CHAPTER V

WATER DISTRIBUTION

5.1. INTRODUCTION

Water is vital for the life in our planet. It is present in the most important activities of human life. These activities include, but are not limited to:

a) Cleaning and hygiene

b) Transportation uses (transport organic waste)

c) Cooling and heating

d) Protective uses (fire protection)

e) Ornamental uses

f) Ceremonial uses (religious services)

Practically every building constructed today in the USA is supplied with potable water.

This chapter includes the study of the basic characteristics of water and waste and description of several means to obtain water.

5.2 THE HYDROLOGIC CYCLE AND WATER QUALITY

One of the primary sources of water supply is precipitation in the form of rain or snow. Much of the rainwater infiltrates into earth, other part flows across the ground and is collected in lakes, rivers, etc. These are the main sources of water. Other sources of water as seas or oceans are used at lower grade, because of the high water treatment cost.

The continuous exchange of water among atmosphere, the earth, and the water reservoirs is know as the hydrologic cycle. (Figure 5.1).

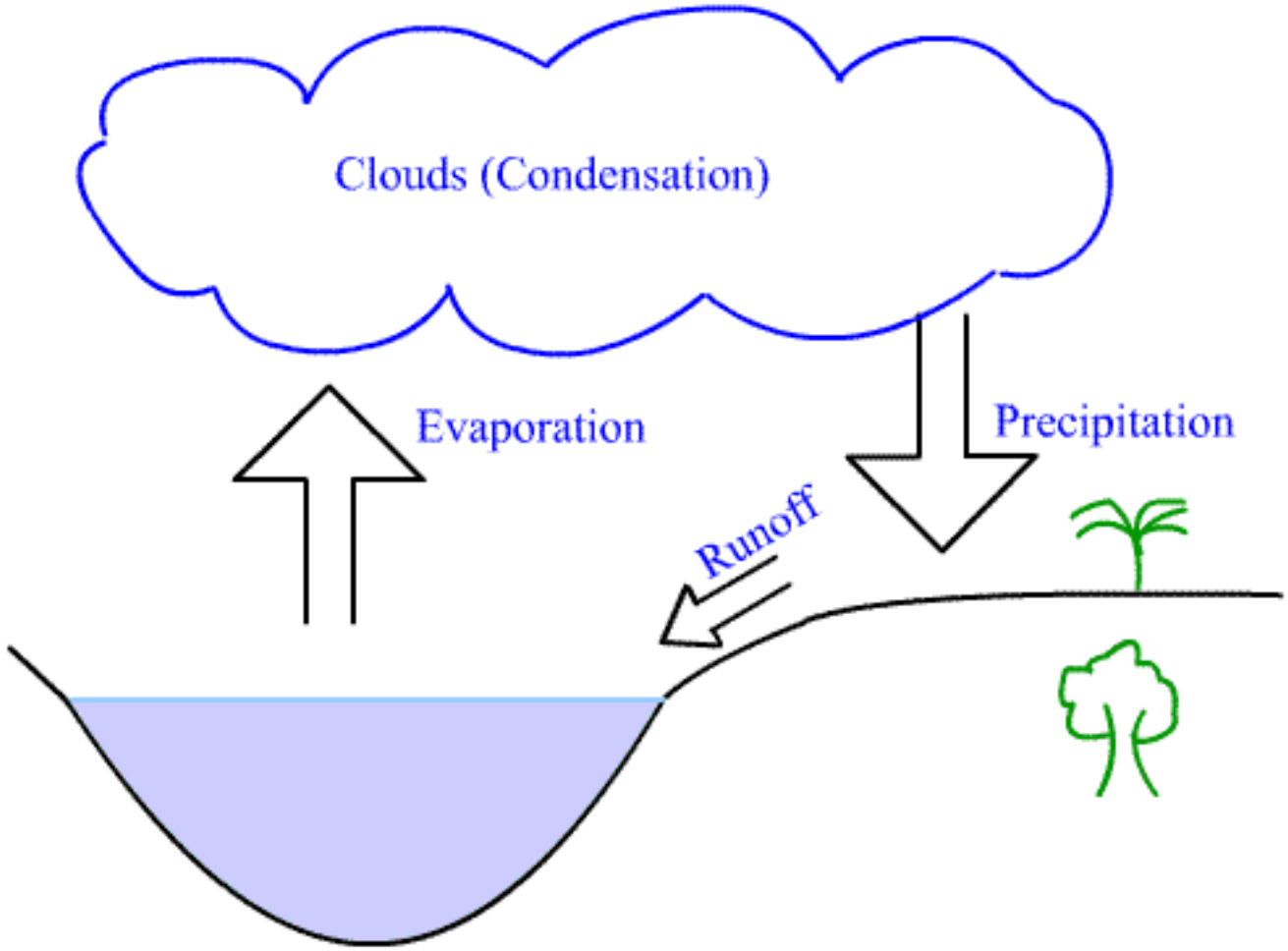

Figure 5.1. The Hydrologic Cycle.

Rainwater is one of the purest sources of water available. The ground and surface water are frequently contaminated. Ground water is particularly subject to chemical alteration because as it moves downward from the surface, different minerals and chemical compounds are slowly dissolved.

Surface water also becomes contaminated. Streams and rivers transport silt and clay along with water, making water turbid. Decaying algae, protozoa and bacteria add color and odor to water and make it dangerous to health. In order to give the necessary quality to water, it is necessary to treat it. The water characteristics are:

I.- Physical

Including turbidity, color, taste and door, temperature and foam ability.

II.- Chemical

Including alkalinity, caused by bicarbonate, carbonate or hydroxide components; hardness; caused by calcium and magnesium salts; PH, which is a measure of the water's hydrogen ion concentration, as well as its relative acidity or alkalinity. A PH = 7 is considered neutral. As the PH decreases, also increases the water acidity and consequently its corrosiveness. As the PH increases, also increases the water alkalinity.

Also water chemical characteristics are affected by toxic substances; chlorides, copper, iron, manganese, nitrates, pesticides, sodium, sulfates and zinc.

III.- Biological

Produced by microorganisms: bacteria, protozoa, viruses.

IV.- Radiological

The radiological pollution comes basically from materials in industry and power plants.

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5.3. WATER TREATMENT

For improving the water quality, it is usually treated by means of one or several of the following procedurals:

a) Sedimentation: Allowing time and the inactivity of the water do the work of settling out heavier suspended particles.

b) Coagulation: Hydrated aluminum sulfate is added to turbulent water. The water is then held in a quiet condition, in which the suspended particles will combine with the aluminum to form flocks. These heavy particles then settle out, in a process similar to sedimentation.

c) Aeration: Water is circulated through a series of perforated plates in the open air, acquiring oxygen. This process improves the taste and color of water, and help remove iron and manganese.

d) Filtration: Help remove suspended particles, some bacteria, and color or taste.

e) Disinfection: Is the most important health-related water treatment. Chlorine addition to water is the typical way of disinfecting it. The effect depends on chlorine concentration, contact time, water temperature and water PH.

f) Corrosion Control: Used to prevent corrosive water from increasing the concentration of hazardous materials.

Also may used other methods as softening, nuisance control, fluoridation, and distillation.

5.4. WATER SOURCES

One of the sources of water supply is precipitation. The quantity of water obtained from rain or snowfall in most of the U.S. locations could be enough to meet a high percentage of typical home or business needs.

In many places, where the rainwater is scarce, small cisterns within the home are common. Those

cisterns, fed from both the rainwater and the public supply, are frequently used for all domestic purposes, including drinking. A typical installation of a system with two cisterns, one located on or under the ground level, and the other located on the roof of a building is shown on Figure 5.2. The lower cistern receives water from the public supply. The water is sent to the upper cistern by means of a pump and from this cistern is distributed to the users in the building. This method is frequently used in places, where the water pressure in the supply system is very small or the supply is made irregularly.

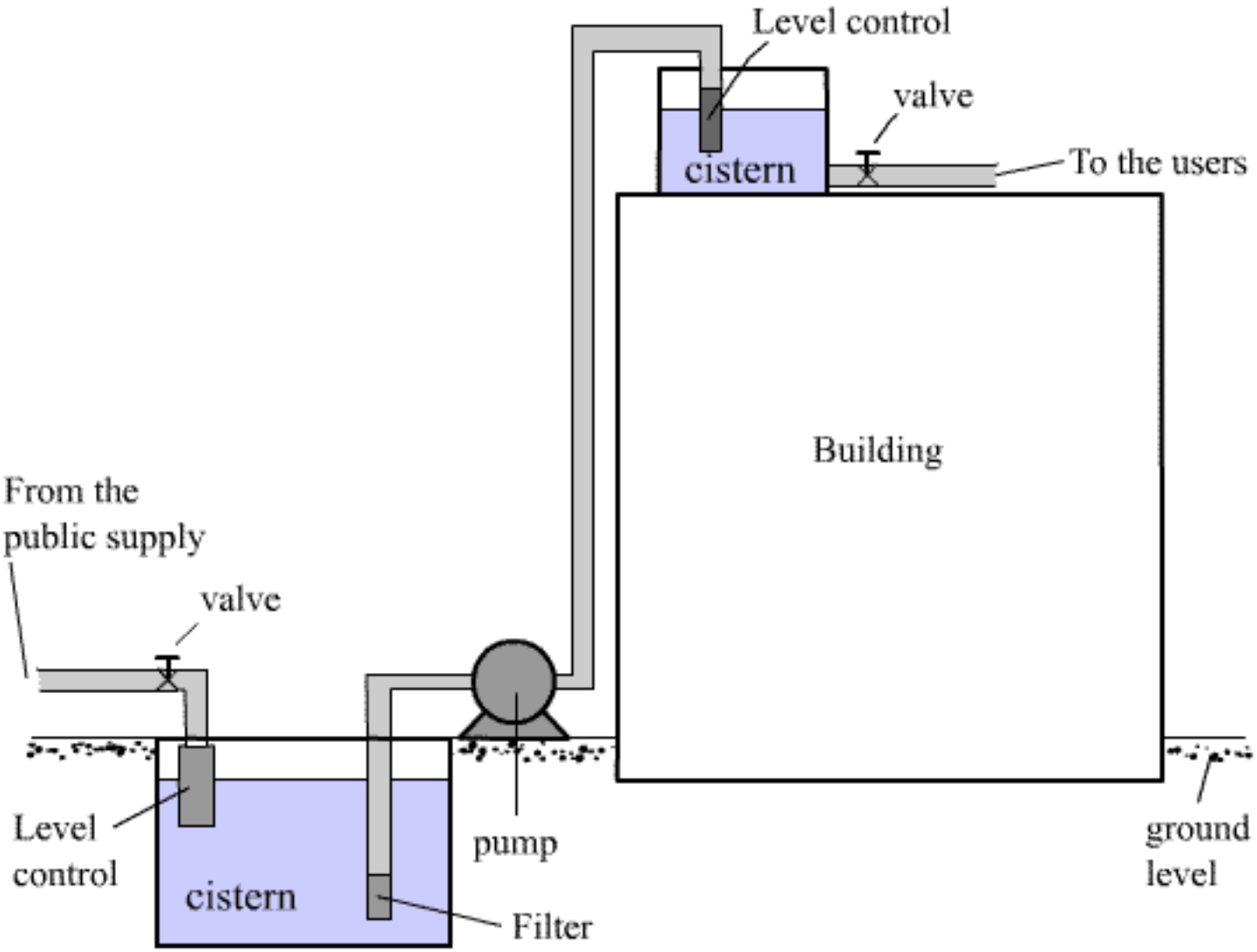

Figure 5.2. Two cistern system for water supply

This method is also used when collecting water from lakes or dams. In this case the lower cistern does not exist, and the upper cistern maybe located on a specially constructed for this purpose structure, as show on Figure 5.3.

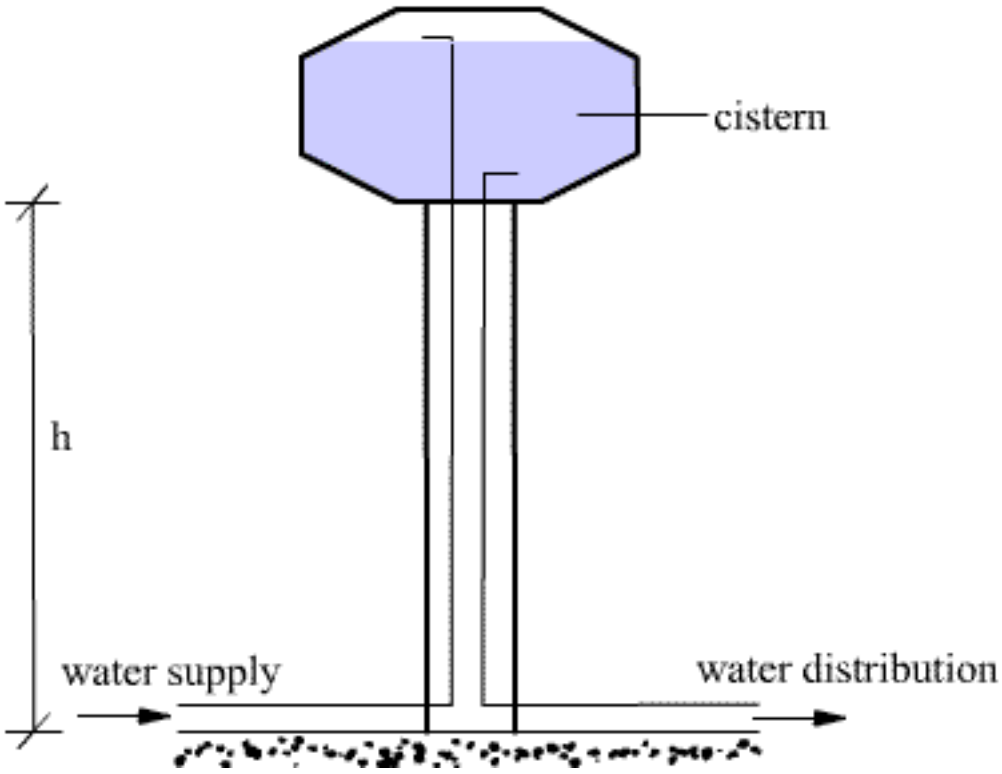

Figure 5.3. Cistern Located at a high h

The high h will determine the water distribution pressure.

Another frequently used source of water is the underground water. This is usually collected digging either shallow or deep wells. When the depth of the well is more than 25 feet, it is called a deep well. They are either bored or drilled through the earth and rocks. The bored wells are usually less than 100 feet deep. They are used when the earth to be bored is boulder-free and will not cave in. The drilled wells require more elaborated equipment. They are very deep and constructed using machine-operated drilling equipment or rigs. Techniques employed for the construction of drilled wells are percussion and rotary.

5.5. PUMPS

Several types of pumps are used for collection of water from wells:

1) Positive Displacement pumps: There are two principal types of positive displacement pumps, the reciprocating pump and the rotary pump.

In a reciprocating pump there is a piston within a cylinder equipped with check valves. The cylinder is ideally located below the groundwater level. The operation of a reciprocating pump is explained on Figure 5.4.

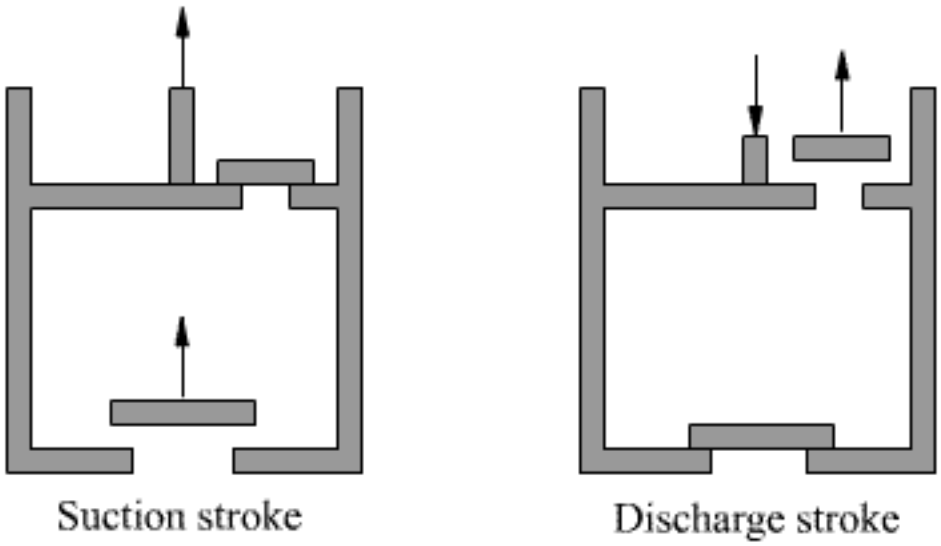

Figure 5.4. Reciprocating Pump.

During the suction stroke, as the piston moves upwards water enters the cylinder through an initial check valve, which allows flow in only one direction. When the piston moves downward, (discharge stroke the water): The water is forced through a second check valve.

The rotary pump has a helical or spiral rotor within a rubber sleeve. As the rotor turn, it traps water between it and the sleeve, forcing the water to the delivery side due to the rotation of the rotor. Figure 5.5 shows a schematic diagram of the rotary pump.

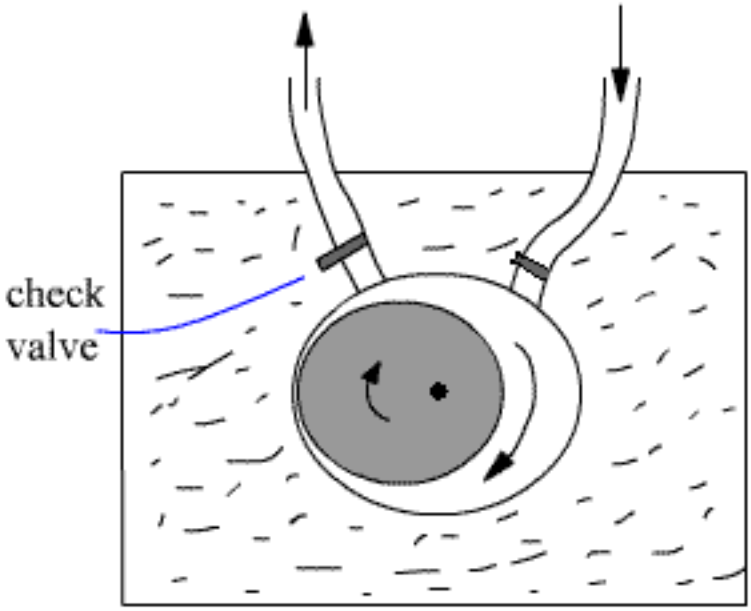

Figure 5.5. Rotary Pump

2) Centrifugal Pumps: These pumps contain an impeller mounted on a rotating shaft. The rotating impeller increases the water's velocity while forcing it into a casing. The centrifugal pumps are frequently used in deep wells.

3) Turbine Pumps: Have a vertical turbine located below groundwater level and a driver motor located higher up. A long shaft is required between the motor and the turbine. Figure 5.6 shows a schematic diagram of a turbine pump.

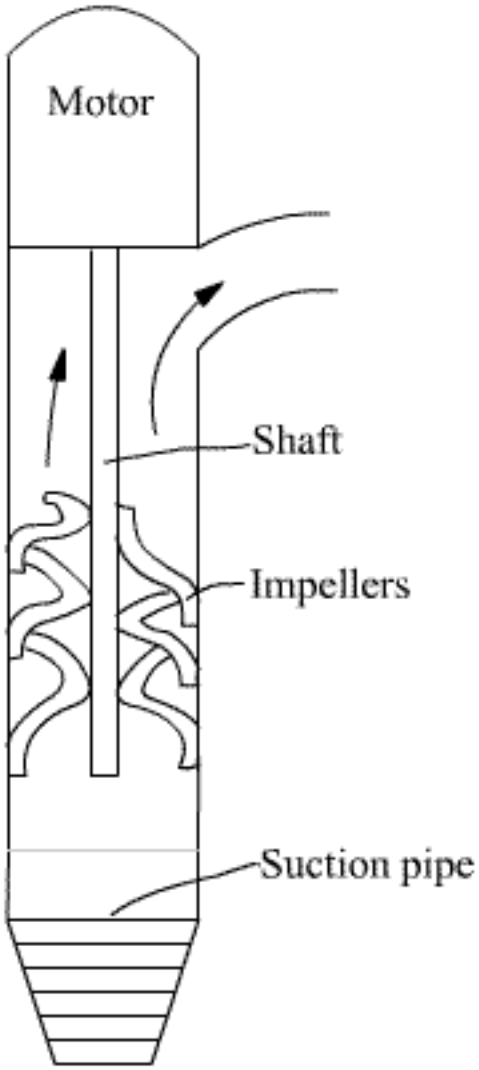

Figure 5.6. Turbine Pump.

When the motor can be submerged along with the turbine, a submersible pump is obtained. The lengthy pump shaft is thus eliminated.

The pump selection is determined by several factors: the rate of yield of the well, the daily and maximum instantaneous flow rate, the size of storage used, and the total operating pressure against which the pump works.

5.6 REVIEW QUESTIONS

5.1. Mention 3 uses of water.

5.2. What are the physical characteristics of water?

5.3. What are the chemical characteristics of water?

5.4. What is water treatment?

5.5. List 5 methods of water treatment.

5.6. What are storage tanks for?

5.7. What does PH measure?

5.8. List 3 toxic substances that could be found in water?