pollution because water treatment is very costly, In general protection from pollution is more efficient than treatment.

Ground water, which is the main source of drinking water in Palestine, may be polluted. If the recharge area of aquifer is polluted from the closure and segregation of the main roads of Palestine by occupier, leading to complications of sewage water, solid waste problem and the usage of random and uncontrolled sewage network.

1.1 Sewage Disposal

The Palestinian villages do not have sewage system to dispose waste water. People dig sewage wells in their land, which is very close to drinking water wells, which is collected during winter. Gradually, wastewater leaks to drinking water wells and to ground water, which becomes polluted with BOD and toxic material, which causes dangers to human life and pollutes soil, and ground water [2].

In some urban areas, sewage is carried separately in sanitary sewers and runoff from streets, which carried in storm drains. Access to either of these is typically through a manhole. During high precipitation periods a sanitary sewer overflow can occur, causing potential public health and ecological damage.

Untreated sewage can have serious impacts on the quality of the environment and on people health. Pathogens can cause a variety of illnesses. Some chemicals pose risks even at very low concentrations can cause a threat for long periods of time because of bioaccumulation in animal or human tissue

1.2 Study Area

One study sample of soil was collected from the north of Tulkarem. It was muddy brown that is suitable for growing olive trees, fruits and vegetables. The other sample was collected from east of Jericho, it was sandy yellow, usually used for the planting banana and some vegetable.

In Tulkarem, the weather is rather hot and dry in summer and rainy in winter, the average rainfall is above 550 mm per year. However, in Jericho the weather is very hot most of the year and the average rainfall is about 150 mm per year.

Due to these differences in climate and soil physical features, we have carried out this study to show the fast absorb of BOD in these two soils and to study the leachate of wastewater to them.

The main sources of ground water pollutions are human waste, solid waste, agricultural waste, including nitrate and phosphate which used on fertilizer, industrial waste which are summarized in the following map Figure (1.1).

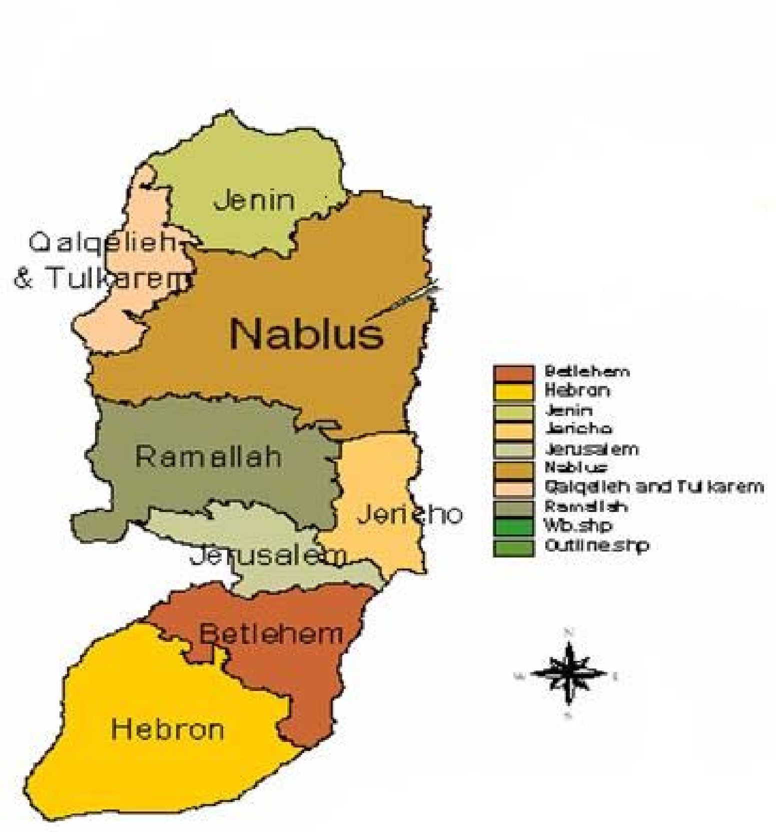

Figure (1:1) West bank District

1.3 Study Objectives

The aim of our study was to achieve the following targets:

1- The effect of biological oxygen demand (BOD) on drinking water.

2- The study of the kinetic of BOD leachate in drinking water through two different soil samples.

3- To investigate the impact of (BOD) on Total Dissolved Solids (TDS), Dissolved Oxygen (DO) in soils and ground water in Westbank.

Chapter two

Background

2.0 Background

2.1 Water in Palestine

The Palestinian people depend on rainfall for water, this water is gathered in small wells. People also depend on water which goes through rocks to form the under-ground wells. People use this water for drinking their animals and watering their plants. About 1-2% of the population only depend on Mineral Health water for drinking.

2.2 Groundwater in Palestine

underground water forms a main source of water in Palestine unlike some countries in the Middle East. The underground Water in Palestine depends on four main aquifer.

A- The western aquifer: this goes towards the Mediterranean. It extends from Tulkarem to Qalqilia in the north to Hebron in the south which includes 360 million cubic meters yearly.

B- The North Eastern Aquifer: its water goes to the east and northeast to Bessan Marj Ibn Amer plain . It also includes Nablus, Jenin and Jalbon aquifer that feed Bessan, which holds 140 million cubic meters yearly.

C- The Eastern aquifer: Its water goes to the east and southeast towards Al-Azraq River, the Dead Sea and Arraba Valley, it also includes the aquifer of Bardala, Bqeea, Al-Maleh, Al-Farea, Fasael, Al-Oga ,Ramallah, and Jerusalem desert which holds 100 million Cubic meters yearly .

D- The Gaza Aquifer: This aquifer is considered as an extension to the Palestinian coastal water resource. It contains 75 million cubic meters yearly[3].

2.3 What is Pure Water?

We know that life is dependent on water and that water exists in nature in many forms (clouds, rain, snow, ice and fog). However, strictly speaking chemically pure water does not exist for any appreciable length of time in nature.

Even while falling as rain, water picks up some gases, ions, dust, and particulate matter from the atmosphere. Then as it flows over or through the surface layers of the earth it dissolves and carries with it some of almost everything it touches, including waste which dumped into it by human being.

These added impurities may be arbitrarily classified as biological, matters (both inorganic and organic), physical and radiological impurities. These include industrial and commercial solvents, metal and acid salts, sediments, pesticides, herbicides, plant nutrients, radioactive materials, road salt, decaying animal and vegetable matter and living microorganisms such as algae, bacteria and viruses. These impurities may give water a bad taste, color, odor or cloudy appearance (turbidity), and cause hardness, corrosiveness, staining or frothing. They may damage growing plants and transmit disease. Many of these impurities are removed or rendered harmless however, in municipal drinking water treatment plants.

Human beings are concerned with domestic water problems such as color, odor and safety to family health, as well as the cost of water treatments. Chemists and engineers working for industry are concerned about the purity of water as it relates to scale deposition and pipe corrosion.

Regulatory agencies are concerned with setting standards to protect public health.

One mesa of establishing and assuring the purity and safety of water is to set a standard for various contaminants. A standard is a definite rule principle or measurement, which is established by governmental authority[4].

2.4 Health Effect Of Drinking Water Contaminants

Chemicals in drinking water, which are toxic, may cause either acute or chronic health effects. An acute effect usually follows a large dose of a chemical and occurs almost immediately, examples of acute health effects are nausea, lung irritation, skin rash, vomiting, dizziness, and in the extreme, death.

The levels of chemicals in drinking water, however are seldom high enough to cause acute health effect. They are more likely to cause chronic health, which occurs after exposure to small amount of a chemical over along period of time, like cancer birth defects, organ damage, disorders of the nervous system, and damage to the immune system.

Evidence related to chronic human health to specific drinking water. Contaminants are very limited. In the absence of exact scientific information, scientists predict the likely adverse effects of chemicals in drinking water using laboratory animal studies and available human data from clinical reports and epidemiological studies. [5]

2.5 Definition of Biological Oxygen Demand (BOD)

Microorganisms such as bacteria are responsible for decomposing organic waste. When organic matter such as dead plants, leaves, grass clippings, manure, sewage or even food waste present in a water supply, the bacteria will begin the process of breaking down this waste, when this happens, available dissolved oxygen (DO) is consumed by aerobic bacteria, robbing other aquatic organisms of the oxygen they need to live.

Biological oxygen demand BOD, is a measure of the amount of oxygen used by microorganisms to decompose waste. If there is a large quantity of organic waste in the water supply, there will also be a lot of bacteria present working to decompose this waste. In this case, the demand for oxygen will be high (due to all the bacteria) so the BOD level will also be high. As the waste is consumed or dispersed through the water, BOD levels will begin to decline. [6]

Another definition of BOD, is a chemical procedure for determining how fast biological organisms use up oxygen in a body of water, it is used in water quality management and assessment, ecology and environmental science. BOD is not an accurate quantitative test, although it could be considered as an indication of the quality of a water source.[7]

2.6 Waste Water Quality Indicators

Any oxidizable material present in a natural water way or in an industrial wastewater will be oxidized both by biochemical (bacterial) and chemical processes. The result is that the oxygen content of the water will be decreased. Basically, the reaction of biochemical oxidation may be written as:

Oxidizable material + bacteria + nutrient + $O_2 \rightarrow CO_2 + H_2O$ + oxidized

Oxygen consumption by reducing chemicals such as sulfides and nitrites is shown in the following equations:

$S + 2O_2 \rightarrow SO_4^{-2}$ …………….. 2.1

$NO_2^- + \frac{1}{2} O_2 \rightarrow NO_3^-$ ………..2.2

All natural water-ways contain bacteria and nutrients, (such as shown above). Those biochemical reactions create what is measured in the laboratory as the (BOD).

Oxidizable chemicals introduced into a natural water will similarly initiate chemical reactions (such as shown above equation) these chemical reactions create what is measured in the laboratory as (chemical oxygen demand (COD)).

Both BOD and COD tests are a measure of the relative oxygen –depletion effect of a waste contaminant. They have been widely adopted as a measure of pollution effect. The BOD test measures the oxygen demand of biodegradable pollutants where as the COD test measure the oxygen demand of biodegradable pollutants plus the oxygen demand of non-biodegradable oxidizable pollutants (COD= BOD+NBOD).

The so-called 5-day measures the amount of oxygen consumed by biochemical oxidation of waste contaminants in a 5-day period. The total amount of oxygen consumed when the biochemical reaction is allowed to proceed to completion is called the ultimate BOD. The ultimate BOD is too much consuming, so the 5-day BOD has almost universally been adopted as a measure of relative pollution effect [8]

Table (2.1) Typical BOD Values [5, 7]

BOD level in ppm	Water quality
1-2	(very good) low level or organic waste in the water supply
3-5	Fair :moderately clean
6-9	Poor: polluted, organic matter is present and bacteria are decomposing it.
100 or greater	Very poor , highly polluted contains high level of organic waste

2.7 The BOD_5 Test.

BOD measures the rate of oxygen uptake by micro-organisms in a sample of water at a temperature of 20ºC over an elapsed period of five days in the dark. There are two recognized methods for the measurement of BOD.

2.7.1 Standard Method.

To ensure that all testing conditions are equal a very small amount of micro-organism seed is added to each sample being tested. This seed is typically generated by diluting activated sludge with de-ionized water. The BOD test is carried out by diluting the sample with de-ionized saturated with oxygen water inoculating it with a fixed aliquot of seed. Test the sample sealed to prevent oxygen from escaping.

The sample is kept at 20 ºC in the dark to prevent photosynthesis for five days, at the end of the period the dissolved oxygen was measured again. The difference between the final DO and initial DO is the BOD. The apparent BOD for the control is subtracted from the control result to provide the corrected value.

The loss of dissolved oxygen in the sample once correction have been made for the degree of dilution is called the BOD_5, (for measurement of carbon aceous BOD).

A nitrification inhibitor is added after the sample has been diluted with water. The inhibitor hinders the oxidation of nitrogen.

BOD can be calculated by:

*Undiluted : initial DO - final DO = BOD

*Diluted : (initial DO) – BOD of seed * dilution factor

BOD is similar in function to chemical oxygen demand (COD), in that both measures the amount of organic compounds in water, however, COD is less specific, since it measures everything that can be chemically oxidized, rather than just levels of biologically active organic matter.

2.7.2 Manometric Method

This method is limited to the measurement of the oxygen consumption due to carbonaceous oxidation, ammonia oxidation is inhibited.

The sample is kept in a sealed container fitted with a pressure sensor. A substance that absorbs carbon dioxide (typically lithium hydroxide) is added to the container over the sample, the sample is stored in conditions identical to the dilution method where oxygen is consumed and ammonia oxidation is inhibited, carbon dioxide is released. Thus, the pressure decreases because carbon dioxide is absorbed form the drop of pressure, the electronic sensor computes and displays the consumed quantity of oxygen.

The main advantages of this method over the dilution method are:

- Simplicity: no dilution of sample required no seeding, and no blank sample.
- Direct reading of BOD value.
- Continuous display of BOD value with incubation [9].

2.8 BOD-Sample Volume

The volume of the sample is determined based on the expected BOD,

Table (2.2) The Volume Of The Sample Based On The Expected BOD

Expected BOD_5 (mg/l)	Volume
Less than 90	250
Less than 350	200
Less than 600	150
Less than 999	100

2.9 Procedure of BOD Measurements.

- The sample is shaked will to insure the homogeneity.

- The sample was then poured into a glass bottle.

- Fill the alkali holder with potassium hydroxide up to the open sides of it. Potassium hydroxide may harm the bacteria in the sample if poured in the sample.

- The sensor was put in and sealed well.
- The sensor was reset by pressing on both A and B at the same time.
- The scale was chosen of the measurement.
- To start the measuring cycle press A, then press B while the chosen scale appears.
- The bottle was put in the magnetic stirrer in incubator of 20ºc.
- after 5-days we got the results from the sensor, the results are BOD_1, BOD_2… BOD_5, however, BOD_5 is the needed value.

2.10 History of BOD

The Royal Commission on River Pollution, which was established in 1865 and the formation of the Royal Commission on sewage Disposal in 1898 led to the selection in 1900 of BOD_5 as the definitive test for organic pollution of rivers. Five days was chosen as an appropriate test period, because this is supposedly the longest time that river water takes to travel from source to estuary in the UK in 1912. The commission also set a standard of 20 ppm BOD_5 as the maximum concentration permitted in sewage works discharging to rivers, provided that there was at least an 8:1 dilution available at dry weather flow. This was contained in the famous 20:30 (BOD_5) suspended soils full nitrification standard which was used as a yardstick in the UK up to the 1970s for sewage to work with fluent quality[10]

2.11 Total Dissolve Solids (TDS), and Electrical Conductivity (EC).

Salinity is a soil property referring to the amount of soluble salt in the soil. It is generally a problem in arid and semiarid regions. Electrical conductivity (EC) is the most common measure of soil salinity and is indicative of the ability of an aqueous solution to carry an electric current. Plants are detrimentally affected, both physically and chemically, by excess salts in some soils and by high levels of exchangeable sodium in others. Soils with an accumulation of exchangeable sodium are often characterized by poor tilth and low permeability making them unfavorable for plant growth [11].

If the EC is more than 4ds/m, the soil is considered saline the concentration of (TDS) in (mg/l) in water calculated due to the EC of TDS is about 5 ppm in water. The water is classified as software, and the TDS is measured directly by rinse the cathode of JENWAY instrument (3540 pH & conductivity meter [11].

2. 12 Leachate Characterization

2.12.1 Introduction

Prior to 1965, very few people were aware of the fact that water passing through solid waste in a sanitary landfill would become highly contaminated. This water, termed leachate, was generally not a matter of concern until few cases of water pollution were noticed where leachate had caused harm (Boyle and Ham 1974). Boyle (1974) also reported that many contaminants released from sanitary landfill, if allowed to migrate, might pose a severe threat to surface and ground water.

2.12.2 Factors Affecting Leachate Quality.

Leachate quality is highly variable. The variation in leachate quality are generally attributed to a myriad of interacting factors such as type and depth of solid waste, age of fill, the rate of water application, landfill design operations, and the interaction of leachate with its environment. The effects of some of these variables on leachate quality are presented below. The quality variations can also be attributed to sampling procedures, sample preservation, handling and storage, and analytical methods used to characterize the leachate. [12]

2.12.3 Processed Refuse.

characteristics from shredded or baled refuse fills also differ greatly.

Lu *et al.* (1984) indicated that leachates from shredded fills have significantly higher concentrations of pollutants than those from unshredded refuse. Attainment of capacity is also delayed, but the rate of pollutant removal, solid waste decomposition rate, and the cumulative mass of pollutants released per unit volume is significantly increased when compared with unshredded fills[13].

2.12.4 Depth of Refuse.

One of the earlier studies performed by Qasim and Chiang (1994) reported that substantially greater concentrations of constituents are obtained in leachates from deeper fills under similar conditions of precipitation and percolation. Deeper fills, however, require more water to reach saturation, require longer time for decomposition, and distribute the bulk of extracted material over a longer period of time. Water entering from surface of the landfill and travelling down through the refuse will successively transfer to the percolating water. Deep fills offer greater contact time and longer travel distance, thus higher concentrations will result[14].

2.12.5 Age of Fills.

leachate quality varies with age, because organic matter will continue to undergo stabilization. It should be noted that release of constituents from solid waste is obviously governed by decomposition processes, and the rate and volume of water infiltrating through the fill. Age is merely a convenient means of measuring and monitoring changes in leachate composition, and extraction of pollutants from the refuse bed. As a result, many studies describe leachate quality as a function of time based on water input rate and leachate generation. Lu *et al.* (1984) indicated that pollutant concentration in leachate peak in early life (that is within 2-3 years), followed by a gradual decline in ensuing years. This trend applies to most of the constituents, but in particular to organic indicators (e.g. BOD, COD, TOC), and microbiological population. Most other constituents exhibit steady decreases in concentration over 3 to 5 years due to continued flushing of the refuse bed. Among these are iron, zinc, phosphate, chloride, sodium, copper, organic nitrogen, total solids and suspended solids. In some cases however, the concentration of heavy metals fluctuated because of precipitation, dissolution, adsorption and complexation mechanisms that may retain or mobilize the metals within the landfill microenvironments. Early research indicated that pathogenic bacteria are present in fresh leachate[13].

Viruses are occasionally detected. There is however, a significant deactivation in bacterial and viral populations with solid waste age. This is attributed to adverse environmental conditions such as initial general associated with solids decomposition processes. Table 2.3 below shows the comparison between new landfill, which is operating less than 2 years with a mature landfill which operating age is greater than 10 years. Large differences can be observed from the constituent shown in Table 2.3.

Table (2.3) Typical Data on the Composition of Leachate from New and Mature Landfills

Constituent	Value mg/L		
	New landfill (less than 2 years)		Mature landfill (greater than 10 years)
	Range	Typical	Range
BOD_s(5-day biochemical oxygen demand)	2,000-30,000	10,000	100-200
TOC (total organic carbon)	1,500-20,000	6,000	80-160
COD (chemical oxygen demand)	3,000-60,000	18,000	100-500
Total suspended solids	200-2,000	500	100-400
Organic nitrogen	10-800	200	80-120
Ammonia nitrogen	10-800	200	20-40
Nitrate	5-40	25	5-10
Total phosphorus	5-100	30	5-10
Ortho phosphorus	4-80	20	4-8
Alkalinity as CaC03	1,000-10,000	3,000	200-1,000
pH (no units)	4.5-7.5	6	6.6-7.5
Total hardness as $CaC0_3$	300-10,000	3,500	200-500
Calcium	200-3,000	1,000	100-400
Magnesium	50-1,500	250	50-200
Potassium	200-1,000	300	50-400
Sodium	200-2,500	500	100-200
Chloride	200-3,000	500	100-400
Sulphate	50-1,000	300	20-50
Total Iron	50-1,200	60	20-200

Source: G. Tchobanoglous, H. Theisen, and S. Vigil, *Integrated Solid Waste management,* New York: McGraw Hill. 1993.

Chapter three

Methods and Materials.

3.0 Methods and Materials.

3.1 Soil Parameters and Area Description .

Two agricultural soil were obtained one from Jericho city, where the total yearly rain fall is about 150 mm with yellow to white soil color. The second from Tulkarem city where the total yearly rain fall is about 600 mm with red to brown color.

Moisture content (organic matter), nitrogen percent , soil texture of both soils were all determined and the results are summerized in table 3.1. [15]

Table (3.1) presents moisture content, pH , organic percent, organic matter percent %P, TDS, BOD and %N in Jericho,Tulkarem soil.

Parameter	Tulkarem soil	Jericho soil
pH	7.8	8.61
moisture Content (%)	19.57	3.73
Organic carbon (%)	3.38	3.74
Organic matter (%)	5.82	6.432
Nitrogen (%)	0.399	0.332
Phosphorus %	0.163	0.196
TDS mg/L	185	65
BOD mg/L	237	216

3.2 Moisture Content.

The moisture content of each soil was determined by drying for 24 hours in AriJ.Levy 500C oven . pH was determined using Jenway 3510 pH meter.

3.3 Organic Content.

The organic content was determined by walkley –black titration method . Oven –dried soil (0.5 g) was placed in 250 mL conical flask and 5 mL of 1.0 N $k_2Cr_2O_7$ was added and swirled. 10 mL of concentrated H_2SO_4 was added to the suspension and swirled gently until the soil was mixed. The flask was left to cool for 30 minutes and then 100 mL of de ionized water (DI) was added to the flask and the suspension was filtered. A 0.3 mL of Ortho-phenanthroline-ferrous complex (0.025M) was added to the flask as an indicator and the sample was titrated with 0.5N $FeSO_4$. As the endpoint was approached, the solution changed sharply from greenish-blue to red-brown.

The amount of $FeSO_4$ used was recorded . The percent of organic carbon and organic matter were calculated using the following equations:

Normality (N) $FeSO_4 = K_2Cr_2O_7$ ml × $K_2Cr_2O_7$ N

Meq $FeSO_4 = FeSO_4 \times$ N $FeSO_4$

Organic Carbon (%) = (meq $K_2Cr_2O_7$ – meq $FeSO_4$) × 0.3 × 1.37

Organic water (%) = 1.72 × organic Carbon (%)

3.4 Nitrogen Content.

The nitrogen percent of each soil was determined by Kheldahl method as follows: 1.0 g of each soil sample was placed in digestion tube, and 12 mL of Conc. H_2SO_4 was added and swilled until the acid was mixed with the sample. The sample was allowed to cool, 0.8 g of $CuSO_4.5H_2O$ and 7.3 g of

Na_2SO_4 was then added as catalyst, and the mixture was heated until the digestion mixture become clear, then the solution was boiled gently for 5 hrs.

The mixture was allowed to cool and 20 mL of DI water was added slowly with shaking, the tube containing the solution was swirled to bring any insoluble material into suspension then the tube contents was transferred to the distillation apparatus. The tube was rinsed three times with water to complete the transfer. A 5 mL of boric acid 20g/L was added to 200 mL conical flask and the flask was placed under the condenser of the distillation apparatus in such away that the end of the condenser was dipped into the solution. A 20 mL of NaOH 10 mol/L was added to the funnel of the apparatus and alkali was run slowly into the distillation chamber.

About 100 mL was distilled. The condenser was rinsed and few drops of indicator (0.1 g bromocresol green, 0.02 g methyl red in 100 mL ethanol) was added to the distillate and titrated 0.1 m hydrochloric acid in the violet end point. The percent of nitrogen was calculated using the following

$$\%N = \frac{(M.V)_{HCL}.M_N}{Wt.1000} \quad 100\%$$

Where:

M: is the molar concentration of hydrochloric acid after being blanked.

V : is the volume in milliliters of hydrochloric acid used in the titration with sample.

M_N : is the molar mass of N in grams /mol = (14.007).

Wt : is the weight of soil sample 1 g.

%Nitrogen in ppm.

Each soil sample was analyzed in order to evaluate moisture, the organic carbon percent, organic matter, and nitrogen percent.

3.5 Phosphorus Content

3.5.1 Sample Preparation for Phosphorus Analysis

1.0 g of each soil sample was heated at 550 °C for 24 hours, and 3.0 mL of conc. H2SO4 diluted with 50 mL of distilled water was added to each sample and boiled for 30 minutes, the pH was neutralized to about 5 using NaOH, H SO4, each solution was replaced in 250 volumetric flask and diluted by (D.W).

3.5.2 Reagent Preparation for Phosphorus Analysis :

1- Ammonium molybadate tetrahydrate (1.2 g) was placed in 25 volumetric flask then diluted with D.W.

2- Potassium Antimony tartarate (0.02908 g) was placed in 10 V.F then diluted with D.W

3- 100 mL of 5.0N H_2SO_4 by diluting 13.8 mL con.H2SO4 then diluted with D.W in 100 V.F

4- the three previous solutions 1,2, and 3 were combined in 200 ml volumetric flask and diluted with D.W

5- 0.528 g of ascorbic acid was dissolved in 100 ml of solution in step four was prepared [in fresh step].

3.5.3 Procedure for Phosphorus Analysis:

* 4 mL of reagent was placed in 25 volumetric flask then diluted with D.W this step for blank reading

* 4 mL of reagent mixed with 1 mL soil was placed in 25 mL V.F then diluted with D.W.

The percent of phosphorus was calculated using the following equation

$$\%P = \frac{C.uv.25mL.250mL.100}{1000.V.wt}$$

Where:

%P= phosphorus percent

C.UV= concentration read by UV

V= volume of sample solution,(ml)

Wt= weight sample in milligram

3.6 Soil Texture

The soil texture refers to the size distribution of the minerals particles found in soil. Particles are normally grouped into three main classes: sand, silt and clay.

Table (3.2) Classification of soil particles according to size.

Type of mineral particles	Size range
Sand	2.0-0.06 mm
Silt	0.06 – 0.002 mm
Clay	Less than 0.002

The soil texture of each sample was determined as follows, after removal of surface litter, and drying the soil, the +2 mm fraction was removed by dry sieving. The soil texture was determined by ASTM 125-hydrometer. table (3.3) presents soil texture of soil samples used in the study.

Table (3.3) Texture of Soil Samples

Soil texture	Tulkarem soil	Jericho soil
Gravels fraction ≥4.75	0 %	23.5%
Sand fraction 2 – 0.075	9.56 %	60.5 %
Silt fraction 0.075 – 0.002mm	66.92 %	11.2%
Clay fraction < 0.002mm	23.52%	4.8%

3.7 Description Method and Materials

In this method, twelve plastic soil columns of 15 cm diameter and 2.0 m high were used in this study as shown in figure (3.1) to present the main parameters (BOD, DO, TDS, TN, TP) concentration with raining felled yearly.

They were filled with two different types of soil (i.e.), 6 columns with soil from Jericho city in the east of Palestine and the other columns filled with Tulkarem soil sample in the west of Palestine.

The columns divided into three groups (a,b,c) :

Group (a) contains (1-4) columns two of them with soil from Jericho and the others from Tulkarem. One of every two column for blank where tap water is added to it and the others for (BOD) were added to present the effect of one year rain-fall represent run number one. Figure (3.2)

Group (b) contains (5-8) columns divided as in group (a), to present the effect of raining at 10 years.

Group (c) contains (9-12) columns divided also as in group (a, b), to present the effect of raining at 25 years.

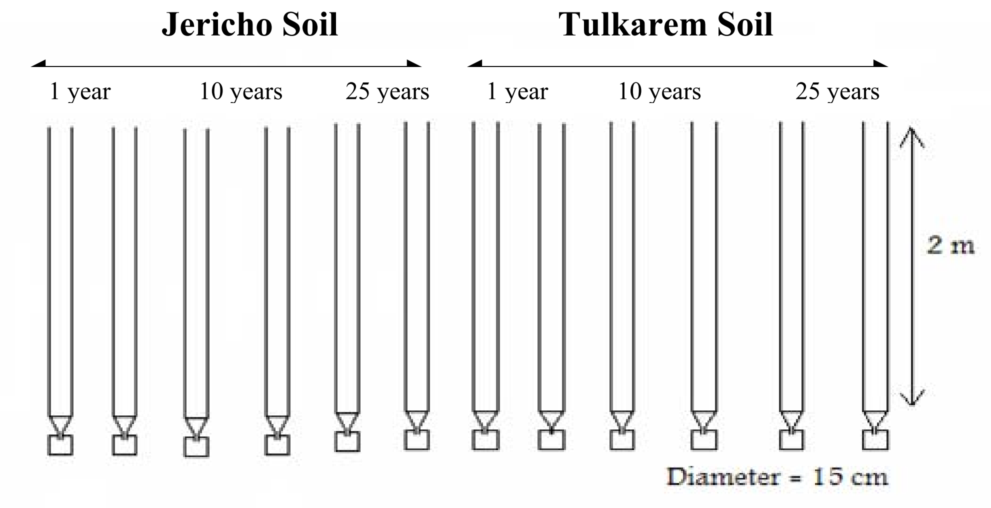

Figure (3.1) Experiment set up draw.

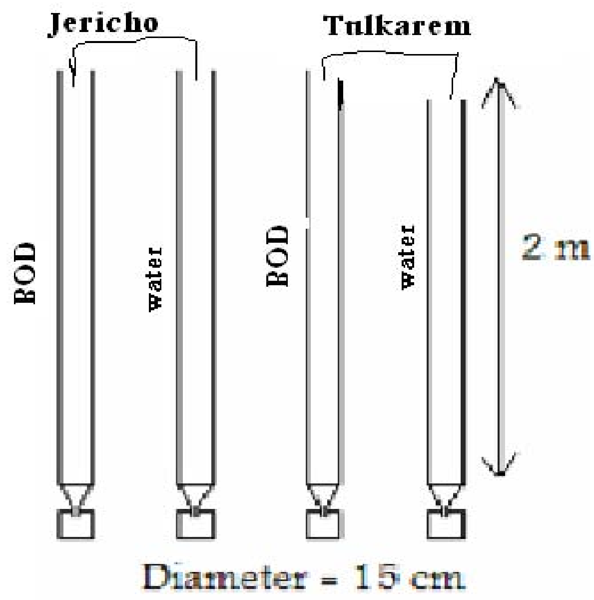

Figure (3.2) Experiment work columns of group (a) short 1 year effect.

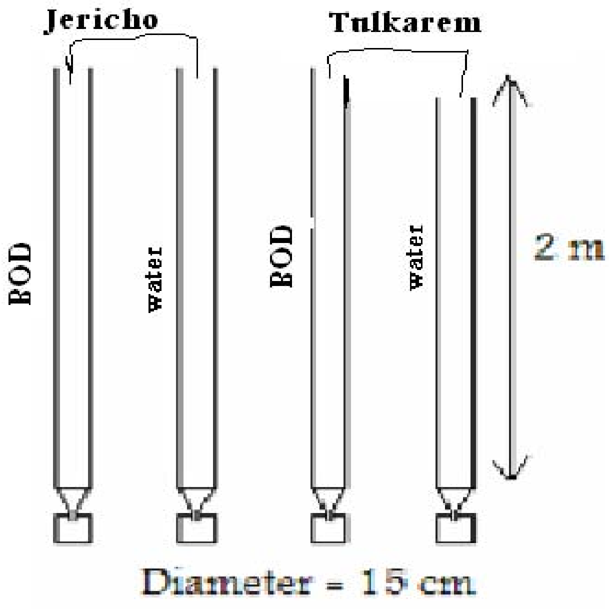

Figure (3.3) Experiment work columns of group (b) short 10 year effect

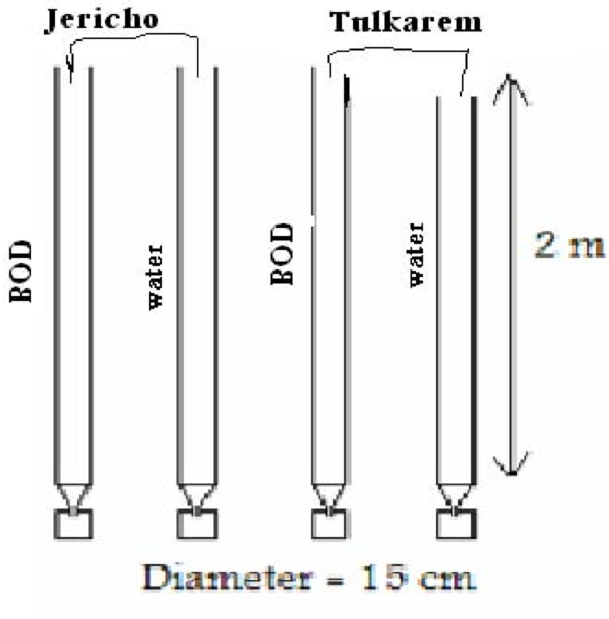

Figure (3.4) Experiment work columns of group (c) short 25 year effect

Figure (3.5) Experiment set up

3.8 Sample Preparation for Blank and Leachate (BOD) Analysis

Sample 1: tap water for blank addition.

Sample 2: the standard concentration of BOD was prepared by mixing 250g of dry sheep compost with 12 liters of water for 5 days. The concentration of BOD becomes about 605 ppm, this concentration not stable may decrease or increase.

3.9 Amount of Water and BOD Added

The amount of water and BOD added was calculated in comparison to the Palestinian weather forecast department (2009)[16]

The average of rain water falling yearly in Tulkarem is about 550 mm, falling in 30 days during winter yearly and 150 mm falling in about 20 days during winter yearly.

The volume of water that was added to each column for one year equals the BOD that was calculated as shown in the equation below

$$\text{Vml (1 year)} = \frac{\Pi r^2 d}{10}$$

Where

r : radius

d : amount of rainfall yearly

V (mL) : Volume of rainfall yearly in one column

Table (3.4) volume of water and BOD (600 mg/l) was added every time in cm^3

	Jericho columns	Tulkarm columns
One year	132 cm^3	324 cm^3
10 years	1325 cm^3	3240 cm^3
25 years	3314 cm^3	8102 cm^3

3.10 Dissolved Oxygen (DO)

DO was measured by HANNA HI 93732 instruments (direct reading)

3.10.1 Measurement Procedure for (DO)

A 60 ml of unreacted sample was filled into BOD bottle and closed with capped then the cap was removed and 5 drops HI93732A and 5 drops of HI93732B was added, the bottle was capped again and swirled the solution. To become orange, the sample replaced to stand.

After 2 minutes 10 drops of HI93732C was added and replaced the cap and swirl the solution, the sample is ready when it is yellow.

Then the covet filled to 1.5 cm(3/4) below the rim with low of unreacted (original) sample, this is the blank.

Then the covet was rinsed with reacted sample. Then filled up to 1.5 cm(3/4) with low of reacted sample, then the covet reinserted in the instrument, (the result directly), by instrument.

Chapter four

Results and Discussion

4.0 Results and Discussion

After each time we added BOD and water the Leachate was collected from each column, and analyzed to test the concentration of BOD,TDS, DO, for each sample. The results shown in Tables (4.1 to 4.4).

The columns (1-4) show the effect of one year, and the amount which was Leachated was very small due to the amount of water which was added to each column.

4.1. Leachate Analysis Results :

Due to limitations, on available laboratory analysis, only the chemical analysis is related to leachate coming out of soil columns (with depth 2.0 m) to study the impact of 25 years, 10 years, 1 year effect when soil was treated with standard solution of BOD with 600 ppm, except the blank columns, the leachate was analyzed at each column, results are discussed in the following paragraph.

The concentration of measured in the leachate collected from the twelve columns (six for soil collected from Jericho, the other soil from Tulkarm), were analysed as a function of time (rain water application) and the results of BOD elevation are presented in table (4.1 to 4.5) and appendix(A,B). The results in table 4.1 collected from leachate, coming out of columns, which study the impacts of 25 years treatment soil tulkarm with standard polluted solution with 600 ppm of BOD, and blank treatment of soil with tap water, to make comparison with Jericho soil, where the result was collected in table 4.2, the concentration in BOD, TDS, DO, was measured and labeled in table 4.1. The result in table 4.3 and 4.4, the same as in table

4.1 and 4.2, but table 4.3 and 4.4 to study the impact of 10 years treatmed soil of tulkarm and Jericho. With the same condition in 25 years treatment. The water which was used in the experiment was tap water from municipality, with a TDS of 310 mg/L, Ca 60 mg/L, Mg 11.8 mg/L, Na 31.9 mg/L, K 2.5 mg/L, PO_4 0.02 mg/L, NO_3 18.2 mg/L.

Table (4.1) Concentration of (BOD, TDS, DO) in ppm of Leachated sample from columns soils of Tulkarm representing 25 years effect.

date	* 25 years Tulkarem BOD			+ 25 years Tulkarem water		
	BOD	TDS	DO	BOD	TDS	DO
2/4/2009	118	1380	3.1	91	760	5.7
3/4	129	1260	2.1	100	800	4.9
5/4	189	1220	1.1	96	666	7.8
7/4	320	1010	0.8	120	710	3
12/4	549	1120	4.3	65	450	2.6
14/4	139	1030	7	113	511	9.6
22/4	188	892	5.2	86	437	9.8
24/4	118	733	3.8	16	360	8.6
29/4	220	844	1	32	378	6.4
1/5	207	828	3	48	340	6.2
10/5	281	1251	2	10	202	7.8
14/5	267	1130	1.2	130	345	1.8
16/5	270	992	2.2	104	372	8
20/5	343	1163	1.6	102	260	8.6
27/5	442	1138	1.2	88	333	7.7
30/5	556	1210	0.6	67	445	8.3

Table (4.2) Concentration of BOD, TDS, DO, in ppm of Leachated sample from columns soils of Jericho representing 25 years effect.

Column type	* 25 years Jericho BOD			+ 25 years Jericho water		
Date	BOD	TDS	DO	BOD	TDS	DO
3/4/2009	140	1310	4.4	91	680	7.9
5/4	186	1160	3.8	43	720	9.2
7/4	197	1210	4.1	27	500	9.4
12/4	318	1180	1.7	59	610	6.7
14/4	386	1015	5.8	91	580	8.6
17/4	159	1111	1.5	51	565	5.9
22/4	140	995	3.1	56	541	9.5
24/4	220	808	8.3	15	349	9.7
29/4	260	1016	6.7	16	389	6
1/5	235	943	2.3	11	368	8.5
10/5	200	801	1	10	322	6.9
17/5	306	710	1.2	7	211	7.1

Table (4.3) Concentration of BOD. TDS, DO, in ppm of Leachated sample from columns soils of Tulkarem representing 10 years effect.

Column type	* 10 years Tulkarem BOD			+ 10 years Tulkarem water		
Date	BOD	TDS	DO	BOD	TDS	DO
3/4/2009	140	967	6.3	120	410	3.6
5/4	207	789	Low range	151	348	6.1
7/4	232	890	2.8	115	290	7.8
12/4	281	880	3.8	5	380	Up range
14/4	290	870	6.8	71	312	7.4
19/4	302	770	3.7	53	273	4.3
22/4	375	844	5.5	54	373	7.1
24/4	378	795	2.9	21	305	Up range
29/4	321	883	5.8	5	307	7.3
1/5	300	1013	3.7	20	262	5.5
14/5	365	845	2.8	12	243	3.6
16/5	512	850	Low range	160	375	3.6
20/5	205	835	3.2	80	365	5.4
22/5	218	785	4.6	70	289	6.
27/5	195	780	3.1	108	308	7.2
30/5	478	883	1.2	91	352	7.6

Table (4.4) Concentration of BOD. TDS, DO, in ppm of Leachated sample from columns soils of Jericho representing 10 years effect

Column type	* 10 years Jericho BOD			+ 10 years Jericho water		
Date	BOD	TDS	DO	BOD	TDS	DO
5/5/2009	182	963	4.2	48	841	5.6
10/5	270	778	2.1	81	625	3.6
13/5	260	820	3.6	32	510	6
14/5	378	760	2.1	19	485	6.3

* BOD refers to solution that has 600 ppm of BOD + water refers to the blank column (no BOD in water just from the soil)

4.1.1 Changes in BOD

The data was collected in tables (4.1 - 4.4) (Appendix a), appears that in April the BOD concentration of the leachate collected from columns was increased with time, in all leachate samples coming out from columns, but the rate concentration of soluble organics as BOD in columns of 25 years effect (table 4.1) of tulkarm soil, and table 4.2 of Jericho soil was increased more than in columns of 10 years treatment due to large amount of standard solution was used in treatment of 25 years effect, the soil become saturated with BOD, this appear clearly from the concentration of BOD in the soil layer table 4.5. in tables 4.1 and 4.2, there is found two an older reading higher than expected value in 12th april. The two samples are not analyzed directly after collected, and not placed at 4 temperature, which may increase the activity of microorganism as bacteria and increase the concentration of biodegradable organics compound (BOD). And support this suggestion, the low concentration of DO at this time, the concentration of BOD in the blank column was decreased with time. This BOD was found in the soil which was filled in each column. This decrease was due to the rinse of water and was referred as blank column. By looking at table 4.1 and 4.2 which represent the concentration of BOD for 25 years in both Tulkarm and Jericho we found that the concentration of BOD was higher in Jericho soil (Table 4.2). This difference was due to the nature of soil of Jericho than Tulkarm (see physical properties of soil analysis in table 3.3 ch3). Jericho soil described as (sandy soil) with large pores which increase the permeability of the soil due to the sand fraction 60.5% in Jericho soil, but 9.65% in tulkarm soil, due to large holes between grains of sand soil of Jericho, accelerate BOD to travel through sand particles then reach the ground water with time, so the concentration of BOD and TDS in leachate from Jericho soil higher than leachate from from tulkarm soil which describe the clay soil. That decrease the permability of soil. This appear clearly in april.

But in May the concentration of BOD in leachate increases in Tulkarm soil more than in Jericho soil, this differences due to the large amount of solution of BOD was added each time in Tulkarm more about four times than that added to Jericho, due to the amount of rain fall yearly the soil become saturated in the columns of Tulkarm more than Jericho. About 30 times of BOD were added to the column representing Tulkarm soil. In the other hand 20 times were added to Jericho columns.

The data in Table 4.3 and 4.4 which represent the leachate concentration for both Tulkarm and Jericho for 10 years study. The concentration of BOD increase with time as in 25 years study, but in Tulkarm soil (table 4.3) was higher than in Jericho (table 4.4). The reason behind that, the amount of rain fall in May is higher in Tulkarm than Jericho. The standard solution was added not enough to pass through the column, The amount of standard solution of BOD added was higher for Tulkarm. Other reason, in May the high temperature in Jericho is much higher than April and this will lead to some evaporation of solution from the column of Jericho soil. This conclusion was observed in the blank columns.

The study of leachate effects of BOD in soil for one year, study showed no effects for the leachate to ground water. This reason due to the small amount of rain fall in one year. This study was represented for columns (1,2,7,8). The only study was done on the analysis of their soil after the leachate . These studies were both BOD ,TDS , TN ,TP. The results are shown in Table 4.5 , further discussion will be followed.

In general soluble organics (as BOD, COD) also decreased in the leachate out of the soil column compared to the entering, the decrease might be attributed the bacterial decomposition within the soil. In addition to the filtering capacity of the soil, this explanation supported by that the concentration of BOD in layers of soil in table 4.5 where the concentration of BOD in soil layers in the column where BOD solution was added higher than found in soil layers of blank where water was added.

4.1.2 Changes in Dissolved Oxygen (DO)

The concentration of dissolve oxygen DO in leachate coming out of columns was decreased with time in all columns when soil was treated with standard concentration of BOD, this decrease due to the increase in BOD concentration. In all cases appear that when BOD was increased the DO was decreased, there is negative correlation between DO and BOD.

Any oxidizable material present in a natural water way or in an industrial waste water, sewage water, will be oxidized both by biochemical (bacterial) or chemical processes. The result is that the oxygen content of the water will be decreased, basically the reaction for biochemical oxidization may be written as:

Oxidization material+ bacteria+ nutrient+ $O_2 \rightarrow CO_2 + H_2O$+ oxidized inorganics such as NO_3^- or SO_4^{-2}.

This decrease in DO in soil and water will affect negatively on the crops in both soils of Jericho and tulkarm.

4.1.3 Total Dissolved Soids (TDS)

The concentration of TDS in the leachate collecting out of the columns were recorded in table 4.1 and 4.4, (appendix A)

The concentration of TDS in the leachate sample from columns was treated with both 600 ppm BOD and water were decreased with time in both soils of tulkarm and Jericho.

The study showed that irrigated the soil by known concentration of BOD at the first days TDS concentration was higher then decreased with time, at the first the BOD solution leachate the soluble ions as (Mg, K, Na, Ca, Fe) from the soil.

Appear that there is relation between the BOD concentration in the leachate sample and TDS when BOD was increased TDS was decreased as shown in appendix A and tables (4.1, 4.4).

The result of TDS concentration in both two soils was decreased with time. Indicate that the two soils are active to leachate TDS from soil, and this TDS during time reach to ground water, and increase the TDS in drinking water and irrigated water which affect negatively on human body and plants growth will decline, because the water become salty, indicate that if the sewage water disposed or collected in wells near clean water at the time through the permeability of soil found road to pollute the clean water. (17)

Another explanation for the decrease of TDS concentration the large cations like Mg^{+2}, Fe^{+3}…etc absorbed through soil layer and the percent of these cations are less than small, cations like Na^{+}, K^{+}, are absorbed on soil surfaces, as shown in table 4.5 which appear that the concentration of TDS in soil layer which support this explanation.

4.2 Soils Analysis

At the end of added (BOD and water) every column divided into three parts, top, middle and bottom of each columns, the soil sample was collected from each part to find the concentration of (BOD, TDS, %P, %N). shown in table 4.5 and appendix (b)

Table (4.5) concentration of BOD. TDS, %N and %P at different depth.

Column	top				Middle(1m)				bottom(2m)			
	BOD	TDS	%N	%P	BOD	TDS	%N	%P	BOD	TDS	%N	%P
1	200	57	0.173	0.0707	189	43	0.263	0.039	170	52	0.314	0.0422
2	138	44	0.213	0.027	-----	46	0.311	0.054	100	48	0.298	0.046
3	216	75	0.198	0.078	162	40	0.196	0.048	160	47	0.208	0.066
4	100	38	0.205	0.028	83	46	0.1862	0.021	75	34	0.126	0.057
5	290	90	0.210	0.095	280	59	0.261	0.075	265	41	0.287	0.061
6	90	47	0.311	0.015	100	49	0.186	0.0133	62	29	0.225	0.005
7	250	115	0.261	0.05	190	159	0.291	0.083	173	168	0.321	0.136
8	113	32	0.187	0.0306	81	42	0.282	0.112	70	160	0.301	0.126
9	256	129	0.139	0.099	200	65	0.145	0.046	192	50	0.153	0.036
10	140	37	0.125	0.076	86	39	0.072	0.039	77	38	0.087	0.039
11	300	185	0.117	0.035	220	197	0.118	0.007	290	44	0.07	0.0025
12	65	31	0.103	0.015	54	38	0.085	0.017	10	28	0.124	0.0104

4.2.1 BOD Analysis in Soil Layers

By looking at Table 4.5 the concentration of BOD was decreased in the soil layers from top to the bottom due to the daily addition of BOD in both soils (Tulkarm and Jericho).

The increased of BOD concentration in Tulkarm soil in each layer compared with Jericho soil was due to the higher amount of BOD added to Tulkarm soil.(more rain). Leachate accumulation of BOD within soil layer of tulkarm due to physical property of clay which decrease the permeability of the soil comparing with Jericho soil. And explane that the concentration of BOD in leachate sample was collected from Jericho soil column which higher than the concentration of BOD in leachate sample was collected from tulkarm soil columns tables 4.1 and 4.2. Other reason leading to the increase 0f BOD in bottom layer is the shortage of TDS.

In the other side, the BOD concentration in the blank column soil decrease with time in both blank Jericho and Tulkarm, with depth (top to bottom).

4.2.2 TDS in Soil Layers

The TDS concentration level in Tulkarm layers, was higher than in Jericho soil levels, this was due to most of salts staying in Tulkarm soil. Due to the type of Tulkarm soil which is clay soil that adsorb cations like Na^+ and K^+ more than Jericho soil. Other observation was the TDS in the bottom layer of Tulkarm soil was higher than the top layer due to the accumulation of salts in the bottom layer. This indicate that Jericho soil is more active to leachate ions due to the permeability of sandy soil of Jericho.

Some variations in results of TDS was due to different amount of rain fall in Tulkarm than in Jericho, which was applied and look in consideration during our study.

Salt in soil affects directly in crops and plants growth, which controls the physical property of soil, if concentration percent of mono cation as sodium higher than the bication (Magnisium, Calcium), the impact of sodium cation makes soil aggregates, also it disperse clay metal, and precipitate between soil pores, and on the surface, caused surface crusting and decreases permeability, pores ness of soil.

The continuous arrogation of crops with BOD, or water in Jericho with high rate of evaporation at summer the soil become during the time salty.

4.2.3 Total nitrogen (TN) total phosphorus (TP)

The concentration of total nitrogen and total phosphorus in the soil layers found to increase with depth from top to bottom, when was treated soil with BOD, indicate that the efficiency of soil in removing nitrogen and phosphorus from waste water is significantly affected by both types of soil and weather (as amount of rain fall yearly, tempreture). The rate of removal was higher in Jericho soil more than Tulkarm soil, nitrogen removal depends basically on the intensity of nitrofication and denitrofication. The higher concentration of nitrate during the treatment with BOD because of the oxidation of NH_4^+-N and inhabitation of NO_3^--N (nitrate) reduction.[28]

The concentration of total Nitrogen in the soil layer found to increase with depth and with time in the columns, during water addition in the blank, this was due to nitrate ions(NO_3^-) which pair with base cations and this lead to accumulation in or within soil layers. [22]

Columns representation:

Column 1: Soil Of Jericho BOD One Year Effect.

Column 2: Soil Of Jericho Water One Year Effect.

Column 3: Soil Of Jericho BOD 10 Years Effect.

Column 4: Soil Of Jericho Water 10 Years Effect.

Column 5: Soil Of Jericho BOD 25 Years Effect.

Column 6: Soil Of Jericho Water 25 Years Effect.

Column 7: Soil Of Tulkarem BOD 1 Year Effect.

Column 8: Soil Of Tulkarem Water 1 Year Effect.

Column 9: Soil Of Tulkarem BOD 10 Year Effect.

Column 10: Soil Of Tulkarem Water 10 Year Effect.

Column 11: Soil Of Tulkarem BOD 25 Year Effect.

Column 12: Soil Of Tulkarem Water 25 Year Effect.

Chapter five

Conclusion and Recommendations

5.1 Conclusions:

During the study of BOD leachate, it was found that BOD leachate was increasing with time when i add more volume of BOD solution which has a concentration of 600 ppm and decreasing in column of blank when water added, in both soils. The BOD in Jerico soil showed more BOD concentration due to the reasons mentioned in the results and discussion.

- TDS of leachate from columns were BOD solution was added decreases with time.
- The dissolve oxygen (DO) decreases with increasing of BOD concentration.
- The BOD concentration in the layers of soil (Top, Middle and Botom) increases with depth and time and decreases in the layers of soil of the blank columns where water were added in both types of soil.
- The TDS in the soil decrease with depth but in Tulkarem soil, TDS concentration more than that found in Jericho soil indicate that the Jericho soil more active to leachate TDS.
- The total nitrogen present in the soil layers increases with depth in blank columns, but decreases with depth (soil layers) with time were BOD solution added.

5.2 Recommendation

Whatever is source, nitrogen (N) essential for achieving optimum yields of grain, forage, and other crops. The same is true of phosphorus (P) and other nutrients. Applying too much nitrogen or phosphorus to crop land can have adverse effects on the environment. Achieving optimum yield without applying excessive nutrients should therefore be a goal of all farmers. Excess nitrogen and phosphorus in surface water and nitrogen in ground water cause eutrophication excess algae growth in surface water and health problems in humans and livestock as a result of high intake of nitrogen in its natural form.

If the sewage water reach the ground water or surface water (sources of clean water) the concentration of BOD reach a dangerous range and increase the concentration of TDS and nitrate ions, so the water becomes contaminated, not suitable for human activities or irrigation and increase the sodium ions in the soil layers which pores between them, and decrease the permeability of soil and increase the desert area due to use ground water in irrigation and the problem increases in the land where the rate of evaporation and transpiration in plants is more than the amount rainfall yearly, especially in Jericho with hot weather, increasing TDS in the

solution of soil decrease the osmotic potential and water potential which damage the crops.

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(21) http://www.esu13.org/soar/epa/soilfiltrationandpermeability.html

(22) **Impacts of solid waste leachate on soil and its simulation to ground water at nablus area.** Al-Najah National univircity by rami tuffaha , pr –M-Haddad, 2006.

(23) Lenore S. Clescerl, Arnold E. Greenberg, Andrew D. Eaton (1999). **Standard Methods for Examination of Water & Wastewater (20th ed.). Washington, DC: American Public Health Association. ISBN 0-87553-235-7.** Also available by online subscription at www.standardmethods.org

(24) A B Clair N. Sawyer, Perry L. McCarty, Gene F. Parkin (2003). **Chemistry for Environmental Engineering and Science (5th ed.). New York: McGraw-Hill. ISBN 0-07-248066-1**

(25) Katri Roppola et al. (2006). **"Comparison Study of Manometric Respirometric Test and Common Chemical Methods in the Determination of BOD7 in a Pulp and Paper Mill's Wastewaters".** Journal of Automated Methods and Management in Chemistry (Hindawi) 2006 (Article ID 90384): 1–5. doi:10.1155/JAMMC/2006/90384.

(26)**http://www.hindawi.com/GetArticle.aspx?doi=10.1155/JAMMC/2006/90384** .A B C Hammer, Mark J. (1975). **Water and Waste-Water Technology. John Wiley & Sons. ISBN 0-471-34726-4**

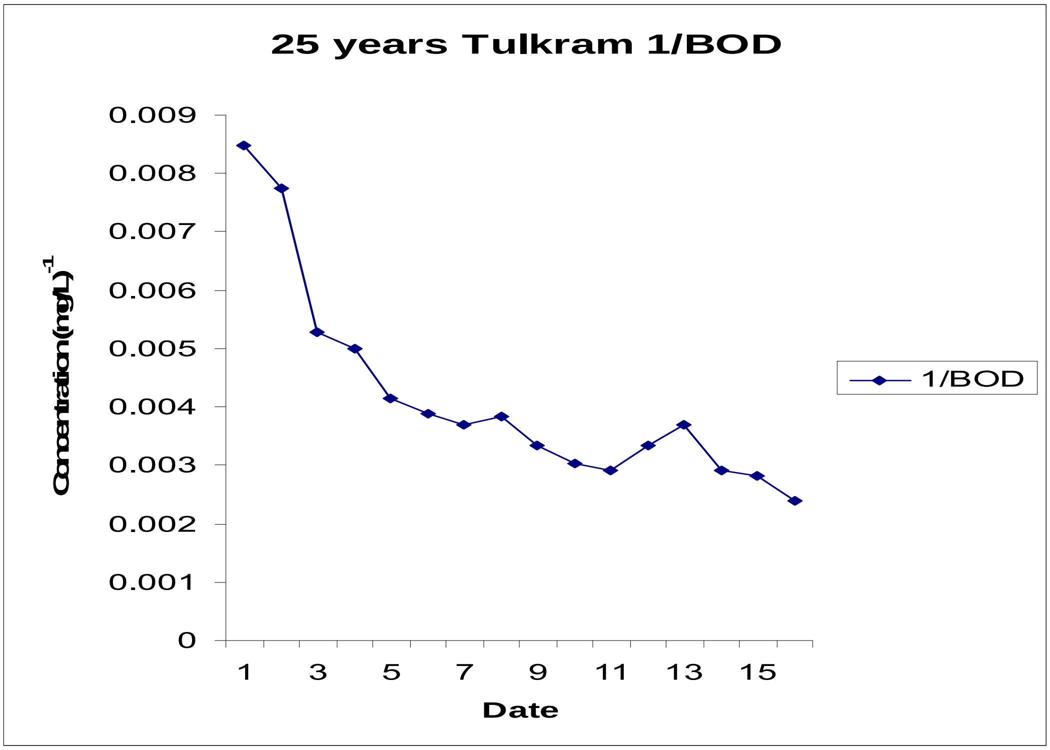
(27) **U.S. Environmental Protection Agency (EPA). Washington, DC.** "Secondary Treatment Regulation." Code of Federal Regulations, 40 CFR Part 133.

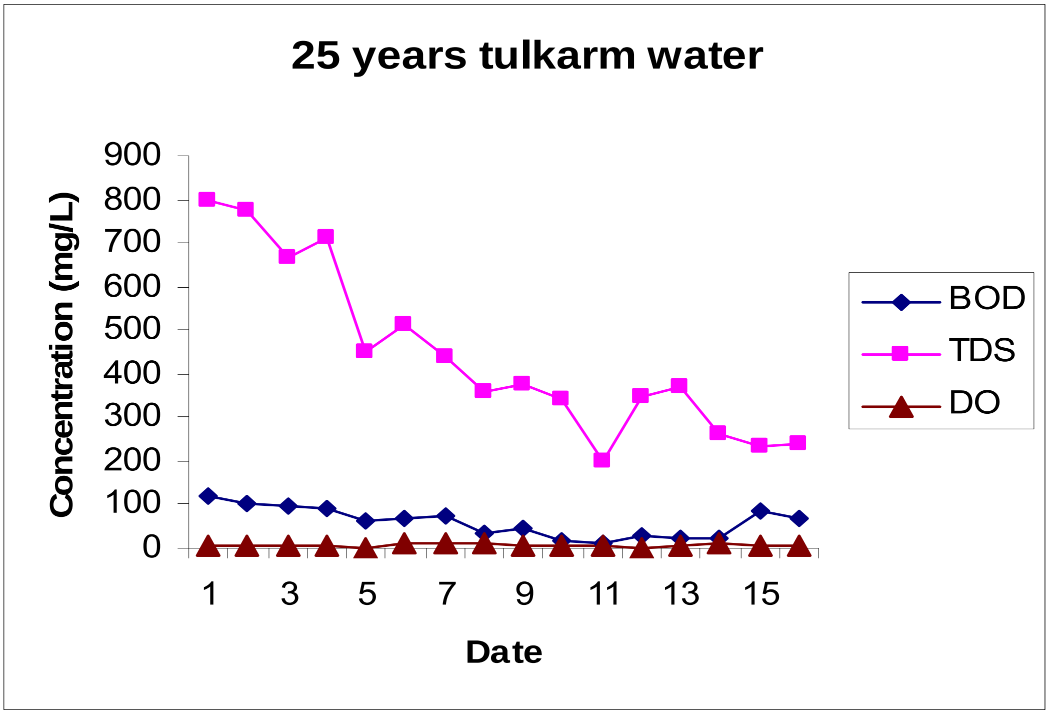
(28) http://www.agent.org/library/eb/519/, **treatment of domestic wastewater with a multi-soil-layering (MSL) system in a temprate and a tropical climate.**

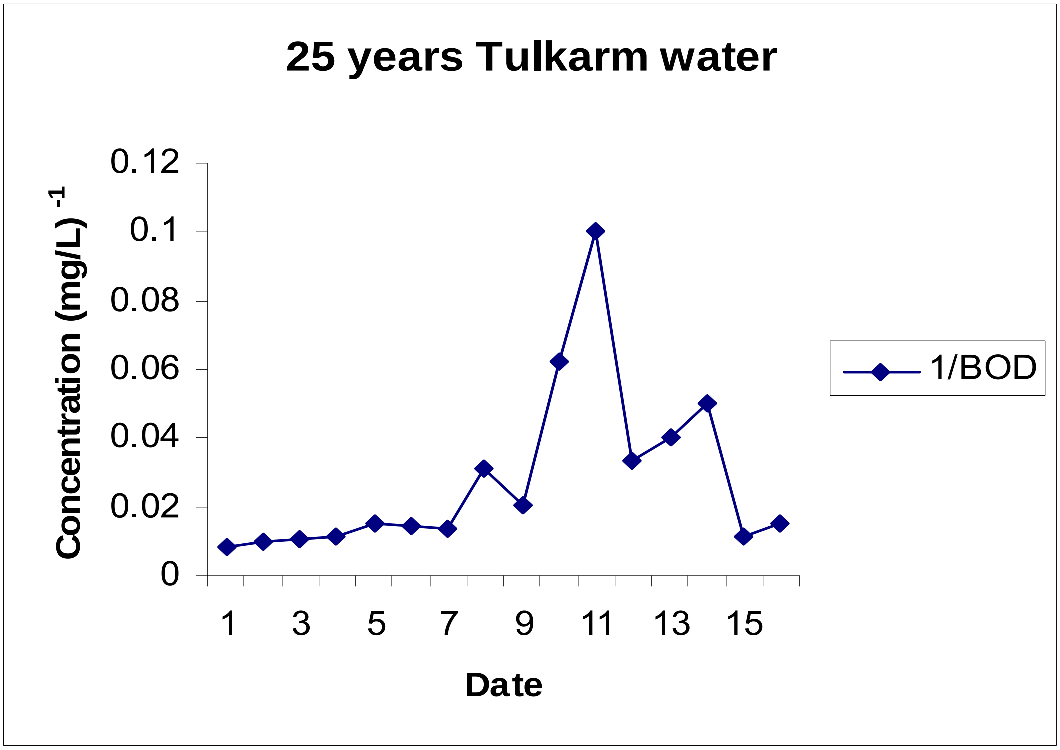
Appendix A

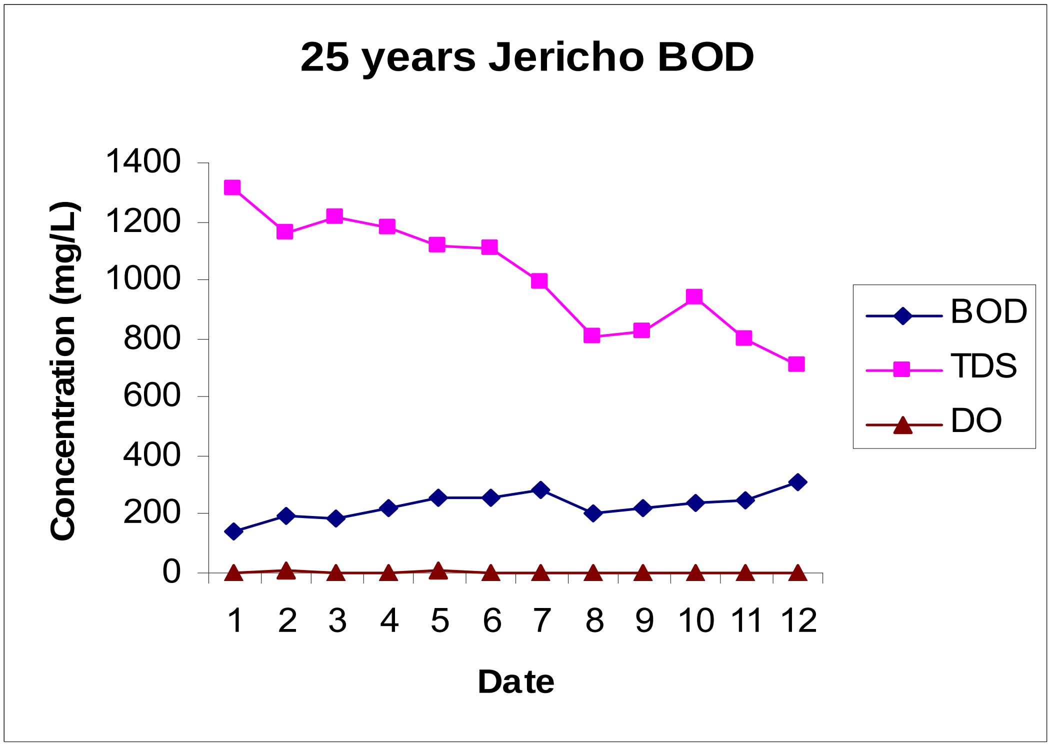
In all tables

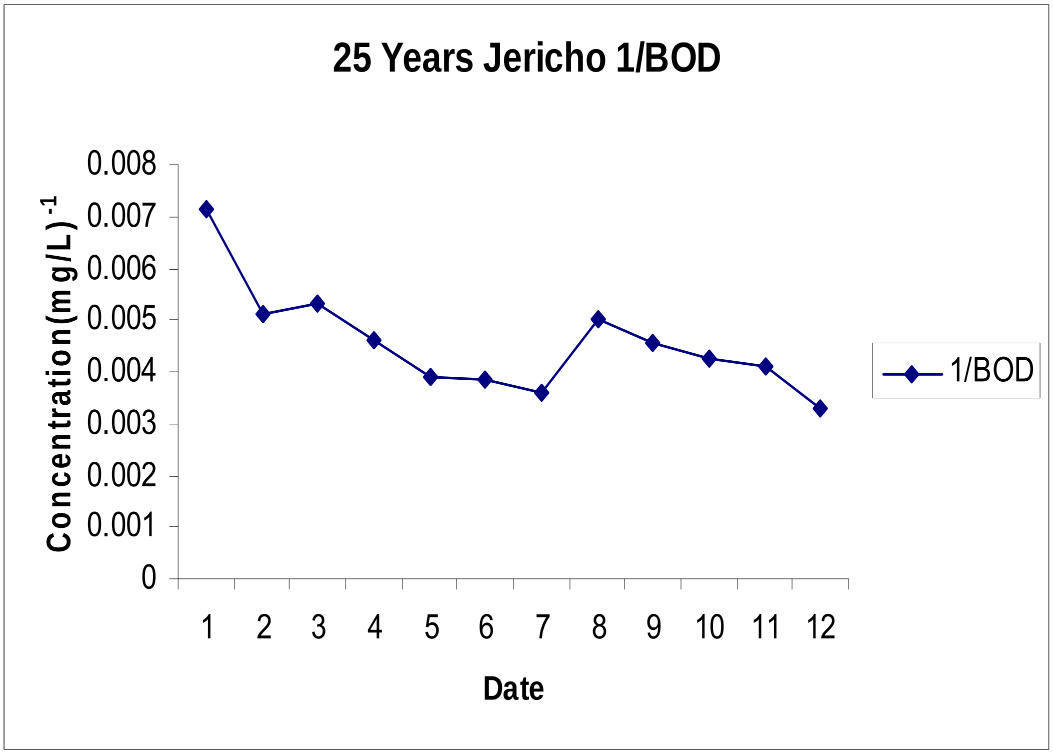
Date = day in specific month

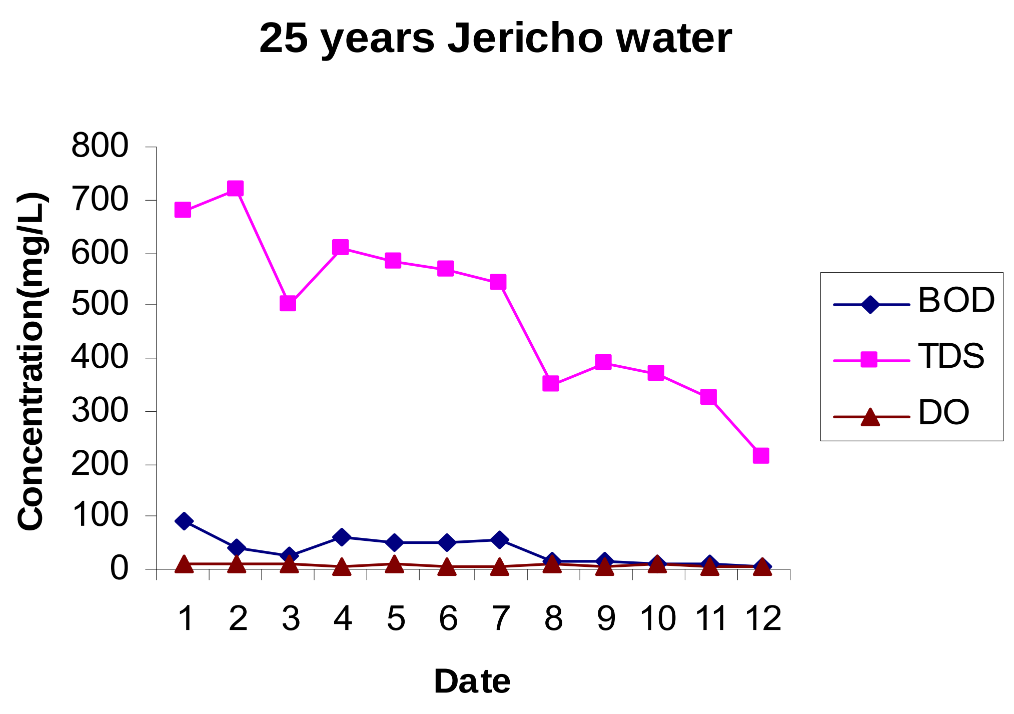


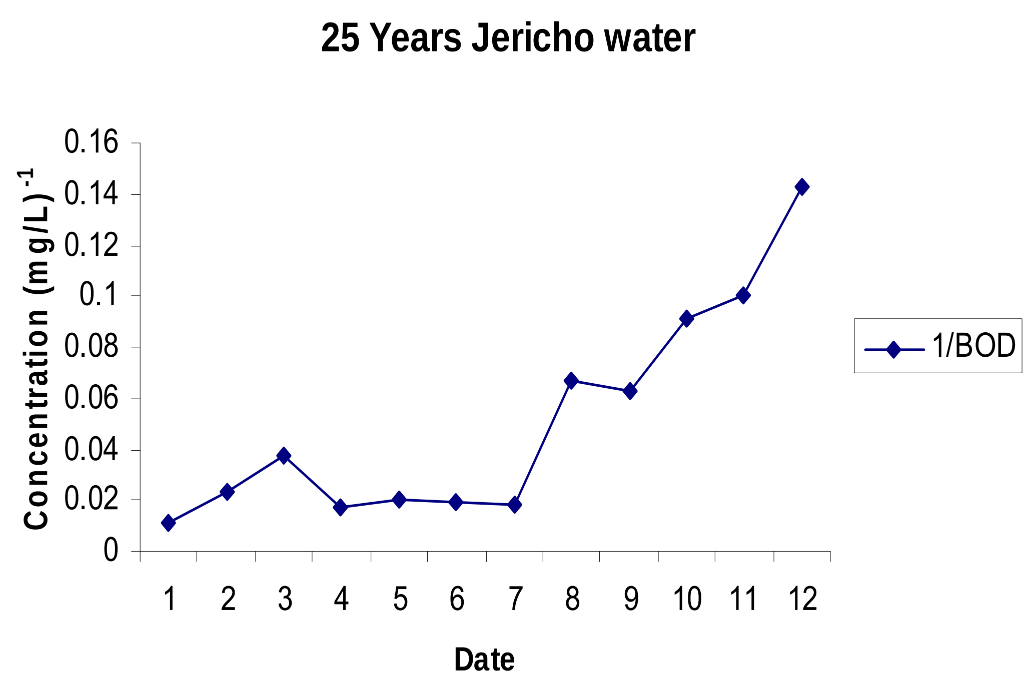

25 years tulkarm water
Concentration (mg/L)
900
800
700
600
500
400
300
200
100
0
1
3
5
7
9
11
13
15
Date
BOD
TDS
DO

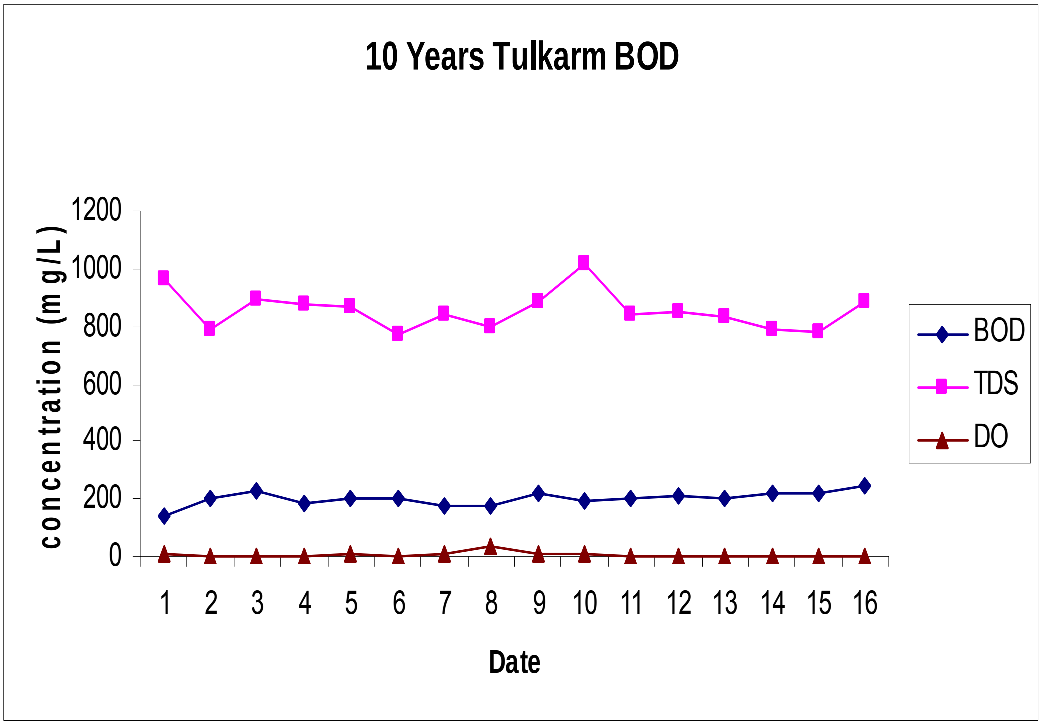

25 years Tulkarm water
Concentration (mg/L) -1
0.12
0.1
0.08
0.06
0.04
0.02
0
1
3
5
7
9
11
13
15
Date
1/BOD

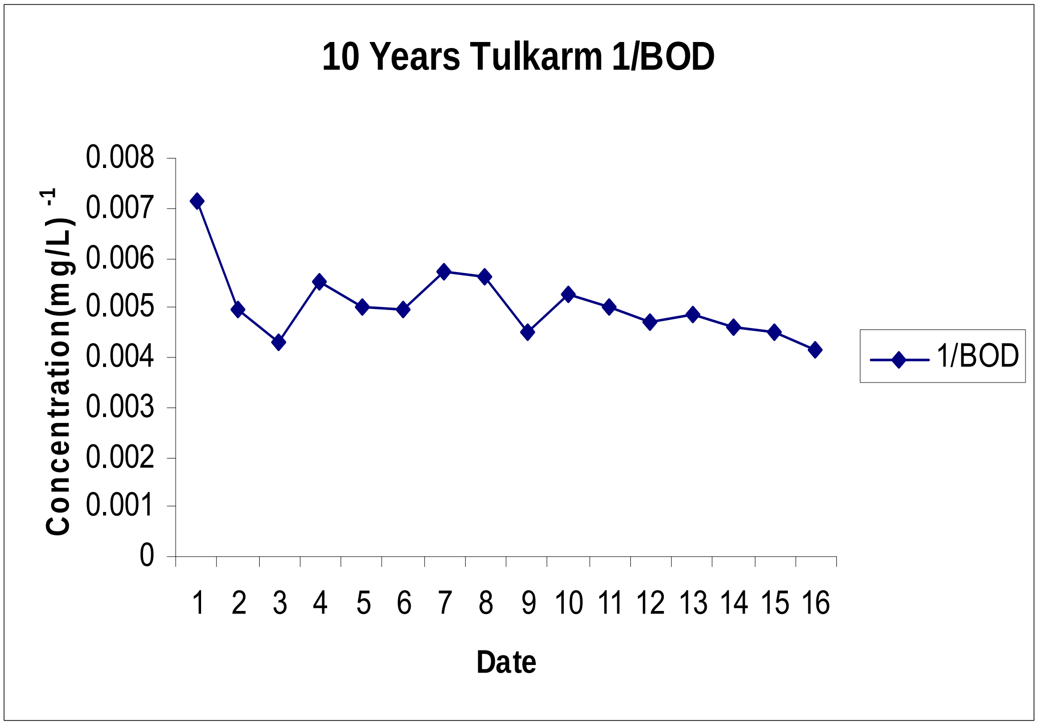

25 years Jericho BOD
Concentration (mg/L)
1400
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
10
11
12
Date
BOD
TDS
DO

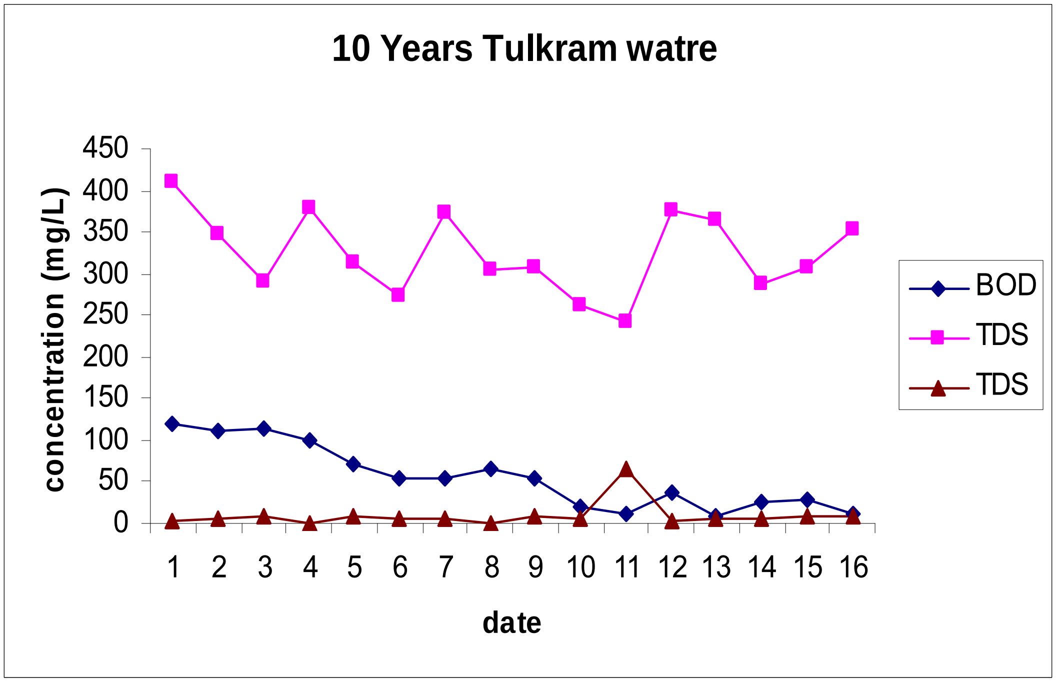

25 Years Jericho 1/BOD
Concentration(mg/L)-1
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
1
2
3
4
5
6
7
8
9
10
11
12
Date
1/BOD

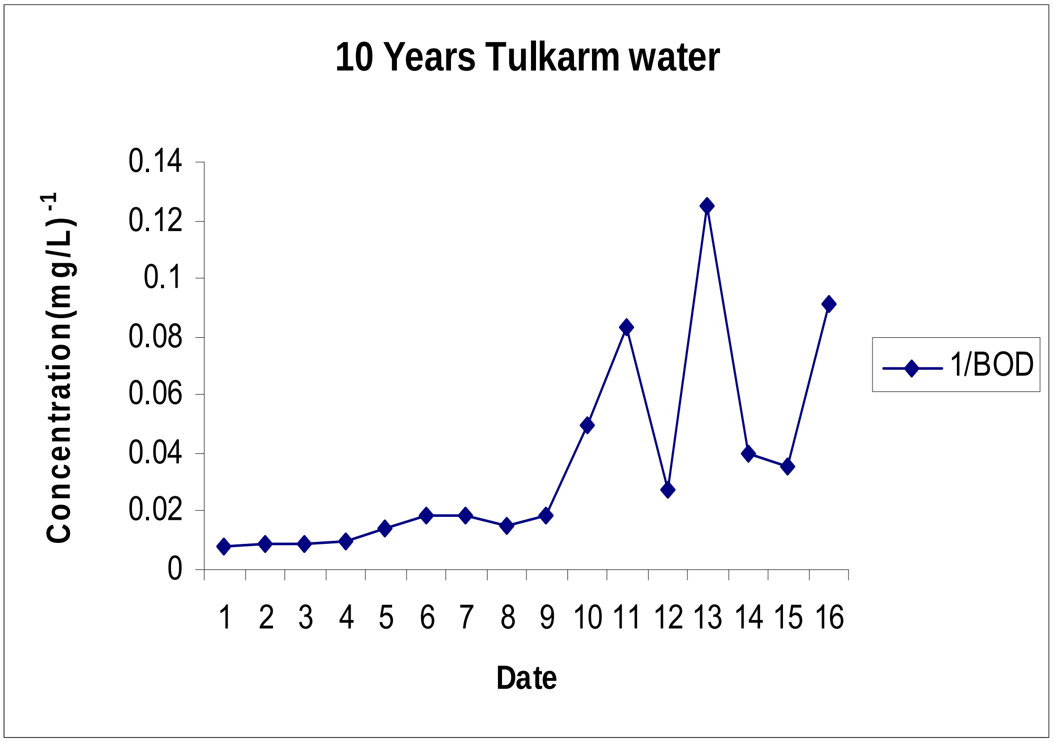

25 years Jericho water
Concentration(mg/L)
800
700
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
9
10
11
12
Date
BOD
TDS
DO

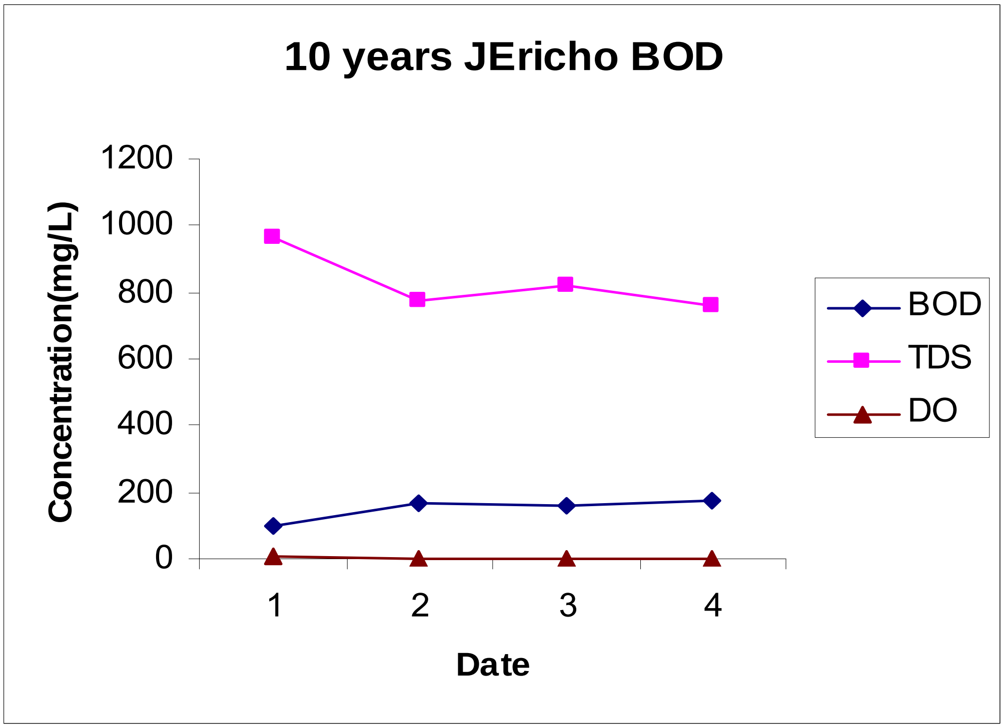

25 Years Jericho water
Concentration (mg/L)-1
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
2
3
4
5
6
7
8
9
10
11
12
Date
1/BOD

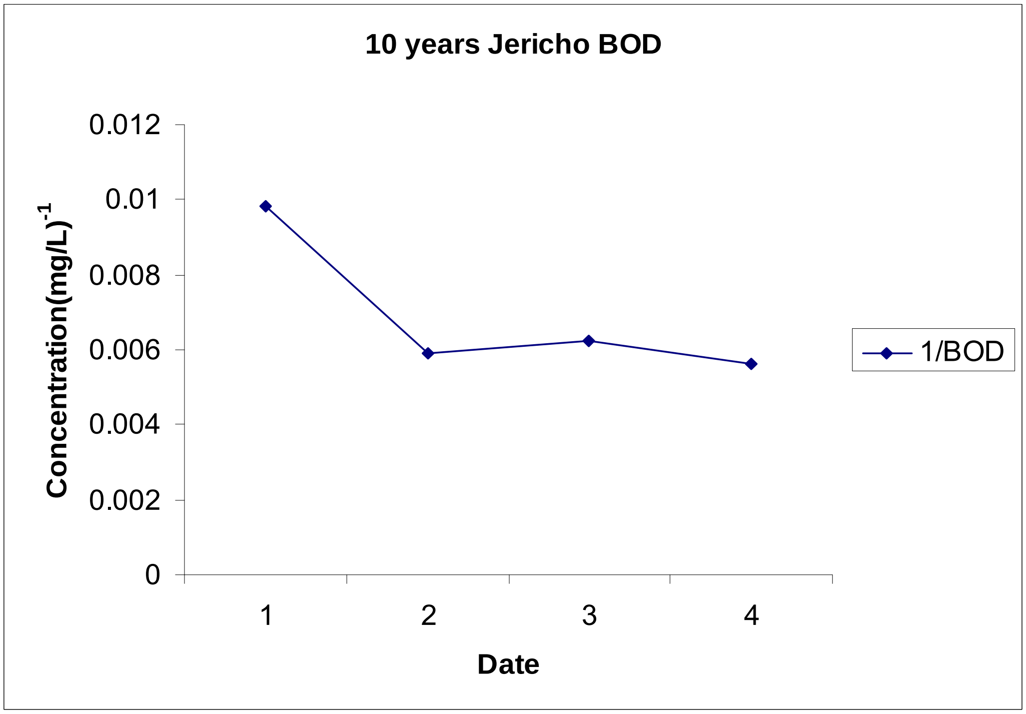

10 Years Tulkarm BOD
concentration (mg/L)
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Date
BOD
TDS
DO

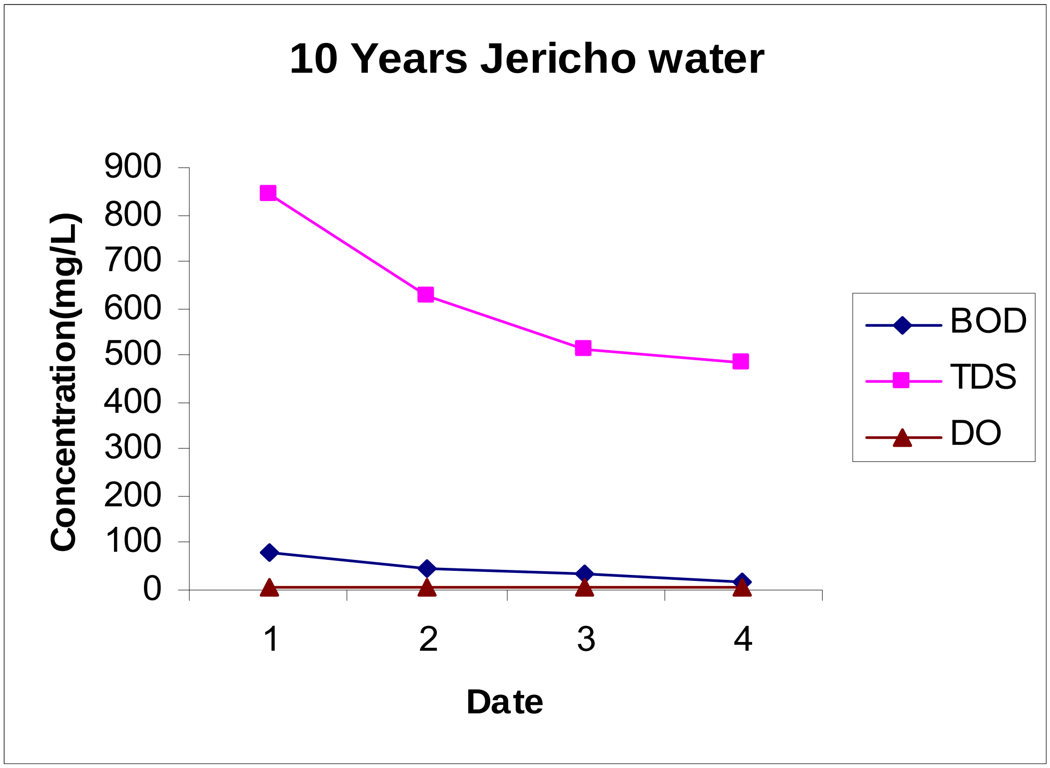

10 Years Tulkarm 1/BOD
Concentration(mg/L) -1
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Date
1/BOD

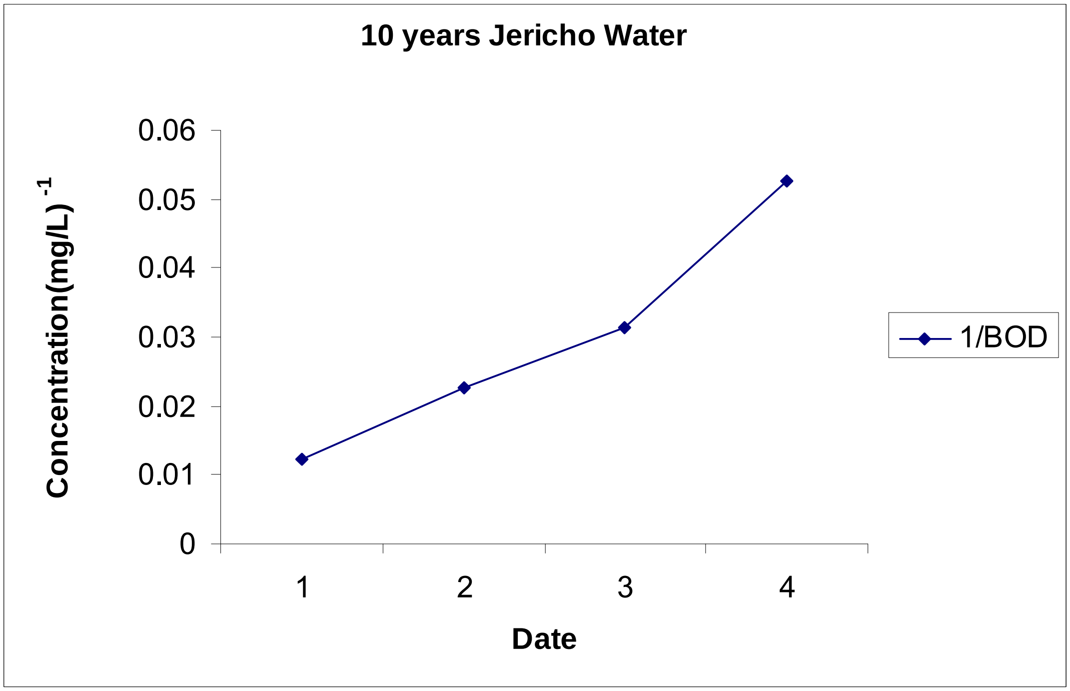

10 Years Tulkram watre
concentration (mg/L)
450
400
350
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
date
BOD
TDS
TDS


10 Years Tulkarm water
Concentration(mg/L)-1
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Date
1/BOD

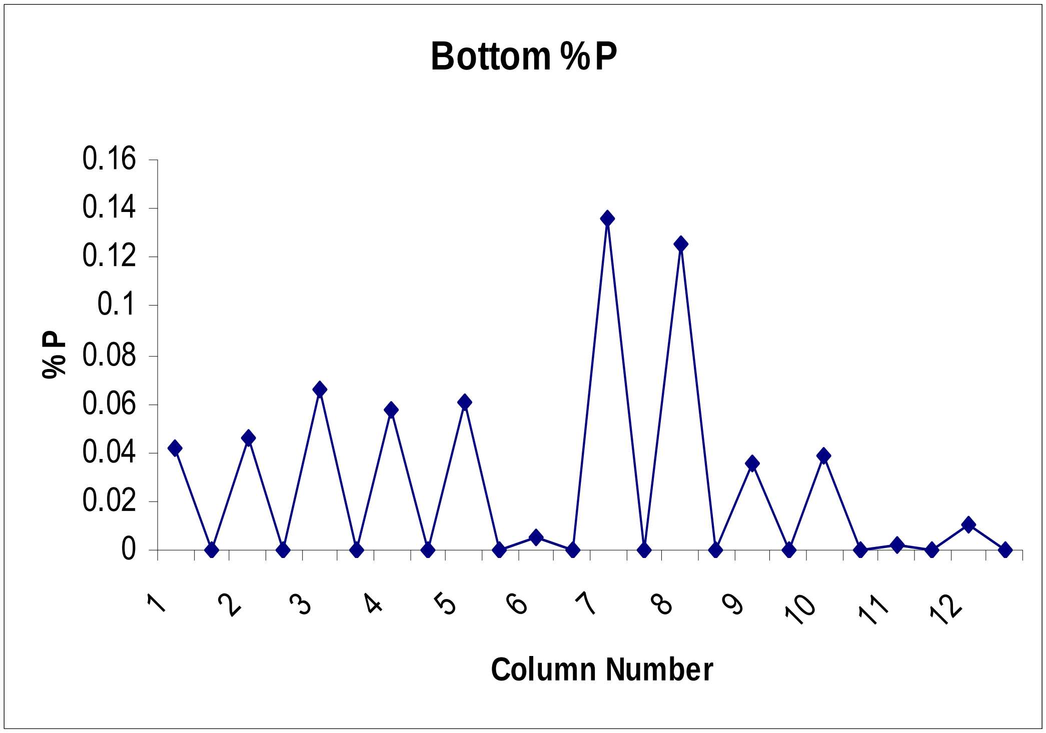

10 years JEricho BOD
Concentration(mg/L)
1200
1000
800
600
400
200
0
1
2
3
4
Date
BOD
TDS
DO


10 years Jericho BOD
Concentration(mg/L)-1
0.012
0.01
0.008
0.006
0.004
0.002
0
1
2
3
4
Date
1/BOD


10 Years Jericho water
Concentration(mg/L)
900
800
700
600
500
400
300
200
100
0
1
2
3
4
Date
BOD
TDS
DO


10 years Jericho Water
Concentration(mg/L) -1
0.06
0.05
0.04
0.03
0.02
0.01
0
1
2
3
4
Date
1/BOD

Appendix B


Bottom %P
%P
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1
2
3
4
5
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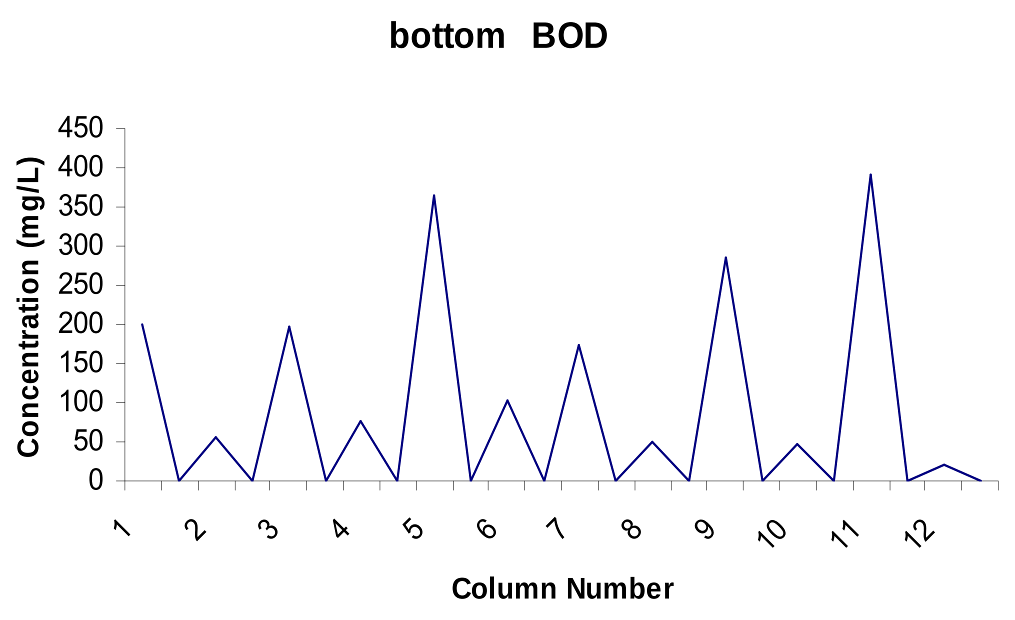
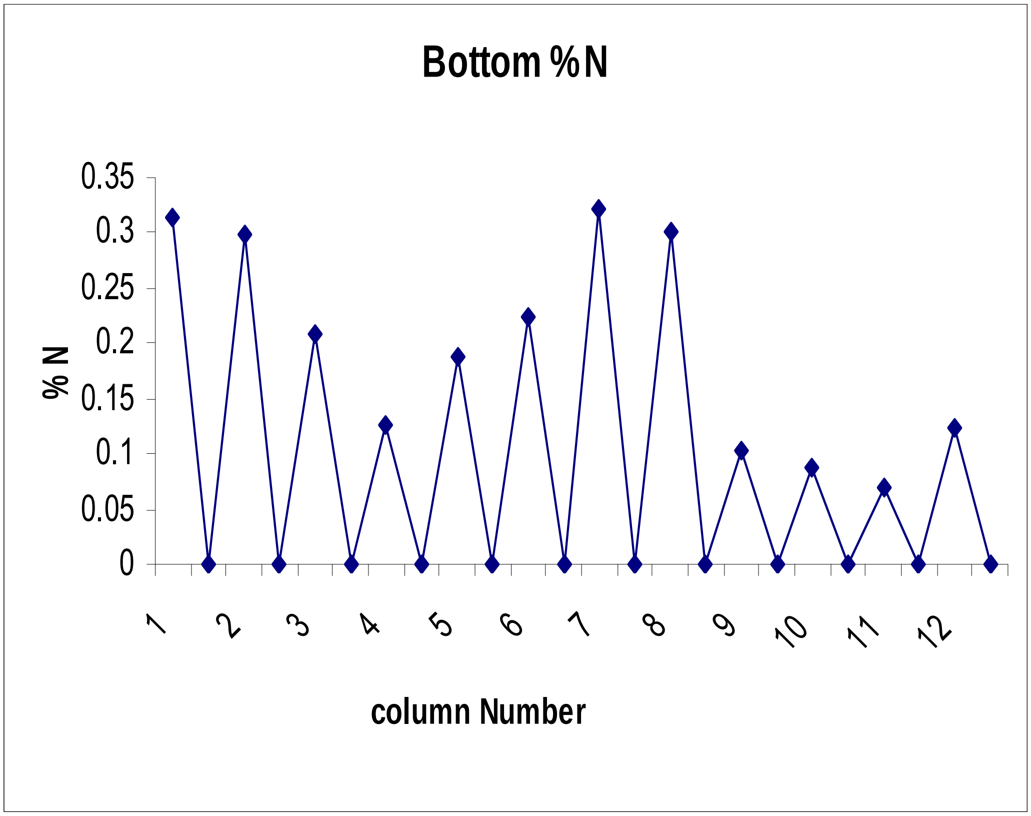
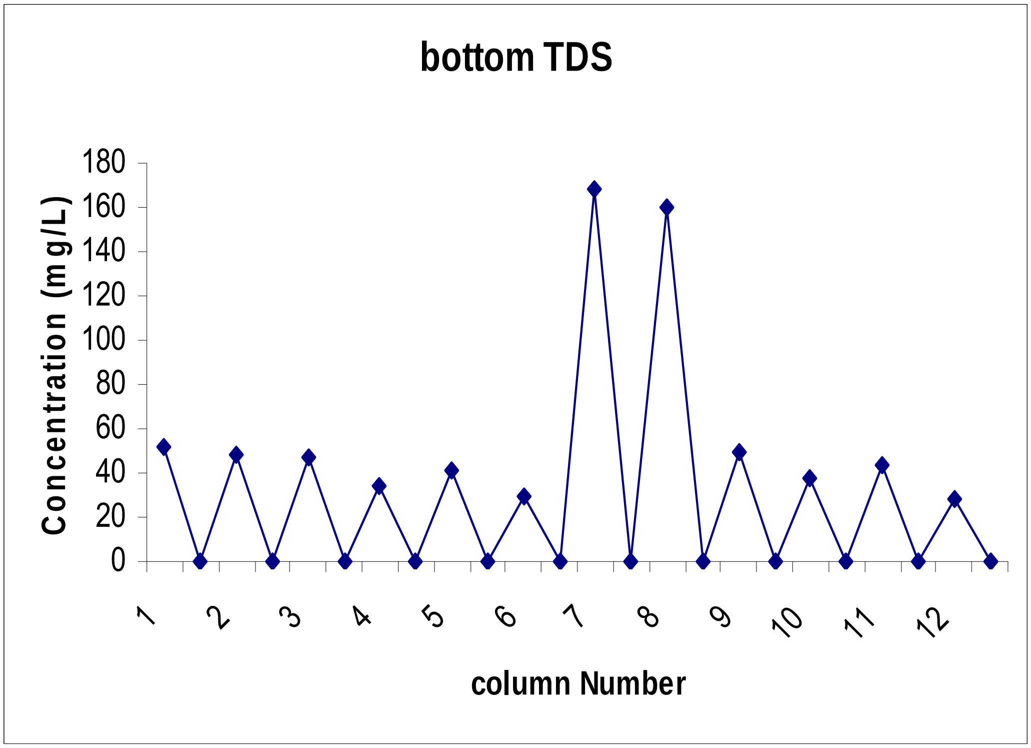
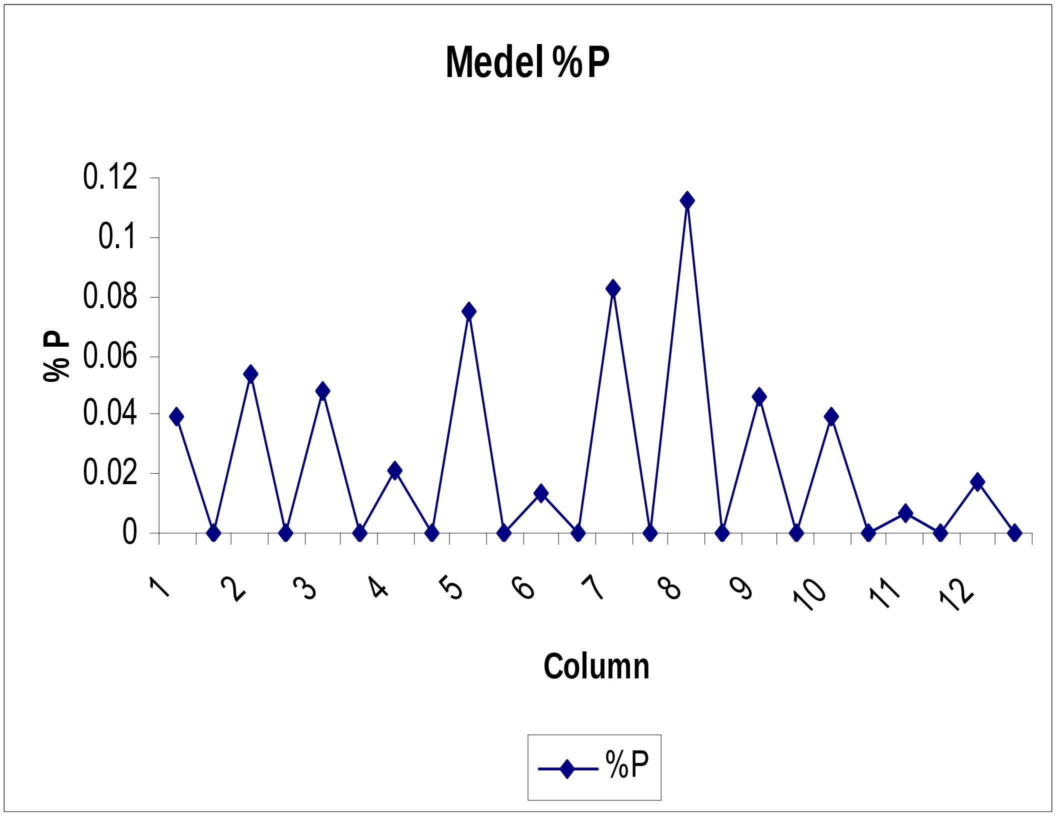
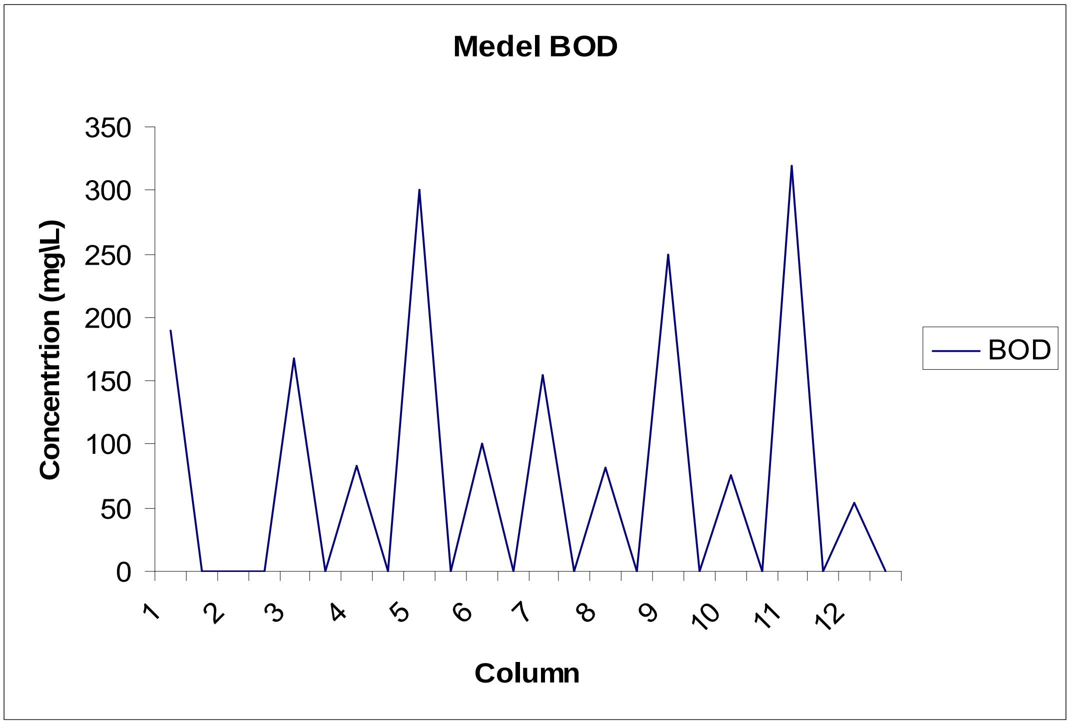
7
8
9
10
11
12
Column Number

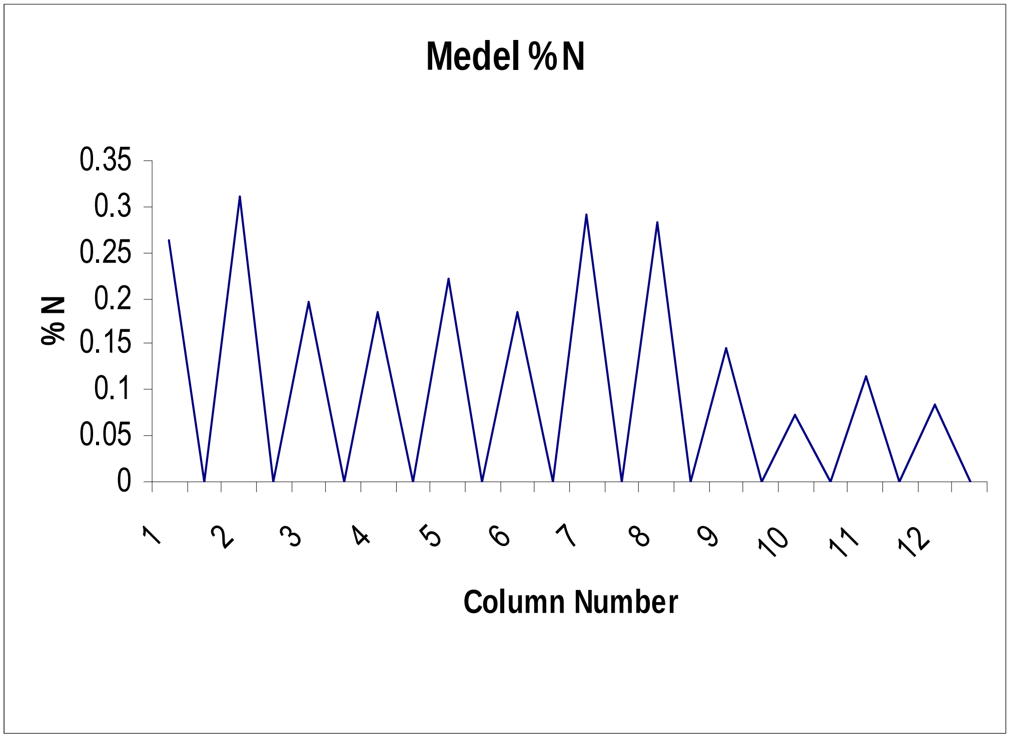

bottom BOD
Concentration (mg/L)
450
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
Column Number

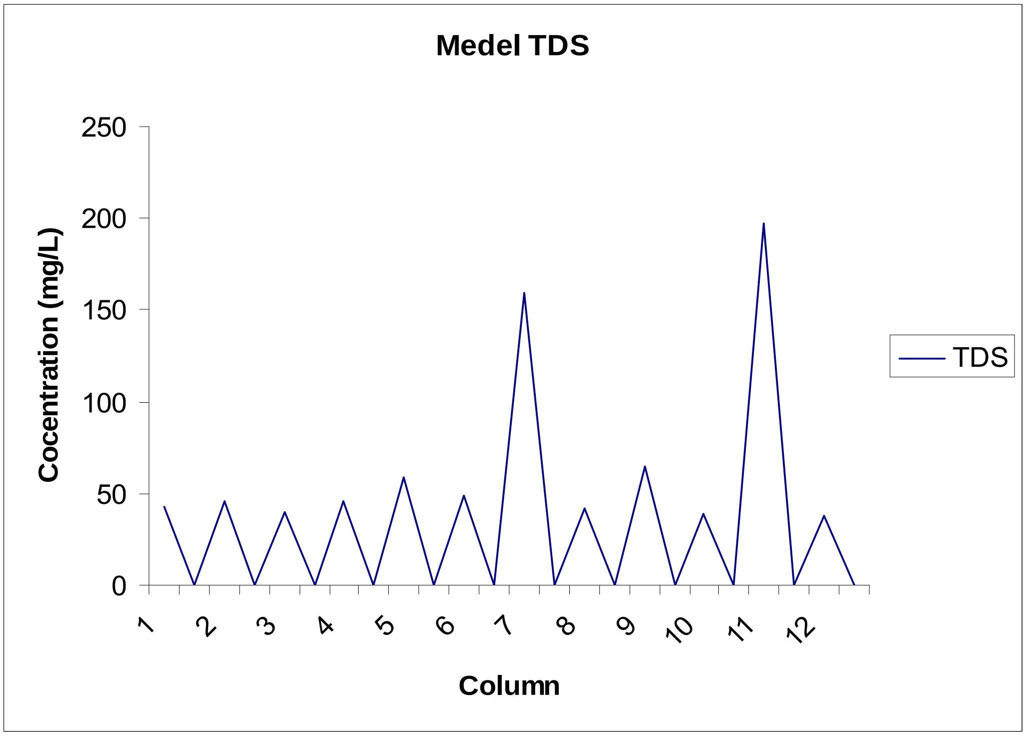

Bottom %N
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
% N
1
2
3
4
5
6
7
8
9
10
11
12
column Number

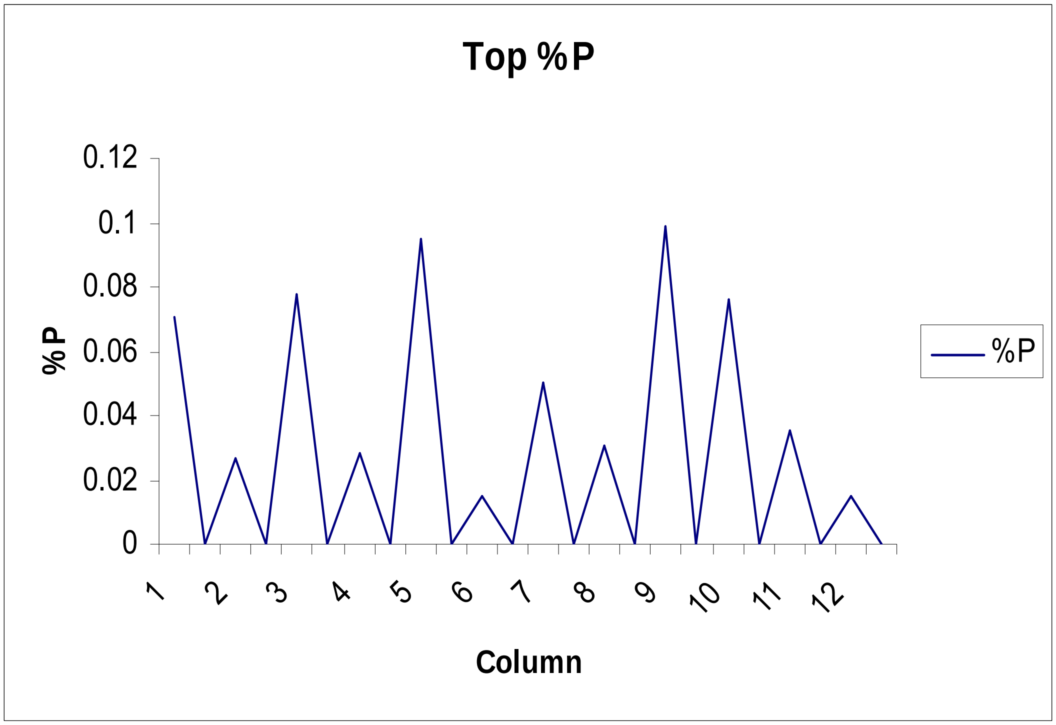

bottom TDS
180
160
140
120
100
80
60
40
20
0
Concentration (mg/L)
1
2
3
4
5
6
7
8
9
10
11
12
column Number

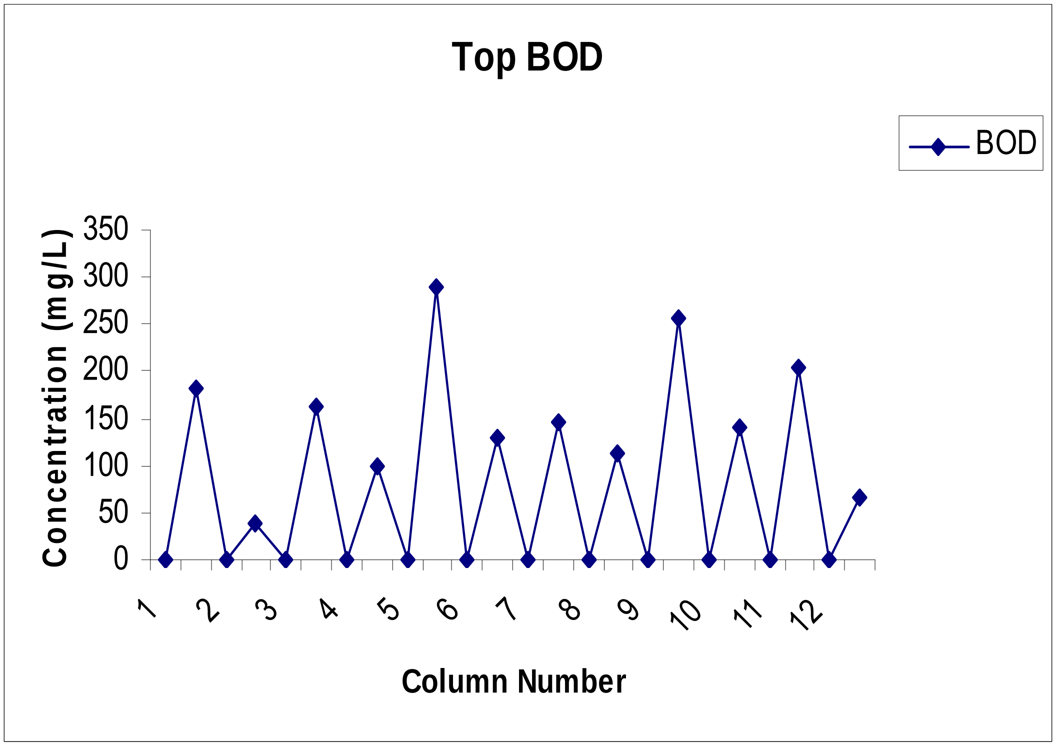

Medel %P
0.12
0.1
0.08
0.06
0.04
0.02
0
% P
1
2
3
4
5
6
7
8
9
10
11
12
Column
%P

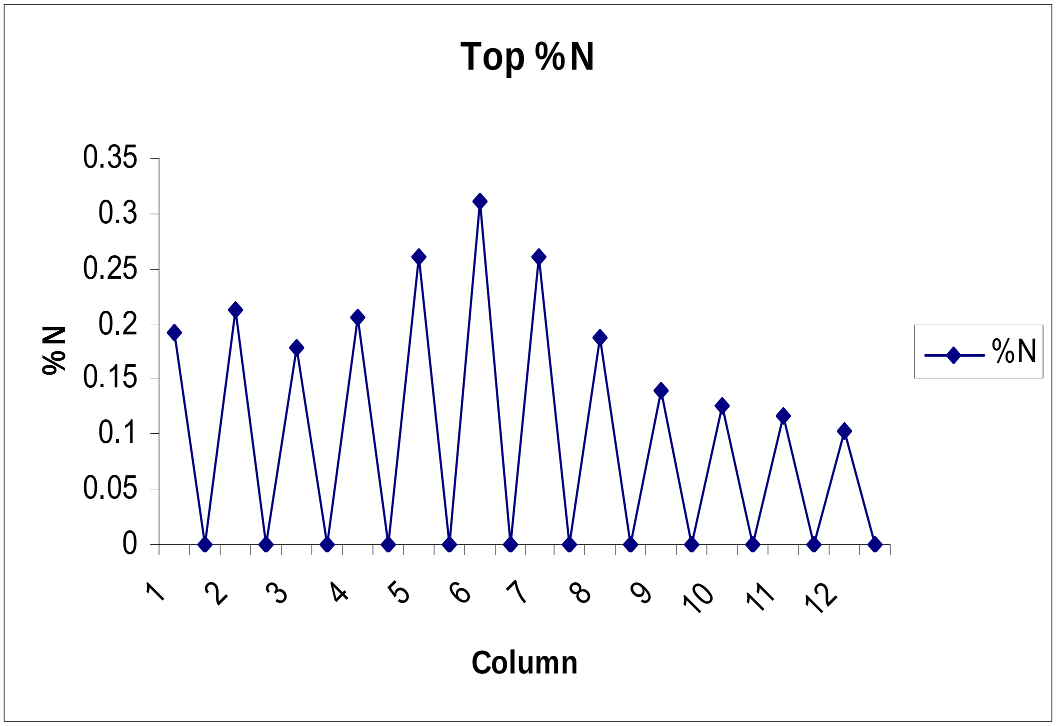

Medel BOD
350
300
250
200
150
100
50
0
Concentrtion (mg\L)
1
2
3
4
5
6
7
8
9
10
11
12
Column
BOD

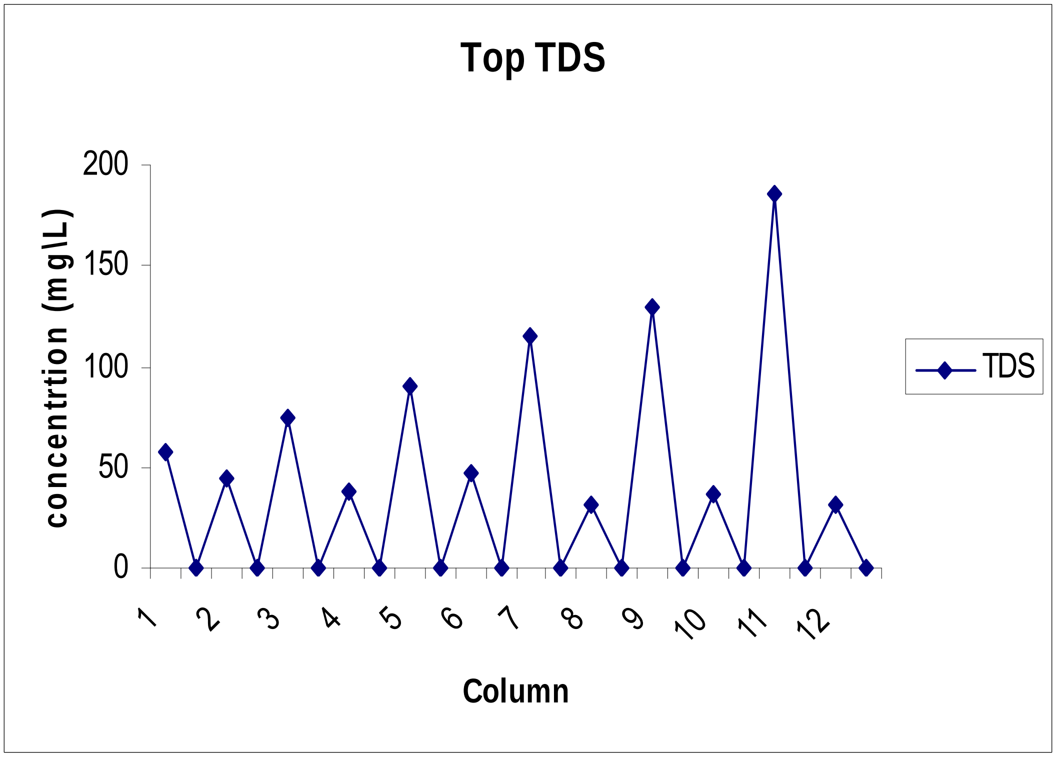

Medel %N
% N
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1
2
3
4
5
6
7
8
9
10
11
12
Column Number


Medel TDS
Cocentration (mg/L)
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
Column
TDS


Top %P
0.12
0.1
0.08
0.06
0.04
0.02
0
%P
1
2
3
4
5
6
7
8
9
10
11
12
Column
%P


Top BOD
BOD
350
300
250
200
150
100
50
0
Concentration (mg/L)
1
2
3
4
5
6
7
8
9
10
11
12
Column Number


Top %N
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
%N
1
2
3
4
5
6
7
8
9
10
11
12
Column
%N


Top TDS
200
150
100
50
0
concentrtion (mg\L)
1
2
3
4
5
6
7
8
9
10
11
12
Column
TDS

جامعة النجاح الوطنية
كلية الدراسات العليا

تأثيرات المركبات العضوية التي تتحلل حيويا على التربة والمياه الجوفية في الضفة الغربية

اعداد

محمد سليم علي

اشراف

د. شحدة جودة

أ.د. مروان حداد

قدمت هذه الأطروحة استكمالا لمتطلبات درجة الماجستير في الكيمياء بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس, فلسطين

2010م

تأثيرات المركبات العضوية التي تتحلل حيويا على التربة والمياه الجوفية في الضفة الغربية

إعداد

محمد سليم علي

إشراف

د. شحدة جودة

أ.د. مروان حداد

الملخص

يهدف هذا البحث إلى تبيان اثر مستهلكات الأوكسجين الحيوية (BOD) على التربة ومياه الشرب في الضفة الغربية كما يبين مدى ارتباط تلوث المياه الجوفية من النفايات الصلبة والمياه العادمة.

أجريت هذه الدراسة على عينتين من التربة, الأولى من مدينة طولكرم في شمال الضفة الغربية, والثانية من مدينة أريحا في شرق الضفة الغربية حيث اجري تحليل كيميائي وفيزيائي لكلا العينتين, واجري البحث في شهر نيسان وأيار من العام 2009.

بعد تحليل العينات تبين أن تركيز (BOD) في المياه المعالجة بالملوث الحيوي الناتجة من عملية الغسل يزداد مع الزمن في كلا التربتين, وفي شهر نيسان ازداد تركيز (BOD) الناتج عن غسل تربة أريحا أكثر من تربة طولكرم وفي شهر أيار وجد أن تركيز (BOD) الناتج عن غسل تربة طولكرم أعلى منه في تربة أريحا.

أما تركيز (BOD) الناتج عن غسل التربتين بالمياه النظيفة (مياه الحنفية), يقل مع الزمن (كلما زادت كمية المياه المضافة) وتركيز الأوكسجين الذائب (DO) يقل مع ازدياد تركيز (BOD) في جميع الحالات. أما تركيز الأملاح الذائبة (TDS) الناتجة عن غسل التربة بالمياه المعالجة بالملوث الحيوي يقل مع الزمن في كلا التربتين.

تركيز (BOD) في التربة بعد المعالجة يزداد في طبقات التربة من أعلى إلى أسفل في التربتين, لكنه أعلى في تربة طولكرم منه في تربة أريحا, وتركيز الأملاح الذائبة (TDS) في طبقات التربة بعد المعالجة في تربة طولكرم أعلى من تربة أريحا أيضا.

أما تركيز النتروجين يزداد بازدياد العمق في طبقات التربة ويزداد مع الزمن أي كلما ازدادت كمية المياه النظيفة المضافة إلى التربة, ويقل مع العمق في طبقات التربة المضاف إليها الماء المعالج بالملوث (BOD).