Pond Water Pollution in Chhattisgarh State and its Remedial Measures Including Appropriate Treatment Technology

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Abstract: ***Water is one of the most important commodities, which man has exploited than any other resource for sustenance of his life. Though about 70% of our planet is water, but most of the water on this planet is stored in oceans and polar ice caps, which is difficult to be recovered for our diverse needs. Most of our demand for water is fulfilled by rainwater, which gets deposited in surface and ground water resources as confined and unconfined aquifers. The quantity of this utilizable water is very much limited on the earth. Only 1% is accessible surface freshwater. This 1% surface freshwater is regularly renewed by rainfall and other means and thus available on a sustainable basis and is easily considered accessible for human use. Roughly ten percent of the world's annual runoff is withdrawn for human use each year. This small figure may suggest ample supplies for the future that is not at all the case. Some areas of the world are inundated with water, whereas others have so little water that human existence is barely possible. Even areas with adequate average precipitation are vulnerable to chaotic variations from one year to the next. Unless major water storage and conveyance facilities are constructed, a region may have plenty of water on the average, but not enough to cover needs during dry spells. The geographic distribution of water does not match well the distribution of people on the planet. Asia with 60% of the world's population has only 36% of global runoff, whereas South America with only 5% of the world's population has 25% of the global runoff. Variations within regions or continents can be extreme. For example, the per capita water availability in North Africa is less than 7% of the African average, which is already low. The unique properties of water which make it universal solvent and a renewable resource also make it a substance, which by virtue of these properties has got a much greater tendency to get polluted. Water can be regarded polluted when it gets changed in its quality or composition either naturally or as a result of human activities so as to become less suitable for drinking, domestic, agricultural, industrial, recreational, wild life and other uses for which it would have been otherwise suitable in its natural or unmodified state. The pollution of water has emerged as one of the most significant environmental problems of the recent times. Not only there is an increasing concern for rapidly deteriorating supply of water, but the quantity of utilizable water is also fast diminishing. The causes of such a situation may be many, but gross pollution of water has its origin mainly in anthropogenic activities viz., urbanization, industrialization, agricultural runoff and increase in human population observed in past one and a half century..Most of the surface waters in India, including rivers, lakes and ponds are getting increasingly polluted due to onslaught of human activities of diverse nature. Though, several steps have been taken on a broader front including National River and Lakes Conservation Plans, but the quality of the water resources seems to be far from satisfactory. This is mainly due to the lack of coordination between various governing bodies and proper operation and maintenance of treatment plants and various other factors like reluctance of people and frequent failure of electricity due to which the untreated sewage or industrial wastes are directly discharged into the water bodies. The National River Conservation Directorate has no satisfactory mechanism to see that the installed effluent treatment plants work well or not. In fact, the quality of waters has shown deterioration in past few years at several places. Although the water bodies have significant self purification capacity to assimilate and render many pollutants harmless, the existing pollution loads often exceed such natural capacities of self-purification.***

Keywords: *c*onfined and unconfined aquifers, self purification, sustainable basis, anthropogenic activities.

1. Introduction

Chhattisgarh is known as a "rice bowl of India" as well as a "State of Ponds." A number of small, medium and large ponds prevail within the boundaries of this state. Ponds are very good sources of surface water aimed at multipurpose use of water. Rural &Semi Urban people of Chhattisgarh depend entirely on pond water for taking bath, washing their clothes and their culinary utensils as well as washing their cattle and other pet animals. Not only this, the low-income group of urban population of Chhattisgarh, a major section of the total urban population is also dependent on pond water for their essential services. Furthermore, pond waters are very good means of groundwater recharge resulting from infiltration and percolation through soil pores. Larger the pore-spaces of the soil adjoining the ponds, higher will be the infiltration & percolation and in turn higher will be the groundwater recharge. Thus, ponds can help in restoring the depleting aquifers as well. Durg district covers an area of 8537 km^2. It consists of 8707 number of villages, each village roughly having its own one pond. Foradministrative convenience, these village are grouped into 12 number of development blocks viz., Bemetara, Nawagarh, Saja, Berla, Dhamdha, Durg, Patan, Lohara, Gunderdehi, Balod, Gurur and Dondi. The district is known for its agricultural produce and Bhilai town is known for its one of the biggest Steel Plant in Asia. According to the 2011 census, Durg district has a population of 3,34,3079 roughly equal to the nation of Uruguay. The district has a population density of 391 inhabitants per sq. km. Its population growth rate over the decade 2001-2011 was 18.95%. Durg has a sex-ratio of 988 females for every 1000 males and a Literacy-rate of 79.69%. As per decennial census of 2011, it is the second most populous district of Chhattisgarh (out of erstwhile 18 distts.) after Raipur.

Geographical information about Durgdistrictis as follows:

- Latitude& Longitude : Between $20^0$23' and $22^0$02' & $80^0$46' and $81^0$58' E
- Height above MSL (Mean Sea Level) : 317.00 Meter.
- Geographical Area: 8537 km^2.
- Forest Area: 764.46 km^2 (8.95% of Geographical Area).

The stagnant waters of ponds are usually called LENTIC WATERS, while the running waters of rivers and streams are called LOTIC WATERS. The self-purification capacity of lentic waters of ponds & lakes are somewhat inferior to that of lotic waters of rivers & streams Streeter-Phelps (1925) enunciated Oxygen Sag Curve depicting the Self-Purification Capacity of water bodies after a profound & consistent study of water quality modeling. Various zones can be demarcated in the ponds depending upon certain ecological factors viz., Light penetration, stratification of temp. and light receiving regions. The pollutants concentrate themselves differentially in these zones based on the prevailing physical and chemical conditions. These zones are usually inhabited by specialized organisms adapted to that environment.

Irrespective of the nature, the mode of entry of pollutants into the ponds and lakes is often common. Broadly speaking, the pollutants can enter into ponds by the following ways:

- Direct discharge in the form of domestic and municipal waste water & storm water into ponds.
- Runoff & seepage.
- River flow transport.
- Reactions & transport across the air- water interface.

Apart from the direct discharges, the major transport of pollutants from land surface to water systems takes place by runoff water, which picks up the materials (soluble & suspended) from the soil and transport them to the receiving waters. A large quantity of soil itself can move with the runoff (soil erosion) to the bodies of water causing silting. Materials from the soils are removed mainly by LEACHING due to the force of percolating and runoff waters. Leaching has been reported to remove huge quantities of pollutants from the refuse tips in the urban, semi-urban and rural areas of Chhattisgarh causing both surface water (i.e. ponds and rivers) and ground water pollution.

On reaching a water body, the fate and behavior of pollutants depend largely upon their nature and a variety of physical, chemical, morphological, morphometric and biological factors. Wind action tends to circulate the water, but the depth of mixing is determined by the temperature stratification and the depth of thermocline. In a highly stratified body of pond water, the thermocline puts a resistance to mixing and allows only the epilimnetic upper layers to be mixed. In isothermal conditions, the mixing of pollutants may be complete, as uniform conditions prevail throughout the water column. However, the ultimate diffusion of the soluble pollutants takes place by the process called "molecular diffusion".

The depth of the bodies of water is also an important factor influencing the mixing of pollutants in the whole water column. As the shallow waters are often well mixed, they provide a better mixing for pollutants in contrast to the deeper waters, where only a part of the water column is mixed completely. The transport of pollutants from the mixing point to the other portion of pond may also be influenced by the slope at the mixing point. The velocity of the drain carrying waste waters is immediately checked by the resistance offered by stagnant pond water causing the sedimentation of a large quantity of suspended matter at the bank. These result in the formation of a saprobic zone in case of an entry of organic wastes due to accumulation of huge quantities of organic matters in the mixing zone.

The nature of the pollutant, whether degradable, non-degradable or persistent, decides its overall accumulation in the water body over a period of time. A reduction in quantity occurs with time in case of degradable pollutants. Every water body has got a self-purification capacity with regard to the biodegradable pollutants depending upon the mixing characteristics and oxygen regime. The rate of inflow, outflow, seepage, overflow and evaporation are important factors deciding the net accumulation of pollutants in waters. The pollutants can also get adsorbed onto the sediments in certain conditions, whether they can live either temporarily until the conditions are reserved for their desorption, or can get permanently buried. Several pollutants like phosphorus, ammonia and heavy metals have been found to be immobilized in this manner. A number of pollutants along with nutrients are incorporated into the body of organisms from where they are released only after their death and decomposition.

Common pollutants of Pond water in Chhattisgarh are as follows:

Pathogens:

Pathogens are disease –causing organisms that grow and multiply within the host. The resulting growth of micro-organisms in a host in called an infection. Examples of pathogens associated with pond water are bacteria responsible for cholera, typhoid and paratyphoid fever, viruses responsible for infectious hepatitis and poliomyelitis, protozoa responsible for amebic dysentery and giardiasis and helminthes or parasitic worms that cause diseases like schistosomiasis & dracunculiasis (i.e. Guinea-worm diseases)

Remedial Measures & Control:

Parthivi College of Engineering & Management, Bhilai is conducting "Pilot Project" on Pond Water Pollution &its appropriate& cost-effective control measures in the premises of the College itself. After microbial examination of the nearby pondwaters, the aforementioned microbes were found in the specimen of the waters. Pathogens may be controlled by Chlorination,Ozonation and UV treatment by solar sterilization, UV treatment by solar sterilization may be cheapest method by warming the pondwater by intensified solar insolation with the help of modified solar panels.

Oxygen Demanding Wastes:

Due to excessive organic loads of pond water through anthropogenic activities such as washing of kitchen utensils by rural folk of Chhattisgarh as well as sometimes dumping of organic wastes, including trashes of crops in the adjoining locations of the pond enhances organic loads specifically during rainy spells. Aerobic bacteria present in pond water oxidize these bio-degradable organic wastes by utilizing oxygen of pond water thereby diminishing the DO content (Dissolved Oxygen) of the pond water as follows:

$$Organics + O_2 \xrightarrow[Bacteria]{Aerobic} CO_2 + H_2O + New\ Cells + Stable\ products[NO_3, PO_4, SO_4]$$

Control Measures:
The depleted DO content of pond water may be restored to a greater extent by mechanical agitators resulting from dissolution of atmospheric oxygen into pond water. When water is agitated vigorously with the aid of mechanical agitator or by cascade fall of the pumped intake water, odor of water is also removed apart from enhancement of DO.

Total Solids (Settleable + Non-Settleable)
Turbidity of Pond water is caused by the presence of total solids viz. clay, silt, organic matter as well as algae & other microorganisms. Turbidity of water is associated with the scattering of light by suspended and colloidal particles present in it. Turbidity is correlated to the no. of particles present rather than the weight of suspended particles. Turbidity in laboratory is measured with the help of Turbiditimeter or Nephalometer in NTU i.e. Nephalometric Turbidity Unit. The standards of turbidity in potable or drinking water usually remain up to 5 NTU. A reduction in turbidity also results in fall of microorganisms since total solids act as shelter for microorganisms. Moreover, turbidity is also objectionable from aesthetic point of view. The settleable& non-settleablesolids as well as microorganisms, are the wide spread symptoms of pond water now a days in Chhattisgarh. Sometimes, pondwater is so turbid that it becomes translucent & opaque in terms of light penetration.

Total solids are introduced into pond waters of Chhattisgarh either naturally or due to anthropogenic activities. The settlable solids are settled immediately after their introduction on the bottom of the pond due to gravity whereas the non-settlable solids remain suspended for varying periods depending upon their size and density. The suspended matter may belong either to organic or mineral category. The organic suspended particles consist mostly of volatile solids derived from the detritus that create an oxygen demand in waters. A small portion of organic matter may also consist of synthetic non-biodegradable compounds which are only sparingly soluble in water. The mineral suspended matter is mostly of natural origin coming as silt with natural runoff.

The fate of suspended matter is governed largely by no. of factors operating in aquatic system. The suspended matters in pond water do not remain suspended for indefinite periods, but tend to settle down with different settling velocities. The settling velocities of particulates can be mathematically evaluated by the Stoke's relation as under:

$$\boldsymbol{Settling\ Velocity} = \frac{\boldsymbol{g}.\boldsymbol{d_p^2}}{\boldsymbol{18\mu}}(\boldsymbol{\rho_p} - \boldsymbol{\rho})$$

where,
d_p*= Hydrodynamic diameter of the particle*
μ *= Viscosity of pond water*
ρ_p*= Density of the particle*
ρ *= Density of pond water*
g *= Acceleration due to gravity = 9.81 m/s*^{2}

The aforementioned mathematical relation reveals that final particles are easily entrained and remain in suspension for highly extended periods, whereas the larger and heavier particles deposit quickly. The particles deposited at the bottom remain quite loose and can be re-suspended in water by the factors like convection and diffusion both turbulent and Brownian. However, the Brownian diffusion is negligible in comparison to turbulent diffusion caused by wave action. Vertical convection is important, especially in the areas of upwelling, and at the time of overturns.

Control Measures:
Settleable solids may be removed by sedimentation. Moreover non-settleable solids may be removed by flocculation followed by sedimentation. For flocculation, MoringaOleifera seeds may be used, whose tree is abundantly found in the sub-tropical climate of Chhattisgarh. MoringaOleifera seed powders are a very good and cheapest coagulant found in rural areas of Chhattisgarh. Laboratory studies reveal that moringa coagulation can remove up to 90 to 99% of bacterial contamination and up to 96% of influent E-coli (Madsenet.al 1987; Nkurunziza et. al 2009). Olduruet.al (2007); noted a 97.5% reduction of coliform bacteria upon treatment with M. Oleifera. Growing naturally in many rural and sub-urban areas of Chhattisgarh state, M. Oleifera could be an inexpensive and widely- available coagulant for pond water treatment purposes owing to its appropriate bacterial removal efficacy.

Total Dissolved Solids (TDS):
Pond water of Chhattisgarh is also enriched in total dissolved solids such as iron, copper & zinc, which are harmful for human beings as well as, specifically, to the animals like cows and buffaloes that use pond water for drinking. Sometimes, total dissolved solids become fatal for these animals.

Control Measures:
For TDS control, a filer media of activated carbon & fine sand is used at the Pilot Project Site in the college campus. However, research works may be carried out for substantial removal of dissolved solids viz., Fe, Cu, Zn etc., with the aid of other filter media like wood charcoal, anthracite, manganese modified sand and $Al(OH)_3$ coated RHA (i.e. Rice Husk Ash or Agro-Silica) and banana plant residues including leaves, stems, pseudo stems & rinds (ash obtained by burning the banana plant residues at 500^0C in Muffle Furnace is a very good adsorbent for removing Fe, Cu & Zn from water). Aluminum hydroxide coated RHA proves to be a good absorbent in removal of iron, copper & zinc which are generally found in pond water of Chhattisgarh. Previously it has been experimented that it forms complexes with fluoride ion for its removal. Here, in case of Fe, Cu & Zn, there are no proofs of formation of any complex. Consequently, removal may be credited to roughening of RHA surface due to modification by $Al(OH)_3$. The removal of Fe, Cu & Zn through a filter medium of $Al(OH)_3$ coated RHA was 0.278 ppm, 0.295ppm and 0.374 ppm as against 0.3 ppm, 0.5 ppm and 5 ppm respectively as per BIS code IS:10500,1992 (Singh etal.2014).

Nutrients:
Nutrients are chemicals such as Nitrogen, Phosphorus, Carbon, Sulphur, Calcium, Potassium, Manganese, Boron and Cobalt that are essential to the growth of living things. In terms of water quality of ponds, nutrients can be considered pollutants when their concentrations are sufficient to allow excessive growth of aquatic plants, particularly algae. Nutrient enrichment can lead to blooms of algae, which eventually die and decompose. Their decomposition removes oxygen from the water, potentially leading to levels

of DO that are insufficient to sustain normal life forms. Algal bloom and decaying organic matter add color, turbidity, odors and objectionable tastes to water that are difficult to remove and that may greatly reduce its acceptability as a domestic water source. The process of nutrient enrichment, called "Eutrophication" is especially important in lakes and ponds. Nutrients as well as other pollution may come from either point-sources or non point sources. The most common point sources are discharges from waste disposal sites, mines, animal feed lots and construction sites, whereas the important non-point sources are runoff from agricultural lands and pastures, abandoned mines and logging sites.

Control Measures:
Effluents from point sources should be treated prior to feeding the ponds, whereas effluents from non-point sources should be restricted to come into ponds by making small bunds or diverting it to natural waterways which are not joining the ponds under consideration. Furthermore, excessive use of chemical fertilizers should be discouraged & at the same time the use of bio-fertilizers should be emphasized

Reason For Pond Water Treatment Aimed At Its Multilateral Utilization By Rural People
In Chhattisgarh, rural and sub-urban people are primarily dependent on pond water for their daily essential services as well as to fulfill their requirements of day-to-day life. They generally accomplish their essential services of the morning of their diurnal routine mostly in pond water. They brush their teeth, wash their clothes and take bath in pond water. Not only this, they wash their cattle and buffaloes, washes the culinary utensils, submerge the statues of religious importance at various pertinent Hindu festivals viz. Dussehra, Ganesh festival, Saraswatipooja etc., irrigate the vegetable crops of their kitchen garden in the proximity to the pond and perform fisheries activities etc. frequently in pond water. Keeping in view the potential pollution scenario of the pond water, there is always a chance of occurrence of enteric water-borne diseases and also outbreak of epidemic water borne diseases due to ingestion of polluted pond water into human body as well as due to bio-magnification of eating the polluted tissues of fish from polluted pond water.

Some Important Water Borne Diseases:
Diseases caused by bacteria:
Some of the important pathogenic bacteria and the diseases caused by them are given in table 3.2.1 as follows:

Table 1: Some important water borne pathogenic bacteria and diseases caused by them

Organisms	Diseases
Vibrio Cholerae and its biotype EI Tor	Cholera
Shigella spp.	Bacillary dysentery
Salmonella typhi	Typhoid
Salmonella paratyphi	Paratyphoid fever
E-coli or Escherichia coli	Infantile diarrhea
Leptospira spp.	Leptospirosis
Pasteurella (brucella or Francisellatularensis)	Tularemia
Clostridium botulinum	Botulism
Other Salmonella and Shigella spp. Proteus spp.	Gastroenteritis

Vibrocholerae causes cholera which is an acute epidemic intestinal disease. The bacterium produces an exo-toxin which causes the gut cells to produce excess water along with sodium carbonate and potassium. The disease is characterized by production of severe diarrhea eliminating 'rice-water' stools in large quantities, which may cause death within few hours due to severe dehydration.

Diseases caused by viruses:
ECHO viruses and coxsackie viruses cause enteritis in human being and outbreaks usually occur due to contamination of water by untreated sewage. The most concerned disease caused by water borne viruses is, however, infectious "Hepatitis" (i.e. jaundice). The hepatitis virus infects liver to induce haphazard production of biles, which gets entry into blood causing yellowness in the body.

Diseases caused by Parasites (Protozoa and worms etc):
The parasite protozoan, "EntamoebaHistolytica" causes "Amoebic Dysentery" (Amoebiasis) in human beings. It infects large intestine causing ulceration which results in the release of necrotic mucous membrane and blood.

Proposed On-site Affordable and cost-effective Pond Water Treatment Plants:
To overcome the dangerous consequences of water-borne diseases (both epidemic and endemic) suffered by the beneficiaries of pond water, an "On-site Economic Pond-Water Treatment Plant" should be facilitated on the bank of each pond so that the users of pond water may perform their essential services viz. brushing their teeth, taking bath, washing their utensils; as well as may accomplish other necessary utilization of pond water in a safe, sanitary and hygienic conditions with a view to abstain themselves from water borne diseases. The proposed waste water after the use of users will be fed to the pond after its primary treatment so as to maintain the constant supply of water for the users throughout the year by recycling.

A lot of funds are allocated to the Community Health Centers of Chhattisgarh by the Government of Chhattisgarh to purchase medicines with a view to tide over the problems generated by water borne diseases. These huge expenditures may be curtailed to a substantial extent by facilitating them fresh and pathogen-free pond water by constructing such on-site cost effective pond water treatment plants on the banks of all existing ponds of Chhattisgarh. Sometimes, the outbreak of epidemics isso vigorous that it takes toll of a lot of people. Many families become devoid of their earning family members due to their death caused by the waterborne diseases and eventually they are ruined at the cost of polluted pond water, since diseases do not differentiate between earning and non-earning members. Therefore, in an era of civilized society of today, it is mandatory to provide fresh and bacteria free water to the rural people of Chhattisgarh as well. Today India is developing and at the same time Chhattisgarh has also seen so many developments in the previous decade in almost all sectors viz. infrastructure, real estate, industrialization, urbanization, general education, technical education, health, agriculture and its allies, forestry etc. But, polluted pond water is a black-spot on all these developmental activities, as majority of population of Chhattisgarh reside in villages still today and are almost dependent upon pond water for their water requirements.

Therefore, it is a need and necessity of today to eradicate this problem of polluted pond water from the topography of Chhattisgarh forever.

On-site cost effective pond water treatment plant should be constructed by innovative technical know-how so as to minimize the cost of the treatment plant. It is here noteworthy to mention that research works are going on in the premises of Parthivi College of Engg. and Management, Bhilai-3 by a teamof highly qualified expertise headed by Mr. R.K. SINGH, H.O.D. (Department of Civil Engineering) PCEM-Bhilai-3, Who is M.E. (Hons.) in Environmental Engineering and possesses a lot of working experience in the field of consultancy in planning, designing and estimating of civil structures as well as a long span of teaching experiences in various Engineering Colleges of Chhattisgarh

Proposed Cost-Effective Mini Pond Water Treatment Plant:

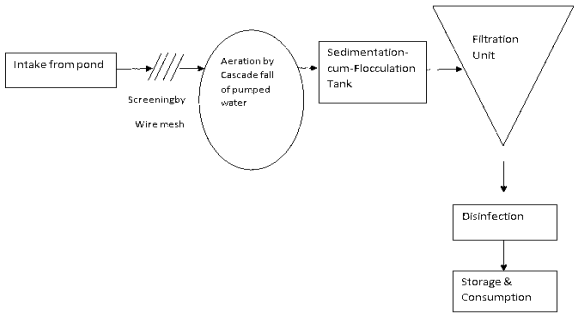

Figure 1: Line Plan

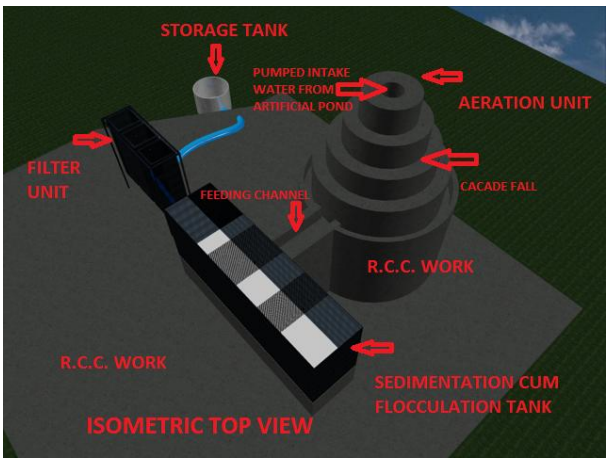

Figure 2: Isometric View

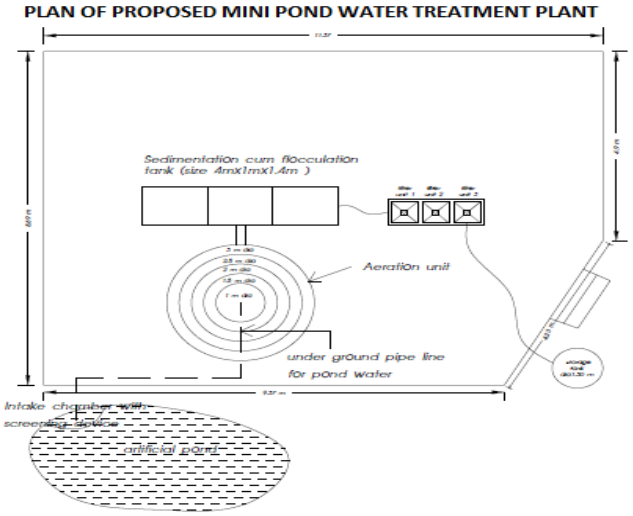

Figure 3

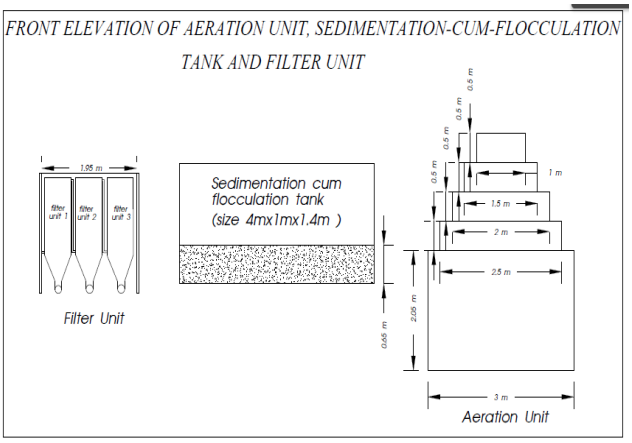

Figure 4

Intake from Pond after Screening By Wire Mesh: Intake from pond is accomplished from intake chamber of masonry works provided with wire mesh of fine to medium pore openings ie.600 micron to 1.18mm so as to remove fibrous materials such as human and animal hairs, plant trashes and other cellulosic materials

Aeration Unit: Aeration is accomplished with a view to enhance the dissolution of atmospheric oxygen for enhancing DO(Dissolved Oxygen) content of intake water .It is proposed to be done by cascade fall of the pumped intake water. Aeration also removes the objectionable odor of intake water.

Sedimentation–cum-Flocculation Tank: In this unit, M. Oleifera seed powders are used as coagulant dose followed by rapid mixing so as to mix the coagulant thoroughly and thereafter slow mixing of coagulant is done so that lighter suspended particles and micro-organisms may get sufficient retention time with coagulant with a view to form "flocs". The floc-laden water is kept in stationary condition or its velocity is so decreased as to facilitate sedimentation of floc particles by gravity. The settling velocities depend upon the mass and density of the particles. Smaller and denser floc settles faster and occupies less volume in sedimentation tank. Once settled, the particles combine to form "sludge" that can be later removed from the tank manually or by automated arrangement. The factors that influence the process of sedimentation include the following:

- Size, shape, weight and density of floc particles
- Viscosity and temperature of pond water
- Surface area and effective depth of the settling tank
- Overflow rate
- Velocity of flow
- Intake & Outlet arrangement
- Velocity of flow
- Inlet & outlet arrangement
- Detention Period (time for which water stay in sedimentation-cum-flocculation tank)

Filtration Unit: Filtration is the step carried out after sedimentation for removing particles of solid matter usually by passing the water through a bed of porous filter media. After filtration, the water obtained is clear and sparkling with negligible turbidity. The aim of filtration is to remove the small floc-particles and micro-organisms still remained in water after sedimentation. Turbidity can shelter harmful micro-organisms and reduce effectiveness of disinfection. Some of the micro-organisms, which might resist disinfection, can be removed here. Besides turbidity & micro-organisms, the process of filtration can also be effective in removal of color, odor and TDS such as iron, copper and zinc.

The process of filtration usually works by a combination of physical and chemical processes. The particles are removed by mechanical straining by trapping them between the grains of the filter medium such as sand. Another mechanism of removal of particles is by adsorption, in which the suspended particles stick to the surface of filter grains or the previously deposited materials. The adsorption of viruses is of great significance during filtration. In Mini Pond Water Treatment Plant (i.e., Pilot Project) emphasis is done on the research works of cost-effective and locally available filter media prepared from wood charcoal, banana residues ash, agro-silica, anthracite, manganese modified sand, Al(OH)3 coated Rice Husk Ash(RHA) , activated carbon, fine sand, coarse sand etc on gravel bed.

Disinfection: The final filtrate from the filtration unit, though of great clarity is not always free from harmful micro-organisms. Disinfection of water (by chlorination, ozonation or UV treatment) is the most important step in obtaining hygienically safe water. The process of disinfection refers to reduction of microbial population to a safe level, which is harmless to human beings. In Mini Pond Water Treatment Plant, emphasis is made on the research works of enunciating the cost-effective disinfection techniques.

Storage and Consumption: The disinfected fresh water is ultimately stored in the storage tank from where, it is proposed to be facilitated to the consumers to meet their various requirements.

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