WATER AND WATER POLLUTION

Hydrological Cycle

- The hydrologic cycle is a summary of the circulation of Earth's water supply
- Processes involved in the hydrologic cycle
    - Precipitation
    - Evaporation
    - Infiltration
    - Runoff
    - Transpiration

Where is Earth's Water Source % of total water Oceans 97% Icecaps, glaciers 2.14% Ground water 0.61% Fresh-water lakes 0.009% Inland seas 0.008% Soil moisture 0.005% Atmosphere 0.001% Rivers 0.0001%

Water is a basic human right & essential need .It has many uses including the irrigation of Crops, The generation of electricity & for transport such as Canals. In term of protecting human health, we are mostly concerned with the use of fresh water for domestic purposes. WHO currently estimate that over 1.1 billion people worldwide still lack access to an adequate supply of clean water.

Uses of water in domestic setting include:

- Drinking.
- Personal hygiene.
- Cleaning e.g. Cooking utensils.
- Gardening e.g. garden vegetables.

Quantity: Generally speaking a minimum of 20-40 Liters per person per day is needed for drinking, personal hygiene & Cleaning.

Quality: The water should be free from chemical & Biological Contamination in addition to be acceptable in term of color, taste & smell, In accordance with the WHO guidelines on the quality of drinking water.

Sources of fresh water:

1. Surface water e.g. streams, rivers, lakes and ponds.
2. Ground water e.g. Wells & spring.
3. Rain water.

Testing of water Supplies: When a new source of water supply is provided, the water from that source should be tested for Physical, Biological & Chemical parameters. A sampling program for periodic testing should also be established for the purpose of continuous monitoring, The frequency of testing will be largely determined by the size of population served .The key indicators of biological contamination in a water supply is the presence of fecal Coliforms. The presence of Coliforms in number greater than 10 Coliform/100ml indicates an unacceptable level of Contamination. There is whole range of chemical Contaminants. One can test for like nitrates, phosphates, fluoride, arsenic & iron. E.g. WHO guidelines for arsenic are 0.01mg/liter. All water tested should be tested with reference to the WHO Guidelines on drinking water Quality.

Classifies chemical in drinking water into three categories:

1. **Substances** (Various metals, nitrates, cyanides) that exert an acute/or chronic toxicity when consumed, as the concentration of these substances in the drinking water increase, So does the severity of the health problems. Below a certain threshold concentration, however, there are no observable health effects.
2. **Genotoxic substances:** (synthetic organics, Pesticides & arsenic) that cause health effects such as carcinogenesis, mutagenicity & birth defects. There is no safe threshold level for these substances that would be considered safe since any amount ingested contributes to an increase in risk.
3. **Essential elements** (Fluoride, Iodine. Selenium) that are a mandatory part of diet intake to sustain health. Deficiencies or high concentration of these elements cause a variety of adverse health effects.

Physical parameters of drinking water:

- **Color:** The color of the drinking water is usually due to the presence of colored organic matter in the Soil, Color is influenced by the presence of iron (usually rusty brown) & other metals.
- **Taste and odor:** originate from natural & Biological sources, from contamination by chemicals or as a side effect of water disinfection. Taste & odor may develop during storage &/or distribution system.
- **Turbidity:** is caused by particulate matter that may be present as a consequence of inadequate treatment or the presence of inorganic particulate matter in some ground water .High turbidity level can protect micro-organism from the effect of disinfection & can stimulate bacterial growth .

Source of fresh water:

- **Surface water** is the most easily accessible source of fresh water but also the source most prone to contamination. Human & agricultural activity nearby often contaminate surface water.
- **Ground water** is more likely to be of a high quality than surface water. However, ground water can be difficult to Access as complicated forms of extraction such as submersible pumps may be needed, Ground water comes from springs, shallow wells or deep wells.
- **Rain water** as in some country it is culturally accepted practice to collect rain water e.g in Jordan rain water is a good quality source of water if surface areas on which it is collected are kept clean also rain water needs to be stored safely.

Storage: A water supply may come from a clean source & be well protected but still become contaminated during storage. Storage containers should be well protected from outside contamination & have an opening which is small & have a tight fitting lid.

Treatment: in many instances some form of treatment will be necessary. The degree of treatment will depend on the quality of the raw water source. Surface water sources tend to require the greatest level of treatment whereas spring water may not require any treatment at all .Treatment may be as simple as boiling in the home or a series of activities resulting in water fit for human uses.

Depending on the quality of the raw water, the following are the stage of treatment that may be followed:

1. Flocculation & Sedimentation. 2. Filtration. 3. Disinfection.

Disinfection: The most common form of disinfection is chlorination. Disinfection is the last stage in the treatment process & is aimed at killing pathogenic organisms in the water. In municipal treatment plant chlorine gas is often used whereas on a small scale other forms of chlorine are used such as granules or tablets. One of the most common forms is granules of calcium hypochloride Containing a 70% Concentration chlorine. Chlorine is consumed by Organic matter & it is therefore important to remove as much organic matter as possible from raw water before disinfection. The stages of flocculation, sedimentation and filtration are all aimed at removing organic matter thus enabling administered chlorine to act on the pathogens that remain. When water is disinfected one aim is to leave a residual of chlorine in the water to deal with additional Contamination once the water leaves the point of treatment up to the point of Consumption. A normal residual chlorine level is 0.2 – 0.5 mg/liter. This compares with the residual chlorine level found in swimming pools of 1.5 -2mg/liter.