Remediation Processes of Upland Groundwater Reservoirs, Eutrophication, Courses and Its Effects on Water Bodies

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Abstract

Water as a universal solvent exist in large volume (plentiful) but just very little to drink, this is as a result of natural phenomenon, industrialization growth, increasing population density with extensive urbanization of the natural environment. In furtherance, the existing water bodies ends up by receiving several pollutants from its intakes namely, point source (dry weather pollutants transported via pipes and channels from the industrial facilities and municipal wastewater treatment plants) and nonpoint source which origins are from agricultural runoffs, construction sites, and land disturbances. These gives rise for the existence of; organic matter, pathogenic microorganisms, iron and manganese, nitrogen and phosphorus as well as other heavy metals. Principally, as a result of effluents discharged from both domestics and industrial processes and consequentially leading to eutrophication (the excessive growths of plants and algae on waterbodies) likewise contaminating the underground water reservoirs through infiltration processes resulting from the nature of existing ground and soil stratifications. However, the remediation processes of Fe and Mn from the existing upland area water reservoirs will involve aeration, precipitation and iron exchange process, sequestering and chemically oxidizing process. Similarly for eutrophication remediation with the water body containing high concentration of N and P, either of balanced mix of high technology (chemically/energy intensive) such as trickling filter and activated sludge, or alternatively a low cost (green options) such as facultative pounds, green algae and phytoremediation are practically applicable sustainable best options.

Keywords: Remediation; Water reservoir; Wastewater; Pollutants; Eutrophication.

1. Introduction

Groundwater are generally any form of liquid water that exist beneath the ground level within a reservoir referred to as aquifers (A layer of porous substrates which conserves and transmits groundwater) (USEPA, 2012; Becky Oskin, 2015 and National Ground water Association 2015). This is as a Resulting precipitation/rainfalls of multiple years of existence, channeled by surface water bodies that seeps underground are however, constituents of groundwater (David Woods, 2011 and Becky Oskin, 2015). The conservation of such liquid water in large volumes within an existing starters is known as reservoirs. And similarly these water sources forms the bulk of underground water reservoirs for agricultural irrigations, industrial uses as well as drinking water source, and are filtered naturally to a higher degree of purity by layers of soils and rocks. Which apparently requires no further treatment process, but it may require secondary disinfection by the addition of chlorine/chloramine. (Becky Oskin, 2015 and National Ground water Association 2015). Groundwater are usually extracted from aquifers as springs, boreholes/wells. similarly, the higher the depth of the flow of such groundwater, then the higher its bacteriological quality (i.e free from pathogenic bacteria/protozoa) and however, deep groundwater may contain rich dissolved solids such as carbonates, calcium and magnesium sulfates, ions of chlorides and bicarbonates that can be associated to the parental rock formation through which the flow of the water originates. Hence in order to make such water portable for human consumptions and domestic uses, there may be the need to minimize the concentrations of Fe and Mn contents. (Becky Oskin, 2015).

2. Groundwater remediation

This is generally the analytical principle of eliminating pollutants that contaminates and pollutes groundwater sources and or converting such pollutants into harmless products prior to human consumption of such polluted groundwater (Hayman and Dupont, 2001; David Woods, 2011 and National Ground water Association 2015). However, so much volumes of ground water are clean and portable, but can also become contaminated/polluted via natural sources and or through human activities such as land disposal and the storage of wastes and byproducts, consequently this results to contamination of the groundwater sources via percolation and leachates reaching the water levels. Globally it was estimated that 25% of the global drinking water is directly drawn from engineered boreholes and similarly 40% are from open dug wells (National Ground water Association 2015). However, present day practices still have impacts on groundwater source, resulting from the over application of fertilizers/pesticides, surface runoff and urban drainage system infiltrations, industrial spills and leakages. Consequentially, the utilization of contaminated groundwater is hazardous to human, animals and plants resulting to poisoning/spread of several diseases. Therefore, groundwater remediation has been designed to addressing groundwater contamination problems. Groundwater contamination has series of pollutants/contaminants ranging from physical, bacteriologicals and radioactive parameters, organic and inorganic chemicals. However, in order to render contaminated groundwater safe and wholesome, only the recommended techniques are effective in the elimination of pollutants and contaminants in groundwater sources (David Woods, 2011 and National Ground water Association 2015)

3. Remediation processes of upland groundwater reservoirs.

3.1 Characteristics of the reservoirs

The reservoirs are located on animal farm (sheep) with soft underlining soil deposit; characterized with unpleasant taste, colour and 5.5 pH scale reading; its water supply are from chalk aquifer which is anaerobic and has the presence of pathogenic organism with high amount of Fe and Mn are Suspected. Therefore, the above reservoir requires a quality analysis for its water supply which is likely to involve both physical and chemical process in order to ensure the water supplies are potable and pathogenic save prior to domestic consumption. Similarly, it should also be save and free from bacteriological harmful substance, turbidity, colour, taste, odour, high concentration of TDS. However, the most effective and conventional treatment process will involves sedimentation, addition of coagulant, filtration, disinfecting, softening process as well as aeration (Gray, 2008).

3.2 Other Quality Analysis to be evaluated from the above reservoirs

The above water source may require to undergo laboratory analysis such as, jar test, pilot plant test column test, and turbidity among others prior to treatment to evaluate for chemical coagulants, as well as pathogens (Gray, 2008).However the recommended quality tests are:

- Physical characteristics which involve (colour, odour, taste, temperature and turbidity);
- Microbiological characteristics that will constitute; (bacteria virus, protozoa and helmith these are achievable through the following series of test methods such as,

multiple tube, ATP testing, plate count, membrane filtration and pour plate test respectively; and

- Chemical characteristics that will involve. (organic and inorganic) however these will comprise of parameters for testing such as, Arsenic < 0.01mg/l, chlorine 0.2- o.5mg/l free residual fluoride < 1.5mg/l Nitrates < 50mg/c , Nitrites < 3mg/c iron < 0.3mg/c, manganese < 0.4mg/c lead > 0.01mg/l, PH should be neutral or 6.8 -7 on pH scale, TDS > 500mg/l. However, these are achievable through electrical conductivity and a gas chromatograph mass spectrometer (Environmental Canada, 2004).

Furthermore, the above agents can be analysed qualitative and or through observation during their quality test as indicated in *table 1* below, with its relative possible causes for contamination.

Table 1: Modified Quality/Colour Observation for Recommended Quality Test

	Water observation	Suspected pollutant
1.	lather	Detergents
2.	Black	Mn, bacterial growths
3.	Brown, Yellow, Red	Fe
4.	Dark brown ,Yellow	Tanning & plants pigments
5.	White deposit, scale	Hardness, dissolved metal
6.	Rotten egg odour	Hydrogen sulphide
7.	Bitter or metallic taste	pH, zinc, copper
8.	Earthy fishy, muddy peatly odors	Organic matters, Alga, bacterial

4. Treatment Process of Taste, Colour and pH

However, it's important to understand that when water is stored prior to its usage it will reduce in its amount of suspended solids (SS), colour and pathogens as a result of natural sediments and self-purification process, however it reduces the fluctuating water quality which improves the treatment process. So also stored water may wallow algae growths subsequently promoters turbidity, colour, smell, pH value as well as promote the presence of Fe and Mn contents within the soil configuration (Masters, 1997; Mamba, 2007).

5. Unpleasant Taste, Odour and Colour

According to (Mamba, 2007), geosmin and 2-methylisoborneol (2MIS) contributed to the presence of taste and colour in water. However the use of β-cyclodexrim polymer is efficient in removing the pollutant through adsorbent via molten phase removal and then permits the water to flow through its treatment and collection process. However, taste in water can result from inorganic salt or metal irons which are usually organic chemical that exist naturally or as a result of biological growth. Algae are examples of majority and usual causes for taste as well as the prevalence of odour, subsequently the unwanted taste, colour and odour can best be treated and or reduced by river-bank (Juthner, 2007). Generally, colour in water supply is as a result of naturally occurring agents such as the presence of Fe, Mn, Microorganism and organic which also include vegetables origin usually humors composition and soil particulates, however the actual colour of water is attributed to the availability of substances in solution at the end of filtration (removal process) of suspended particles/materials through coagulants and sand filter media (Mamba, 2007).

6. pH value of 5.5

The characterized reservoirs having a pH of 5.5 scale value, requires an immediate treatment attention because as its indicated from *figure 1,* a scale reading of 0-14 is the calibration of pH scale, where pH less than 7 is termed as an acidic solvent, and greater than 7 is known to be basic (alkaline) and a value of 7 being the neutral level. Therefore, a pH of 5.5 from the above wells shows that the water supply is slightly acidic which will result to stains in pipes, hence it should be treated to mitigate the presence of corrosion in metal by oxidizing and aeration process (Environment Canada, 2004).

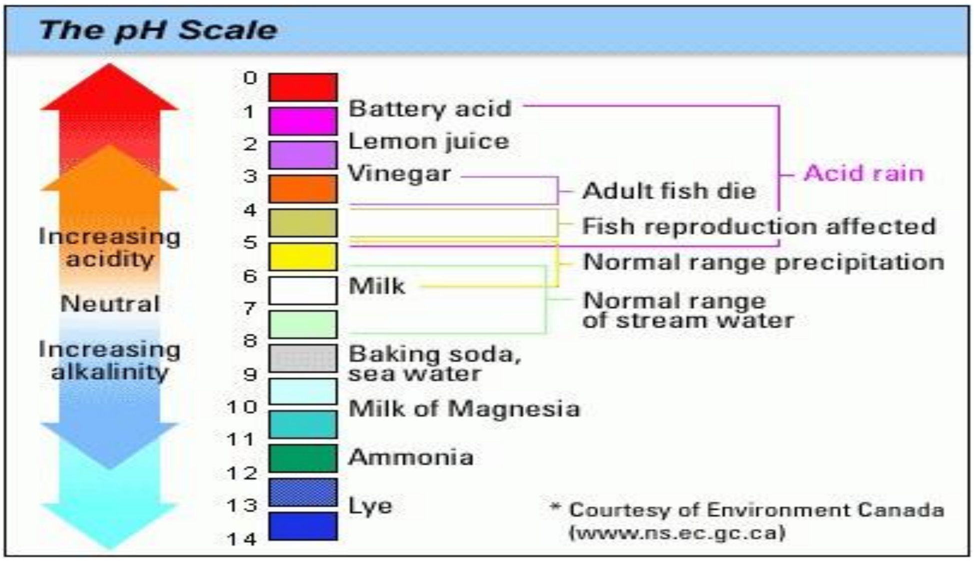


Figure 1: pH scale Sources: (Environment Canada, 2004).

7. Biological (Pathogenic) Organisms

Generally ground water source within farm lands are prompt to pathogens contamination resulting from animal faeces which occurs through percolation, leachate and run off. However animal faeces infected by cryptosporidium parasitic has millions of spore like cells known as oocysts which are proven to be infectious (Health protection Team, 2006) and are complicated and tedious to treatment if present in water distribution. However, the ingestion of 10-100 of spore like cells will lead to cryptosporidiosis persistent and severe diarrhea (Water UK, 2001) E.coli is the principal indicator organism targeted as in this case, as it has the ability to survive for weeks in static (ideal) phase, and generally it's not so difficult to detect under laboratory investigations. (Gray, 2008). Hence, the pathogenic organisms determined as well as ensuring their types provides an effective treatment process, however slow granular filter bed and coagulation in water treatment is an effective means of mitigating bacteriologicals and viruses, similarly their remnants are completely being disinfected through chlorination, the use of ozone as well as ultraviolents process, which the end product of the water becomes palatable, however the presence of chlorine lives a residual through distribution process which remains effective means of disinfection (Gray, 2008).

8. Treatment process of Fe and Mn

Water source associated with anaerobic characteristics usually disrupt treatment process which requires aeration prior to further stage of treatment (Gray, 2008) Fe and Mn in drinking water has no significant health implication, however high concentration result to unpleasant taste and odour (McClure, 2006) Fe and Mn in their excess lead to correlation in treatment works and resulting to insoluble ionic deposit within networks and this retired (slows) flow rates within the network process (McClure, 2006). However some of the problem related to Fe and Mn is that it provide bitter taste in water as well as it promotes the growths of microbes, it also affect textiles, food and dyes, however the following are remediation process of Fe and Mn in water source or prior to distribution for domestic uses.

8.1 Aeration

As it's demonstrated in *figure 2a and 2b* the general procedure is the use of air bobbles within the water to oxidize the Fe and Mn. The air as indicated is pumped from the bottom of the aeration tank from series of nozzle of pipes vertically upward through the water and the oxidized Fe and Mn are subsequently removed through filtering process (Dvorak, 2007).

8.2 Precipitation Process

This process of removing Fe and Mn is basically refers to the adjustment of the water pH value in the treatment works by the addition of crystal alum which allows for the formation of setting of precipitates with time, while percentage remaining are filtered by slow sand filter. However a pH value of 10-11 for the water containing Fe and Mn is needed in facilitating the process more effectively (Clayton, 2011).

8.3 Ion Exchange Process

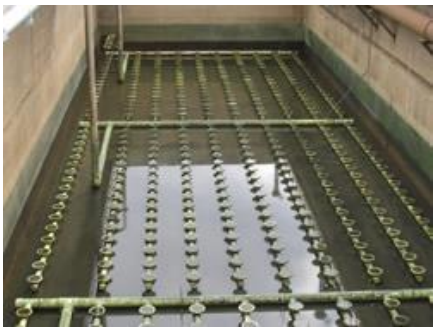
However, the exchanging process of irons helps to facilitate removing the presence of hardness (softening) of water, it however neutralizes soluble Fe and Mn by passing the water through a physical process of resin bedding that which absorb the unwanted neutralized iron and generally which renders the irons less volatile (Clayton 2011).

8.4 Sequestering Process

This process in water treatment is usually, refer to as stabilization process in which it allow for chemically binding of both Fe and Mn together with existing available soluble irons present in the water as it contains a very low concentrations of irons in respect to the smaller amount of its volumes present. Apparently, not only Fe and Mn are removed but also other undesirable ions.

8.5 Chemically Oxidizing Process

(Dvorak, 2007) this process is suitable in high volume of concentration greater than 10mg/l as well as effective in the presence of organic matters or when iron bacterial are usually present. This process involves similar procedure as that of aeration process, hence the available metals are generally being oxidized to form particles which permit filtration process. However compound such as O_3, Cl, or $KMnO_4$ are generally applied as oxidizing agents, while a slow sand filter traps/captures the available particles (Dvorak, 2007). The oxidizing time is usually longer which will requires a storage tank, and apparently makes the treatment more expensive. However the use of chlorine for oxidizing process, will require additional treatment process with an activated carbon filtration to remediate taste due to residual chlorination process (Dvorak, 2007).



2a: Empty aeration tank showing air diffusers

2b: Aeration tank in operation

Figure 2: Aeration tanks source: (Michigan water treatment n.d)

9. Discharge of high concentration of effluent in to water body resulting to eutrophication

9.1 Eutrophication

This is a phenomenon that is associated to the environment as a result of being much enhanced with the presence of nutrients level such as nitrogen (N) and phosphorus (P), which adversely affect habitats usually water bodies, and however will subsequently become problem to aquatic life, plant and animal (human), so also this effect will results to algae blooms (Lehtiniemi et al. 2005) and plant growth as a result of the limited growth process requiring photosynthesis for regeneration (Schindle, 2006). *Figure 3a and 3b,* shows the contributing factors to different source of intakes for nutrient, which are usually attributed to the contamination of the water body, however the use of fertilizer for farming activities, presence of erosion on land, rain fall as well as the possible activities within the water body such as aquaculture and sediments released in the presence of sunlight for its rapid catalytic reaction.

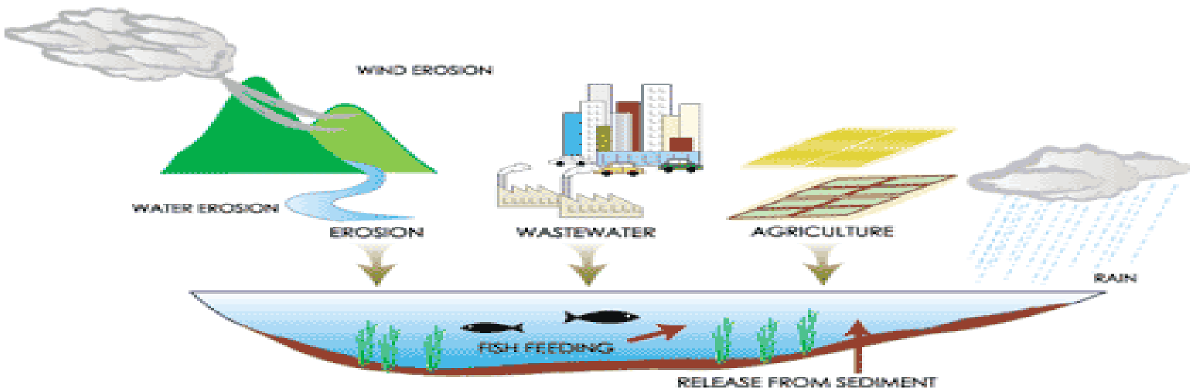


Figure 3a agents of eutrophication discharges in to water body
Source: (United Nations Environment Programme n.d).

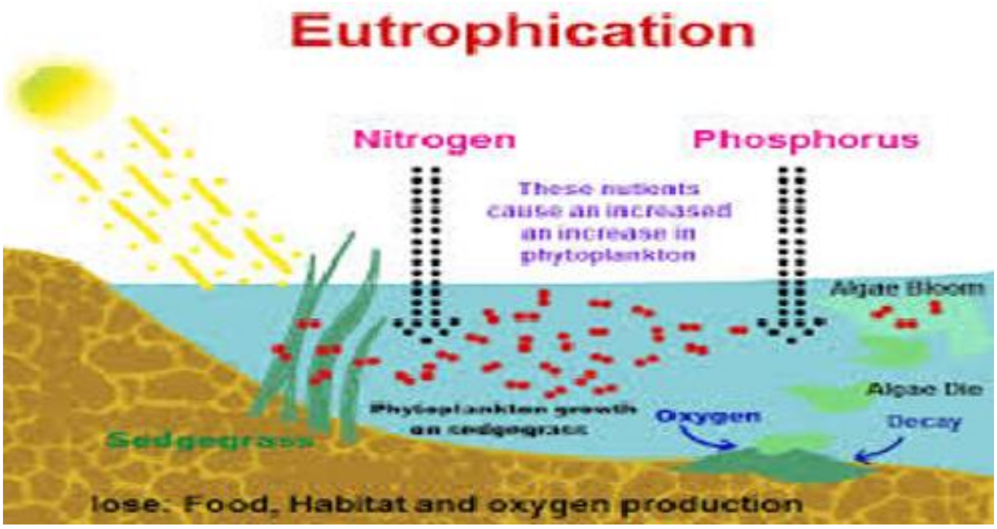


Figure 3b: effect of eutrophication on the water body source: (NCS Pearson 2014).

The process from *figure 3* is as follows;

- Increases the input for nutrient (nitrates and phosphates) that enters water bodies;
- It increases the rate of algae productivity within the receiving water body (resulting to greater increase for algae reproductions);
- High rates of decompositions as a result of the decomposers respirations;
- Resulting to a large numbers of dead organic matters, as a result of decomposer because of the availability of algae for consumption (food);
- High increased for oxygen demands but declines in oxygen levels; and
- Resulting to death of more organisms.

9.1.1 Impact of Eutrophication's

- Resulting deaths of aerobic organisms/animals;
- Poisoning of organisms as a result of algal blooms;
- Turbidity increases;
- Diminishing for macrophysics survival;
- Decline in biodiversity as well as losses for food chain lengths;
- Vast Losses for water resources to humans; and
- Negative implication on tourism as a result of bad smell/odour and aesthetics.

9.1.2 Treatment Process for Eutrophication

The physical environment requires utmost attention, and this has brought about series of treatment process in the forms of secondary biological patterns of limiting treatment process, which are designed to remediate biological oxygen demand (BOD) that makes the water secure for discharging into existing water bodies. (Downings et al, 2001; Huissman et al, 2004) varieties of strategies has been developed by water resources managers to limiting/minimizing cultural eutrophication which includes; altering nutrients ratio, diversion of excessive nutrient, physical mixings, the application of protent algaecide as well as herbicide, and shading receiving water body with water base stains.

10. Trickle(ing) Filter (Fixed Film) remediation Process for N and P

The general concept of this treatment process allows for the removal of SS and BOD which constitutes rotational distributors arms, which aids in spraying over the bedding of rocks, synthetic material or granular midbrains *figure 4* (Eddy, 2003 and Tilley et al. 2014).

However, the various space within the film aid the circulation of air to allow for easy aerobic process which are maintained and subsequently permits the waste to trickles down and the organic agents within the water are then diffused through the membrane which allows for metabolic process within the profile and hence percolates through the filter to be collected at the settling basin alongside the treated waste water for discharging. However the efficiency of the filter relies on its ability to recirculate its temperature as well as its organic load and hydraulics.

10.1 Merits of Trickle(ing) Filter

It has the ability to remove 80% - 90% of BOD, effective in NH_3 removal as well as its compatibility with small area which does not consume space, and capable of resisting process such as shocking loads and has moderate operation cost (Eddy, 2003 and Tilley et al. 2014).

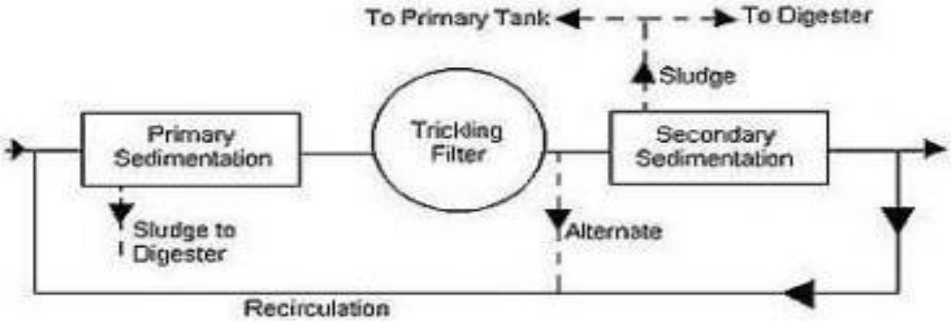


Figure 4a: operating principle flow chat of trickle(ing) filter

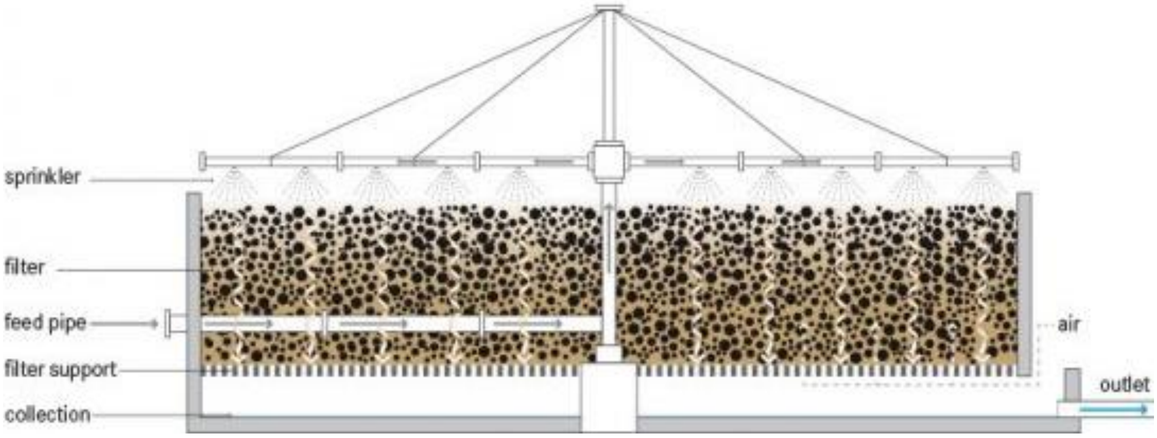


Figure 4b: section through trickle(ing) filter Sources: (*Tilley et al.2014*)

10.2 Demerits

It's not efficient in the removal of nitrogen and phosphorus, it also do produces high turbidity in its effluent comparable to activated sludge process, it also has clogging incidences and its sludge requires treatment, so also a source for breeding mosquito, snails and several insects (Eddy, 2003).

11. Free film (activated sludge) as remediation process for N and P

This process is generally sustainable in removing higher volume of BOD available, however aeration of the effluent with the sludge and subsequently agitated while the sludge is collected from the combined treated liquors through sedimentation. However, its collected from the reactor as demonstrated from *figure 5*, the suspended growths are treated in the clarifier simultaneous with effluent feeding from aeration tank, with the settling of the microbes in the clarifier which permit the removal of 99% suspended particle (Eddy, 2003).

The result is a free effluent capable of being discharged into the environment (water bodies) and 95% of its biomass are channeled back to aeration tank for regeneration process of treatment while overloading is achieved for removing remnants (Eddy, 2003 and Tilley et al. 2014).

11.1 Merits. This process is more effective in removing higher volume of BOD and has virtually negligible odour problem, it is however flexible and it's adaptable to pH and variation in temperature, it also has the ability for controlled degree of nitrification and the overall construction processes is low.

11.2 Demerits

Highly expensive as it requires consistent pumping of air for its optimum performance, sludge need disposal, and it also has higher operating value with sensitivity to shocking load.

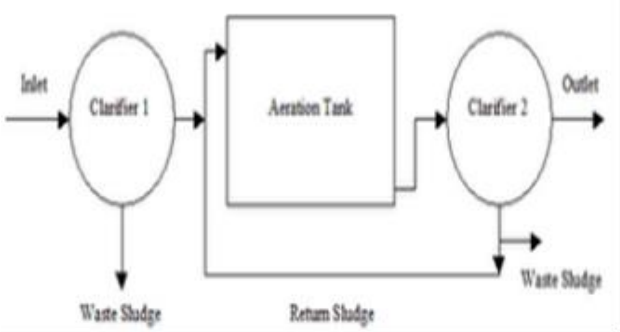


Figure 5: operating principle flow chat of activated sludge

12. Facultative pond as remediation process for N and P

This process of wastewater treatment is also refers to as stabilization pond and are generally used for municipal waste water treatment and are more effective in countries with abundant sunrays, however this pond is made of shallower artificial basin consisting sets of anaerobic, facultatives ponds with an active treatment within the anaerobic pond, aimed at removing SS alongside soluble elements or organic matters known as BOD *figure 6*. However, secondary process taking place with the stabilization pond and the majority of the BOD are mitigated via coordinating process of algae as well as heterotrophic organisms (bacteria's), and the main function of tertiary removal by the maturation ponds is usually the removal of nutrients such as nitrogen (N). However, the configuration of the facultative pond is to remove BOD which is designed on volumetric biological oxygen demand (g BOD/m^2.d) (Hassan, 2011). But however, stabilization ponds can be designed in series connection with one another via inlet and outlet flow pipes (anaerobic, facultative and aerobic maturation) in order to enhance treatment process or they can function individually on their own depending on the design requirements (Kayombo et al. 2004).

The removal efficiency of BOD from each of the ponds are referenced to *figure 6;*

- Anaerobically 50% - 80% BOD removal with retention time of 1 to 7 days, and its primary function is to remove BOD and to allow for settlement of non-digestible materials and solids which are non-degradable and provides for sludge setting at the bottom. Similarly, it also dissolves organic matters, as well as break down biodegradable matters;
- Facultative also has a primary function for removing BOD with efficiency of 80% - 95% at retention time 5 - 30 days, and however this pond is effective in reducing odour, stores residues which is at the bottom sludge, it also provided for positive

waste water treating process via the sedimentation and oxidizes organic materials aerobically with high pH value, and are capable of illuminating micro-organisms that can inflict disease (WSP, 2007); and

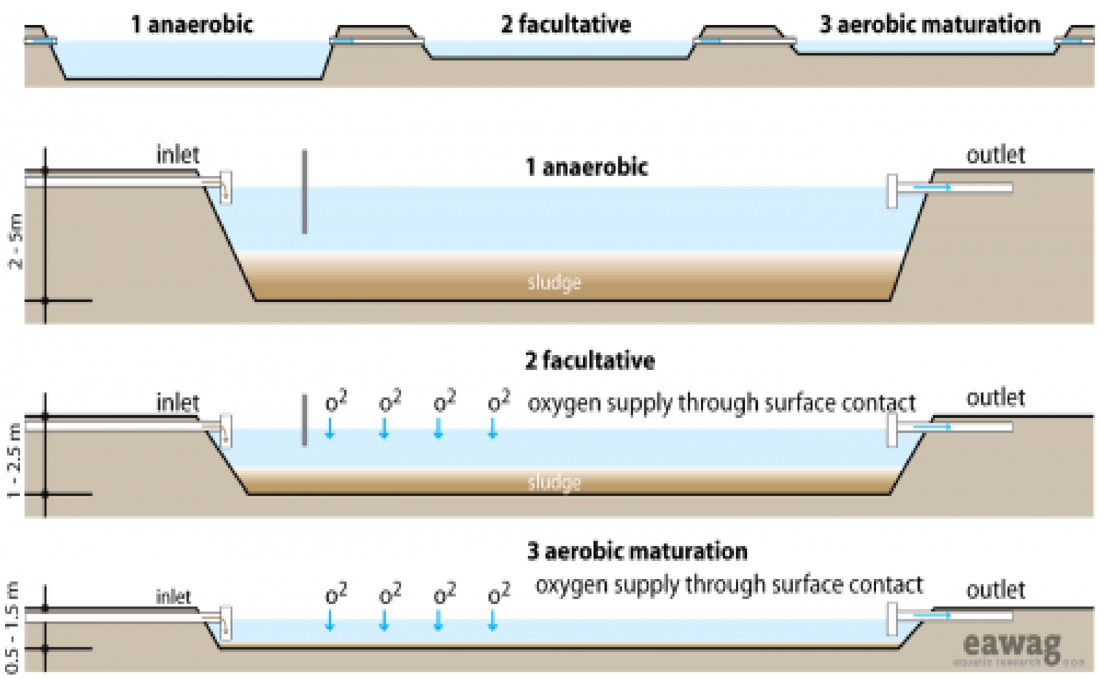


Figure 6: Stabilization ponds for waste water remediation (treatment) process
Sources: (compendium of sanitation system, 2014)

- Maturation pond has the ability to remove 60% - 80% BOD and 90% pathogenic and this can only be effective within given retention time of 15 - 20 days. Nevertheless both facultative and maturation pond requires higher pH which is greater than scale reading of 9 as well as temperature and high sunray intensity, this then implies their optimum effectiveness can be archived through design and applications within temperate regions of the globe. (Tilley, 2008).

13. Green Algae (Chlorella sp.) remediation process for N and P

However this process relies on microalgae as its principal driving mechanisms and which has proven effectiveness in the remediation process of nutrients, nitrogen and phosphorus in waste water, xenobiotic compound and metals as well as organic matters in waste water treatment process (Blackall et al. 2002). Similarly, as a result of microalgae capacity for assimilating nutrients comprising of both N and P (Shi et al 2007) And the merits for its uses for microalgae includes; the ability to recycle and assimilates N and P to algae biomass (fertilizer), and it has less operative expense as a result of the nutrient in wastewater are effective for micro algae harvesting with 90% reduction of fresh water life cycle, with no competition for source of food for generation process within the environment. However chlorella is effectively used microalgae for nutrients remediation globally. And it's also productive as a result of its fast growth process with higher lipid product (Xu et al 2006; Li et al. 2007) and this process usually involves chlorella sp. isolation then followed by a pre-culture process for 12 hours at 25^0c in 150ml flask in order to determine the removal of nutrients such as N and P.

13.1 Nitrogen (N) removal

Chlorella Sp. Will confirm high removal proportion of total nitrogen in effluent comparable to effluent waste water in proportionate of 50% - 25%. However, the presence of dissolve inorganic nitrogen will be removed for value greater than 83%.

13.2 Phosphorus (P) removal

However, in influent waste water, the removal proportionate of total phosphorus is 90% and 60% removal efficiency and in effluent this shows that chlorella Sp. Has the ability to utilize phosphorus at a lower concentration, because this is evidently as it was established in a different chlorella Sp. after being cultivated in secondary treated sludge (An et al. 2003).

14. Phytoremediation process of pollutants (contaminants)

Phytoremediation mitigation method principally involves the use of plantation agriculture. In this process pollutants are remediated by complete removal or undergoes transformation to harmless and apparently valuable uses (Leather international, 2013). This remediation process involves the use of plant for immobilizing the pollutants within the water bodies and even in soil, however it also allows for degradation as well as extraction of pollutants *figure 9*. Phytoremediation have been a valuable tool for remediation processes which are always termed to be cheaper and as well as a clean methods in usage. However its drawbacks are:

- Contact has to be between the plants roots and the contaminants, also plants needs the ability to extend their roots to the rich of the pollutants or vice vassal (EPA, 2002).
- It relies on the plants growth and hence takes longer remediation period to actualise. And this factor permits aquatic life, human as well as the ecological system are faced with risks and uncertainties, however the problem is not associated to the mitigation techniques desired (EPA, 2002).

Moreover, phytoremediation process of waste water are generally classified in regards to the contaminants fate as well as the technique to be employed. Similarly, the effective methods used in waste water treatments and management are; phytodegradations, phytoextractions and phytoimmobilisations (EPA, 2002; USDA, 2002; and EPA, 2011).

14.1 Phytodegradations of waste water contaminants

This process is also known as phyto-transformations which is the sequential illumination of pollutants via plant roots up taking of nutrients. However plants used in this scenario has the ability to extract toxic and harmful elements, detoxify and metabolize such elements or compounds as the plants nutrients (Kidney, 1997). This remediation process in waste water, is the application of microalgae's to degrade nutrients composition in waste water. Microalgae utilizes nutrient for their cell formations *figure 7*, (Mamun et al., 2012). Which are aided usually by Flavin's as well as polysubstratemonooxygenase enzymes activities as a result of hydrolytic and redox reactivity. (Zakrzewski, 2000; Walker et al., 2002). During conjugation process, activated compound/pollutants compete for C 6 H 12 O 6 molecule, (COOH) + (NH_2) for production of smaller amount of toxic substances that contains polar structure by catalytic reaction called "UDP-dependent glucosyls transferase and N-acetyl transferases" Inactivated contaminants are illuminated at the end of compartmentalisations by conjugation to permit safe deposition for derived toxin (Spaczyński, 2012).

14.2 Phytoextractions of waste water contaminants

This process is also known as phytomininginvolve i.e planting crops/plant species capable of accumulating contaminant (hyper-accumulator plant) within plant shoot and leaves *figure 7*, and are harvested while pollutants are removed from the affected environment. Plants with the ability of hyper accumulations are capable of absorbing significant quantities of metals that are nonessentials (EPA, 2002). Phytoextractions are only effective when pollutants are cable of moving from roots to shoots within the plant, aided by translocations processes, under the influence of certain pressures from the roots as well as leaf transpirations. After which the contaminants are retaking in by the plant sap to the leaf cell. Implementation of effective legislative laws need to be observed in order to curtail and limits these menaces in order to create a sustainable environment.

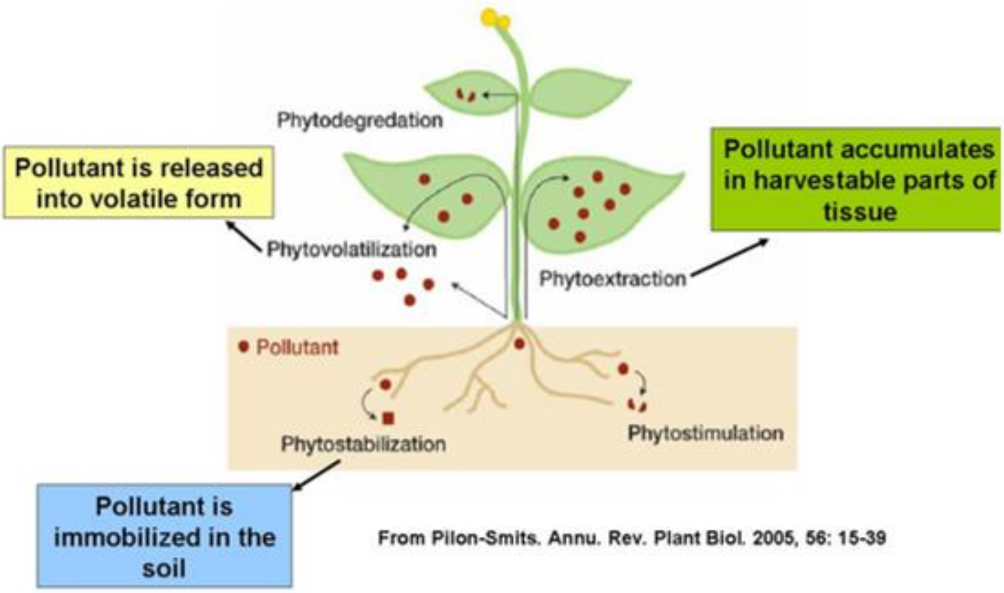


Figure 7: Pphytoremediation's processes for pollutant Sources: (Pilot-Smith, et al. 2005)

14.3 Phytoimmobilisations of waste water contaminants

This process also referred to as phytostabilisations, this however involves the fussing of pollutants presence within the water and which generally renders the pollutant non-bioavailable by breaching the available transportation means. And this is achievable via active binding of pollutants plant roots, absorptions and accumulations of non-harvestable plantations which are usually effective in wetland areas or by humus molecules and the physical sequestrations of metal (EPA, 2002; USDA, 2002).

15. Conclusion

It can be concluded that, both the uplands and chalk aquifer reservoirs requires a quality analysis which are both physical and chemical processes in order to ensure the water supply is potable and pathogenic save prior to domestic consumption. However these reservoirs water supply should be completely free from bacteriological harmful substance, turbidity, colour, taste, odour, high concentration of TDS. However it will be recommended that an effective and conventional treatment process such as; sedimentation addition of coagulant, filtration disinfecting, softening process as well as aeration should be involved. Prior to these, the above water source is required to undergo laboratory analysis such as, jar test, pilot plant test column test, and turbidity among others before treatment to evaluate for chemical presence.

Furthermore, in lieu of the eutrophication phenomenon attributed to the existing water bodies, with a resulting consequences for discharging untreated excessive concentration of nitrogen (N) and phosphorus (P), this will however have negative effects on the habitats usually water bodies, and subsequently will subsequently become problem to both aquatic life, plants, animals and human beings, so also this effect will results to algal blooms in the affected water bodies and plant growth as a result of the limited growth process requiring photosynthesis for regeneration. Usually the contributing factors to eutrophication are the different source of discharge/intakes for nutrient such as; fertilizer for farming activities, presence of erosion on land, rain fall as well as the possible activities within the water body such as aquaculture and sediments released. However proper monitoring and the enactment of legislative laws need to be in place in order to reduce or curtail human contributory factors for sustainability to prevail within the environment.

Nomenclature

pH Potential of Hydrogen
Fe Iron
Mn Manganese
O_3 Ozone
Cl Chlorine
$KMnO_4$ Potassium permanganate
SS Suspended solid
TDS Total dissolved solid
N Nitrogen
P Phosphorus

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