**Republic of Iraq**

**Ministry of Water Resources**

# Waste Water Production Treatment and use in Iraq

## Country report

**By**

**Expert**

**Ahmed Mohammed Aziz**

**And**

**Dr. Ahmed Aws**

**2012**

**Title : Waste Water Production , treatment and use in Iraq**

**Abstract :**

The use of treated waste water is important for agriculture development; farmers in Iraq have been utilizing sewage water without treatment the most serious problems in this area are related to pathogens, heavy metal contamination and salinity build –up.

Studies carried out in Iraq have shown that treated sewage water can be used to irrigate fodder crop and some vegetables.

In general, in Baghdad, treated effluent directed to the Diyala River from treatment plants goes to Tigris River through additional natural flow purification processes before it is abstracted for irrigation downstream**.**

**Water Availability and Use:**

**The total renewable water resources available,**

Surface water (50045 MCM) per capita annual share /1528CM year 2010

Groundwater (4228 MCM) per capita annual share /140CM,

**Use of available water in different sectors**

| | |
|---|---|
| Agriculture | 46.000 BCM |
| Domestic | 3.78 BCM |
| Industrial | 2.77 BMC |
| Electricity | 0.40 BMC |
| Groundwater | 2.58 BMC |
| Treated waste Water | 0.58 BMC |
| Agricultural drainage | 7.00 BMC |

**Waste Water Production and treatment**

The use of domestic waste water for crop production has been practiced for several centuries .There are agronomic and economic benefits of wastewater used in agriculture. Irrigation with wastewater can increase the available water supply. In addition to these, direct economic benefits that conserve natural resources. The fertilizer value of many waste water effluent from domestic sources could supply all of the nitrogen and much of the phosphors and potassium that are normally required for the agricultural crop production , in addition micronutrient organic matter also provide additional benefits .

The volume of waste water generated by municipal and industrial sectors in Iraq about (580 MCM) and about (7 BCM) drainage water.

**The main sources of waste water for reuse in Iraq are the following:**

1- **Municipal sewage**

Large quantities of waste water come from urban, which have sewer networks. The constitute of sewage depends on characteristic of the urban area. The key pollutants that affect the selection of the treatment process are suspended solids , ammonia and organic nitrogen , phosphorus ,BOD5, l, in addition , domestic sewage is infected by pathogenic organ, viruses , bacteria , protozoan and helminthes eggs .

In Baghdad we have three big sewage treatment plants

- New Rustamiyah treatment plant

Design capacity (300,000) m3/day.

- Old Rustamiyah (175,000) m3/day. -

Karkh treatment plant (205,000) m3/day.-

We have other sewage treatment plant in some governorate as follows

| **Governorate** | **Design capacity m3/day** |
|---|---|
| Najaf | 42,000 |
| Kerbala | 48,000 |
| Maisan | 14,000 |
| Babylon | 12,000 |
| Theqar | 17,000 |
| Salah Al-din | 20,000 |
| Qadissiya | 12,000 |

In Iraq we have about (580) million m3 of treated sewage waste .If we consider water use for agriculture is (15000) m3 /ha. That means we can irrigate about (38666) ha.

| Project name | B.O.D5 | C.O.D | T.D.S | S.S (2) | PO4 | SO4 | NH3 | NO3 |
|---|---|---|---|---|---|---|---|---|
| Karkh sewage | 15 | 86 | 2644 | 36 | 9.5 | - | 1.8 | - |
| Old rustumiyah sewage | 50 | 92 | 1766 | 99 | 3.2 | - | - | - |
| new rustumiyah sewage | 35 | 146 | 2507 | 20 | 7.9 | - | - | - |
| Maisan sewage | 16 | 38 | 1252 | 66 | 1.8 | 340 | 0 | 20 |
| Salah–Alddin sewage | 5 | - | - | 200 | 3.4 | - | 1.2 | 280 |
| Najaf sewage | 48 | 121 | 2031 | 142 | 4 | 779 | 10 | 8 |
| Kerbala sewage | 84 | 144 | 2424 | 640 | 5.4 | 860 | 4.65 | 7.9 |

**Table (1) pollution concentration for some treatments plant mg/l**

**2- Industrial**

Most Industrial effluents are derived from industrial factories may be so loaded with organic and inorganic substances.

The effluents and the treatment of the waste waters of some industries are of greater concern than the domestic sewage of the same area; the industrial effluents if possible should be kept away and treated separately from municipal sewage treatment.

Purification of industrial wastes by natural processes in streams is not recommended. Estimated quantities of industrial waste water in Iraq are about 200 MCM /year.

Total industrial of reclaimed waste water remains very limited because of high cost and non- rigid environment metal laws.

**3- Agriculture Drainage**

A large source of water is available from drainage of irrigation activities. Surface irrigation produce return flows as 20-25% of the original supply volume depending on the irrigation efficiency soil type, and cropping patterns with other factors.

Reuse of drainage water for agriculture require careful management to prevent salts accumulation in soil.

The quantity of drainage water is about (7) BCM.

**Treatment process for wastewater in Iraq-grouped into three stages described below:**

**1- Primary Treatment**

The principal step is plain sedimentation of settleable matter , there is (8) ponds which will removed heavy solids present in raw sewage in this stage about 40% of (BOD5) and 55% of suspended soil will be removed . The retention time is usually (2-4) hours approximately 30% of some organic nitrogen, phosphorus and heavy metal reduced**.**

**2- Secondary Treatment**

There is (6) aeration ponds where the degradable organic matter is consumed as food by bacteria in the presence of oxygen. The Bactria uses some of the organic material for growth.

The remainder is oxidized to carbon dioxide and water. Some of the combined nitrogen and phosphorus present in the waste water and absorbed by the Bactria at the same time.

During the primary and secondary treatment pathogenic organisms are largely removed.

Disinfection is the last process against any pathogenic organisms remaining in wastewater .In chlorine contact until chlorine is the most generally used disinfection in the prevention of water-borne disease.

**3- Disposal of wastes sludge**

In Rustamiya treatment plant (figure 1), there is digester units for sludge. The residence time in a digester is about (45) days anaerobic Bactria are analyzer the organic matter to methane and carbon dioxide.

Sludge which is produced as a byproduct of most treatment processes are spreading in drying beds.

**Utilization of wastewater at special irrigation system**

One of the main progressive methods of natural biological treatment of wastewater is their use in agriculture at special irrigation system (SIS).the use of wastewater for irrigation would ensure full treatment of wastes. Where absorption of dissolved matter makes 70 – 100% deficit of water resources in future makes the use of wastewater in agriculture especially promising. In Iraq most of non treated wastewater used by farmer to irrigate some food crop like (lettuce, cabbage,peppers,tomato,peans) also the raw sewage used for nonfood crop like (Alfalfa,clover.maize,cotton,sunflower).most of treated wastewater from Rustumiya and Karkh treatment plants discharged to Diyala and Tigris river if the treatment not following national environmental it will increased river pollution.
In Iraq some farmer used drainage water to irrigate wheat and Barely more than (1.5) million hectare of reclaimed lands discharged drainage salty water to main outfall drain. Table (2) shows average water salinity for years 1994 - 2002

| year | Average.TSS M.O.D at north Part KM 0 BAGHDAD | Average.TSS.M.O.D at end of north part KM 150+00 | Average.TSS.M.O.D at Middle part KM 300 | Average.TSS.M.O.D at middle part DALMAG lake | Average .TSS .M.O.D.at south part NASSRIYA |
|---|---|---|---|---|---|
| 1994 | 7288 | 7369 | 7976 | 12724 | 10981 |
| 1995 | 6007 | 5855 | ------- | 11240 | 6084 |
| 1996 | 5771 | 5950 | 6453 | 14805 | 6312 |
| 1997 | 5525 | 5606 | 6053 | 13071 | 6203 |
| 1998 | 6183 | ------- | ------ | 12010 | 6063 |
| 1999 | 5328 | 5635 | 6248 | 19379 | 6939 |
| 2000 | 6151 | 6045 | 6846 | 46654 | 7443 |
| 2001 | 6358 | 6918 | 13825 | 60338 | 7023 |
| 2002 | 6399 | 6543 | 6392 | 29595 | 6555 |

**Table (2)**
**AVERAE SALINTY FOR WATER IN MAIN OUTFALL DRAIN FOR YEAR 1994 TO 2002**

**Policies and Institutional for Wastewater Management**

Iraqi government has issued regulation No. 25 year 1967 about protection of stream and reservoirs from pollution. This law prohibits wastewater discharge in to the water bodies without special permit issued by the health administration.

The law regulates quality and quantity of wastewater that is allowed to be discharged into natural waters. Table (3) quality standards for water sources according to regulation (25) issued by Iraqi government.

In addition to regulation No.25 Baghdad sewerage board has issued the instruction regulating proportion of different chemicals in the industrial waste water to be discharged into municipal sewerage system.

The regulations valid in Iraq now require further improvement .The ministry of environment did new regulation under publication.

**Research on different aspects of wastewater**

Study (Ahmed Aziz) concerns with the effect of some heavy metals (pb.cd) .In sewage water on plant-soil pollution and reflection of this effect on the growth and production of lettuce in the field.

Experiment was conducted at Rustumiyah sewage treatment plant by using :

1- Dried sewage sludge treatment (A) .Table (4)
2- Non-treated sewage treatment (B). Table (5)
3- Treated sewage treatment (c). Table (6)
4- Tap water treatment (D).

The results summarized as follow:

1- There was high increase in the value of (pH) for all treatment and highly significant decrease in the value ECe for all treatment. (C.E.C) was highly significant increased for treatment (A.B.C).

2- The quantity of organic matter was significant increased for the treatment (A.B). As well as total-N significantly increased for treatment (A) and (C). The results indicate also significantly increased in available phosphors for treatment (A) and (B) same increased shown for available potassium for treatment (c) and (B).

3- Significant increase in soil bulk density for treatment (B, C).

4- The results indicate a high significant increase in the dry weight for treatment (A, B).

5- For heavy metals the result indicates a highly significant increase in soil total lead as well as available plant lead for treatment (A,B) while the results indicate significant decrease in plant lead for treatment (C) . As for Cadmium results indicate a highly significant increase in soil total, available and plant Cadmium for treatment (A, B), while there was significant increase for plant Cadmium for treatment (C) .

6- Results indicate microbiological pollution with chloroform group for the treatment (A, B) more than for treatment (C).

It was concluded that under field conditions in which the experiment was done , treated wastewater effluent can be used to irrigate agriculture crops such as fodder ,industrial crop , trees production nuts and other similar trees, treated effluent reduce the danger of soil and plant pollution with heavy metal and pathogens .Also it will improve the soil physical and chemical properties .

Table (7) show phytotoxicity and threshold levels of heavy metals for crop production

The results showed that sewage sludge and untreated influent with its positive value as a crop nutrient source and improving soil properties it will cause a potential hazard pollution to the soil and plant from microbiological and heavy metals accumulation .

| Constituents | | Units | Con. Level |
|---|---|---|---|
| 1. | Colour | - | Normal |
| 2. | Temperature | - | - |
| 3. | Suspended solid | - | - |
| 4. | PH | - | 6.5 – 6.8 |
| 5. | Dissolved Oxygen | Mg/L | More than 5 |
| 6. | B.O.D.5 | " | Less than 3 |
| 7. | C.O.D. ($Cr_2$07method) | " | - |
| 8. | Cyanide $CN^-$ | " | 0.02 |
| 9. | Fluoride $F^-$ | " | 0.02 or more as naturally present |
| 10. | Free chlorine | " | Trace |
| 11. | Chloride | " | 200 or more as naturally present |
| 12. | Phenol | " | 0.005 |
| 13. | Sulfate | " | 200 or more as naturally present |
| 14. | Nitrate ($No_3$) | " | 15 |
| 15. | Phosphate ($Po_4$) | " | 0.4 |
| 16. | Ammonium ($NH_4$) | " | 1.0 |
| 17. | DDT | " | N.L. |
| 18. | Lead (pb) | " | 0.05 |
| 19. | Arsenic AS | " | 0.05 |
| 20. | Copper Cu | " | 0.05 |
| 21. | Nickel Ni | " | 0.1 |
| 22. | Selenium Se | " | 0.01 |
| 23. | Mercury Hg | " | 0.001 |
| 24. | Cadmium Cd | " | 0.005 |
| 25. | Zine Zn | Mg/L | 0.5 |
| 26. | Chromium Cr | " | 0.05 |

| Constituents | | Units | Con. Level |
|---|---|---|---|
| 27. | Aluminum AL | " | 0.1 |
| 28. | Barium Ba | " | 1.0 |
| 29. | Boron B | " | 1.0 |
| 30. | Cobalt Co | " | 0.05 |
| 31 | Iron Fe | " | 0.3 |
| 32 | Manganese Mn | " | 0.1 |
| 33 | Silver Ag | " | 0.01 |
| 34 | Total hydrocarbons and their compounds | For detail refer to regulation No.25 | - |
| 35 | Sulfide S | - | - |
| 36. | Ammonia N as $NH_3$ | - | - |
| 37. | Ammonia gas (N as free $NH_3$) | - | - |
| 38. | Sulfur dioxide ($So_2$) | - | - |
| 39. | Petroleum Alcohol | - | - |
| 40. | Calcium Carbide (CaC) | - | - |
| 41. | Organic Solvents | - | - |
| 42. | Benzene | - | - |
| 43.. | Chlorobenzene | - | - |
| 44. | TNT | - | - |
| 45. | Bromine | - | - |

Table ( 3 )

**Quality standard for water sources according to regulations issued by Iraqi government**
**( Regulation 25 )**

| | | |
|---|---|---|
| 3.14<br><br>7.25 | (ds/m at $25^{o}$) | EC<br><br>PH |
| 57.0 | $Ni^{2+}$ | Total concentration for trace elements mg $kg^{-1}$ |
| 3.20 | $Cd^{2+}$ | |
| 318.0 | $Pb^{2+}$ | |
| 378.0 | $Zn^{2+}$ | |
| 126.0 | $Cu^{2+}$ | |
| 355.0 | $Mn^{2+}$ | |
| 2525.0 | $Fe^{3+}$ | |
| 14.0 | Total N | |
| 12.5 | gm $kg^{-1}$ | |
| 7.5 | PO4 | |
| 350.0 | K<br>Organic matter | |
| 120.0 | $NH_2$-N Mic/g | |
| 116.0 | $NH_3$-N Mic/g | |
| 42.0 | $SO_4^{2-}$ | Ions concentration Meg $L^{-1}$ |
| 4.01 | $HCO_{3-}$ | |
| - | $CO_3^{2-}$ | |
| 16.20 | $CL^{-}$ | |
| 0.97 | $K^{+}$ | |
| 17.30 | $Na^{+}$ | |
| 18.2 | $Mg^{2+}$ | |
| 22.15 | $Ca^{2+}$ | |

Table (4)

Some Chemical properties for dry sludge

| | | |
|---|---|---|
| 3.20<br><br>7.52 | (ds/m at $25^{o}$) | EC<br><br>PH |
| 0.08 | $Cr^{2+}$ | Total concentration for trace elements<br><br>mg $kg^{-1}$ |
| 0.098 | $Cd^{2+}$ | |
| .093 | $Zn^{2+}$ | |
| 0.284 | $pb^{2+}$ | |
| 0.051 | $Mn^{2+}$ | |
| 3.80 | $Fe^{3+}$ | |
| 1.60 | $Cu^{2+}$ | |
| 0.48 | $B^{+}$ | |
| 0.19 | $CN^{-}$ | |
| 2.85 | $P^{3+}$ | Mg $l^{-1}$ |
| 22.2 | $NH_2$ - N | |
| 0.00 | $NH_3$ - N | |
| 6.11 | $HCO_{3-}$ | Cations and an ions<br><br>Mg $l^{-1}$ |
| 0.16 | $CO_3^{2-}$ | |
| 12.86 | $SO_4^{2-}$ | |
| 11.5 | $CL^{-}$ | |
| 0.322 | $K^{+}$ | |
| 13.21 | $NA^{+}$ | |
| 8.22 | $Mg^{2+}$ | |
| 7.91 | $Ca^{2+}$ | |

Table (5)

Some Chemical properties for None treated waste water

| | | |
|---|---|---|
| 2.71<br><br><br>7.63 | (ds/m at $25^{o}$) | EC<br><br><br>PH |
| 0.03 | $Cr^{2+}$ | Total concentration for trace elements mg $kg^{-1}$ |
| 0.006 | $Cd^{2+}$ | |
| 0.005 | $Zu^{2+}$ | |
| 0.048 | $pb^{2+}$ | |
| 0.051 | $Mn^{2+}$ | |
| 0.670 | $Fe^{3+}$ | |
| nill | $Cu^{2+}$ | |
| 0.23 | $B^{+}$ | |
| 0.003 | $CN^{-}$ | |
| 1.89 | $P^{3+}$ | Mg $l^{-1}$ |
| 0.25 | $NH_2$ - N | |
| 33.3 | $NH_3$ - N | |
| 5.14 | $HCO_3^{2-}$ | Cations and an ions Mg $l^{-1}$ |
| 0.16 | $CO_3^{2-}$ | |
| 10.57 | $SO_4^{2-}$ | |
| 9.70 | $CL^{-}$ | |
| 0.408 | $K^{+}$ | |
| 12.52 | $Na^{+}$ | |
| 8.14 | $Mg^{2+}$ | |
| 6.55 | $Ca^{2+}$ | |

Table (6)

Some Chemical properties for treated waste water

**Conclusions and recommendations**

1- Lack of knowledge of the long term effects of use treated wastewater for agriculture and also the availability of other sources of water in Iraq have prevented large scale application.

2- A policy for wastewater reuse must be clearly established prior to any development activity in this field.

3- Training is recommended at different levels research work on wastewater reuse should be directed towards finding ways to reduce hazards on human health.

4- Use of treated wastewater for portable and domestic purposes is not recommended unless it should be treated close to the standards required for drinking water.

5- Use of treated wastewater recommended for the following purposes:

A- Municipal uses for street cleaning, gardens, watering of road sides

B- Agricultural uses for irrigation of forests, fodder crops.

C- Industrial uses for cooling pipes of boiler

6- Capacity building to increased knowledge for users of wastewater regarding to health risk.

**References**


1- ESCWA water development united nations New York 2007.

2- Effect of some heavy metals in dry sludge and wastewater on lettuce growth and soil pollution (Msc thesis by Aziz Ahmed) Baghdad – Iraq.

3- General scheme of water resources and land development in Iraq 1990 (Baghdad – Iraq).

4- Impact of sewage wastewater on the Environment in Sulaimaniya governorate Kurdistan region - Iraq by nature Iraq Sulaimaniya – Iraq.

5- Treatment and use of sewage effluent for irrigation edited by M.B pescod UK and A.Arar FAO Rome – Italy 1985.

6- Water pollution control

Edited by Richard Helmer and I vanido

Hespanhol WHO / UNDP 1997.

| Heavy metals | Phytotoxicity (ppm) (1) | Threshold level for crop production (ppm) (2) | Damages to crops(3) |
|---|---|---|---|
| Cd | ---------- | 0.01 | Toxic to beans, beets and turnips at concentrations as low as 0.1ppm in nutrient solutions. Conservative limits recommended due to its potential for accumulation in plants and soils to concentrations that may be harmful to humans. |
| Cu | 60-125 | 0.2 | Toxic to a number of plants at 0.1 to 1.0 ppm in nutrient solutions. |
| Ni | 100 | 0.2 | Toxic to a number of plants at 0.5 ppm to 1.0 ppm; reduced toxicity at neutral or alkaline pH. |
| Pb | 100-400 | 5 | Can inhibit plant cell growth at very high concentrations. |
| Zn | 70-400 | 2 | Toxic to many plants at widely varying concentrations; reduced toxicity at pH>6.0 and in fine textured or organic soils. |

(1)Skordas and Kelepertsis, 2005 ;( 2) & (3) Pettygrove and Asano, 1988.

**Table (7)**

**Phytotoxicity and threshold levels of heavy trace metal for crop production**

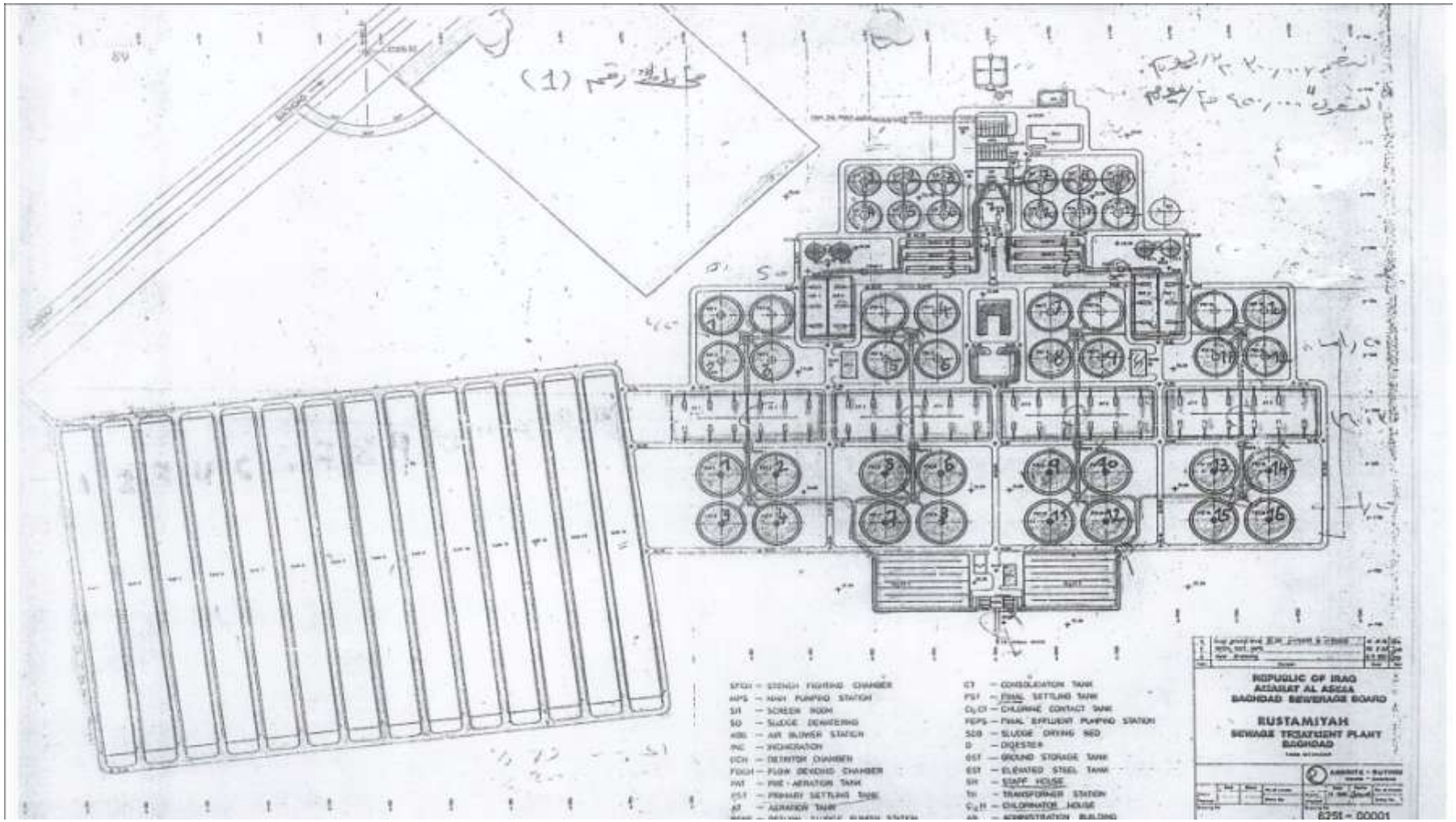
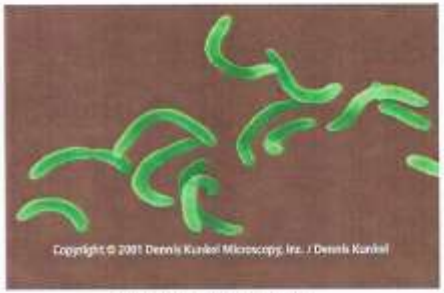

(1)
REPUBLIC OF IRAQ
AMANAT AL ASIMA
BAGHDAD SEWERAGE BOARD
RUSTAMIYAH
SEWAGE TREATMENT PLANT
BAGHDAD

Figure (2)
Shown none treated water used to irrigate vegetable in sulaimani government

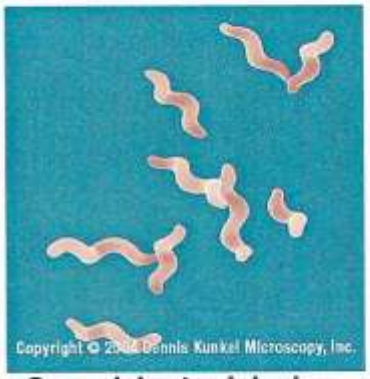
- **Living Organisms**
- Bacteria, Viruses, Protozoa, Helminths

**surface, ground and sewage waste waters.was analysis of bacteria E-coliform ,T-coliform(Cell/100ml)**

# Bacteria




**Vibrio cholerae**
- Cholera




**Campylobacter jejuni**
- Gastroenteritis


**Escherichia coli** (pathogenic strains)
- Gastroenteritis

## Microbiological composition