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STUDY AND ANALYSIS OF A TYPICAL WATER DISTRIBUTION NETWORK IN SAMAWA CITY

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ABSTRACT

In this paper, a comprehensive study on the water distribution network had been done by analyzing a typical water distribution network in Samawa city step by step. Pipe installation, and pressure drops along this network were studied and analyzed to find out how far this network design effective.

KEYWORDS: Water Distribution, Pressure Drops, Fittings

INTRODUCTION

The unit operations for water purification and treatment include the following:

- Precipitation Crystallization
- Sedimentation Evaporation
- Filtration Activated-carbon treatment
- Ion exchange Reverse osmosis
- Disinfection other membrane separations

The following industries are major users of purified water:

- Power generation Petroleum
- Beverage Pulp and paper
- Aluminum Chemical
- Iron and steel food
- Textile Electronics

Water is used primarily for steam generation (boiler feed), industrial processes, cooling tower makeup, and potable water supply.

IMPURITIES IN WATER

All natural waters contain suspended or dissolved inorganic or organic chemicals to some degree. Whether they are present in high enough concentration to be considered as impurities depends on the water use. The impurities can be classified as follows [7-10]:

- Inorganic Organic Biologically active
- Suspended Bacteria

- Colloidal Immiscible Viruses
- Dissolved Miscible Algae
- Soluble Protozoa

In turbulent streams, suspended solids range from small pebbles down to colloidal clay particles 0.1 to 0.001 μm in diameter. The water may also contain organic solids, algae, and bacteria. Dissolved inorganic solids are usually bicarbonates, sulfates, and chlorides of calcium, magnesium, and sodium, as well as compounds of silica, iron, and manganese. Nonferrous metals and organic compounds may be present in low concentrations, which nevertheless exceed the EPA's proposed limits. The presence of dissolved calcium and magnesium compounds (termed *hardness*) leads to scale formation in boilers and fouling of evaporative cooling systems, and is the biggest cause of plant water problems. Other dissolved solids may be considered as impurities, depending on their concentrations and the intended water use.

Sedimentation processes are used to clarify turbid and/or colored waters, and are used in conjunction with chemical precipitation to remove dissolved impurities such as iron, manganese, calcium, and magnesium compounds, as well as silica and fluorides [8].

On a few occasions, unaided sedimentation will be employed to remove suspended solids, but usually the process will include the addition of chemicals to improve removal of solids. The particles suspended in water result in a turbid, or colored, appearance that is objectionable, and they have a static charge (usually negative) that causes the particles to repel each other and remain suspended. By adding certain chemicals, it is possible to neutralize these charges, permitting the particles to agglomerate and settle from the liquid more effectively [9]. The current practice is to refer to this neutralization or destabilization step as *coagulation* and the subsequent gathering together of the particles into larger, more settle able "flocks" as flocculation.

Inorganic chemicals such as aluminum sulfate (alum), ferrous sulfate (copperas), ferric chloride, and sodium aluminate, as well as a long list of organic polymers, are used for coagulating and flocculating suspended matter in water. Coagulation takes place very quickly—a few seconds to 1 minute—and the chemicals should be added with intense mixing in order to obtain maximum efficiency. Flocculation, on the other hand, normally requires detention periods of 20 to 45 min, and, once the chemicals have been added, should be accomplished by relatively gentle mixing. The mixing is carried out in a flocculation basin, and its purpose is to bring about the maximum collisions between the suspended particles without shearing or breaking apart the particles that have already been formed. [11-13].

This will limit the particle velocities to the range of 1 to 6 ft/s (0.305 to 1.83 m/s), depending on the "toughness" of the flock that is produced. Equipment should be provided for varying the intensity of the mixing so that the optimum velocities can be achieved. Organic polymers (polyelectrolytes) are frequently used as flocculent aids. They facilitate the gathering of the already coagulated or destabilized particles into larger and less fragile flock particles that have better settling characteristics.

The type and amount of chemicals required to treat a given supply of water are best determined by laboratory jar tests. These tests should be made on fresh samples at the same temperatures and other conditions that will be present in the full-scale plant. No other reliable method has been found for predicting the best chemicals and optimum dosages for clarifying water. Typically, dosages of inorganic coagulants (alum, ferric chloride, etc.) might range from 10 to 100 mg/L, cationic organic coagulants from 1 to 5 mg/L, and anionic organic flocculants from 0.1 to 1.0 mg/L. Many chemical Suppliers and equipment manufacturers will perform jar-test studies at reasonable fees and make recommendations as to the best chemical, equipment, and sizing for treating a water supply. Generally, sedimentation processes are used primarily for the removal of suspended material from water, but the removal of dissolved mineral impurities such as in the lime or lime–soda ash softening process is an equally important aspect of sedimentation in the treatment of water. In the softening process, hydrated lime or hydrated lime and soda ash are added to react with the dissolved CO_2 and the calcium and magnesium salts that commonly cause the hardness of water. The following equations describe some of the reactions that take place in the formation of the calcium carbonate and magnesium hydroxide precipitates. [14-15]

$$CO_2 + CA(OH)_2 \rightarrow CaCO_3 + H_2O$$

$$CA(HCO_3)_2 + CA(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$$

$$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2 + 2H_2O$$

$$CaSO_4 + Na_2CO_3 \rightarrow CaCO_3 + Na_2SO_4$$

A coagulant is normally added along with the lime and soda ash to improve clarity of the product water. When the lime requirements are high, economies can usually be realized by using quicklime (CaO) in a lime slacker to convert it to the hydrated lime [$Ca(OH)_2$]. When requirements reach approximately 200 lb/h (90 kg/h), the economies or quicklime should be investigated.Neither calcium carbonate nor magnesium hydroxide is completely insoluble, so some amount, depending upon the type of treatment, temperature, and other conditions, will Remain in solution. Unlike most compounds, $Mg(OH)_2$ and $CaCO_3$ are less soluble at higher temperatures. Temperature and changes in temperature of the liquid being treated are extremely important considerations in the design and operation of sedimentation units. The rate at which a particle settles in water is inversely proportional to the kinematic viscosity, a property that varies with the temperature. Thus, the settling rate of a given particle at 40°F (4.4°C) is only 63 percent of what it would be at 70°F (21.1°C). Rapid changes of inlet water temperatures to settling units will cause thermal currents, which at best are disruptive to the settling of particles and at worst, are totally upsetting. Manufacturers typically limit changes to 2°F (1°C) per hour in their performance guarantees. The rate at which chemical reactions proceed in water is higher at higher water temperatures. A common rule of thumb is a doubling of the rate for each 18°F (10°C) increase in temperature. In general, warm but constant water temperature is desirable in treating water.After all these steps care should be taken in water distribution network to ensure that the spent efforts will not be useless.

The usual way is currently in the distribution of potable water that the method used is currently in the distribution of potable water are based on the number of Arnona where the water distribution system is subject to specific time frame and thus the time required to operate the compounds water booster stations, also any non-specific equation sports be at the expense of the number of arnona, regardless of the number of persons residing in one home actual consumption per person multiplied by the rate of an amount of money to and from three periods of time owe property assessments culminating convergence 60 consecutive days where consumption rate of persons in the cities at a rate of 400 L\per person either inhabitants in rural areas is 260 L \per person as detailed below:- The amount required batch Iraqi dinar =) Number of Arnona in rural or city) *) 3750 dinars or 2250 dinars) for each 60 day.

Then the practical results as follows:

- Current distribution mechanism depends on the number of Arnona and it is approaching slum where the 8) hours a day. - rate of daily operation of the least draft or hydro complex lasts at least 6
- In distribution mechanism (current) on the basis of the number of Arnona be operating time open absence of mathematical equation minutes link between the number of people beneficiaries and quantity of water already

allocated for each house, where the amount of water the hyphen house contains 10 people is the same quantity hyphen house contains only one person.

- Through practical experience daily follow-up, we find that the citizen in Iraq (need actually \ 200 liters per day) of drinking water but does not accept B 10 cubic meters of potable water a day even in periods of winter or summer cruel).
- Through FIELD flights we found that the more water biphenyls goes to the gardens and lakes spoil without any control.
- Do not match current method of distribution and the current situation which lads its raw resources and water, where the more studies and research to prove that the amount of water in crude Euphrates and Tigris river basins and most of the countries of the world concern about scarcity, according to United Nations sources and studies.
- In the current way water distribution find its platform and technical norms do not apply international United Nations need the individual water Actual and average lower and upper its limits. The average use of potable water, cooking, personal hygiene in) -a .) any family of 15 liters per person per day to less the maximum consumption at home per person per day and drink washing comprehensive, cookingand other uses be 300 L \day)

PROPOSED PROJECT COMPONENTS AND PARTS

- Electrical lock "2
- Digetal Electrical water flow meter.
- Solar cell (50*50 cm) with iron handle.
- Manhole (75* 100*75) cm.
- Mechanical lock 2 " if need.
- Mechanical water flow meter.

THE IDEA OF THE WORK OF THE PROJECT

Summarized idea of this project, including the following:-

- Supplying odometer and electronic flow meter.
- Supplying electrical lock.
- Supplying mechanical lock.
- Supplying solar energy cell with dimensions 50 x 75 cm with iron cover and padlock.
- Buildinga hole measuring 75 x 75cm.

These partswill be connected together at the entrance to the network of points are nutritious water criteria required passing to the region, taking into account actual need of a citizen by considering one home needs about 2000 liters with losses in the network where passing each quantity throughthe flow meter.

ECONOMIC FEASIBILITY OF THE PROJECT

Run system pumps a timetable and measured depends on the population density with actual need actual citizen of water according to test. Studies logical United Nations and UNICEF International with consideration lower and upper limits and various age groups throughout the year. Where summarized the importance of the project:

- Helps the project proposed to reduce the number of workers in complexes stations water filtering through the codification of the demand for drinking water.
- Pumps are run, commensurate with the number of the population plus percentage losses
- The project will help to reduce the demand for chlorine and other chemicals in projects.
- The project will help to reduce the number of operating hours for each pump to the half which results in reducing the rate of maintenance and repairs.
- The project helps in the future the electronic control, through the Internet and other software on all the points distribution areas and water as well as knowledge of the imbalance in malfunction any division or when a decrease in pressure, or upsetting any pump.
- The project helps in reducing the operating time of the electrical generators to the half and thus reduces the cost.
- The project helps proposed in reducing fuel consumption to the half as well as reduces the demand for fuel oil and motor.
- Reduces electrical power needs.
- The project will help in prolonging life complexes projects water filter filter stations, lifting the drinking water.
- The project helps proposal in electronic control to all points of distribution and residential areas in technical and accurate to the extent.
- Helps the project proposal to the codification of drinking water - very accurate where commensurate and the amount of water expected elevations in Tigris and Euphrates rivers in the future the basis of the project.
- The project will help promote the use of clean and renewable energy projects in water complexes and networks with solar energy in power generation, capable of recycling electrical engine special close when closed and unlock the system.
- The project will help when developed in the future to reduce the number of workers where the method of collection electronically and be payment will be very modern manner.
- The project will assist in the measurement and calibration in water distribution networks share water and depending on the amount of raw water and actual need for each network control of the major networks (water flow meter) for the amount of water passing in and sub-system.
- We can through this knowledge project requirement for each compound annual or water) draft crude filter from the water where the water meter readings user it is cumulative and also quantities we can study (flow meter required water water filter for all projects of the Ministry of Municipalities for the purpose of coordination with the Ministry of Water Resources, where will we have a database fixed annual.
- Can circulate how to link in the future to all houses and residential houses where can be replaced by the solar energy card National have cost 4 of amperage only. Home \ One 3 17 - can use the project with open and closed water networks together. The diagram below represents system design ideal drinking water network (type closed).

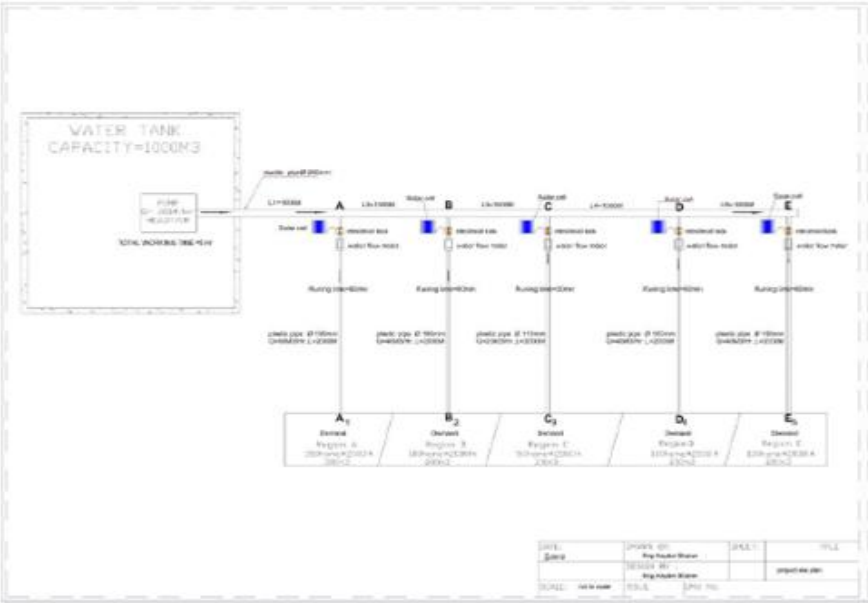

Figure 1: Shemitc of Flows Pipes

SYSTEM DESIGN IDEAL DRINKING WATER NETWORK (TYPE CLOSED)

First type streetscape are closed. 2. Type II networking. 200 M 3\Hours = 5 hours \ number of hours pumping = 1000

16.67L/S =60*1000/3600 =60m3/Hr =300/5 = AA1 (pipeone).

11.12 L/S = 40 *1000/3600 = 40m3/Hr. = 200/5 =BB1 (pipe two).

5.56 L/S = 20 *1000/3600 = 20m3/Hr. =100/5 =CC1 (pipethree).

55.56 L/S = 200 *1000/3600 = 200m3/Hr. = 1000/5 =PA (Pipe four).

38.89 L/S =1 40 *1000/3600 =1 40m3/Hr= 60-200 = AB

27.78 L/S =1 00 *1000/3600 =100m3/Hr= 40-140 =BC

22.23L/S =80 *1000/3600 =80 = 20-100 =CD =

12.12 L/S =40 *1000/3600 =40m3/Hr= 40-80 =DE =We impose the lowest pressure is required at each point of the network = 25 m pressure required for each point = 25 + attributed that point.

- Design the pipe AB

We impose Qatar pipeline = 250 mm 60 L/s = 55.56 = q city overland = 0.03 and through the table on tube diameter is 250 MM, we find that:- V=1.18 m/s and hydraulic gradient = 4.521 M/ 1000m along the tube PA = 1000M * 70 -4.5 = 65.5 M = a pressure when (a =0.5 M) impose attributed pressure at a = 65.5 > 25.5M from pipe design aa1, we found Q=60 M3 /hr =16.67 U.S. L/s 17 L/s, we assumed pipe diameter is 160 mm, so from tables we found :- V= 0.9 442 Hg = 5.619 M/1000 pipe length AA1 = 2000m so, 2000 /1000 * 5.619 == 11.24 m.

65.5-11.24 = 54.26m

Pressure shall be = 26.

26<54.26 it is …… …ok.

- Design the pipe AB.

We assumed pipe Diameter = 250mm.

Q=140 m3/ Hr = 38.89 L/s = 40 L/s and from the tables

We found the following.

V=0.786

Hg =2.142mm/1000m

The pressure at the point B is:

61.21m =65.5 - (1km * 2.142) =pressure at B.

m =that pressure at point

B= 26m

26<61.21 it is ok.

- Design pipe BB1
- We assumed the pipe diameter is 160mm.

Q=40m3 /Hr =11.2 L/s, from the tables we found.

V=0.611, Hg= 2.539

Pipe length is = 2000m.

Head =61.21 - (2000/1000 * 2.539) = 56.13m.

Assumed B1 eleva

26<56.13 it is OK.

- Design the pipe BC.

Assumed pipe Diameter is = 250mm and the pipe

Length = 1000m.

Q = 100m3/Hr=27.78 =28 L/s

From the tables we found

V=0.56m/s, Hg = 1.15m.

0.5901 - 0.4918 =0.1

0.1/5 *3 =0.06, v=0.4918 +0.06 = 0.56 m/s.

1.264 - 0.9086 */5 = 0.24

H =0.9086 + 0.24 =1.15m, we assumed "C" elevation

C=1m and pressure is 26m.

H= 61.21 - 1.15 = 60.05 > 26 OK.

- Design CC1 assumed pipe Diameter is 110mm, pipe

  Length is 2000m

  Q= 20m3 /Hr 5.56 l/s but from tables we found:

  V=0.7030

  Hg= 5.465 = Head 60.05 - (2000/1000*5.465) =49.12>26

  OK.

- Design pipe CD, assumed pipe diameter =160mm,

  Pipe length is 1000m

  Q=80m3/Hr = 22.23 l/s =22l/s

  And from the tables: - V= 1.222 m/s, Hg =9.031 m/1000m

  H at D =60.05 -9.031 =51.02 m

  We assumed D point elevation = 1m and pressure at D =26

  51.02>26….. ….OK.

- Design pipe DD1

  Assumed pipe Diameter 160mm, pipe length 2000m.

  Q=40m3/Hr = 11.12 L/s

  From tables

  V=0.611 m/s, H= 2.539

  Hal w= 51.02 - (2000 /1000 * 2.539) = 45.94>26 OK.

- Design pipe DE

  Assumed pipe diameter is =160mm, pipe length =

  1000m

  Q= 40m3/Hr =11.2 L/s and from tables we found

  V=0.611

  H= 2.539

  H at E = 51.02 - 2.539 = 48.48 OK.

- Design pipe EE1

  Assumed pipe diameter = 160 mm, pipe length= 2000m

  Q=40m3/Hr =11.2 L/s from tables we found

  V=0.611, H= 2.539 m/1000m

Hat E1 = 48.48 – (2000/1000*2.539)

=43.4>26 OK.

CONCLUSIONS

The project idea is depending on electrical controller on the drinking water sources by using the following parts:

- Water flow meter.
- Digital flow meter with digital timer.
- Electrical lock.
- Mechanical lock.
- Solar cell with Iron handle.
- Manhole (75*75*100) cm.
- We will connect the all parts to gather and set up

The digital system according to the water needs standards for each one person, so. When the water flow bass quantity is enough the system locks will be close automatically, conclusions:

- The project will minimize the needs of human workers and hence increase the economic benefits.
- The project will reduce the needs to chemicals used in the operation.
- The project will reduce the needs for fuels and maintenance cost by minimizing the operation time.
- The project will promote the use of renewable energy via utilizing solar energy.

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