# Direct Filtration for Drinking Water, Habbaniyah Lake (Iraq)

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## Abstract

This research aims at elimination of the sedimentation stage from water purification systems, here waters supplied from lakes. chemical are used to coagulate any remaining suspended materials before the filtration stage, chemical used include alum with some catalyst, such as poly electrolytes.An integrated 5,50 m high Direct filtration unit was constructed in the laboratory, it included four main units: an axial flocculating unit, a filtration unit, injection unit for pumping coagulants and clay materials, and a backwashing unit, a piezometric board is also included tot give reading at each 10cm of filter height . Water is supplied to the system through a constant head tank by gravity action. filtration is done through two mediums, a crushed brick layer2 to 5mm sizes(30to40)cm deep and a quartz sand layer 0-.60to 0.75mm (30to40)cm deep.

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***Index terms***— an axial flocculating unit, a filtration unit, injection unit for pumping coagulants and clay materials, and a backwashing unit, a piezometric board.

# 1 Purpose Introduction

Water purification is the removal of contaminants from untreated water to produce drinking water that is pure enough for the most critical of its intended uses, usually for human consumption. Substances that are removed during the process of drinking water treatment include suspended solids, bacteria, algae, viruses, fungi, minerals such as iron, manganese and sulfur, and other chemical pollutants such as fertilisers.

Measures taken to ensure water quality not only relate to the treatment of the water, but to its conveyance and distribution after treatment as well. It is therefore common practice to have residual disinfectants in the treated water in order to kill any bacteriological contamination during distribution. guidelines, each country or territory or water supply body can have their own guidelines in order for consumers to have access to safe drinking water.

Natural/or Artificial Lakes in Iraq normally extending over a huge area that trapped large amounts of Turbidity. Lakes provide long detention times, low water speed that can be negligible, allowing for adequate settling of the larger turbidity particles and suspended solids. In general, larger lakes have lower turbidity levels. Algae are common and normal inhabitants of surface waters and are encountered in every water supply that is exposed to sunlight. Algae typically range in size from 5 to 100 microns.

Many microorganisms commonly found in source waters do not pose health risk to humans, As Filters represent the key unit process for particles removal in all surface water treatment. Optimization used prior to the filtration process will control loading rates while allowing the system to achieve maximum filtration rates. Direct filtration is one of several treatment processes that can be applied in combination with others to produce potable water. Low turbidity (<20 NTU) and algae count in the order of 106 units/liter among other factors, III.

# 2 History of the Gravity Water Filter

1835? London, England. Queen Victoria recognized the increasing health dangers of the drinking water supply. Cholera and typhoid epidemics were commonplace.

She requested John Doulton (of later to become Royal Doulton), to produce a water filter with his ceramic making capabilities. Using various earth and clay materials, he created the first gravity water filter stoneware, Doulton water filters. With her satisfaction in the filter, Queen Victoria bestowed upon Doulton the right to apply the Royal Crest to each of his units.

1862? John Doulton's son, Henry Doulton introduced the Doulton Manganour (new, efficient purifying medium which could be readily renewed), carbon water filter. With Louis Pasteur's new findings about bacteria in this same period, a more advanced understanding of bacteria made it possible for the creation of a porous ceramic which could filter out tiny organisms.

Gravity fed water filtration! and the Berkey?? We're getting there? 1901? King Edward VII knighted Henry Doulton and honored his company use to the word ROYAL in reference to its products. Hence the name "Royal Berkey", one of the larger gravity water filter units available today. Doulton's water filters gained popularity and wide spread use by hospitals, laboratories and residential water filtration throughout the world as far away as Africa and the Middle east.

Throughout the decades, the Doulton company modified the ceramic filters by adding small, pure silver particles (anti-microbial), which made the filter elements self-sterilizing and they registered the trade name "British Berkefeld". Once these improvements were made, the gravity filters became popular with, and trusted by relief organizations such as UNICEF, the Peace Corps, Red Cross and used in over 140 countries throughout the world.

1998?Through a distribution partnership with British Berkefeld, the US based company, "New Millennium Concepts", began distributing their products locally. NML pushed the envelope of the product and created the "Black Berkey" purification element. Black Berkey purification elements are more powerful than any other gravity filter element currently available. They were tested with 10,000 times the amount of pathogens required for standard protocol and removed 100% of the pathogens (tested under an electron microscope), setting a new standard in water purification.

# 3 IV.

# 4 Processes for Drinking Water Treatment

A combination selected from the following processes is used for municipal drinking water treatment worldwide:

? Pre-chlorination -for algae control and arresting any biological growth

? Aeration -along with pre-chlorination for removal of dissolved iron and manganese

? Coagulation -for flocculation

? Coagulant aids, also known as polyelectrolyte -to improve coagulation and for thicker floc formation

? Sedimentation -for solids separation, that is, removal of suspended solids trapped in the floc

? Filtration -removing particles from water

? Desalination -Process of removing salt from the water

? Disinfection -for killing bacteria.

World Health Organization (WHO) guidelines are generally followed throughout the world for drinking water quality requirements. In addition to the WHO Technologies for potable water treatment are well developed, and generalized designs are available that are used by many water utilities (public or private). In addition, a number of private companies provide patented technological solutions. Automation of water and waste-water treatment is common in the developed world. Capital costs, operating costs available quality monitoring technologies, locally available skills typically dictate the level of automation adopted.

# 5 Global

V.

# 6 Advantage of Direct Filtration Process

Several advantages can be realized when compared to the conventional systems. The advantages of this system may be summarized as follow.

? has low capital and running cost, Lose (1951) and Monscvitz (1978),

? easy to construct and to use, Foly (1967) and Hutchison (1977),

? requires minimum number and small size of the treatment units, thus occupies less surface area as compared to most conventional systems,

? Requires less number of labor, facilities, and equipments, companied with the conventional systems.

? require less dose of chemicals and coagulants (Fadel 1989),

? has a reliable effluent with negligible algae problems (Fadel and ??arakat, 2004; ??adel et al., 2004).

? can be applied for several types of water having low, medium, or high turbidity,

? can be washed by raw water with suitable period of ripening, and

? does not require periodical surface and cleaning, thus produces less amount of wastewater.

VI.

# 7 Effect of Filter Depth on the Removal Efficiency

It is well known that, the filter depth has a direct relation with the filter efficiency, i.e., increasing the filter depth will increase the filter efficiency. The effect of filter depth on the removal efficiency of the direct filter. The new investigations are, when the filter depth is shorter than 0.4 m, no significant efficiency is observed. For filter depth ranging from 0.4 -0.8 m, a significant increase is observed in the filter efficiency.

# 8 VII.

# 9 Effect of Filtration Rate on the

Removal Efficiency

# 10 Effect of Media Particle Size on Removal Efficiency

The Media particle size strongly affects the filter efficiency.

1 st -High effect of grain size on the performance of direct filtration. Removal efficiency comes down to insignificant value at using particle of size >5mm.

2 nd -Particle size of 0.1-2 mm is recommended.

At some cases of pre-treatment work, particle size greater than 3 mm may be of use.

# 11 IX.

# 12 Effect of Alum dose Concentration on the Removal Efficiency

Several factors may Govern the optimum dose of alum such as, size of Turbidity particles, turbidity level, and the G potential of Coagulation, surface loading, etc. many studies shows the effect of coagulant dosage on the performance of direct filtration, some stated that, there exist an optimum dose at which the filter produces high effluent efficiency.

# 13 X.

# 14 Filtration Mechanism

Filtration depends mainly on kind of particles, and the filter media. In addition to Rate of filtration, Dosage and type of coagulants Used In general One or more of below factors affect the filtration:-1 stdeposit mechanism, as the particles bigger than the size of media porosity will be settled over the media, also the suspended solid take a specifies path depend mainly on porosity but even though some of the particles pass through the media, as there are some factors affecting the mechanism such as direct distortion, Brownian movement or van der wave forces, 2 nd -fixation mechanism, which is the sedimentation of particles over the filter Surface as part of slow filtration flow, or vibration of particles because of different electrical charges ,or van der waals forces.

3 rd -detachment mechanism, as part of above forces and particles being catch either over the surface /or in side media porosity, the filtration rate may increase, and the flow may change from laminar flow to Turbulent, so particles may separated again and move deep or even pass through the filter media, this can be solved using stronger polymers, and variable filtration flow,

To solve above we can do either 1 st -increase particles size inside the media be injecting polymers inside the filter. 2 nd -reduce particle size inside the passing solution by pumping water from down to up.

3 rd -Reduce filtration rate. Inside each layer.

Which can be done using radial filtration? XI.

# 15 Theoretical Analysis of Filtration

As deep filter media used to inshore removal of collides, then continues increase in head losses till the filter reach its blocked stage. And then Back wash should be done.

# 16 XII.

# 17 Laboratory Tests Performed

An integrated 5,50 m high Direct filtration unit was constructed in the laboratory, it included four main units: an axial flocculating unit, a filtration unit , injection unit for pumping coagulants and clay materials, and a backwashing unit, a piezometric board is also included tot give reading at each 10cm of filter height . Water is supplied to the system through a constant head tank by gravity action. filtration is done through two mediums ,a coarse media layer with 2 to 5mm sizes (30to40)cm deep, and a quartz sand layer 0-.60to 0.75mm (30to40)cm deep.

The first stage included the laboratory procedure, using the constructed filtration system, Baghdad water supply was used, with the addition of kaolin (fine mud used as turbidity)to increase turbidity to find the best combination of variables, loading ,to highest water yield together with highest efficiency, experiments were run to find the effect of filtration rate ,type &and depth of filtration materials, effect of coagulating material and added catalyst in addition to the control of flocculation time and velocity gradient.

# 18 XIII.

# 19 Habbaniyah Lake

All Results mostly theoretical in laboratory, will never give a good idea for the advantages of direct filtration for the rezones that all environmental changes are mostly controlled in the lab, with some real exceptions that there are many field test using the Direct filtration using water from lakes in many country such as USA ,UK ,Egypt ,Brazil., Argentina and allot others , all the test shows that this method is very good in producing a good quality of Drinking water and long Run of filters with a special parameters for each individual case, this lead the need to make field test for the water of Habbaniyah lake in Iraq which is located in To start the test at site using Direct filtration ,and Lake water first a diversion has been made for Unit No.3,the Primary Settling tank was canceled, two group of test was made using lake water with Turbidity >10.0 mg/l first using Alum As coagulant ,and second Group used Alum in addition to Polyelectrolyte. Field first group of tests used Alum as Coagulant with Dosage of 10.0 mg/l and 12.5 mg/l, water produced with very high Quality compared with conventional treatment sequence but the filter working time was about 5-6 hours compared with 12 hours if the plant is working with its original sequence , test was repeated using assistance coagulants like polymers with Dosage of 0.01 mg/l in addition to Alum dosage concentration 5,0 mg/l , filter working time increased up to 27,0 hours ,with filtration efficiency about 67% ,and clear product water 1.48 FTU , see Table **??**bove XV.

# 20 No

# 21 Feasibility Study

As any work needs to be evaluated through feasibility study, in which all future expenses should be considered as effective factors, Habbaniyah Lake is surrounded with many big cites, so this study will conceder falluja city to evaluate using direct filtration water plants ,the city is about 20 Km to the east ,also results will be compared with conventional treatment plants using Euphrates River water for this comparison we suggested using plants with capacities of 2,000 m3/day, 100,000 m3/day , 250,000 m3/day , 500,000 m3/day, Estimated costs for settling tanks is about 20-30% of total plant initial costs, this study will consider the running and maintenance cost of the plants, keeping in mind that the expected annual influence in worker salary is about 5%,and the influence in construction materials and equipment is around 33%, annual Bank found of 10% is considered, below is a figure for 2,00 m 3 /day plant , the study clearly shows that this size of plants will not give any benefit before 5 years,

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Figure 1:

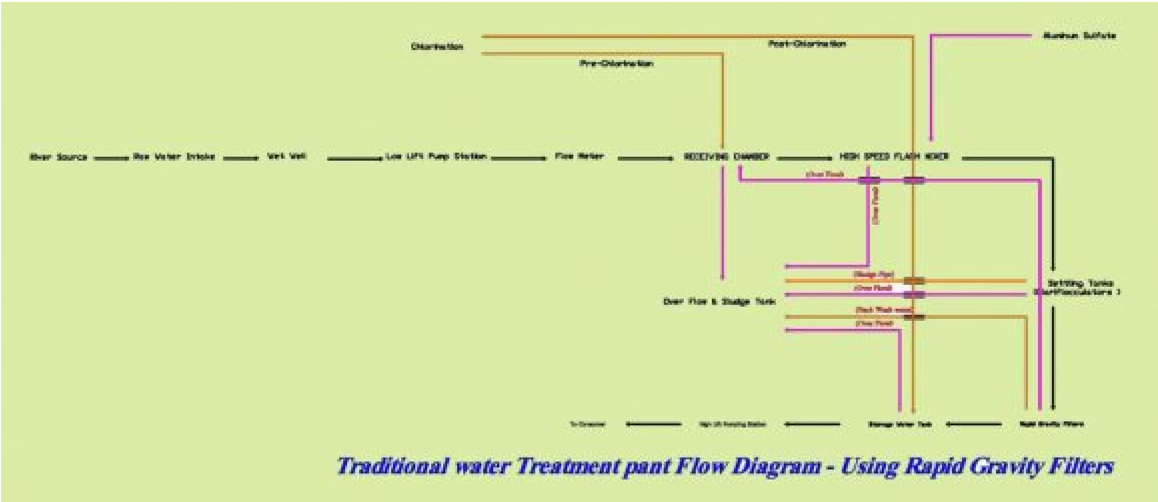
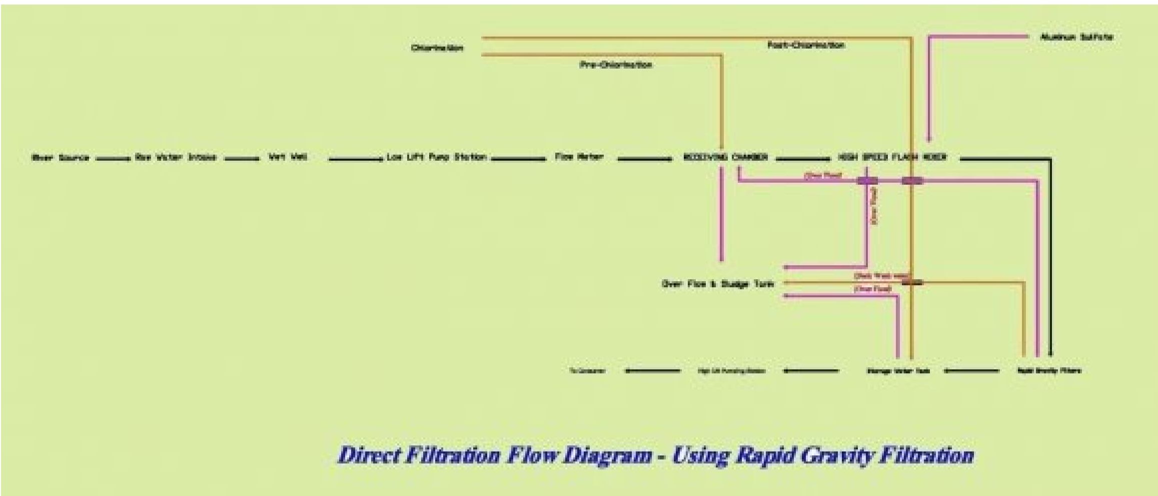



Figure 2:

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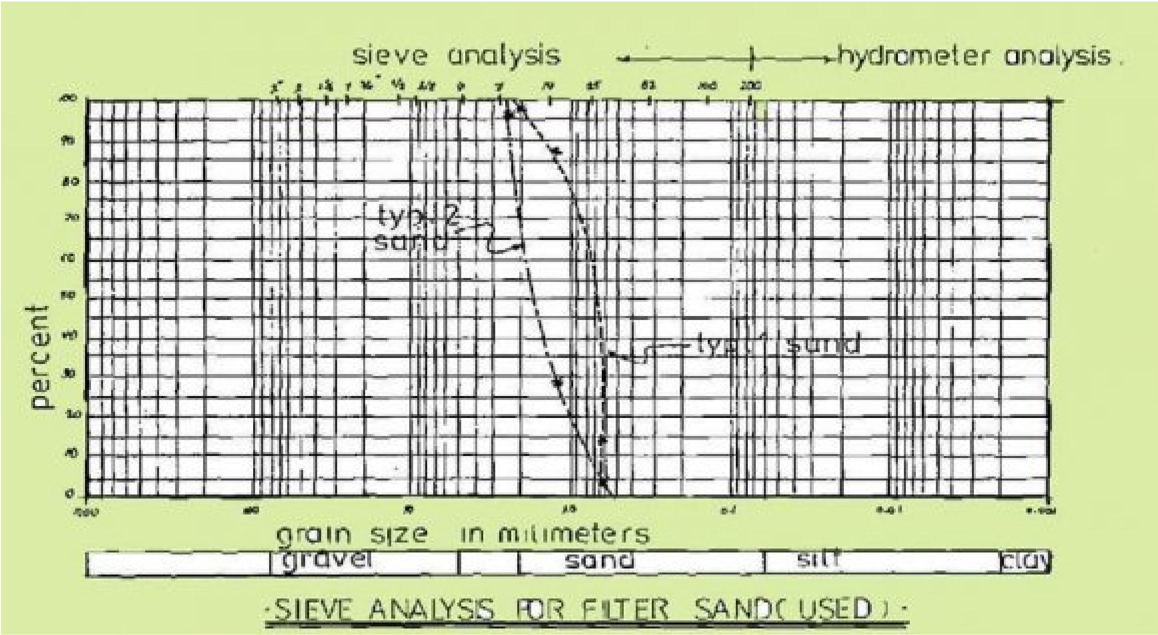


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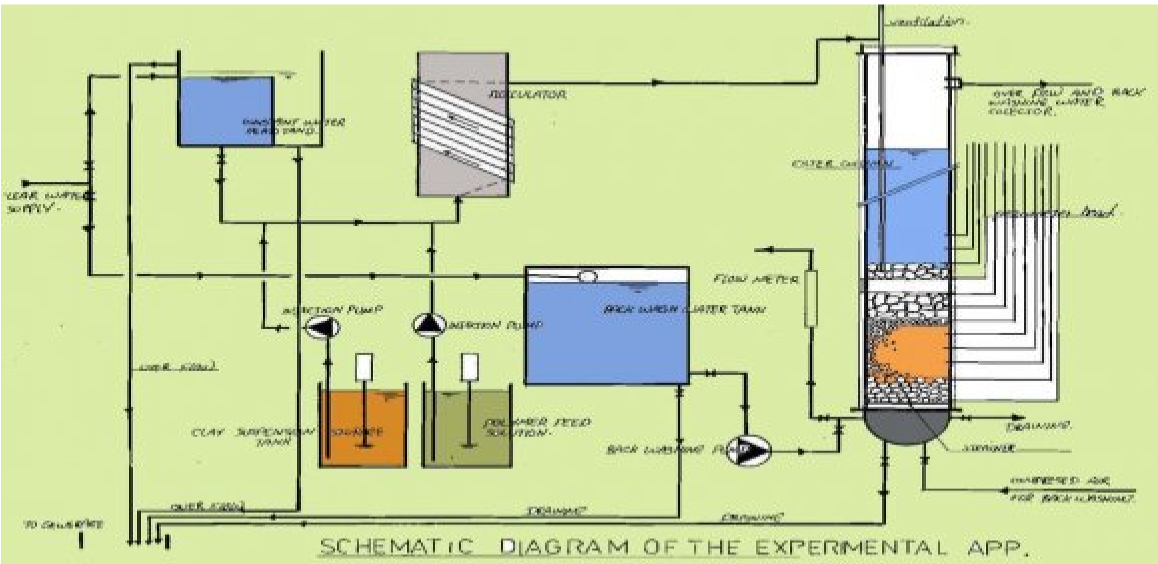


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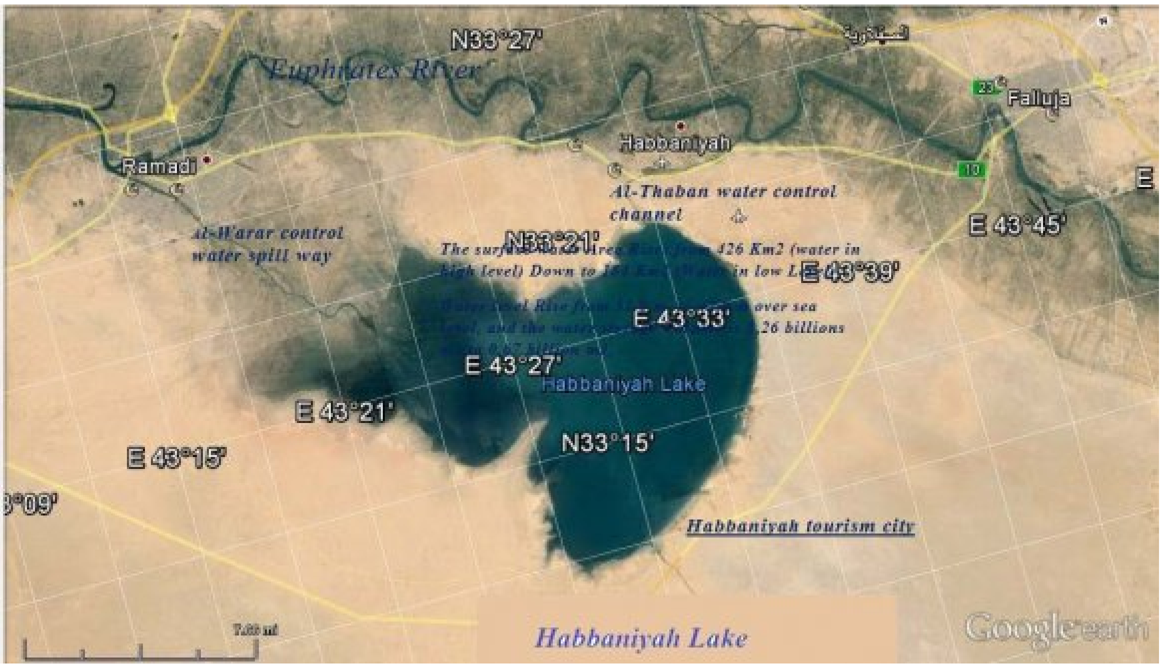
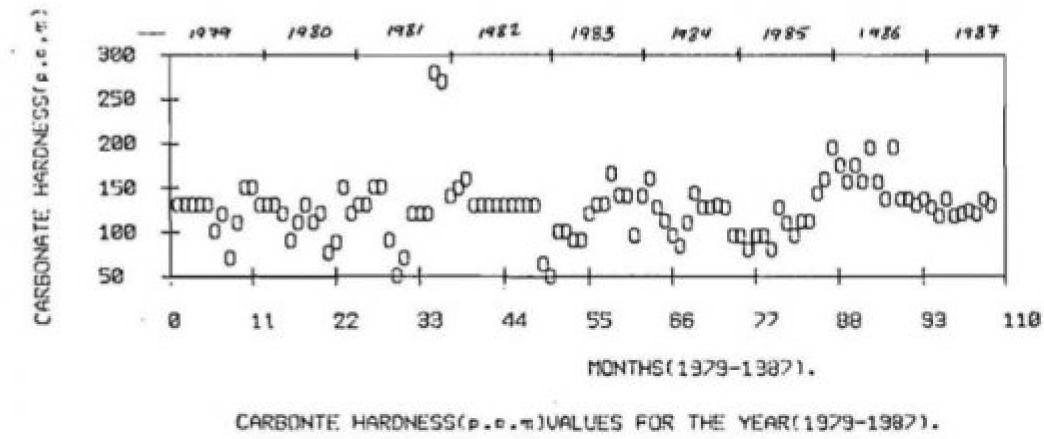



Figure 6:


Figure 7:

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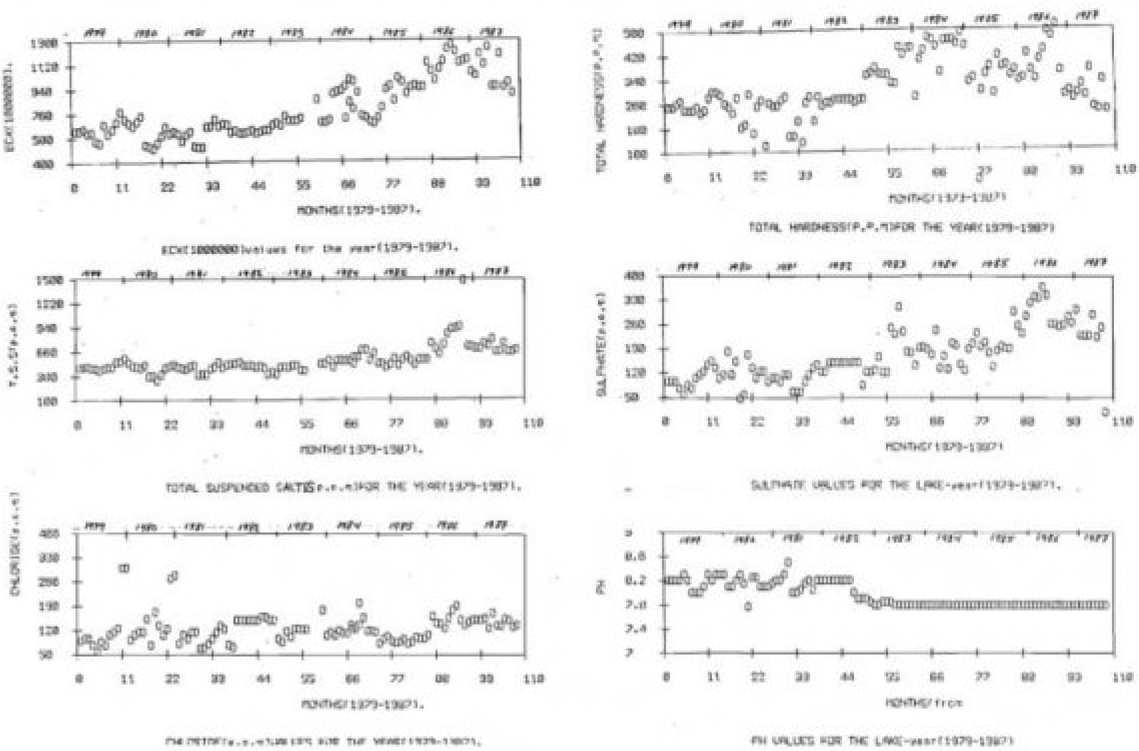

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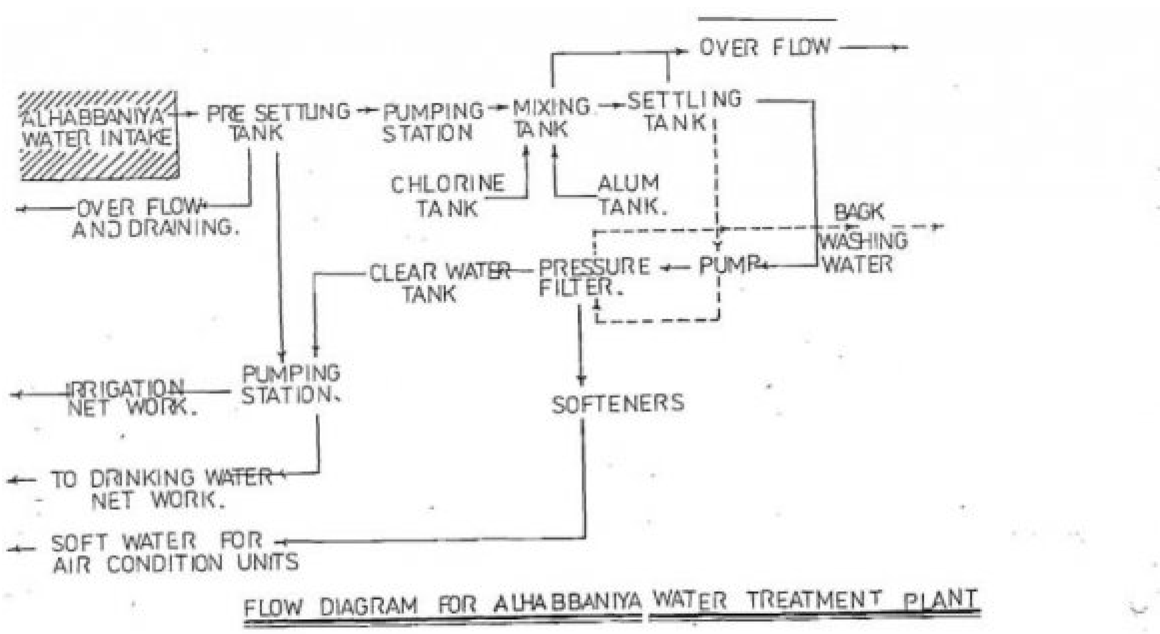


Figure 10:

179 [1] [2]

[1]© 2014 Global Journals Inc. (US)Direct Filtration for Drinking Water, Habbaniyah Lake (Iraq)

[2]© 2014 Global Journals Inc. (US)

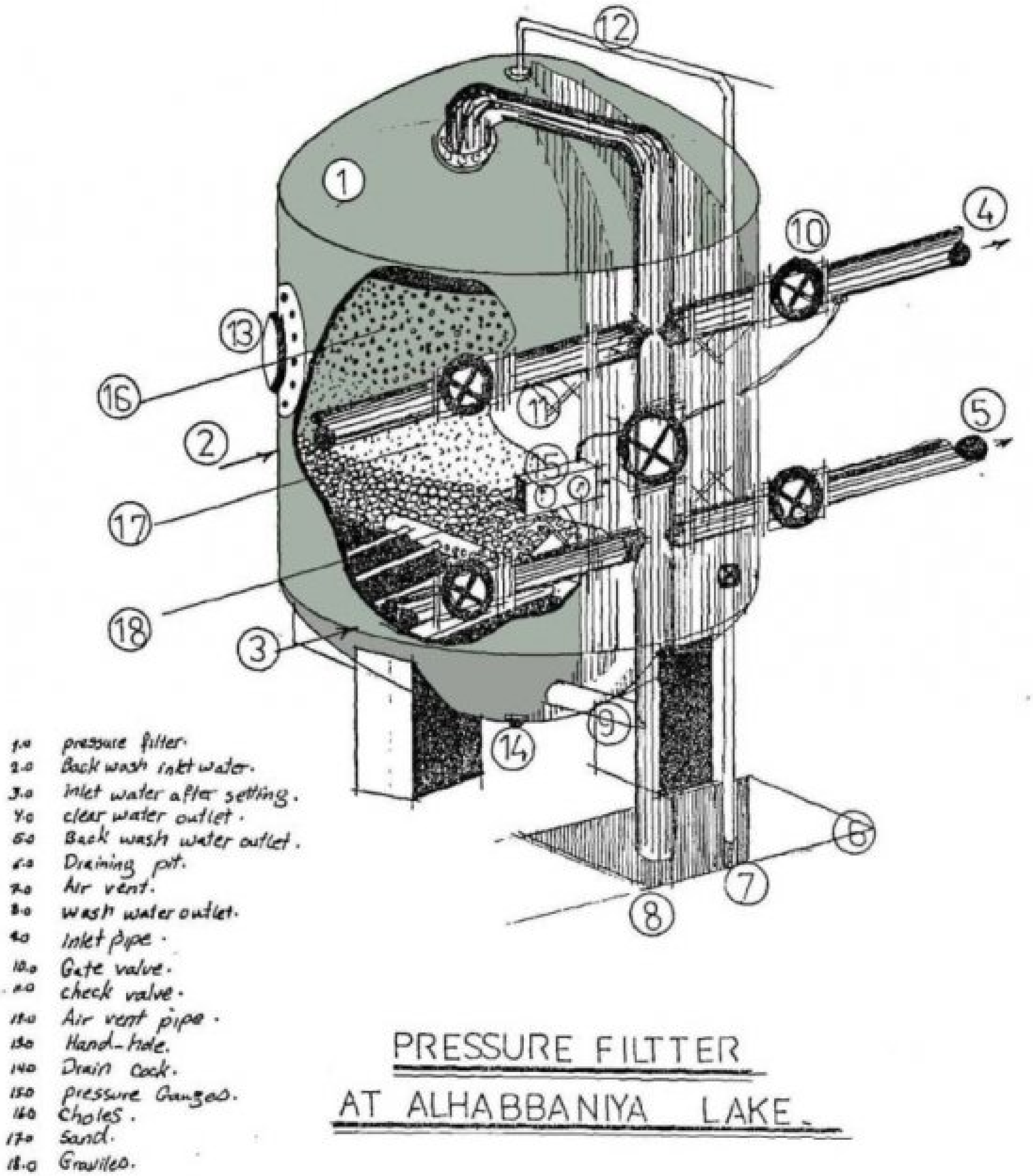
1.0 pressure filter.
2.0 Back wash inlet water.
3.0 Inlet water after setting.
4.0 clear water outlet.
5.0 Back wash water outlet.
6.0 Draining pit.
7.0 Air vent.
8.0 wash water outlet.
9.0 Inlet pipe.
10.0 Gate valve.
11.0 check valve.
12.0 Air vent pipe.
13.0 Hand-hole.
14.0 Drain cock.
15.0 pressure Gangeo.
16.0 Choles.
17.0 Sand.
18.0 Gravileo.
PRESSURE FILTTER
AT ALHABBANIYA LAKE.

Figure 11:

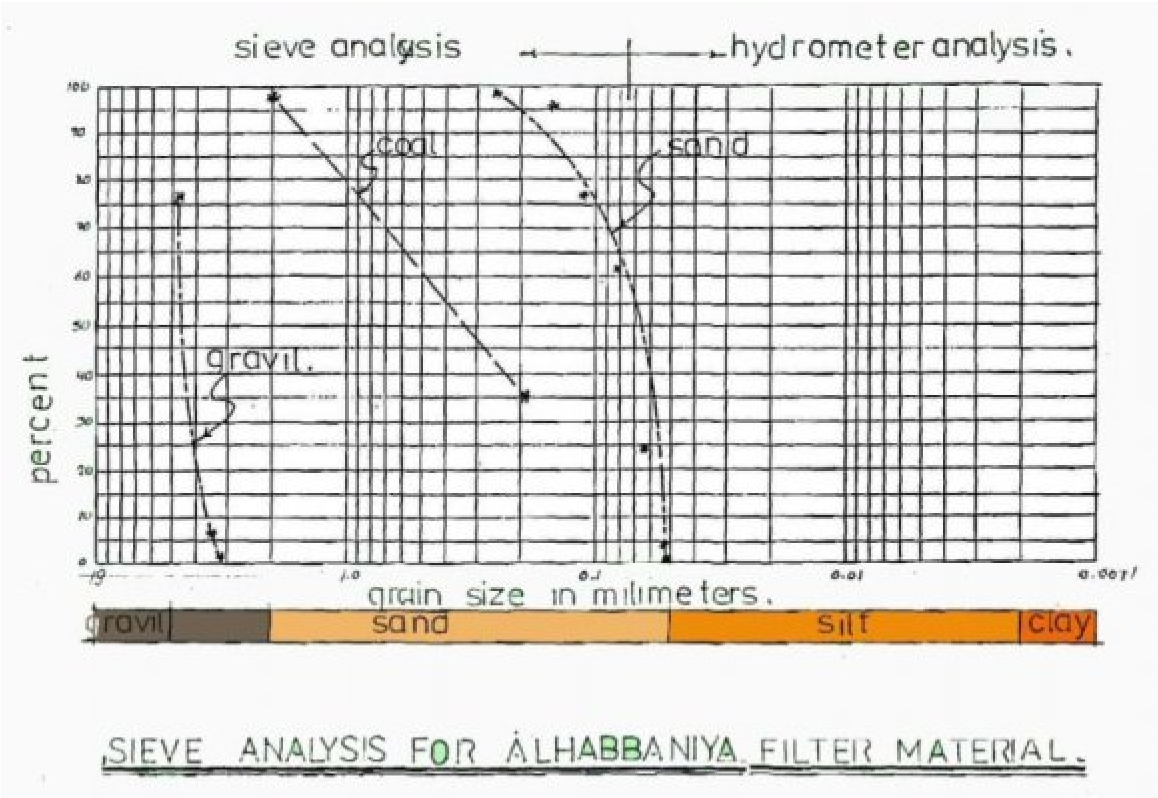


Figure 12:

| | Test Type | Av.Inlet Water Turbidity in (FTU) | Av.Out let Turbidity in (FTU) | Filter efficiency | Type of Coagulants Used in the Test | Time of operation in (hr.) | Water production in (m3) |
|---|---|---|---|---|---|---|---|
| 1 | Direct Filtration | 8.385 | 2.585 | 69.17 | Alum 10mg/l | 5.80 | 211.99 |
| 2 | Direct Filtration | 7.80 | 1.573 | 79.83 | Alum 12.5 mg/l | 6.00 | 271.50 |
| 3 | Direct Filtration | 4.39 | 1.48 | 86.25 | Poly. 0.01mg/l +Alum5 mg/l | 27.00 | 1189.88 |
| 4 | Direct Filtration | 4.668 | 2.645 | 43.33 | Alum 12.5 mg/l | 22.00 | 1353.13 |

c) Field Test Results

Figure 13:

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