

ENVIRONMENTAL HEALTH

BY MR. KASUJJA HENRY - MEDICARE

WATER AND WATER RELATED DISEASES

Water is essential for life and health but it can also be a source of danger especially if it is contaminated and not treated functions like

- it is part of every cell in our bodies and is necessary for most basic functions like digestion and respiration
- it is a good solvent and many substances, some useful and harmful to life may be dissolved in it

REASONS WHY WATER IS ESSENTIAL TO LIFE

- water is part of every cell in the body
- it is necessary for basic body functions like digestion
- it is necessary for personal hygiene
- it is used in washing utensils and clothing's
- it is used in cooking food
- it is essential for animals and plants

DISEASES TRANSMITTED BY WATER AND PREVENTIVE STRATEGIES

Although water is essential for life and health, it can also be a danger for health.

Diseases transmitted through water, can be divided into three main categories;

- water washed diseases
- water born diseases
- water related diseases

However, we can also have water based diseases

WATER WASHED DISEASES

When there is lack of water or lack of adequate water for personal hygiene, there is a possibility of diseases transmission and spread

The water washed diseases include;

- diarrhea and vomiting (gastro – enteritis)
- dysentery
- skin diseases such as scabies
- eye diseases such as trachoma and conjunctivitis

Diarrhea and vomiting (gastro – enteritis)

Is a condition where a person vomits frequently and passes watery stools or faeces. It frequently affects children who play in dirty surroundings their hands become contaminated by germs which are later swallowed.

This condition can be made worse by giving the foods which are hard to digest such as beans and fats.

HOW GASTRO – ENTERITIS IS SPREAD

- by drinking water which is not safe from a stream, river, well or spring
- by eating food that has been handled by dirty hands or eating food that has not been washed properly or has been washed in dirty water.
- by eating food without washing the hands after visiting a latrine
- by using dirty bottles and other utensils for feeding young children
- by eating food that has been contaminated by flies

SIGNS AND SYMPTOMS OF GASTRO – ENTERITIS

- Frequent passage of loose watery faeces
- vomiting
- fever in some cases
- loss of appetite
- abdominal pains
- a dehydrated i.e. lack of enough water in the body
- a dehydrated child under the age of 18 months will have a sunken fontanel (a soft spot on the top of the head)
- the eyes are sunken, and the mouth and tongue are dry with no saliva
- the skin is wrinkled and dry
- the child's urine output is very little and the breathing is deep and rapid
- There is general loss of weight and the child is very weak.

PREVENTION OF GASTRO – ENTERITIS

- Mothers and other people who handle food must wash their hands before preparing and serving food.
- Milk and untreated water should be boiled so that the germs are killed
- Milk and water should be stored in clean utensils and covered with clean cloth or lid
- Food must be covered properly to avoid contact with flies, dust, rodents, dogs, cats, e.t.c.
- Through personal and general hygiene must be practiced
- In rural areas, people should construct pit latrines and use them

MANAGEMENT OF GASTRO – ENTERITIS

1. Before a child is taken to hospital, give plenty of home – made fluid e.g. milk, porridge, soup, fruit juices e.t.c.

Take the child to the nearest health facility for treatment and advice
breast feeding should continue.

2. Bacillary dysentery

Is a severe infectious disease characterized by an abrupt onset of abdominal pain, severe blood stain diarrhea with mucus, vomiting and fever. It mostly affects children, the malnourished and elderly people. The disease occurs in areas with poor sanitation and commonly seen in places where people do not use latrines and water sources are not protected.

HOW BACILLARY DYSENTRY IS SPREAD

- ❖ Through contamination of food or water by the faeces of a sick person or a healthy carrier
- ❖ Through flies landing on food
- ❖ Through direct contact with a sick person
- ❖ Through indirect contact with toilet seats, doorhandles, beddings and clothes

CONTROL AND PREVENTION OF BACILLARY DYSENTRY

- ❖ People should construct and make use of latrines in rural areas. The faeces of the Which have been left around a home stead should be collected and disposed in the latrine and the latrine should always be covered to prevent flies from entering it
- ❖ The community should use a safe water supply
- ❖ Food should be prepared and served in clean surroundings, after a meal, the remaining food should be kept covered in clean containers.
- ❖ Hands should be washed with clean water and soap before eating and after eating

- ❖ Flies should be controlled by destroying the breeding areas or spraying the breeding areas.
- ❖ Bedding and clothes should not be washed in communal water sources

3. SCABIES

Is an infestation of the skin by a very small organism (mite). The disease is characterized by itching and a rash when the mite borrows into the skin.

The disease affects people with poor personal hygiene and is common in over crowded areas with poor sanitation. It also occurs in areas with inadequate water supply where people can not wash themselves regularly.

SPREAD OF SCABIES

- ❖ It is spread through direct or indirect contact with the infected person.
- ❖ It is also spread through contact with towels, clothes and beddings used by an infected person

SIGNS AND SYMPTOMS OF SCABIES

Scabies usually affect skin between the fingers and toes, wrists, elbows and armpits, legs, buttocks and around the genital area. There is severe itching which is worse in warm weather and when the effected person feels hot especially in bed. There is constant scratching because of the itching.

PREVENTION OF SCABIES

- ❖ The effected person should wash daily with clean water and soap

- ❖ The infected person's clothes should be washed in very hot water and if possible the clothes and beddings should not be shared to avoid spread of the disease
- ❖ People should always wear clean dry clothes
- ❖ People should wash themselves regularly
- ❖ Safe clean water should be used for bath and washing clothes
- ❖ Infected people should be treated with benzyl benzoate which is available for most shops.

CONJUNCTIVITIS

Is the disease of the eyes which is characterized by red, running eyes with a watery or pus discharge. The eyelids are swollen and stuck together in the morning. Some people also have headaches.

Conjunctivitis is caused by germs of the bacteria and virus group. It usually affects people with poor personal hygiene.

HOW CONJUNCTIVITIS IS SPREAD

- ❖ Conjunctivitis spreads through direct contact with the discharge from the eyes and through contaminated fingers, clothing or other articles
- ❖ It may also be transmitted by flies or contact with genital discharge during sexual intercourse.
- ❖ New born are infected through direct contact when they pass through a birth prevention of conjunctivitis
- ❖ People should be told that dirty eyes can cause eye diseases, and that they should wash their eyes and face daily with clean water.
- ❖ The community should ensure that people have clean water for washing themselves and their clothes.
- ❖ Refuse must be disposed off properly to control the breeding of flies and thus reduce the incidence of eye diseases.

- ❖ Maintaining a well balanced diet with particular attention vitamin A intake and proteins
- ❖ All infected individuals should be taken to a health facility for treatment

TRACHOMA

Is an infectious disease which cause severe scarring of the cornea and eye lids. It is a common cause of blindness.

This disease is found in almost all climates but mostly in dry areas, especially where there are many flies and little water.

HOW DOES TRACHOMA SPREAD

- ❖ It is spread through direct contact with discharge from infected eyes, soiled clothes of the infected person or by flies
- ❖ Children are affected more than adults and the severity of the disease depends on the environmental conditions e.g. lack of water exposure to winds and dust

HOW CAN TRACHOMA BE PREVENTED

- ❖ Provision of safe water for people in dry areas and regular washing of the face
- ❖ Infected individuals should be taken early for advice and treatment

WATER BORNE DISEASE

1. TYPHOID FEVER

Is a serious infectious disease with fever, abdominal pains, diarrhea or constipation. The infected person may have a high temperature of 104° in the first week. During the second week will experience pain. This disease can affect everybody in the

community except those people who have been vaccinated against it or have had recent attacks

HOW TYPHOID FEVER SPREAD

- ❖ A source of the infection is the faeces or a sick person or a health carrier.
- ❖ Drinking contaminated water or eating contaminated food can cause infection.
- ❖ Flies also spread the disease

SIGNS AND SYMPTOMS OF TYPHOID

- ❖ Headache
- ❖ Diarrhea
- ❖ Constipation
- ❖ Abdominal pain
- ❖ High temperature of 104° in the first week
- ❖ Experience of pain and swelling of abdominal pain in the limbs in the second week
- ❖ In the 3rd week if not treated, the person becomes semi – conscious

PREVENTION OF TYPHOID

- ❖ Infected individual should be taken to hospital for treatment immediately. His contacts should go with him incase e.g. have been infected
- ❖ Provision of safe water for drinking and washing. In areas with untreated water communities should be advised to boil the water. Water sources should be protected from contamination.
- ❖ Construction of pit latrines with covers or ventilated improved pit latrines

- ❖ Improving personal hygiene e.g. washing hands before handling food and after visiting a latrine, covering drinking water and food to avoid contamination.
- ❖ Proper food hygiene habits should be observed. E.g. proper storage thorough cooking, covering prepared food and avoiding raw foods during typhoid outbreak
- ❖ The health centre and hospital health worker should follow up contacts so as to detect any health carrier.
- ❖ If a typhoid outbreak occurs people should be vaccinated; this will protect them for three years.
- ❖ Controlling the flies' population by eliminating their breeding grounds through the provision of refuse pits and dustbins and by spraying insecticides.
- ❖ There should be proper supervision in places where food is prepared and served in large quantities e.g. schools, hotels, hospitals, prisons. Food should be served hot during outbreaks.

AMOEBIASIS

Is an infection that is characterized by fever, chills, bloody stools or stools with mucus and mild abdominal pain plus diarrhea.

It can spread to the liver and cause an abscess (a collection of pus, often caused by bacteria). The faeces of a person suffering from amoebiasis is the source of infection.

MODE OF TRANSMISSION

- ❖ Through water that has been contaminated by the faeces of an infected person
- ❖ By eating food that has been handled by someone whose hands have been contaminated with faeces or urine

- ❖ By flies when they eat the faeces of an infected person and walk on food.

PREVENTION OF AMOEBIASIS

- ❖ The community should be given health education on the importance of personal hygiene like proper disposal of faeces, washing hands after visiting the toilet and before handling food.
- ❖ Environmental conditions are also an important factor and people must ensure that;
 - ✓ They dispose off human excreta properly
 - ✓ They make provision for a safe water supply for the community and protect all water sources
- ❖ Vegetables must be properly cooked so that the germs are killed. Fruits must be well washed using safe water. Food handlers must be medically examined to exclude amoebiasis. public health officers must inspect all food premises for general cleanliness
- ❖ people suspected to have amoebiasis must be taken to hospital for treatment and contacts of the sick person must also go and be tested and treated

CHOLERA

it is a serious acute intestinal disease which is characterized by sudden onset of diarrhea. vomiting and rapid dehydration followed by circulatory collapse. it is caused by germs called vibria cholera (bacteria) the faeces and vomit of an infected person are the source of infection. cholera is common in people of low social economic status and affects people of all ages.

MODE OF TRANSMISSION OF CHOLERA

- through drinking water which has been contaminated by

- ✚ by eating food which has been washed in contaminated water or handled by contaminated hands
- ✚ flies carry cholera germs to food and the mouth

PREVENTION OF CHOLERA

- ✚ improving personal hygiene and use of pit latrines
- ✚ improvisation of safe water supply and the protection of water sources
- ✚ washing hands before handling any food and keeping food free from flies and dust last through diarrhea and vomiting
- ✚ controlling the fly population by clearing the potential breeding grounds.
- ✚ during cholera outbreak communal eating should be avoided as the food is often not prepared and handled hygienically
- ✚ raw food must be avoided during cholera outbreak
- ✚ active immunization is of little value because the immunity only last for a short time

HEPATITIS

it is also a disease of the liver and is infectious and characterized by abrupt onset of fever, headache, loss of appetite, nausea and abdominal pain and followed a few days by yellow coloring of the eyes (jaundice) it is caused by virus and the source of infection is the faeces and fluids of an infected individual.

MODE OF TRANSMISSION

One type of hepatitis is spread through drinking water or eating food which has been contaminated by the faeces or fluids of a person suffering from hepatitis.

Hepatitis can affect anybody but it is more severe in undernourished people and children.

PREVENTION AND CONTROL

- ✓ take the infected person to hospital for treatment
- ✓ health education should be directed towards good sanitation and personal hygiene with emphasis on the disposal of faeces and urine
- ✓ the community and individual members should maintain a high standard of hygiene

WATER RELATED DISEASE

They include; malaria, bilhazia (schistosomiasis) guinea worm and yellow fever.

MALARIA

is severe or mild disease caused by parasite called plasmodia. these parasites are usually carried by the female anopheles mosquito today, malaria is the only disease, a part of AIDS that shows a significant rise in both morbidity and mortality world wide

MODE OF TRANSMISSION

malaria is spread through a bite of a female anopheles mosquito. this mosquito bites a sick person and sucks up the germs of a sick person's blood and then bites a healthy person therefore injecting germs into his or her body. these germs go into the blood stream, develop and start destroying red blood cells.

SIGNS AND SYMPTOMS OF MALARIA

There may be headache and malaise, with chills followed by fever, joint pains, nausea and vomiting.

There may also be abdominal pains, loss of appetite and convulsions especially in children.

COMPLICATIONS OF MALARIA

The main complication of malaria is anemia and cerebral malaria.

Anemia is a deficiency of red blood cells or hemoglobin content to the red blood cells resulting in lack of energy and paleness. Anemia develops because the malaria germs destroy the red blood cells.

Another severe complication of malaria is cerebral malaria if the disease is not properly treated for a long time, the patient may have severe headache, fever, drowsiness (confusion), convulsion and unconsciousness

A pregnant woman is less resistant to malaria. She may become very ill with anemia and may abort or have a baby with a very low birth weight.

note: treatment is effective when the patient completes a dose prescribed by a doctor or clinician.

PREVENTION AND CONTROL OF MALARIA

- ✓ the control of malaria can be done in stages; in stage one, break the life cycle of the mosquito by
 - ✓ draining the suspected places of all its stagnant water
 - ✓ burying all used tins broken pots, bottles and calabashes and destroying used tyres and old plastic with all plastic items which can hold water
 - ✓ pouring a good amount of oil such as paraffin on stagnant water to suffocate the larvae in water
 - ✓ introducing fish to ponds and pool with stagnant water

in the second stage the adult mosquito is controlled or eradicated by

- ✓ using insecticides to kill them
- ✓ clearing the bush and cutting all grass surrounding the homestead
- ✓ white washing or painting houses with bright light color that discourage mosquitoes.

the third stage involves self protection by

- ✓ using a mosquito bed net which is treated
- ✓ using mosquito repellants e.g. mosquito coils
- ✓ houses should be built away from mosquito breeding places

note; in malaria areas the use of drugs for prevention is only encouraged for pregnant women.

BILHAZIA (schistosomiasis)

is a disease of both the urinary and alimentary systems caused by a parasite called schistosoma. it is characterized by passing blood stained urine and stool plus abdominal discomfort.

Bilharzia mainly affect children and adults who are involved in irrigation schemes or fishing.

the larvae of the schistosomes are the sources of infection and are found in water which is inhabited by snails.

SYMPTOMS OF BILHAZIA

the symptoms of bilhazia include;

- ✓ itchy skin rash at the site of entry
- ✓ abdominal pain
- ✓ fever and tiredness
- ✓ bloody urine or faeces

PREVENTION OF BILHAZIA

- ✓ people with blood in their urine and faeces should go to the hospital for tests and treatment
- ✓ members of the infected person's family should also go for a check up and treated accordingly.
- ✓ the community should construct pit latrines and use them
- ✓ people should not wash, pass urine or defecate in or near the community's water source.
- ✓ children should be discouraged from bathing or swimming in infected water.
- ✓ the community should use alternative water source while they drain all the contaminated water from ponds or pools
- ✓ chemicals that kill snails (molluscides) should be used
- ✓ any bushes surrounding the river or pond should be cleared to ensure that the parasites do not stick onto the plants or shrubs
- ✓ safe water should be provided for drinking, bathing and washing clothes and utensils
- ✓ wear boots when working in irrigation schemes or in areas suspected to have bilhazia.

SOURCES OF WATER CONTAMINATION

it is easier to prevent water from getting dirty than it is easier to clean it. therefore it is important to consider the possible sources of between the time that water falls as rain and the time it is used

rain water is usually contaminated when it is falling

- ✓ rain absorbs dust, smoke and particles from the atmosphere especially in countries with big manufacturing industries.
- ✓ later rain water is contaminated during collection when the collection surface are dirty i.e. containing rotten leaves, dust,

smoke, insects or birds droppings which usually collect into the storage tunnel.

- ✓ shallow well may be contaminated by contents from nearby latrines excreta, washed into it from surrounding ground, nearby latrine or by dirty containers used for drawing water.
- ✓ River water may be contaminated by human animal faeces, refuse and industrial waste.
- ✓ When water runs over the earth, it may become contaminated with human or animal waste, refuse, fertilizers or industrial waste. This contamination is less high up on the mountain and greater near towns.
- ✓ rivers, lakes and dams maybe contaminated by bathing, urinating or defecating in the water
- ✓ Piped water may be contaminated from leaks in the pipes especially when these pass near dirty drain.
- ✓ water may be contaminated during storage or service at home especially if the containers used are not clean

Note; contamination of water is mainly from human and animal waste. These contain disease causing organism.

To prevent this contamination we must protect our sources of water and later on treat the water before using it

SOURCES OF WATER

the sources of water include lakes, rivers, bore holes, springs, rain. these can be divided into 3 main groups.

- i. rain water
- ii. surface water which also includes; water that falls on high hills (up land surface water)
- iii. underground water

RAIN WATER

ADVANTAGES

if collected from iron sheet or tiled roof into gutters and then clean, closed tanks. this is normally purest natural water

DISADVANTAGES

- i. it is very difficult to collect from thatched roofs
- ii. the gutters and large tanks are required to store sufficient rain water to last into the dry system.
- iii. the water is soft and does not contain any essential mineral salts.
- iv. it may not taste good in some people

2. SURFACE WATER

When water falls it collects on the surface in streams, rivers, ponds, lakes, swamps and dams

Some of it gradually soaks down into the ground until it meets a layer of very hard earth or rock which it cannot get through.

Such a layer which may be near the surface or deep down is called an impermeable layer. if it emerges by itself, it is called a spring if you have to dig to reach the water it is called a well.

With a machine such as a drill bit, a hole may be bored through the impermeable layer. This becomes a bore hole.

ADVANTAGES OF SURFACE WATER

- ✓ Whether in ponds, lakes shallow wells, springs, streams, shallow springs or rivers or in water holes or dams is the commonest source of water to most people.
- ✓ it is accessible it can be obtained by hand or by simple pumps and the lakes and rivers are permanent all the year round

DISADVANTAGES

- ✓ it is easily and frequently polluted as it runs over the ground where humans and animals urinate and defecate
- ✓ people also wash and bathe in it
- ✓ it can be polluted by chemicals used in agriculture or industries
- ✓ attempts must be made to prevent pollution and also to purify this water which is quite expensive

UPLAND WATER

ADVANTAGES

- The water that collects into streams above where people live is often plentiful and clean and makes very good drinking water.
- if it can be piped to people living lower down the hill, the water comes by gravity and no pumping is required

DISADVANTAGES

- the source must be protected
- if animal grazing or human settlement occurs in the catchment area, the water will be polluted
- in some areas the increasing population has led to shortage of land in the lower slopes of hills and people have moved up into the catchment area, polluting the supply to those living below them

UNDERGROUND WATER

- As the water seeps through the ground and travels underground it is filtered as soil is a good filter.
- underground water is usually clean and often plentiful and permanent
- it may come from a long way and it is not so dependent on local rain.
- many rural areas and small towns use this type of water

DISADVANTAGES

- Water from deep wells and deep springs has usually dissolved a lot of salts and other minerals, making the water salty
- some times it is too salty or hard unless the salts are removed which is an expensive process.
- this water generally needs pumping from great depth, often to tanks or reservoirs before reaching the user.

SEA WATER

by the time water reaches the sea, it always contains some salts. these becomes further concentrated by evaporation and over million of years, sea water becomes too salty for drinking without very expensive purification to remove the salts

METHODS OF TREATING WATER (Purification)

there is no simple and reliable water treatment process suitable for small community water supplies. it is better to choose source of naturally pure water and then correct it and protect it from pollution so that treatment is not necessary. sometimes even when we protect our water completely, we must treat our water

water can be purified in the following ways

- i. storage
- ii. sedimentation
- iii. filtration
- iv. sterilization/boiling

Storage and boiling are the most common methods of purifying water in rural communities

STORAGE

- i. when water is stored, all the particles and micro – organism present in water, settle at the bottom of the container and they can be poured away
- ii. Using three water pots (3 – pot system) where two of the pots should be large and used for fetching water on alternate days.
- iii. the first pot should be allowed to stand for 24 hours, then it is stored in the smaller pot and the remainder is used for washing
- iv. the second big pot is then used in the same way as the first big pot
- v. if water is stored for at least 48hrs, any schistosome in each will become non effective before they leave the tank

SEDIMENTATION

this means allow suspended matter in water to settle to the bottom of the container. the same principle works in urban water works although alum is added to enhance the sedimentation process. the top clean and clear water may be subjected to further treatment before storage and consumption to render it germ free, while the dirty portion is poured away

For larger communities, a small sedimentation tank can be built although it is not usually possible to arrange for coagulant chemicals.

chemicals to be added to the water to assist sedimentation. sedimentation does not remove some of the harmful organisms from polluted water but it helps to clarify water for treatment by filtration or chlorination.

FILTRATION

- water is filtered to make sure that all particles and most of the micro – organisms are eliminated from water.
- it is an important treatment process through which bacteria are removed from water using large sand filters or small homemade filters .
- it can be done on a small scale for a house hold or on a large scale for a village or town
- The best sample house hold filter is a candle filter though expensive.
- water is placed into the top container, filters through the pottery candle and is stored in the bottom container

DIAGRAM

The candle is the most common used home filter and when used, handles should be clean thoroughly and when boiled every few days. from time to time, the candle is brushed to clean it and some candles have a silver catalyst that kill bacteria.

The commonest large scale filter is made of different grades of sand is arranged in layers with stones at the bottom then coarse sand (large grain) and fine sand (small grain) sand filter for the public water supply are usually built in concrete containers for a few houses, smaller sand filters in special metal containers may be useful.

DIAGRAM

GENERAL ARRANGEMENT OF A TYPICAL RAPID SAND FILTER

DIAGRAM

RAPID SANDFILTER

It is designed to filter a large volume of water in a very short time. The rate of filtration of rapid sand filter is above $4.8\text{m}^3/\text{m}^2/\text{hour}$.

The principle of operation of an rapid sand filter is basically physical straining of the water. It requires very small space compared to a slow sand filter.

before water is released into the rapid sand filter it is first treated with coagulants followed by sedimentation.

the rate of filtration is 30 – 40 times higher than that of Slow Sand Filter

wash sstm for cleaning purposes

a well designed and well operated sand filter will remove 97% - 99% of bacteria in the row water.

SLOW SAND FILTER

the process of filtration is a combination of sedimentation, physical, straining and biological activities.

- rate of filtration for slow sand filter is $0.2\text{m}^3/\text{m}^2/\text{hour}$

- growth of micro organism take place in the top most layer of the sand soon after the filter is put into use
- the microbial growth forms a sticky, gelatinous coat on top layer of sand.
- this layer forms due to uninterrupted operation in the filter. formation of this layer promotes the efficiency of the filter medium. as time passes, this efficiency lowers the rate of filtration until it becomes unacceptably low.
- when it reaches this point, the filtration is stopped, the top most layer of sand is scrapped off and the filter is put back into operation.

HOME MADE SAND FILTER

DIAGRAM

STERILISATION

- it is the final stage of water purification necessary for whole some drinking water.
- the idea of sterilizing water is to make it completely free from micro – organisms.
- micro organisms die when water is sterilized
- on a large scale for big towns this is done in the water works by adding chlorine to water that has been filtered
- on a small scale, water may be sterilized either by boiling or by adding chlorine

BOILING

- it is capable of destroying most micro – organisms over and the cysts
- it is the easiest and safest way to sterilize water but very few people are prepared to do this regularly.
- the water must reach boiling point and boil for 15 – 20 minutes
- boiling cannot destroy toxic chemicals
- no technical skill is used in boiling
- boiled water should be safely stored

CHLORINATION

- chlorine is the most commonly used disinfectant especially in urban water supply it destroys the germs and control the growth of algae
- jik is the trade name of 1% solution of chlorine for house hold use
- two drops of chlorine is added to one liter of water to provide reasonable sterilization
- halazone is a tablet that release chlorine into water

note; iodine can also be used for treating water

- 2 drops of iodine are sufficient to disinfect one liter of water and iodine tablet such as globaline and portable aqua (commercial names) are also used in sterilization of a small amount of water.

MUNICIPAL WATER TREATMENT PROCESS

AERATION

this assist in removing odour and tastes i.e. it removes substances like dissolved iron and manganese which always turn water brown removes dissolved gases like carbon dioxide and ouder due to decomposed organic matter

Pre - chlorination

it accomplishes similar objectives to aeration and also controls the growth of algae.

Coagulation or flocculation

it takes control of colloidal matter by addition of a coagulant and the coagulant mostly used include; aluminum sulphate, iron (II) sulphate and iron III sulphate

Sedimentation

this takes place under quiescent conditions and it achieves the following results;

- removal or reduction of turbidity
- removal of substances that causes color, taste and odour
- removal of bacteria, ova, and cysts

efficiency of sedimentation depends upon;

- i. type of suspended matter
- ii. size of suspended matter
- iii. shape of suspended matter
- iv. weight of suspended matter
- v. retention time

filtration

rapid or slow sand filters can be used as follows;

- physical straining of the water

- all colloidal matter is retained on sand
- the use of sand bed produces a filtrate which is a clear liquid

WASTE STABILISATION PONDS(WSP)

- these are large shallow man made lakes in which bacteria helps to purify raw sewage
- for each type of pond an extra or spare is made. this enables any pond to be isolated for maintenance work or to allow sludge to be removed.
- this system is suitable for treating sewage (household waste water and excreta) from quite large communities

possible application of waste stabilization pond

- i. treatment of sewage collected by a network of sewers
- ii. treatment of sewage collected in small bore sewers
- iii. treatment of night soil collected from a community
- iv. Waste stabilization ponds take up large area of land and so are suitable only where land is easily available.

THE PURIFICATION PROCESS BY WASTE STABILIZATION PONDS

Incoming sewage, which has usually been passed through metal screens to remove large solids, enters a system of ponds as shown below

DIAGRAM

Some of the wastes float to the surface as scum while others sink to the bottom as sludge. over a period of time bacteria living in the pond feed on the wastes partially treating them.

sunlight is needed to encourage the growth of algae which are essential to the purification process in facultative ponds.

warm temperature accelerates the treatment of wastes and wind is important to ensure good mixing of the pond contents.

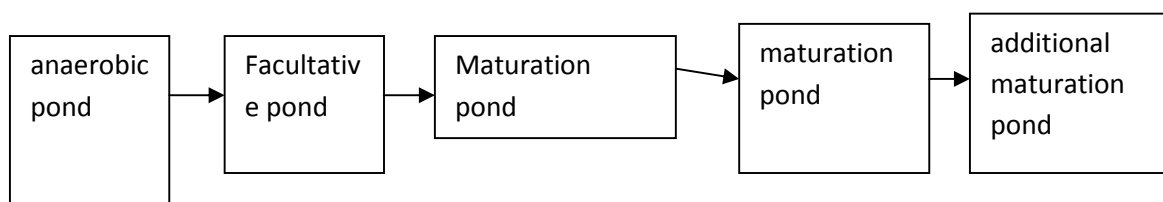
waste stabilization ponds work well in hot climates.

pond form and lay out

ponds are often rectangular in plan, with depth varying from 1 – 6m.

there are three types of ponds which may be used

- i. anaerobic ponds
these are used to pre – treat strong waste waters
- ii. facultative ponds
these are used to break down the organic matter in the sewage.
- iii. maturation ponds
are used to destroy the faeces pathogens
the typical system might look as follows



Anaerobic pond performs the same function as septic tank so they may not be necessary if the stage comes from septic tanks along small bore sewers

MAINTAINANCE OF THE PONDS

- ✓ Any scum that collects on the pond surfaces should be removed and buried
- ✓ If screens or grit traps are used to collect the easily separated solid material at the inlet to the ponds. the materials collected should be buried.
- ✓ Grass around the ponds must be cut regularly
- ✓ Anaerobic and the facultative ponds will require de – sludging every few years as necessary (anaerobic ponds every 3 – 5 years while facultative ponds every 10 – 15 years
- ✓ Some bird scaring may be necessary inorder to reduce the likelihood of bird droppings polluting the partially treated sewage and also to reduce cross pollution between ponds.
- ✓ Water carried disposal methods to sewage pits septic tanks, sewage forms or oxidation ponds

1. Septic tank

- ✓ The purpose of a septic tank is to treat and receive sewage of domestic nature
- ✓ May be used on single houses, small groups of houses, large buildings, all institutions where it is not possible or economically hard to connect to such sewage using a sewer

OPERATION OF SEPTIC TANK

- + Primary treatment of sewage in a septic tank takes place beginning with separation of solid matter from liquid
- + Heavier materials settle at the bottom of the septic tank as sludge and the lighter matter rises to form scum
- + The surface of the scum dries up and become crust like there by forming an air tight seal; this favors the growth of anaerobic bacteria.

- ✚ The particles under go decomposition by anaerobic bacteria and fungi resulting in considerable reduction in the volume of the sewage.
- ✚ The liquid matter then discharges into a soak pit

MAINTAINANCE OF THE SEPTIC TANK

- ✚ Before a new tank is put into use, it should be filled with water to test for the leakages
- ✚ A ripe sludge should be added in order to speed up biological disintegration of the feacal matter.
- ✚ Inspection should be made as often as possible to detect defects in the septic tank
- ✚ No disinfectant should be washed into the septic tank
- ✚ The effluent should discharge normally into a soak pit

WAYS OF PROTECTING WATER SOURCES

- ✚ Protection of springs and gravity water system. Springs have a reliable flow and can make ideal source of water for a community water supply
- ✚ No pumping is required to extract water from springs
- ✚ Springs are protected in order to increase spring water yield and reliability, protect the spring from surface pollution and water contamination by consumers or users
- ✚ Springs are protected by building a box of brick or concrete around the spring so that water flows directly out of the box into a pipe to out boing exposed to pollution from outside
- ✚ In excavating the foundation for a spring box, it is important to avoid digging the impervious layer of rock or soil because the water may seep down wards so that the spring disappears.

TYPICAL – CROSS SECTION OF A PROTECTED SPRING

DIAGRAM

CROSS SECTION OF A SPRING PROTECTED BY WATER AID IN UGANDA

DIAGRAM

STEPS IN SPRING PROTECTION

1. Community approval

The community should be consulted for their consent, approval and participation then an agreement with the community on roles and contribution of each partner should be made.

2. Preliminary assessment of spring

The following assessment should be made

- a. Permanency of the spring. This can be conferred by use of retrospective information by key persons in the community usually the aged person
- b. Possible sources of pollution. A sanitary survey should be undertaken to find out any possible source of pollution to the spring. These may include
 - i. Refuse dumps
 - ii. Pit latrine constructed close and to the upper site of the spring
 - iii. Soakage pits

- iv. Indiscriminate defecation by communities on which
upperside of the spring
- c. Water yield. Since most springs have more than one weeping
eye, the spring water yield is best determined after opening the
spring eyes. Water from the spring eyes is then directed to a
common point and into a container of known volume.
The time taken to fill the container is measured and yield
calculated by dividing the volume of the container by time taken
i.e.

$$\text{Water} = \frac{\text{yield of contain}}{\text{Time taken}}$$
 It is expressed in liters/time
 Spring yield is important in determination of size of spring box
 which serves as a temporal reservoir.
- d. Estimating water demand from the spring. This is done by
obtaining data on the number of people using the spring and the
average daily water demand for house holds based on water
uses.
 The community should be involved in this exercise
- e. Other feasibility assessments. These include, topography or
ground formation around the spring access to the spring and
availability of materials including local materials
- 3. Sketch planning.
 A neat initial sketch of the spring box, embankment wall and other
spring accessories such as eatle trough and cloth – washing area,
water drwing arear, diversion channels and fencing should be
done.

Diagram of sketch plan

Spring box

4. Procurement/ collection of necessary material

- An estimation of material required should be done
- As part of their contribution, the community should be able to provide locally available materials
- The other required materials should be procured and transported to the site
- The necessary tools and equipment should be assembled at the site

5. Opening spring eyes and excavating

The spring should be done by digging around the eye of the spring to remove all mud and other wastes in order to open and expose the weeping eyes. This often increases the spring flow. Then assessment of spring yield should be repeated and all eyes should be covered by the embankment wall

6. Construction of embankment wall and spring box

- This is supposed to collect water from all the spring eyes and direct it into the spring box
- The wall should be extended so as to collect water from all eyes
- The embankment wall should be constructed of concrete and should be leak proof to prevent water seeping through.
- All the water collected should be directed to the spring box through the inlet holes to the back of the box
 - Spring box
 - ✓ This acts as a temporal water reservoir and a settling receptacle for suspended solid in the spring water.

- ✓ It also holds the draw pipes, the overflow and wash out pipes
- ✓ The spring box should be leak proof and covered to minimize contamination
- ✓ Inlet to the spring box should be placed higher than the outlet so as to avoid back pressure of the spring eyes a situation that may result into spring diversion
- ✓ Adequate over flow should be provided slightly higher than the draw pipes

Construction of other spring components

The water drawing area should be constructed to the convenience of water drawers. To design these components, the height of common water drawing containers should be considered

Where the ground formation sticks stairs should be provided to enable drawers move down and up from the screen with less straight

IMPORTANT POINTS ON SPRING PROTECTION

The point where the water emerges known as the eye of the spring should be covered carefully with selected gravel.

The material should not be too coarse to load the soil behind it and not finer than the existing soil behind to block the floor of water

Stones are placed in gradually increasing size towards the spring box

Springs may sometimes flow strongly for brief period of rain and the whole structure must be strong enough to resist rain

- In most springs fine sediment is suspended in water
- It is also important for the spring box to have a removable cover so that it can be clean from time to time
- Alternatively one or more small sponges may be connected to a single silt trap where the silt is allowed to accumulate and periodically cleaned out
- Care is required to prevent surface water from running into the spring box and polluting the water in it.
- Puddled clay should be used to back fill behind the spring box in order to seal the ground against infiltration
- The top of the spring box should be at least 30cm above the ground and the access hole should have a lip around it and a cover which is not easily removed.
- A ditch may be dug on the uphill side of the spring and the excavated soil thrown up into the bank to divert surface water
- A fence or hedge planted on the bank will help to keep people and animals away.
- Make sure that the spring is not rarely a stream which has gone underground and is re – emerging.
- Make sure that the source and the collecting area are not likely to be polluted by a surface runoff
- Checking that there are no latrines within 30m upstream of the spring.
- Making sure that if the spring is to be connected to a piped water system, it is on higher ground than the area to be supplied
- Taking care that the spring tank is not built on swampy ground or on land which is subjected to erosion and that the flow from the protected spring itself will not cause erosion or damage

PROTECTION OF SHALLOW WELLS

- Hand dug wells are the oldest and widely used water sources in most parts of the developing world
- Protecting a well may be done at a site of an existing water hole or along side stream or river at a point where water will filter in from below but above the level which it may be flooded
- It is best to dig a well in the dry season when there is little water
- It may be necessary to keep emptying the first water out to enable the digging go on.
- When the well is deep enough. The sides should be built up with stones, cement blocks or bricks. Then the area outside the wall should be filled in to make a slopping apron
- Making a well deeper and building up its sides will greatly improve the quality of water.

Other improvements on the shallow well include;

- A water proof apron should be built around the top of the well so that spilled water can not run back into the well
- Given the limited financial and human resources, hand pumped equipment wells are the most suitable and low cost approach providing drinking water in most rural areas
- If it is possible to obtain and maintain a pump, then a strong well covers should be made
- If appropriate lined, covered and a suitable hand operated pump is installed the quality of the well water may be maintained
- If the well is covered, and the pump gets broken, people will fetch water from another source.

WHY DO WE PROTECT WELLS

Community shallow wells are mainly protected for the following reasons

- To prevent contamination
- To avoiding collapsing of the well and make it more durable
- Increase water yield
- Make easier drawing of water by beneficiaries
- Avoid accidents

WAYS THROUGH WHICH OPEN WELLS MAY BE CONTAMINATED

Open unprotected shallow wells may be contaminated through the following ways;

- i. Polluted ground water especially if located close to pit latrines, soakage pits or leachates from refuse dumps
- ii. Contaminated containers used in drawing water from the well
- iii. See page from the surface through the top
- iv. Rubbish thrown down to the well
- v. Surface run off water especially during heavy rains
- vi. Spill contaminated water
- vii. Cracks of the apron if protected

WAYS OF PREVENTING CONTAMINATION

- i. Wells should be sites away from latrines, refuse dumps and soakage pits. They should be placed atleast 30m from the water source.
- ii. Clean containers should be used for getting water from the wells. The container for drawing water from the well should be one and should always remain inside the well; where possible, hand pumps should be installed.

- iii. Wells should be properly lined to prevent collapsing of wells and contamination through upper ground see page.
- iv. Children should be prevented from playing around wells and if possible a permanent cover should be fixed to the well.
- v. A head wall should be built to prevent surface run off and also in keeping animals away from the well
- vi. Construction of a firm apron with good spill way
- vii. The area around the well should be kept clean and fenced to keep away an shallow well siting
- viii. It's the ability to identify well points in an area, which can be done either traditionally or by use of modern machines.
- ix. The right time to site a shallow well is during the dry period because this allow one to get permanent ground water
- x. The user should be consulted so as to agree on the proposed site; this helps to avoid conflicts regarding ownership, operation and maintenance of the new
- xi. The choice of site should consider risks associated with pollution, erosion flooding and accessibility
- xii. Traditional methods of well siting. This can be done using
 - ❖ Natural indicators which include use of local vegetation such as acacia tree, local topography and history of other existing wells
 - ❖ Other methods include, forked stick method, welding rods and modern method

STAGES OF SHALLOW WELL DEVELOPMENT

1. Digging

This is normally done manually and it requires skill and experience

- a. Well size. The size and the shape of the well depends on the quality of soil and stability usually wells should have an average

size of 1 – 5m for stability and minimum of costs. Once water is struck, the diameter can be increased in order to increase water

b. Well shape. It can be square or round. However round wells;

- Use less material
- Are much more quicker to build
- Are suited to resist compression forces from the over burden
- Require less skills in construction

c. Digging process

- Should usually start at the end of rains
- Should start with a smaller hole which is then widened once water is struck

