ON FARM PURIFICATION OF WATER TO PRODUCE POTABLE WATER FOR DAILY USE FOR A FARM FAMILY

BY

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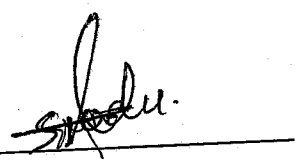
DECLARATION

I hereby declare that this project is a record of a research work that was undertaken and written by me. It has not been presented before for any degree or diploma or certificate at any university or institution. Information derived from personal communications published and unpublished works of others were dully represented in the text.



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DATE

CERTIFICATION

This project entitled "On Farm Purification of Water to Produce Potable Water For Daily Use for a Farm Family " by ASIODU .S. CHUKWUEMKEA meets the regulation governing the award of the Degree of Bachelor of Engineering (B. ENG) of the Federal University of Technology Minna, and it is approved for its contribution of scientific knowledge and literacy presentation.

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DEDICATION

This project work is dedicated to God Almighty who have given me the grace and strength for accomplishment and my parents for their support although this degree program.

ACKNOWLEDGMENTS

My sincere gratitude goes to God almighty for his grace and strength all through my degree program, may his grace continue seeing me through all through my endeavor n life (amen). I would also like to acknowledge the department for the opportunity to study under its supervision. To the HOD and all my lecturers. From the inception of my studies in the institution

ABSTRACTS

This project is aimed at solving the problems of availability of potable, water on farms. It is not restricted to farms only, but in other places. The availability of water ands its consumption is not just enough, but also knowing the quality of water is being consumed is very essential to human health. This is why basic researchers being carried out on various means of purifying available water on the farm. The various s conclusions or results obtained from the researches are been guided by some defined standards laid down by various bodies responsible for the quality of water which is to be consider by individuals to avoid world crises (WHO).

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CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Water is an essential element which constitutes of mainly H+ and (O2) oxygen which is important for plant an human sustenance. About 78% of the earth is covered by water from which plants and animals use directly or indirectly for the various metabolic activities. Due to the pressing need for water, its purification is of up most importance n this research and has been a global problem for many decades.

Taking a case study like the Niger delta region of Nigeria , which is faced with problems of water contamination and pollution by various activities of the oil producing companies. There is pressing nee for the availability of potable (H20) water of the occupants of this region.

What purification generally means is foreign water from all kinds of impurity it contains, such as contaminants or micro organism. Water purification is not very one sided process; the purification process contains many stamps. The steps that need to be progressed depend on the kind of impurities found in the water.

Over time the ecosystem has developed sophisticated ways to process ands store natural waste products such as sediments, nutrients, heavy metals and bacterial water is the primary medium for transporting these material through the ecosystem. The community acts as buffer that filters and processes sediment and debris from floods, waste product from aquatic and terrestrial plants and animals.

1.2 Sources of Water on a Farm and Problems Associated with these Sources

i. Deep groundwater

ii. Upland lakes

iii. Rivers, canals an low land reservoirs

iv. Atmospheric water generation n

v. Rainwater harvesting

Problems associated with these sources

i. Industrial pollutants

ii. Sewage effluent

iii. Ph Level of these waters

iv. Micro organism's contamination etc.

1.3 Objectives Of The Study

The project has been designed to discuss some of the possible ways water could be purified to produce potable water for human consumption. At least to produce 1 gallon of potable water by principle of "evaporating still" also to discuss the possible solution to the identified problem.

1.4 Significance of this Project

This project will enable not only agricultural researchers but also farmers know how to utilize and produce water which is good enough for their consumption.

It will also at some point enable them know how best to s t ore. Apply these resources effectively. It will also help to reduce dependency of farmers on the

independent water co-operation and at times o low rainfall he will have available water for utilization.

1.5 Statement of Hypothesis

A hypothesis is a tentative guess that is to be tested an either accepted or rejected through further investigate. I intend using certain hypothesis to find facts so that recommendation s can be made. Rain ate is not totally pure. Chemicals used in purification are harmful to human health.

1.6 Scope of the Study

The project work is not only limited to the possible ways by which water can be collected, stored and purified for human utilization but also some engineering and biological methods of carrying this out

1.7 Limitation of the Study

This research is faced with lots of obstacles like time, water sample for various analysis, inadequate information due to unwillingness of the ministry of agriculture with the ministry of water resources t produce any done research work related to this topic.

Financial constraints were a very big limitation to this study. based on the fact that some information were to be gotten on the internet and various sources outside the institution.

CHAPTER TWO

2.0 Literature Review

2.1 water purification generally means freeing water form any kind of impurity it contains, such as contaminants or micro organisms. Water purification is not a very one sided process; the purification process contains May steps. The steps that need to be progressed depend on the kind of impurities that are found in the water.

Over time, ecosystems have development sophisticated ways to process and store natural waste products such as sediments, nutrients, heavy metals and bacteria. Water is the primary medium for transporting these materials through most ecosystems. The" water purification" process is accomplished to varying degree in a variety of ecosystems including streams, methods, estuaries and forest.

Sources of drinking water to be used in public or private water supplies can be drawn from a variety of source's different sources of raw water demands different treatment methods to render it fit for human consumption

2.2 Sources of Water

a) deep groundwater

b) upland lakes

c) rivers, canal and low land reservoirs

d) atmospheric water generation

e) \rainwater harvesting

Deep groundwater:- the water emerging from some deep groundwater's may have fallen as rain many decades or even hundreds of years ago. Soil and rock layers will have naturally filtered the groundwater to a high degree of clarity even before it is pumped to the treatment plant. Such water may emerge as springs, artesian springs, may be extracted from borehole or wells. Deep groundwater is generally of very high bacteriological quality but may be rich in dissolved solids especially carbonated and sulfated of calcium and magnesium. Depending on the strata through which the water has lowed, other ions may also be present including chloride and bi-carbonate and three ay be a requirement to reduce iron or manganese content of this water to make if pleasant for drinking, cooking and laundry use.

Upland lakes an reservoirs:- typically located in the headwaters of river systems, upland reservoirs are usually sited above any human inhabitations an my be surrounded by a protective zone to restrict the opportunities for contamination. Bacteria and pathogen levels are usually low, but some bacteria, protozoa or algae will b present. Where upland are forested or peaty , humic acids can colour the water. Many upland sources have low PH which requires adjustments.

Rivers, canals and low land reservoirs: low land surface waters will have a significant bacterial load and may also contain algae, suspended solids an a variety of dissolved constituents,

Atmospheric water generation:- is a new technology that can provide high quality drinking water by extracting waste form the air by cooling the iar and thus condensing the water vapor

Rainwear harvesting or fog collection:- which collect water from the atmosphere can be used especially in area with significant dry seasons and in areas which experience fog even when the is little rain.

2.3 Water Hazards

Large rivers may b polluted with sewage effluent surface runoff industrial pollutants from sources far upstream. However even small industrial pollutants from sources far upstream. However even small streams, springs and wells may b contaminated by animal wastes an pathogens of dead animals upstream is not uncommon. In most parts of the world, water ay contain bacterial or protozoa contamination originating from human and animal waste or pathogens which uses other organisms as an intermediate host. Less commonly in developing countries, like Nigeria where the sanitary conditions are still very low standard, organisms such as vibro cholera which causes cholera and various strains of salmonella which causes typhoid and para-typhoid diseases. Pathogenic viruses may also be found in water. The larvae of flukes are particularly harmful in area frequented by sheep, deer or cattle. If such microscopic larvae are ingested, they can from potentially life threatening cysts in the brain or liver.

Some other water hazards are diarrhea, dysentery and enteritis. These are a major causes of death of most developing courtiers. It also leads to frequent illness and impaired growth in children . they are caused by bacteria of the genus, shigella and protozoa called *entarweoba histolyttica.*

Also, skin and eye infection can be caused by impure water. The medical records, skin infection appear as skin sepsis, skin ulcer scabies, leprosy etc.

2.4 Water Pollution and Its Sources

- Industrial wastes
- Sewage disposals
- Human wastes
- Chemical pollution

2.4.1 Water Pollution Parameters

Any new or untried source of water should be examined for quality before expensive development is undertaken. Good quality water for household purpose must be free of harmful bacteria. Sediment, objectivable materials taste, odour, etc.

Testing for contamination should be made by a qualified person. Local government or municipal officer (health) usually cooperate in making these test. I many countries and communities, there are health laboratories where health officers can have the test made. There are many things to be tested for while determining water quality standards. World health organization (WHO), national agency for food and drug administration drinking water regulation (NAFDAC) Nigeria and national primary drinking water regulation (NPDWR.US) 2001) recommended an acceptable quantity of materials to make a water sample quantity useful for human use.

These parameters are stated below, also with a table below showing summary of these agencies regulations;

Physical parameters – colour, odour, temperature, density, turbidity,

Chemical parameters- PH, alkalinity, hardness, SO42+ etc.

Biological parameters- bacterial, salmonella etc.

Fig 1: table 1; showing regulations

NO	Physical parameters	Maximum acceptable concentration (WHO	MAXIMUM ALLOWABLE CONC. (NAFDAC)	MAXIMUM CONTAMINATION LEVEL (NPDWR)
	PH range	7.0-8.5	6.5-8.5	6.5-8.5
	Turbidity unit	5(NTU)	-	5(NTU)
	Odour	Unobjectionable	Unobjectionable	Unobjectionable
	Taste	✓	✓	✓
	Temperature	✓ 29^{0}C	26-30^{0}C	30^{0}C
	Inorganic constituents			
	Alkalinity	100mg/l	100mg/l	100mg/l
	Iron (Fe)	0.05-0.3mg/l	-	0.3mg/l
	Calcium	75-300mg/l	75-300mg/l	75-150mg/l
	Chlorine	200mg/l	200mg/l	200-250mg/l
	Fluorine	1.5mg/l	-	4.0mg/l
	Phosphate	10-150mg/l	10-150mg/l	10mg/l
	Microbiological standard			
	E. coli /ncl	No growth	O (max)	5% samples
	Bacterial	-	No growth	No growth

2.5 Techniques of Water Purification

There are various ways in which water could be purified. These techniques or methods can be grouped into (3) different properties thus various methods are listed below;

- Screening
- Flocculation
- Sedimentation
- Filtration
- Coagulation
- Disinfection
- Precipitation
- Adsorption oxidation
- Boiling solar still
- Distillation
- Electrode-ionization
- Reverse osmosis
- Ultraviolet purification

These various techniques of water purification shall be grouped by means of their properties, stating their possible effects.

2.5.1 Chemical Methods of Water Purification

Coagulation: - if the suspended solids in the water are fined or colloidal in size, chemical are often used to effect more complete removal of suspended matter. The coagulants react with the water and turbidity particles to form floe. Te must commonly used coagulants are alum [$AL(SO_4)_3.18H_2O$] which reacts with the alkalinity in water to form an aluminum hydroxide floe, according to the equation.

$$AL_2(SO_4)_3.18H_20 + 3Ca(HCO_3)_2 \rightleftharpoons 3CaSO_4 + 2AC(OH_3) + 6CO2 + 18H_2O$$

The usual dosage of alum is-40 mgls. It is usually used because it is th most common, and cheap to afford by everyone. (D.M Mints 1981)

Disinfection :- more than 50% of pathogens in water will die within 2 days and 90% will die by the end of 1 week. However, a few pathogens may survive for 2 years or loner making disinfection necessary the principal means of disinfection involves the use of coloring, ozone and ultraviolet radiation.

By chlorine,

$$CL_2 + H_2O \longrightarrow HOCL + CL^- + H^+$$

The amount of chlorine should not be more than 0.2mg/l

Chlorination: - the most common disinfecting method is some form of chloride or its compound such as chlorine or chlorine dioxide. Chlorine is a strong oxidant that rapidly kills many harmful micro organisms because chlorine is a toxic gas, there is a danger of a release associated with its use. This problem is avoided by the use of sodium hypochlte which is relatively inexpensive solution that release free chlorine when dissolved in water

Ozone (O_3):- is a relatively unstable molecule " free radical " of oxygen which readily gives up one atom of oxygen providing a powerful oxidizing agent which is toxic to most waterborne organisms. It is a very strong. broad spectrum that is widely used in Europe. It I san effective method to inactivate harmful protozoan that form cyst, it also works well against most pathogens. Ozone is made by passing oxygen through ultraviolet light or a "cold" electrical discharge. To use ozone as a disinfectant, it must be created on site and added to the water by bubble contact. Some of he advantages are

i. production of relatively fewer dangerous s by products

ii. Lack of taste and odor produced by ozonation

Ultra violet radiation:- is very effective at inactivating cysts, as long as the water has a low level of colour so the UV can pass through without being absorbed. The main disadvantage to the use of UV radiation is that, unlike ozone treatment, it leaves no residual disinfectant in the water. Because neither ozone nor UV radiate leaves a residual disinfectant in the water, it is sometimes necessary to add a residual disinfectant after they are used.

Precipitation: - the removal of hardness for water is not essential to make the wate safe. It may only reduce soap consumption and lower the maintenance cost of pluming fixtures. The (2) basic methods are lime soda process and the ion exchange process

$$Ca(HCO3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3 + 2H_20$$

Adsorption :- this is the process of collecting soluble substances that are in solution on a suitable interface. The interface ban be between the liquid and a gas, a solid or another liquid.

Oxidation:- this a process in which the oxidation state of a substance is increased by means of chemical reaction. In water treatment, oxidation is used to convert undesirable chemical spaces to specie thaw are not harmful

$2Fe^{2+} + CL_2 \rightleftharpoons 2Fe3^{+} + CL-$

2.5.2 Physical Methods of Water Purification

Screening:- the first step in purifying surface water is to remove the large debris such as sticks, leave trash and other large particles which may interfere with subsequent purification steps. It may be done with a coarse seven or micro seven. Because clogging of the seven occurs rapidly, the mesh is washed continually with the high pressure sprays.

Aeration: - this is a form of gas transfer and is used for variation o operation including the following

- Addition of O2 to oxidize dissolve on and manganese
- Removal of carbon dioxide
- Removal of hydrogen sulphide
- Removal of volatiles oil and similar dour and taste producing substances released by algae and similar micro-organism.

It is accomplished either by exposing the water to air or by introducing air into the water. We have four principal types of gravity aerator

i. Spray or fountain aerator

ii. Injection aerators

iii. Mechanical aerators

Flocculation n: flocculation is a process which clarifies water. Clarifying means removing and turbidity or colour so that the water is clear and colorless. Clarification is done by causing a precipitate to form in the water which can be removed using simple physical method. Initially the precipitate forms very small particles but as the water is gently stirred, these particles stick together to form a bigger particle.

Coagulants or flocculating agents that may be used include.

Iron III hydroxide: - this is formed by adding a solution of an iron (III) compound such as iron II chloride to pre-treated water with a pH of 7 or greater.

Aluminum hydroxide is also widely used flocculating precipitate although there have been concerns about possible health impacts

Sedimentation: - the rate of settling of a particle in water depends on the viscosity and density of waste and also the size shape an specific gravity of the particle. Water purification by sedimentation is the provide conditions so the suspended materials in water can settle and. Detention periods varying from 1-10 hours with proper design, shallow basin will give good performance. As particle settle to the bottom of the basin layer sludge is formed on the floor of the tank. This layer must be removed and treated. The amount of sludge that is generated is significant, often 3% -5% of the total volume of water that is treated. Thank may be equipped with mechanical cleaning devices that continually clean the bottom of the tank or the tank can be taken out of service when the bottom needed to be cleared.

Filtration: - after separating most loc, the water is filtered as the final step to remaining suspended particles and unsettled floc. The must common type of filters a rapid and filter . Potable pump filters are commercially available with ceramic filters data filter 5000 to 50,000 l per centridge, removing contaminants doe to 0.2-0.3 micrometer range. But the viruses are not filtered so need disinfection by chemical or ultraviolet light is required after filtration. Some water treatment plants employ pressure filters. These work on the same principle as rapid gravity filters differing in that the filter medium is enclosed in a steel vessel an the water is forced through it under pressure.

Advantages

Filters out much smaller particles than paper and sand filter can

Filters out virtually all particles larger than their specified pore sizes

They are quit thin and so liquids flow through them fairly rapidly

They art reasonably strong and so can withstand pressure differences across them typically 2-5 atmospheres.

2.5.3 Biological and other methods of water purification

Boiling:- this is the best method to make water safe to drink. Boiling water kill bacterial. Boiling water will kill disease causing microorganisms like giardia lambia and cyptosoridium which are commonly found in rivers and lakes. At high elevation, though the boiling point of water drops sot that extra boiling time is required. Water temperatures above 70^0C will kill all pathogens within 30 minutes, above 85^0C within a few minutes, and boiling at 100^0C most pathogens will be killed, excluding certain

pathogen and their spores, which must be heated to118 degree Celsius (e.g. botulism – clostridium). This can be achieved by using a pressure cooker as regular boiling will not heat past 100^0C

Solar distillation (solar still):- solar distillation may use a pre manufactured and easily portable still, commonly referred to as a solar still, it has tits roots I a makeshift still that can be constructed simply from readily available components. The solar still relied on sunlight to warm and evaporate the water to be purified. The water vapour condenses, usually on a plastic sheet suspended as an inverted cone, dripping into collection dish placed beneath its centre. Note that while the solar still shares exposure to UV and intra red radiation with SODIS, it is essentially a complete different mechanism. And the two should not be confused. In an extreme survival situation the solar still can b used to prepare safe drinking water from usually unsuitable sources, such as ones own urine. (Ya. D. raport 88).

Solar water disinfection:- in solar water disinfection (SODIS) microbes are destroyed by temperature and UVA radiation provided by the sun. Water is placed in a transparent plastic bottle. Which is oxygenated by shaking placed for six hours in full sun which raises the temperature and gives and text ended dose of solar radiation, killing source microbes that may be present. The combination f the 2 provides a simple meted of disinfection for tropical developing countries.

Reverse osmosis:- mechanical pressure is applied to an impure solution to force pure water through a semi-permeable membrane. Reverse osmosis is theoretically the most thorough method of large scale water purification available, although perfect semi

permeable membranes are difficult to create. Unless membranes ark well mainlined, algae and otter life forms can colonize the membrane.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Reconnaissance

A site visiting survey was carried out based on the area of interest "Delta State" in the southern part of Nigeria. The major source of water in the area is the flowing rivers that surrounds the region to the soil type in the area (clay) and industrial activities being carried out in the region i.e oil production, gas flaring etc. This waters cannot be regarded as safe water for basic human needs and consumption.

3.2 Techniques of Harvesting Water from their Sources to the farm.

by collection of water in dams

By collection of water from aluminum roofs into storage tanks.

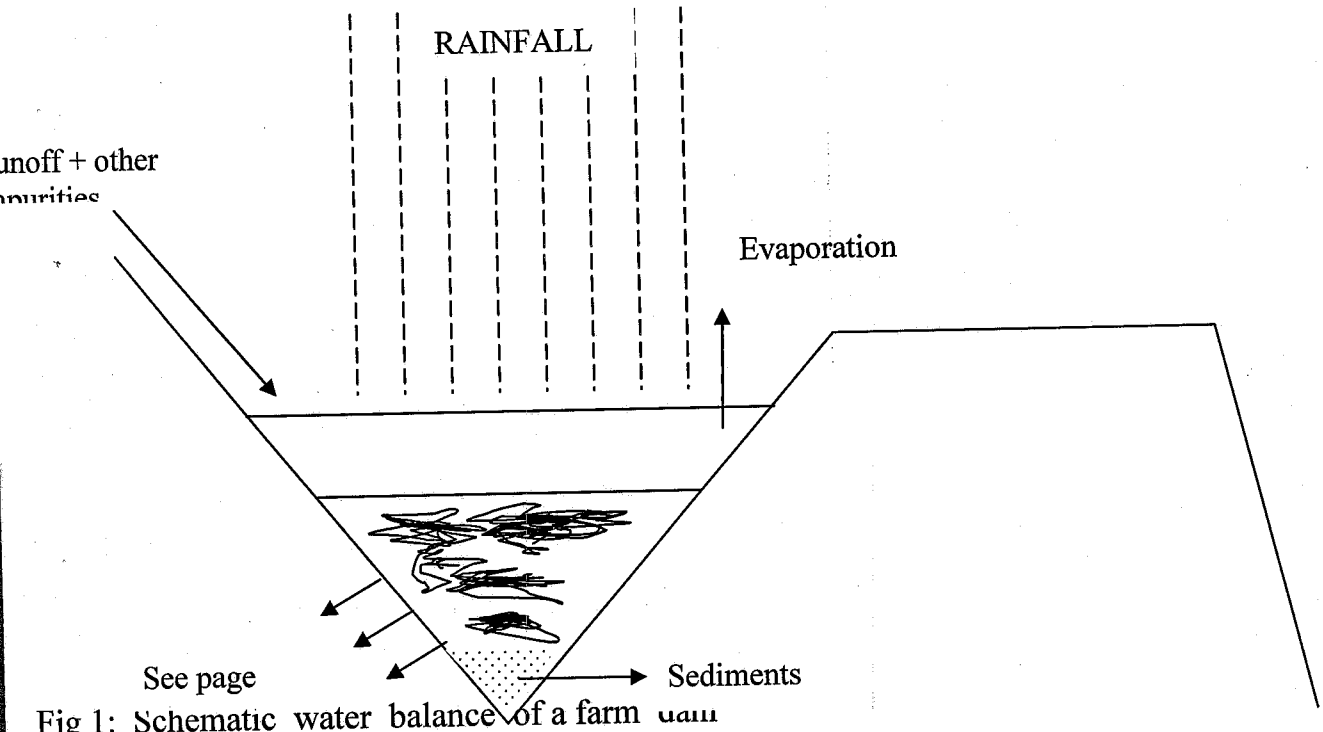
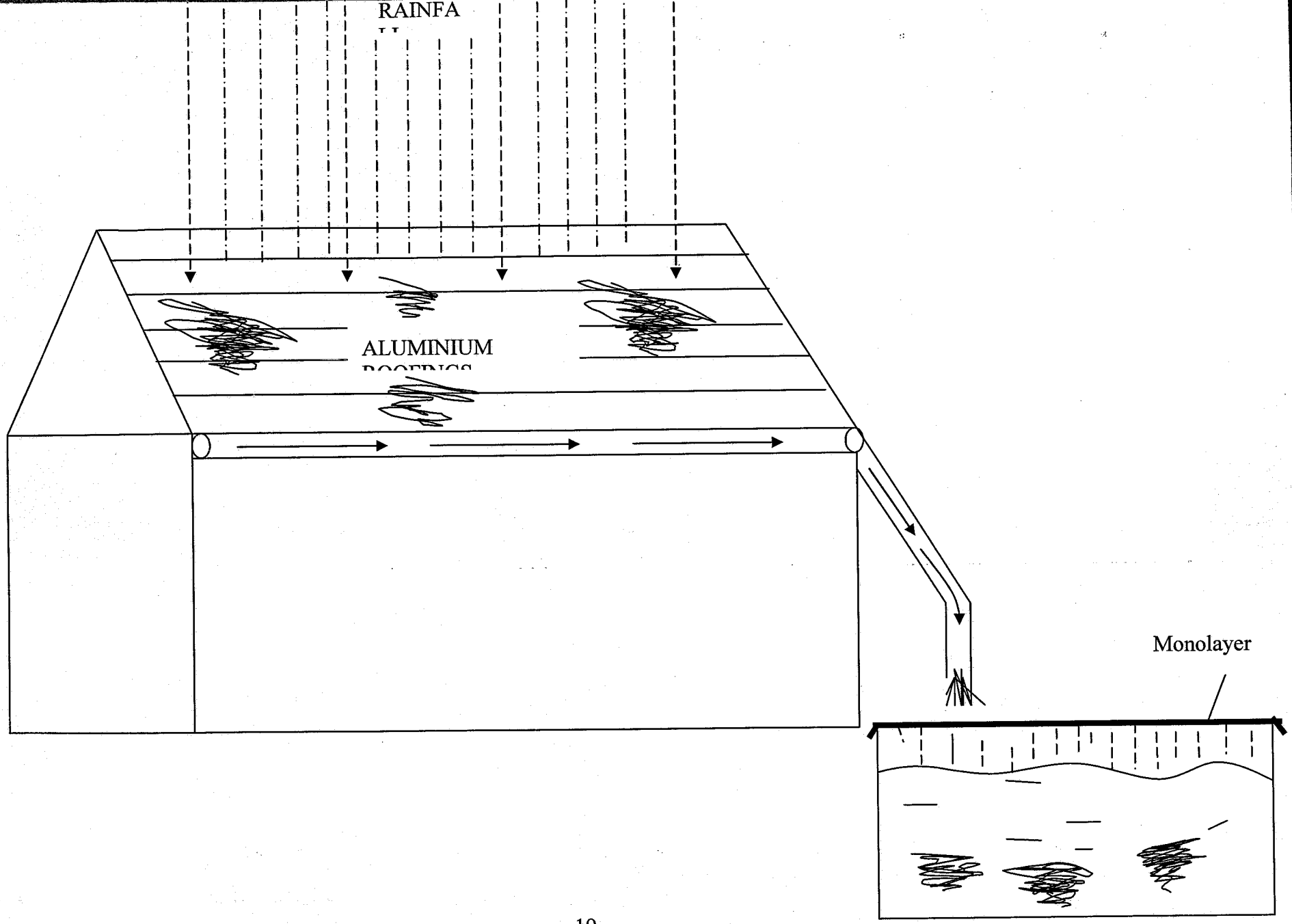


Fig 1: Schematic water balance of a farm dam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ALUMINIUM
Monolayer

3.3 Water Purification by Solar Rays

The possibility of water disinfection by ultraviolet rays has long been known, but the method had for a long time had no application in water supply technology, mainly for economic considerations. This method also known as bactericidal irradiation has certain advantages over chlorination. For instance, the natural organoleptic properties of water are not changed. This process occurs more quickly than in chlorination. Irradiated water can be immediately supplied to consumers bactericidal rays kill not only vegetative species of bacteria, but also spore forming ones.

In studies of drying off of bacterium uradiated by ultraviolet light it has been established that light rays with wavelength 200 – 295 μm have the highest bactericidal effect. The maximum of bactericidal effect full's on the wavelength around 260 μm. the process of drying - off of bacterial obeys the equation

$$p = p_o e^{\frac{-Et}{K}}$$

Where:

P = No. of live bacteria per unit volume after bactericidal irradiation

P_o = Initial No. of bacteria per unit volume.

E = flux intensity of bactericidal radiation

t = time of irradiation

k = resistivity of bacteria.

The effect of water disinfection depends on the product of the intensity of bactericidal irradiation E by the irradiation time t.

This also depends on the absorptive of water which depends substantially on water composition and varies within a wide range for waters of various sources. It depends mostly on colour index, turbidity and concentration of iron in water. But salts like chlorides, sulphates, ammonia, have practically no effect on absorption of bactericidal radiation.

The most common sources of bactericidal radiation are high pressure mercury – quartz lam (type PRK) and low – pressure argon mercury lamp (type RKS – 2.5). high – pressure (0.05 – 0.1 Mpa) mercury – quartz lamps have the bulb temperature up to 250 -300^{0}C and are powerful sources of visible light and ultra – violet rays with the maximum radiation hues at 365.0 – 366.3 μm.

These lamps have a high electric power (up to 2.5kw) and thus emits a large amount of bactericidal rays.

Special low pressure argon mercury lamps (type BUV) are more efficient. The tube of a lamp is made of uviol glass and contains a mixture of mercury vapours and argon at a pressure of 399 – 532pa. the bulb temperature of a burning lamp is 40^{0}C.

Argon - mercury lamps have a relatively low power and not withstanding their high efficiency can only be used in disinfecting plants of small capacity.

Table 2:

Though this method has not been tested especially in developing countries like ours. Most farms cannot afford the technology so this implies that other methods of purification most be adopted in order to produce potable water on the farm. The ultraviolet purification can be an expensive venture because of its high electric power consumption but could be tried by using an evaporating still or storage facility.

Plate type	Through put capacity m^3/h	Maximum pressure, Mpa	Type and number of lamp	Power consumption KW
OV – IP	3		BUV – 60P, 1	0.06
OV – AKKh – 1 (two - chamber)	60		PRK-7m, 2	2
OV -IP - RKS	50- 70		RKS-2.5,1	6

3.4 Water examination and purification processes

3.5.0 physical examination

3.5.1 conductivity

Conductivity measurement responds to all ionic materials in a sample, whether they are intentionally added treatment chemicals, contaminating minerals or dissolved gases such as CO_2 (in the form of carbonic acid, bicarbonates or carbonates). Contaminants can be deionizer regenerate chemicals from inadequately rinsed resins, air with CO_2 not completely removed by deaerators, carry over from drum boilers or leaks from condensers or other heat exchangers.

3.5.2 pH Determination

pH is the logarithm in base 10 of the reciprocal of the hydrogen ion concentration given in mole per litre. The pH represents the instantaneous hydrogen activity while the value of alkalinity and acidity represents the buttening capacity of the water sample

$pH = -\log_{10}(H^+)$ the pH scale of value extends from 0 (very acidic) or 14 (very alkaline), with middle pH value of 7 corresponding to the neutral majority of the public and farm occupants will be supplied were based on the soil type and various environmental factors.

3.5.3 Turbidity Determination (Abserptometric method)

This is a physical parameter, which measures the relative clarity of a given liquid or water sample. Water with cloudy or opaque appearance has a higher turbidity compared with clear ones due to the presence of clay, silt and organic matter.

Procedure : Press program number 95, enter, the display will show full or nil and the new icon fill a sample cell with 10ml of deionizer water (the blank) place the blouse into the cell holder tightly covered.

The sample cell with the instrument cap. Press zero, the cursor will move to the right then the display will snow Fall. Fill another sample cell with 10ml of ample. Place the sample cell into the cell holder. Tightly cover the sample cell with the instrument cap press read , the cursor will move to the right, then the result in foruazin attanuation unit (FAU) will display.

1 FALL = 1NTU

NTU – Nephelometric turbidity unit.

The turbidity of water should not exceed 1.5mg/c. the concentration of insoluble suspended matter in water is determined also be a measured volume of water (H_2O) to be tested is filtered through a membrane fitter which has been dried to a constant mass weighed. The filter is then dried to 105^0c IN A drying cabinet to constant mass and weighed again. The different in the mass of the filter before and after filtering gives the concentration (mg/l) of suspended mater tested.

3.6 Water Purification Processes

The best method of determining the methods to be carried out on the stored water can be enhanced by (1st) Identifying the kinds of impurities that needs to be removed. Impurities like clay silt, tiny particles etc. mostly physical particles and they can be seen physical with the eye or by filtration . getting a white cloth or cotton or filter cloths are used and a sample of the water is passed through the cloth. Some particles will be deposited on the cloth and will aid the elimination and purification process.

3.6.1 Coagulation of Floating Particles or Suspended Particles

The most popular coagulant is impurities (commercial) aluminum sulphate $AL_2(SO_4)_3.nH_2O + mSiO_2$ which contains 33% of anhydrous aluminum, sulphate and up to 23% of insoluble impurities. It is the cheapest type of coagulant in the market and is readily available after 30 minutes of addition in storage. Its dissolving forms flakes which starts to settle below the tank by gravity.

Another popular coagulant that can be used is iron vitriol which can be obtained also in the markets iron vitriol ($FeSO_4. 7H_2O$) when dissolved in water forms iron (II) hydroxide which can be oxidized to iron (II) hydroxide by dissolved oxygen or specially added chlorine. Flanges too are formed after a while and settle down at a rate 1.5 times that of aluminum hydroxide flakes,

but the process of oxidation can occur sufficiently quickly only at the pH of water more than 8. Absolutely precaution has to be taken when adding these coagulant to avoid concentration of these chemicals.

3.6.2 Filtration of settled coagulated particles

In farm water purification, filtration is one of the main processes of water treatment which makes it possible to improve the quality of water to the standard of potable water.

One of the popular methods of filtration of floating impurities is fattening through various screens and clothes in various types of filters, including micro filters, micro screens and acoustic filters.

On farms the mostly widely used are micro filters which are very effective for separator of plankton. A micro filter has a rotating drum provided with filtering elements in the form of fine plastic net with the mesh size 40 - 60μm. the operating characteristics of micro filter are as followers:

Filtering intensity $10 - 25 L/sm^2$

Pressure loss $0.1 - 0.6m$

Rotational speed of the drum $1.25 - 5min^{-1}$

The practice of application of microfilters has shown that they can retain 30 – 40% of suspended matter, 75 – 95% of phytoplankton and 100% zoopolankton. These nets should be micro operated in the storage tank or facility of water to screen away the flakes and other suspended matter in the tank. Remembering that the storage is partitioned into cells so the filtered part of the water will move to the next cell for the next process. This will ensure that most particles have been partially removed.

3.6.3 Chemical disinfection of (H_2O) water.

The methods of water clarification and decoloration by coagulation, settling and filtration make it possible to retain the major part (90 – 95%) of bacteria present in form water. There are many methods of water disinfection i.e physical method ultra sound, radioactive irradiation, ultra – violet light.

Farm water is mostly characterized by micro – organisms, pathogens, bacteria etc. these pathogens most be eradicated before farm water can be eliminating these organism. Chlorine and its derivatives kill bacteria present in the already filtered water. It also oxidizes the organic substances and for the reason is a good reagent for preventing reproduction of micro organism in farm water. After the filtered water has been moved to another cell in the storage facility, for efficient chlorination, the water should be intermixed thoroughly

with chlorine added and allowed to stay in contact with the reagent for at least 30 minutes.

The dose of chlorine is determined by a chlorination test so that the water conveyed to the farm house and consumer has a residual content of non reacted chlorine between 0.3 – 0.5mg/l under this requirement, the dose of chlorine for chlorination of the already filtered water is equal to 0.5 – 2.0 mg/L pending what is called chlorine absorptivity of water. At positive temperature and normal atmosphere pressure, chlorine is a greenish – yellow gas with a stifling smell and density of 1.5 -2.5 times that of air. Also, at an increase in pressure (at positive temperature) gaseous chlorine changes to the liquid state. Therefore it is kept and transported in the liquid state in special steel flask at a gauge pressure of 0.6 – 1.0 Mpa.

$$CL_2 + H_2O \rightleftharpoons HCL + HCLO$$

Hypochlorous acid will be formed if chlorine is dissolved in water. The degree of dissociation of hypochorous acid depends on the PH of the water

pH %	4	5	6	7	8	9	10	11
OCC%	0.065	0.5	2.5	21.0	75.0	97.0	99.5	99.9
HOCL,%	99.95	99.5	97.5	79.0	25.0	3.0	0.5	0.1

3.7 Stabilizing treatment for preventing corrosion in pipelines

The corrosive affect of water on metallic surfaces can be prevented by the following methods : application of protective coatings on metallic surfaces exposed to water; removal of corrosive agents (oxygen, hydrogen sulphide, carbon dioxide) from water; formation of calcium carbonate films on internal surfaces of pipes; and water treatment with sodium hexameta phosphate.

The first method is used quite widely in view of the fact that such coatings are relatively inexpensive.

Examples are: -

- Asphalt – bitumen
- Polymeric coatings
- Sand - cement coatings of internal surfaces of pipes.
- A reliable method of decreasing the corrosive properties of water is degassing, i.e removal of gases from water note tht ; oxygen is the most active corrosive agent. This method is however in applicable for treating large masses of water in view of the high cost and complexity of equipment.

it is possible to use lining soda and caustic soda as alkaline reagents.

CHAPTER FOUR

4.0 DISCUSSION OF RESULT

4.1 INTRODUCTION

In the pursuit of the objectives of this project work, which was mainly researching on methods of water purification on a farm and also, finding out improvements of already existing methods, the work tends to proffer solution to production of potable drinking water for subsistence arm household. This work basically shows methods of purification which could be carried out by almost any farm or household on the farm.

The results found were compared to standards given or set by the world health organization acceptable limit (1996 Edition)

4.2 Biological effect of solar rays (ultraviolet rays) on water parameters.

This is the determination of physical and biological effect of solar radiation on bacteria and the vegetative life in the water body, temperature turbidity, taste and odour.

4.2.1 micro – organism

Many micro – organism living in water posses different resistivity to solar or bactericidal rays. But this method shows a very effective and efficient method of killing various vegetative and pathogenic bacteria. Where artificial form of energy is applied i.e argon mercury lamps of 399 – 532 Pa, a bulb temperature of 40^0C, some organism are killed.

4.22 Taste and Odour

In the wet seasons it is observed that most rivers and wells have salty taste and are odorless. This method has no effect on the tasty form of the water but reduce odours that are present, especially if the water sources is rain.

4.23 Turbidity

The WHO guide line for turbidity is 5_{NTU}. The presence of turbidity is due to colloidal materials, which gives the water a cloudy appearance, which is unattractive. This may encourage the growth of plankton and often microorganism.

This could be avoided by filtration and chlorination which could by used before solar radiation.

In the wet season turbidity is usually high. 70.5 $_{NTU}$

4.2.4 Temperature

The appropriate temperature for potable water is about 28^0C very hot or cold water is not desirable. Temperature affects the properties of water such as viscosity, density solubility of chemicals and bacteriological activities.

4.3 Chemical Parameters And Effects Of Purification Methods

The chemical composition of water depends on the characterization of the catchment area. The chemical parameter which will be discussed will be those affected by the method of purification, those listed by the WHO which are required by humans for sustenance

4.4 Hardness of Water

Hardness of water is due to presence of calcium and magnesium. The most common unit of hardness is 1mg/c (which is equivalent to R.16 mg/L of magnesium ions. $CaCO_3$ can be eliminated gaseous carbon dioxide and insoluble calcium carbonate. Hardness of natural water like rain is not harmful to human health.

4.5 Alkalinity

Alkalinity is due to the presence of salts of week acids; the major influencing compounds as far as pH variation is concerned are hydroxide, carbonate and bicarbonates. There is no correlation between alkalinity and health in evaluation of potable water.

4.6 pH Concentration

The world health organizations guide level for drinking water pH recommended ranges 0.5 – 8.5 .

It shows that wet season pH of water ranges between 7.75 – 8.41 which is well within range if the purification methods are employed.

4.7 Iron and Manganese

Iron and manganese can be present in natural waters in different form, depending on pH index of oxygen content. Long time consumption of drinking water with high concentration of iron can lead to liver disease.

The concentration of iron in potable water is limited to 0.3mg/l and that of mg to 0.1 mg/l.

4.8 Phosphorus

This is encountered in natural waters in the form of suspended particles of minerals and organic compounds, ions of orthosphosphoric acids and organic complexes. They can influence substantially the growth of aquatic plants. By methods of solar radiation and boiling this effect can be reduced.

4.9 Total Dissolved Oxygen

The acceptability limits recommended for (TDS) total dissolved oxygen is 100 mg/l.

4.10 Iodine

Iodine occurs in natural waters i.e rain, underground waters in negligible concentrations. It is an important biologically active micro element and should be present in potable, water in a concentration not less than 10^{-8} mg/l in order to prevent endemic goiter.

4.11 Observation Based on the Solar Radiation Purification Method

- this method is relatively new to most small farms in Nigeria
- lamps such as Argoa – mercury have been used and found to be efficient but have relatively low power

- high - pressure mercury – quartz lamps, though being less efficient, can be employed for disinfection of large quantities of water.
- This solar radiation can effectively destroy microorganisms in water quantities
- For small settlements in agriculture farms, a plant type OV – IP with a power consumption of 0.06kW can be employed for disinfection of water in tanks or storage facilities.

4.11.1 Observation Based on Conventional Methods of Purification

- Analysis of water samples have to be taken before any chemical disinfection processes can commence to determine impurities in the water. This may be an expensive process for most farms.
- Standards have been laid for potable water by governing bodies which must be been laid for potable water by governing bodies which must be strictly followed for purification processes.
- Purification reagents are readily available
- This process destroys both chemical and biological impurities
- Less on no electrical power is consumed in this process.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

One of the basic requirements in the development of any community is to have a quality water supply for both drinking and domestic uses. For water to be safe for any of this use, the composition must be within the level recommended by the world health organization standard. The results obtained shows that before nay purification process commences some parameters have to e checked before any method is employed especially parameters like turbidity pH and alkalinity.

The solar radiation method can be a very effective method of purification of forms especially small farms, but has a possible set back of power consumption, accessibility of lamps. The conventional methods can and as always been the easiest means of water purification on most Nigerian farms till date and this has been so because not much is expanded on the reagents for purification and basic research has shown that this method is effective on like the solar radiation method which has no standard.

5.2 Recommendations

An important cause of water pollution is the general lack of environmental awareness. This awareness should start from implementation of good health policies by the government. Also, governments lack of founding on water purification projects is a big back on the implementation of modern methods in farms in the country. It should also be noted that for maintenance of safe potable water , storage facilities should be well protected against pollutants and dumps should not be sited where the water table is high as this may also leads to chemical pollution of water sources.

Forth investigation should be carried out on the solar radiation process to obtain a clear of its efficiency and effectiveness.

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