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Rehashing of Domestic Wastewater: Installation & Treatment

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Abstract

This project is on "Rehashing of domestic Wastewater in The Campus of Raja Balwant Singh Engineering Technical Campus, Bichpuri (AGRA)"aim to treat the domestic wastewater and it is useful for domestic as well as irrigation purpose and most important thing that after a little applying RO system, the treated water may be useful for drinking purpose. An estimated 35 liters per second for 8 hours/day sewage is generated in the campus of college from various sources in the campus such as from college cafeteria, mess kitchens, bathrooms, effluent water from septic-tanks of hostels and water from water booths of college. The domestic wastewater contains very much impure substance as well as biological, physical and chemical which affect the water properties not suitable for and also not useful for environment. So to remove or to treat we have to treat so much tests of domestic wastewater of college campus so that it may be capable for laundry purpose, irrigation purpose as well as for drinking purpose.

The DIFFERENT TESTS AS:- pH value, hardness, turbidity, chloride, salt and total dissolved solids and dissolved solids, Biological Oxygen Demand, etc. in the wastewater which are mostly present in water by taking different samples of different places of college campus.

Keywords: *Domestic wastewater, Installation, Treatment, Recycle, Reuse, Waste Water, Sewage, Biological Oxygen Demand.*

INTRODUCTION

There are vital issues of water, food and energy securities for India and the world. Most of water resources have shortage of water due to which Industrialization and urbanization get affected. Demand of fresh water for present and future could be met by increase efficiency of water resources and water demand management. Thus waste water or low quality water can be support for management of water demand after some essential treatments [1–5].

India like developing country contains total account for 4% of water resources and 2.40% of land area of the world but it represents 17.1% of the total world population. As per survey of an organization(CWC, NEW DELHI2011) on water availability and consumption, presently the total utilizable water resource in the country has been estimated to be about 1125 BCM (Billion Cubic Meters) in which (690 BCM from surface and 435 BCM from ground), which is just 28% of the water derived from precipitation.

About 85% (688 BCM) of water usage is being diverted for irrigation (Figure 1), which may increase to 1072 BCM by 2050 [6–10]. Major source for irrigation is groundwater. Annual groundwater recharge is about 433 BCM of which 212.5 BCM used for irrigation and 18.1 BCM for domestic and industrial use (CGWB, 2011). By 2025, demand for domestic and industrial water usage may increase to 29.2 BCM.

Thus water availability for irrigation is expected to reduce to 162.3 BCM. With the present population growth-rate (1.9% per year), the population is expected to cross the 1.5 billion mark by 2050. Due to increasing population and all round development in the country, the per capita average annual freshwater availability has been reducing since 1951 from 5177 m3 to 1869 m3,in 2001 and 1588 m3 , in 2010.

It is expected to further reduce to 1341 m3 in 2025 and 1140 m3 in 2050. Hence, there is an urgent need for efficient water resource management through enhanced water use efficiency and waste water recycling.

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recycling.

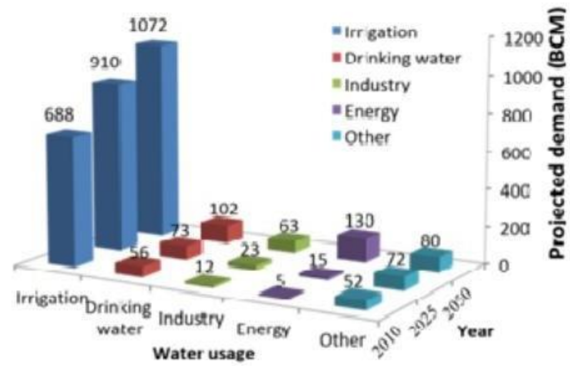

Figure :1 Projected water demand by different

Sectors (Central Water Commission, 2010)

Figure: 1 Projected water demand by different sectors

Thus on the basis of above survey we made a proposal to treat the sewage water which not includes the water with human and animal dung (excreta).

Project name: Rehashing of domestic¬ wastewater in the campus of Raja Balwant Singh engineering technical campus bichpuriagra

Estimated cost of installation of plant¬ for treatment of domestic wastewater is about INR. 70,00,000.00

Project is based on the wastewater¬ treatment.

Consideration of water: Water¬ included from water drinking point (RO points of college as well as from the residential units of college campus), water from washrooms/bathrooms of all residential units, college campus and water from Kitchens of Mess and cafeteria.

We had not considered water from¬ toilets and water having the human excreata.

The complete project is divided into¬ four parts

Preliminary treatment¬
Primary treatment¬
Secondary treatment¬

Tertiary treatment (if required)

OBJECTIVE OF STUDY

The main objective of quality check of domestic waste water and treated water is:

1) On study of quality we have an idea about different type of pollutants.

2) It helps to install the wastewater treatment as well as recovery plant for industry as well as for domestic purpose for whatever in that local side.

3) It helps to control over the wastage of water and helps to maintaining the existing ground water resource which is our primary aim.

4) Current and future fresh water demand could be met by enhancing water use efficiency and demand management. Thus, wastewater/low quality water is emerging as potential source for demand management after essential treatment.

NEED OF STUDY

An NGO with which Hollywood actor Matt Damon is closely attached, surveyed over the water crisis and the human health, gives some terrifying water facts (globally):

- 3.575 million people die each year¬ from water-related diseases

- 43% of water-related deaths are due to¬ diarrhoea.

- 84% of water-related deaths are in¬ children ages 0 - 14.

- 98% of water-related deaths occur in¬ the developing world.

- 884 million people, lack access to safe¬ water supplies, approximately one in eight people.

- The water and sanitation crisis claims¬ more lives through disease than any war claims through guns.

- At any given time, half of the world's¬ hospital beds are occupied by patients suffering from a water-related disease.

- Less than 1% of the world's fresh¬ water (or about 0.007% of all water on earth) is readily accessible for direct human use.

Recycling and reuse of waste Water in the campus of Raja balwantsingh engineering technical campus bichpuri, agra

As we know that the level of ground¬ water table is decreasing day by day in the ‘Agra’ region and water pollution is also increasing day by day i.e. it’s a big issue for health concern and public hygiene.

The project is totally based on the¬ recycling of wastewater which will be reusable in the campus.

There is a great reusability of water in the¬ RBS Engineering Technical Campus, Bichpuri, Agra like gardening, water sprinkling over playground and other plantation use.

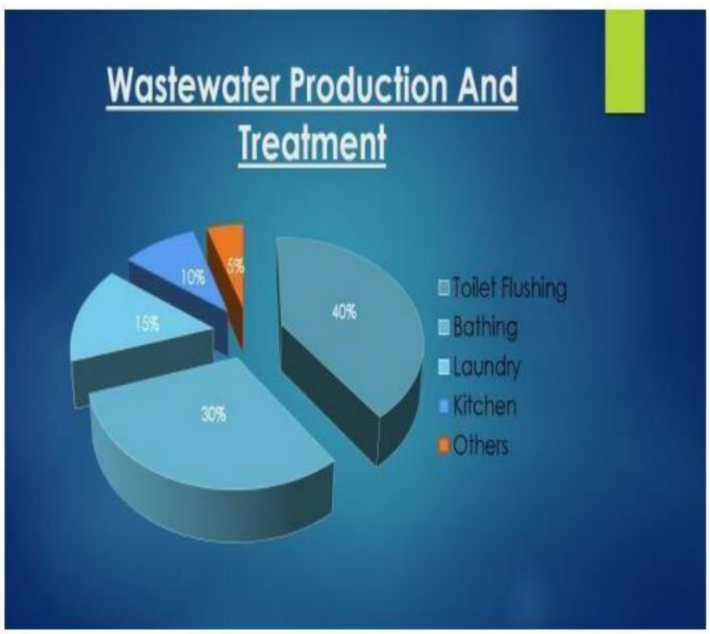

Fig.2: Wastewater Production and Treatment.

PHYSICS AND CHEMISTRY

Water is the chemical substance with chemical formula H2O one molecule of water has two hydrogen atoms covalently bonded a single oxygen atom. Water is a tasteless, odorless liquid at ambient temperature and pressure, and appears colour-less in small quantities, although it has its own intrinsic very light blue hue. Ice also appears colour-less, and water vapour is essentially invisible as a gas.

Water can be described as a polar liquid that slightly dissociates into the hydronium ion (H3O + (aq)) and an associated hydroxide ion (OH− (aq)). **H2O (l) H3O + (aq) + OH− (aq)** The dissociation constant for this dissociation is commonly symbolized as Kw and has a value of about 10−14 at 25 °C. Percentage of elements in water by mass: 11.1% hydrogen, 88.9% oxygen. WATER QUALITY Water quality refers to the chemical, physical and biological characteristics of water.

It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water [11–15].

HUMAN CONSUMPTION

Contaminants that may be in untreated water include microorganisms such as viruses, protozoa and bacteria; inorganic contaminants such as salts and metals;organicchemical contaminants from industrial processes and petroleum use; pesticides and herbicides; and radioactive contaminants. Water quality depends on the local geology and ecosystem, as well as human uses such as sewage dispersion, industrial pollution and use of water bodies as a heat sink, and overuse (which may lower the level of the water) [16– 20].

INDUSTRIAL AND DOMESTIC USE

Dissolved minerals may affect suitability of water for a range of industrial and domestic purposes. The most familiar of these is probably the presence of ions of calcium and magnesium which interfere with the cleaning action of soap, and can form hardsulphateand soft carbonate deposits in water heaters or boilers. Hard water may be softened to remove these ions. The softening process often substitutes sodium cat-ions. Hard water may be preferable to soft water for human consumption, since health problems have been associated with excess sodium and with calcium and magnesium deficiencies. Softening decreases nutrition and may increase cleaning effectiveness.

Qualitative and quantitative measurements are needed from time to time to constantly monitor the quality of water from the various sources of supply. The harbormaster should then ensure appropriate water treatment within the fishery harbor complex as well as initiate remedial measures with the suppliers when water supply from outside is polluted.

WATER SAMPLING

Water sampling and analysis should be done by ISO-certified laboratories. Wherever laboratories available locally are not ISO-certified, it is advisable to get their quality assessed by an ISO certified laboratory by carrying out collaborative tests to ensure that variation in the accuracy of results is sufficiently small. Unreliable results exacerbate problems of pollution when corrective action cannot be taken in time. Sampling and monitoring tests should be carried out by qualified technicians [21–25].

Water Sample Collection The monthly grab samples were collected in polyethylene container at the points were stream flow measurement was taken. The water sample for analysis was collected at each sampling station and subsequently stream flow was measured [26–30]. The samples for residual chlorine present in the treated water analysis were collected in the same site by filtering 100 ml of water in filtering with watsman paper number 42. In the case of tributaries the flow measurement and water quality samples were taken immediately the tributary confluence in to reservoir at monthly basis. The water samples were stored in 20o C-28o C [31–35].

PROCEDURE OF TREATMENT OFDOMESTIC WASTEWATER

Screening is the first line of treatment at the entrance to the wastewater treatment plant. Here two coarse screens and two fine screens intercept solid debris (plastic, paper, leaves, wood etc.) from the waste stream. The two revolving drum shaped, forty millimeter screens for coarse screening and two four millimeter screens for fine screens are constructed of stainless steel and replaced the old-technology, 19 millimeter screens.

The screenings are extracted by screw conveyors, washed and dewatered and transported to a large waste skip which is trucked daily to an offsite landfill. It is the first operation in wastewater treatment to remove most of the bigger and longer visible objects such as trees, branches, sticks, rags, boards, animals etc. present in raw water of surface water sources as the screens protect pumps and other mechanical equipment and to prevent closing of valves and other appurtenances.

In this plant the chamber of coarser screening and the chamber of fine screening is merged in a single chamber of dimension 5 m ×3.5 m× 1.90 m. it reduces the extra cost of separated screening chambers. The main objective of the merged screen chambers to reduce the extra expenditure and arrangement in the plant and also reduces the land acquisition for the plant. The spacing between the coarse screen and the fines screens is designed 2 meters which reduces the choking of water flow in the tank [36– 40].

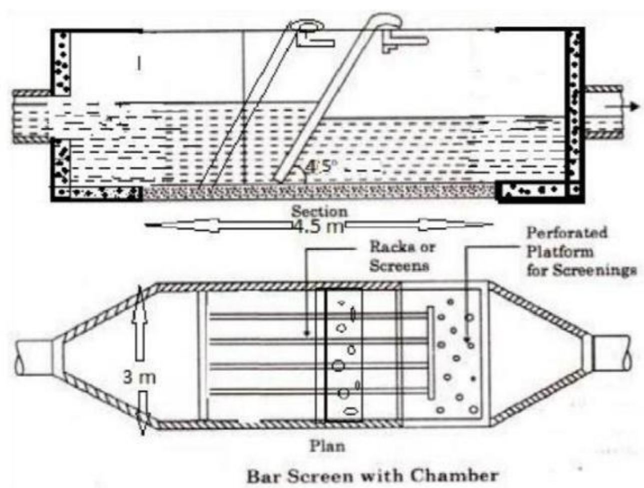

Fig. 3: Screening Devices Used in Wastewater Treatment

CHARACTERISTICS OF SCREENINGS

Screenings are the material retained on bar racks and screens. The smaller the screen opening, the greater the quantity of collected screenings will be [41, 42].

Although no precise definition of screen able material exists and no recognized method of measuring quantities of screenings is available. Screenings exhibit some common properties.

SCREENINGS RETAINED ON BAR RACKS

Coarse screenings (collected on racks or bars of about 5/8 inches or greater spacing) consist of debris such as rocks, branches, pieces of timber, leaves, paper, tree roots, plastics and rags and organic matter. The rag content can be substantial and has been visually estimated to comprise from 60 to 70% of the total screenings, volume of I and 4 inches (25 and 100 mm) screen respectively.

SCREENINGS RETAINED ON SCREENS

Fine screenings consist of materials that are retained on screens with openings less than 16mm. Screens with 2.5 mm to 06 mm openings remove 5 to 10% of effluent suspended solids. Screenings from fine screens have been reported to have volatile solids content varying from 65 to 95%. In comparison to coarse screenings, their bulk densities are slightly lower and moisture content is slightly higher. Fine screenings contain substantial grease and scum which requires similar care.

OIL AND GREASE REMOVAL (SKIMMING TANK)

The dimension of skimming tank is designed on the basis of per day peak flow of water i.e. 1036.8 m3 /day but the capacity of the tank is 5\m×3m×1.9 m (28.5 m3) for detention period 10 min. The water coming from kitchens, bathrooms and laundry is normally high in oil, grease and detergent, contents. Such contaminants in the wastewater diminish the treatment system's efficiency. It is necessary to remove these contaminants before proceeding with further steps.

To solve this problem interceptor boxes (grease traps), are placed after the facility, before the grey water joins the wastewater networks. In centralized wastewater treatment systems, the grease trap is placed before the settling tank, before the treatment process. In these grease traps the solids form settled layers and most of oil and grease float. The low temperature of the content in the interceptor tank helps to solidify the grease that can later be removed. To make sure that the grease floats in the interceptor tank, the water coming through should have a retention time normally greater than 30 minutes of peak flow, and the tank should have a volume equivalent to 1 to 3 times the average daily flow.

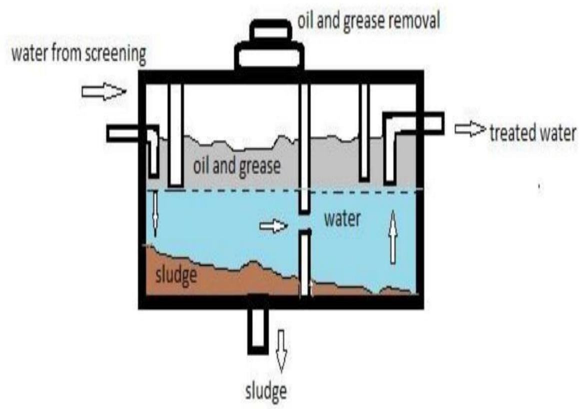

Fig. 4: Skimming Tank.

GRIT REMOVAL

Grit removal is done in grit chambers, channels/basins. Inorganic solids such as pebbles, sand, silt eggshells, glass and metal fragments, heavier organics such as bone chips, seeds etc. when collected together, constitute grit, are removed from wastewater to prevent damage to pumps and to prevent their accumulation in sludge digester.

Grit chambers are in fact sedimentation tanks designed to separate heavier inorganics by sedimentation due to gravitational forces and to pass forward the lighter organic material. It is placed after the screening chamber.

The dimension of grit chamber is designed the per day peak flow of water i.e. 1036.8 m 3 /day but the capacity of the tank is 18m×1.15 m×2.1 m (43.5 m3) for detention period 60 sec. the velocity of horizontal flow is maintain in such a way that the settling velocity in the chamber should lie between 0.016 m/sec to 0.22 m/sec i.e. maintained up to 0.3 m/sec by a centrifugal pump place before the grit chamber. Most of the substances in grit are abrasive in nature and will cause accelerated wear on pumps and sludge handling equipment.

Grit deposits in areas of low hydraulic shear in pipes, sumps and clarifiers may absorb grease and solidify. These materials are not biodegradable and occupy valuable space in sludge digester so they should be separated from organic suspended solids. Because, infiltration is a major source of inorganics,

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the quantity of grit varies with the type, age and condition of pipe in the collection system. Grit removal facilities basically consist of an enlarged channel area where reduced flow velocities allow grit to settle out. Two configurations of grit chambers are available –

a) Channel type

b) Aerated rectangular basin.

And we adapted the channeltype grit chamber which helps in the proper gravitation of sludge or proper settling of the suspended particles.

As shown in figure below:

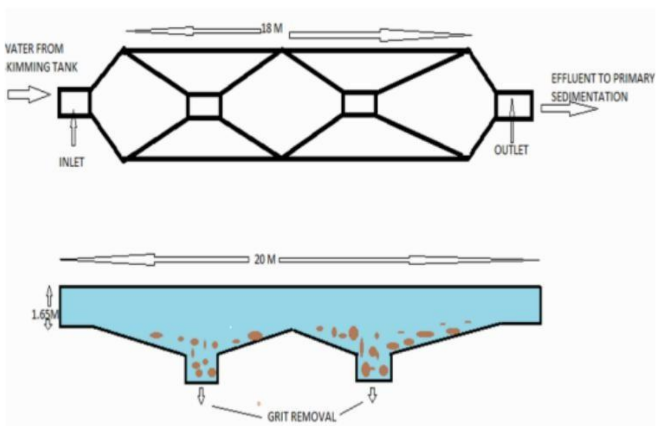

Fig. 5: Designed Grit Chamber for the plant.

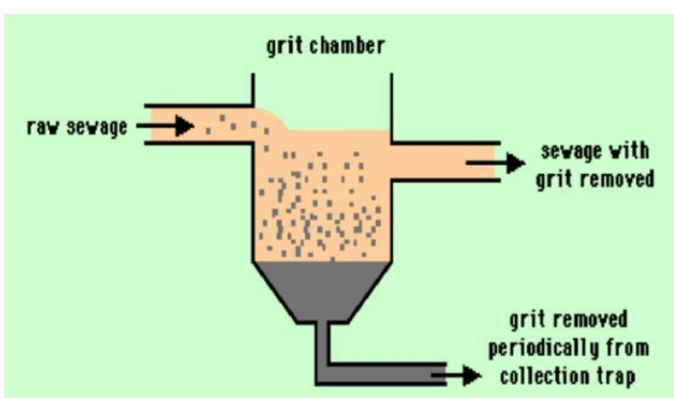

Fig.6: Grit Chamber in Single Cross Section.

PRIMARY SEDIMENTATION WITH COAGULATION

Primary Sedimentation in wastewater treatment plants are used to remove settable solids from waste water. Coagulation is the process of mixing of chemical to make the flocs of very small size inorganic particles. We designed the rectangular primary sedimentation tank with coagulation chamber which has the function of gravity settling.

There, the mechanical scrapper device is not used to scrap the sludge from the bed of the tank. The bed of the sedimentation tank has slope of 1 in 50 which results the automatic collection and removal of sludge from the tank.

It is considered the coagulation process is done in the parallel to the sedimentation process. At the inlet point of the sedimentation tank we made an arrangement of the coagulation chamber with fan mixer. As in figure 6. The total length of chamber is 14 m designed for the flow rate of 35 l/sec. and at the outlet point of the sedimentation tank a chamber for tube settler is made to influence the rate of settling.

The total detention period of the primary sedimentation tank with the coagulation chamber is about 4 hours.

The Primary sedimentation tank with coagulation and flocculation is designed on the principle based on the consideration of Rich (1963) and Camp (1946). They considered individual particle dynamics and stated that settable solids attain a terminal viscosity. According to Camp (1946) and Rich (1963), if all solids in wastewater are discrete particles of uniform size, shape and density and settle independently, i.e. no effect on the settling velocity of an any other particles, then the efficiency of sedimentation is only a function of terminal settling velocity.

In the case of thickening, the particles concentration increases, causing a decrease in clarification rate. Waste water solids are flocculent, rather than discrete. Flocculation in sedimentation basin is due to the differences in settling velocities of particles and the velocity gradient in the liquid caused by the eddies, resulting from turbulence.

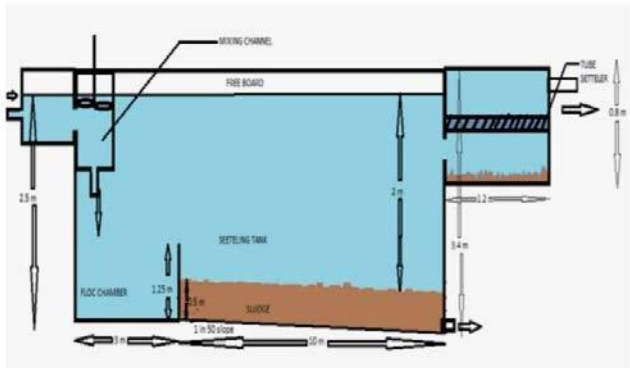

Fig. 7: Sedimentation with Coagulation.

COAGULATION

Very fine particles, present in waste waters, which cannot be removed in plain sedimentation, may sometimes be settled by increasing their size be changing them from flocculated particles for this purpose, certain chemical compounds (like ferric chloride, ferric sulphate, alum, chlorinated copperas, etc.) Called coagulants, are added to the wastewaters, which on thorough mixing, from a gelatinous precipitated, called floc. The fine mud particles and other colloidal matter present in wastewater get absorbed in these flocs, forming the bigger sized flocculated particles.

The process of additional and mixing of chemicals is called coagulation. The coagulated sewage is then made to pass through sedimentation tank, where the flocculated particles settle down, and get removed.

DETERMINATION OF COAGULATION

Dose (Jar Test)

The dose of chemical required for coagulation depends on the quality of water. The optimum dosage of coagulant is determined in practice by trial. Commonly the jar tests method is employed for that purpose. The amount of coagulant is increased stepwise, and all jar are mixed simultaneously for 10 to 30 minutes. The jar in which floc first makes it appearance is assumed to have received the most economical dose. It may be observed that the dose of chemical differs from time-to – time for the sole source of water.

Coagulant (Sodium Alluminate) Dose
Coagulant used in the water treatment system:

Sodium Aluminate ($Na_2Al_2O_4$)

Sodium aluminate $Na_2Al_2O_4$ is alkaline in reaction and is used very much less often than alum because of its high cost. It reacts with the salts of calcium and magnesium, as under:

Chemical Reaction

$Na_2Al_2O_4 + Ca(HCO_3)_2 = CaAl_2O_4 + Na_2CO_3 + CO_2 + H_2O$ .... (1)
$Na_2Al_2O_4 + CaCl_2 = CaAl_2O_4 + 2NaCl$ ………………..(2)
$Na_2Al_2O_4 + CaSO_4 = CaAl_2O_4 + Na_2SO_4$ ....(3)

The coagulant removes both temporary and permanent hardness, and is effective for a pH range of 6 to 8.50 naturally available in water.

Method of Dosing the Coagulant:

Generally there is 2 methods are used for coagulant feeding in the water treatment plant:

1. Dry feeding and
2. Wet feeding We used the method of dry feeding of coagulant (sodium aluminate).

Daily Consumption of Coagulant:

The amount of water to be treated per day = 35 lit/sec.= 3.024 MLD

As per the test in lab we found the desired dose of sodium aluminate per 100 ml of water sample is 0.8 mg/100 lit.

So quantity of sodium aluminate required per day = (8 × 3.024 × 106) / 106 = 24.192 kg.

Daily consumption of sodium aluminate in the plant = 24.192 kg

DRY FEEDING OF COAGULANT

The two common devices are used for dry feeding. In each case the coagulant, in a powder form, is kept in the tank with hopper bottom. In order to prevent the arching of the chemical, agitating plates are placed inside the tank. In next figure the feeding is regulated by the speed by the toothed wheel which is connected to the venture device in the raw water pipe. The feeding is regulated by the helical screw. The drive unit of the helical screw is governed by the venture device in the raw water pipe.

FLASH MIXTURE FOR COAGULATIONMIXING BASIN WITH MECHANICAL DEVICE

Most of the modern water treatment plants now have mixing basin with mechanical devices as 'flash mixture' in which the raw water and the coagulant are agitated vigorously by a paddle operated by a variable speed motor. The intensity of mixing is dependent upon the temporal mean velocity gradient (G) defined mathematically as

G = (P/υV)1/2

Where,

P= power,

V= Channel volume and

υ= Absolute viscosity.

The turbulence and resultant intensity of mixing is based on the rate of power input to the water. Propeller type impeller, commonly employed in flash mixers, have high revolving speeds ranging from 400 to 1400 rpm. A detention time of 30 to 60 sec. is provided in the flash mixer unit which are deep ,circular or square tanks , with the ratio of height to diameter (or side) of 1:1 to 3:1. The value of G is kept 300s [1] or more. Power requirement s is from 1 to 3 watts per m^3/hr. of flow. The usual ratio of impeller diameter to tank diameter is 0.2 to 0.4. The shaft speed of propeller is so kept that a tangential velocity of greater than 3 m/s is imported at the tip of the blades.

Fig. 8: Coagulant Mixing Device.

TUBE SETTLER

Fig. 9: Tube Settler.

Tube settlers parallel plates increases the settling capacity of circular clarifiers and or rectangular sedimentation basins by reducing the vertical distances a floc particles must settle before agglomerating to form larger particles. Tube settlers use multiple tubular channels sloped at an angle of 60 degree and adjacent to each other, which combine to form an increased effective settling area.

This provides for a particles settling depth that is significantly less than the settling depth of a conventional clarifier, reducing settling times. Tube settlers capture the settable fine floc that escapes the clarification zones beneath the tube settlers and allows the larger floc to travel to the tank bottom in a more settle able form.

The tube settler's channel collects solids into a compact mass which promotes the solids to slide down the tube channel. Tube settler offers an inexpensive method of upgrading existing water treatment plant clarifier and sedimentation basins to improve performance. They can also reduce the tankage/footprint required in new installations or improves the performance of existing settling basins by reducing the solids loading on downstream filters.

Made of light weighted PVC, tube settler can beeasily supported with minimum structure that often incorporates the effluent trough supports. They are available in a variety of module sizes and tube lengths to fit any tank geometry, with custom design and engineering offered by the manufacturer.

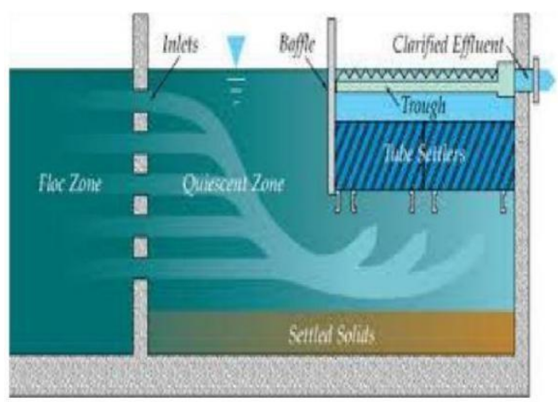

Fig. 10: Tube Setteler.

The advantages of tube settlers can be applied to new or existing clarifier/ basins of any size:

- Clarifier / basins equipped with tube¬ settlers can be operate at 2 to 4 times the normal rate of clarifiers/basins without tube settlers.

- It is possible to cut coagulant dosages¬ by up to half while maintaining a lower influent turbidity to the treatment plant.

- Less filter backwashing equates to¬ significant operating cost saving for both water and electricity.

- New installation using tube settlers can¬ be designed smaller because of increased flow capability.

- Flow of existing water treatment plants¬ can be increased through the addition of tube settlers.

- Tube settlers increase allowable flow¬ capacity by expanding settling capacity and increasing the solids removal rate in settling tanks.

NEUTRALISATION

After being treated from the primary sedimentation tank the water got changed the properties in basic nature and to neutralize the basic nature of water after the primary sedimentation with coagulation.

After the primary sedimentation of water, the property of water will be disturbed to acidic or basic nature. To neutralize that disturbed property of water there is a requirement of neutralizing agent. On the basis of nature and coagulant property in the water we need acid or base for making water neutral.

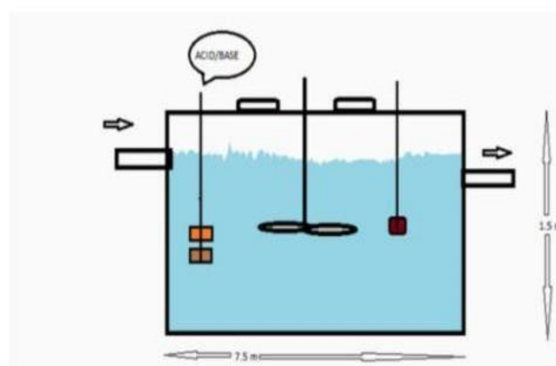

Fig. 11:NeutralizationTank.

SECONDARY SEDIMENTATION

Excellent removal of organic matter from domestic waste water by activated sludge process is possible only by proper design and operation of secondary activated sludge process in possible only by the proper design and operation of secondary clarifiers. It has three distinct purposes:

a) Thickening of biological solids for recycle

b) Clarification of effluent and

c) Storages of biological mass in the settler.

Coe and Cleverer (1916) were the first to provide a comprehensive description of thickening and design of secondary sedimentation. The steady state model was developed to predict solids handling capacity based on batch settling tests. Dike Coe and Clevenger (1916), Kynch (1952) considered the upward propagation of zones of higher concentration with lower solids handling capacity, and presented a theoretical and more complicated interpretation of the batch settling process. In this project we have designed the circular secondary sedimentation tank in which the influent coming from the neutralization tank.

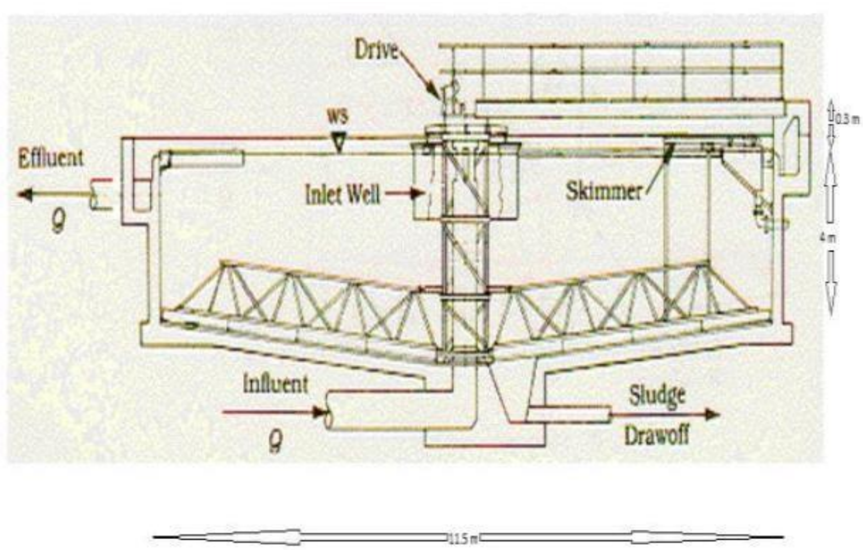

Fig.12: Secondary Sedimentation.

DISINFECTION (CHLORINATION)

The principal chemical processes used for wastewater treatment are chemical precipitation, usually performed in conjunction with sedimentation, chlorination used for disinfecting effluent prior to discharge. Chemical precipitation is used for phosphorus removal and to increase the removal of suspended solids.

Sodium aluminate is the salt used to precipitate phosphorus and is used as coagulants to improve suspended solids removal. The salts react with alkalinity in the wastewater to produce metal hydroxide flocs which assist in suspended solids removal. Due to production of metal hydroxide fiocs, the chemical quantities required to precipitate phosphorous often exceed stoichiometric requirements by a factor of two or three.

Bench scale testing is required to predict the of reduced water flow on chemical treatment performance (Davis 1980). Disinfection of treated wastewater is accomplished by addition of chlorine. Reduction of wastewater flows should proportionately decrease chlorine usage.During disinfection the main aim is restricted to kill the unicellular organisms, mainly bacteria. A number of theories exist for explaining the disinfection action of chlorine on the pathogenic organisms. Nascent oxygen theory explains that chlorine in water gives out nascent oxygen which oxidizes the unicellular organism and kills them. Enzymatic hypothesis given and stump is more widely accepted.

It states chlorine first penetrates through the cell wall of organisms and then react inside with the enzymes which are essential for bacterial life. As enzymes become ineffective the bacteria get destroyed.Factor which will affect the efficiency of chlorination are:

- The nature of the organism destroyed.¬ Shore forming organism are not easily destroyed by chlorination.

- The temperature of water. The higher¬ the temperature, the more rapid and efficiency is the disinfecting action.

- The control time. Longer the time,¬ higher the percentage destruction.

- pH value of water. At pH of 5 the¬ chlorination is most efficient. The designed dimension of the chlorination tank is as per the water tank standards: 5 m x2.5 m x 1.9 **See Figure 13.**

CHLORINE DEMAND OR DOSE

Chlorine Dosing

After the secondary sedimentation treatment of water the chlorine is used as the disinfectant for the removal of microbes and bacteria from the water.

Daily Consumption of Chlorine Demand

Quantity of water to be disinfected per day = 3.024 MLD

We found the requirement of chlorine @ 0.5 ppm = (0.5×3.024×106)/106 = 1.512 kg

Daily bleaching powder consumption

Since we are using bleaching powder for chlorine dosing and bleaching powder consists about 33% as free chlorine in it.

So the daily consumption of bleaching powder = 1.512×100/30 = 5.04 kg.

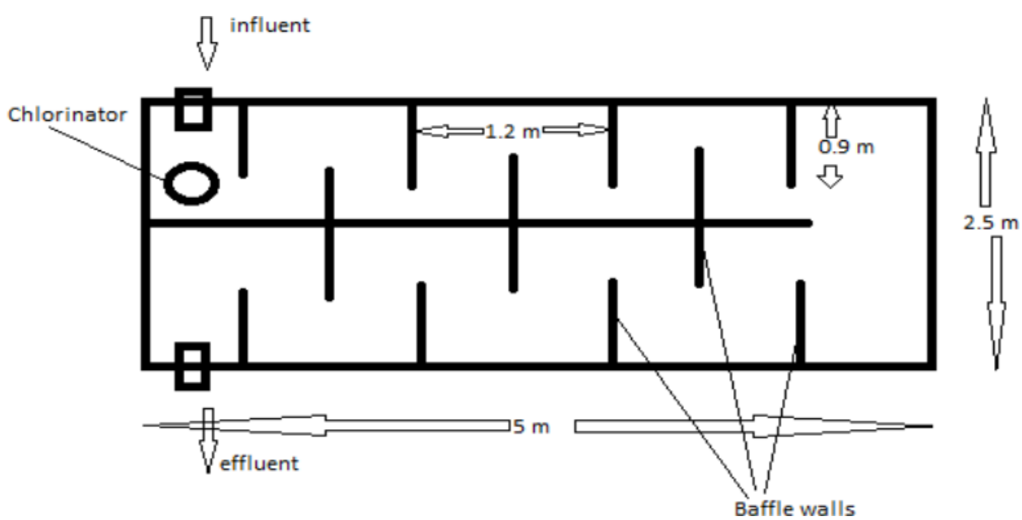

Fig. 13: Chlorination Tank.

FILTRATION BY GRAVITY RAPID SAND FILTER (RSF)

Rapid sand filtration is used here to absorb the turbidity still present in the water and also to remove the suspended colloidal particles from the water after the secondary sedimentation tank. In this project of water treatment plant we put the gravity sand filter because the water in the secondary treatment process almost reaches the standards for irrigation purpose but still some organic and inorganic suspended particles are present into the water so this unit is installed and the main aim of including this unit is to make the water nearly to the standard of drinking water.

Rapid Sand Filtration, in contrast to slow sand filtration, is purely physical treatment process. As the water flows through several layers of coarse grained sand and gravel, relatively large particles are held back safely. However, RFSs never provide safe drinking water without adequate pretreatment and final disinfection. Usually, coagulation and flocculation and chlorination are applied for that purpose.

TREATMENT PROCESS AND BASIC DESIGN PRINCIPLES

The major parts of a Gravity rapid sand filter are:

- Chamber: filter tank or filter box
- Filter media (sand)
- Gravel support
- Under drain system
- Wash water troughs

We designed the dimension of the rapid sand filter as per the design criterion of the sand filter as following:

Required number of each unit of RSF is 3.

Dimension of each filter bed = 5 m × 4 m × 3.80 m

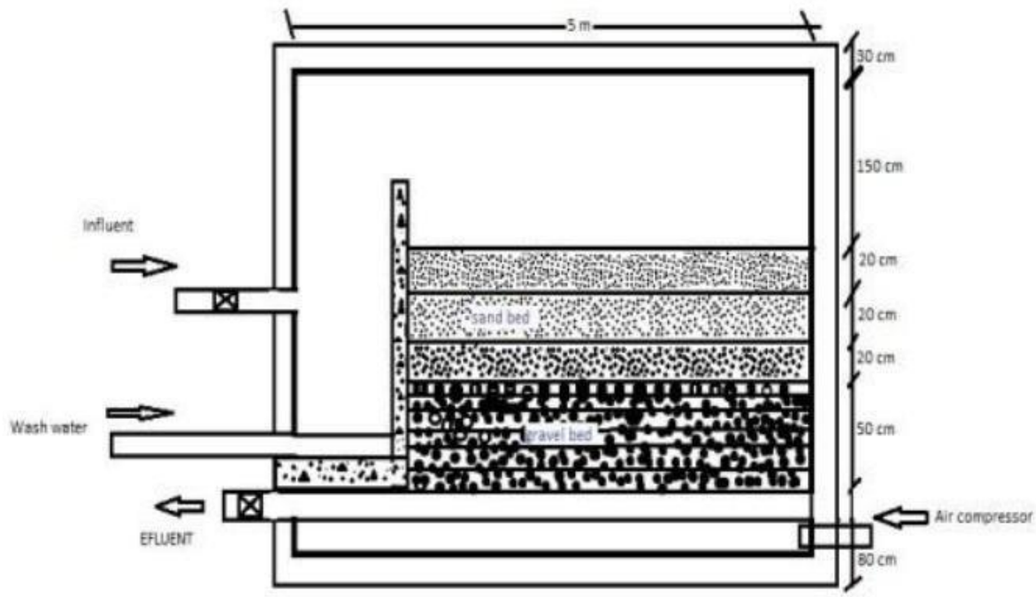

Fig. 14: Section-Rapid Sand Filter.

CASCADE AERATOR

Cascade aerator is an arrangement in the treatment process of waste water which removes the carboneus material from the treated water coming from the rapid sand filter. In this the water is kept in the contact of air with a pressure of 150 l/sec. by which the oxygen present in the air oxidises the impurities present in the water.

Thus water become odourless and colour is non objectionable.

The main aim of the cascade aerator is to remove the oxidisable impurities from the water which still remain in the treated water after the chlorination and sand filtration. It is also responsible to remove the foul odour of the water. The water pressure of the cascade aerator is maintained by a centrifugal pump of power 3 horse–power.

This water enters in the cascade aerator from its bottom to vertically upward and get contact to the air. The cascade aerator is as shown in the following figure.

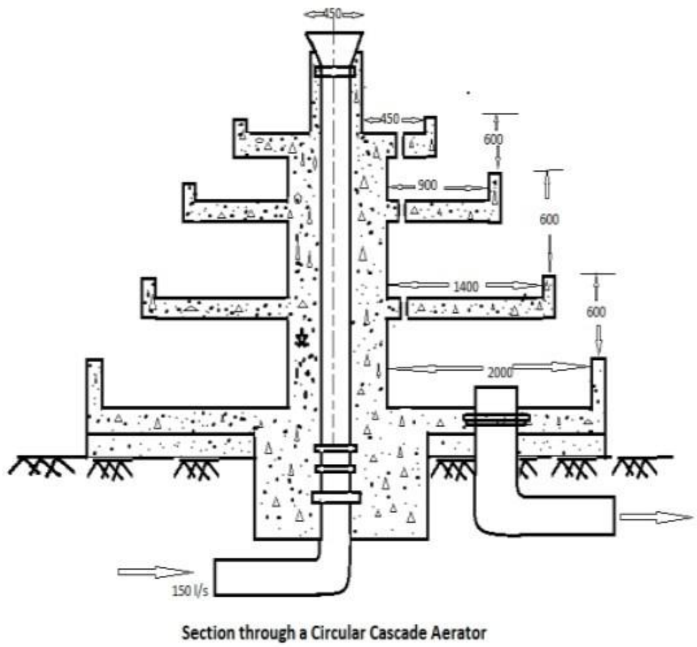

Fig. 15: Section Cascade Aerator.

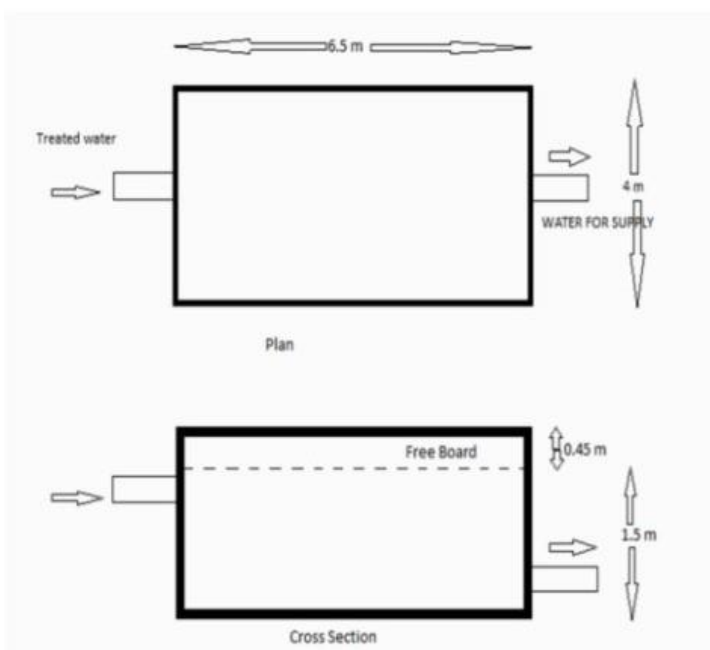

Fig. 16: Supply Tank.

SUPPLY TANK

After the water passing through the cascade aerator the treatment process completed and whole treated water is collected in the supply tank for the further distribution to the different living purposes. The dimension of supply tank is similar to the receiving chamber.

TESTS AND PARAMETERS OF WATER:

S NO.	PARAMETERS	SAMPLE WASTE WATER QUALITY	TREATED WATER QUALITY OBTAINED	STANDARD IRRIGATION WATER QLTY
1	COLOUR	GREYISH	ALMOST COLOURLESS	COLOURLESS
2	ODOUR	UNPLEASANT	ODOURLESS	ODOURLESS
3	TEMPERATURE	30^0-32^0C	20^0-27^0C	
4	TURBIDITY	30.75 NTU	4.6 NTU	-
5	SUSPENDED SOLIDS	400 mg/l	45 mg/l	-
6	ALKANITY	175 mg/l	136 mg/l	-
7	pH	10.75	8.14	5.5-9
8	DISSOLVED OXYGEN	4 mg/l	7.89 mg/l	-
9	OIL & GREASE	50 mg/l	6 mg/l	<10 mg/l
10	TOTAL HARDNESS	100 mg/l	20 mg/l	-
11	CHLORIDE TEST	500 mg/l		-

ESTIMATION AND RATE ANALYSIS

For 1m3 concrete Cement required = 8.4 bags. Each bag of cement having 50kg weight. Sand required = 0.42 m3 Ballast required = 0.84 m3

S. NO.	CHAMBER	REQUIRED CONCRETE (m^3)	REQUIRED STEEL	CEMENT (bags)	SAND (m^3)	BALLAST (m^3)
1.	RECEIVEING TANK	21.37	1166.906	179.508	8.9754	17.9508
2.	SCREENING TANK	11.78	527.576	98.952	4.9476	9.8952
3.	SKIMMING TANK	13.915	609.916	116.886	5.8443	11.6886
4.	GRIT CHAMBER	25.47	1076.99	213.948	10.6974	21.39
5.	PRIMARY SEDIMENTATION TANK	27.684	4335.50	232.5456	11.627	23.25456
6.	NEUTRALISATION TANK	21.37	1230.156	179.508	8.9754	17.9508
7.	SECONDARY SEDIMENTATION TANK	59.59	4043.00	500.556	25.0278	50.0556
8.	CHLORINATION TANK	12.29	785.686	103.236	5.1618	10.3236
9.	RAPID SAND FILTER	93.62	6050.00	786.408	39.3204	78.6408
10	CASCADE AERATOR	8.8	303.5	73.92	3.696	7.392
11.	SUPPLY TANK	21.37	1166.906	179.508	8.9754	17.9508

	MATERIAL REQUIREMENT					
SR. NO.	PARTICULARS/ ITEMS	QTY/Nos.	RATE		COST	
			Rs.	Pcs.	Rs.	Pcs.
1	**Materials**					
	Cement	2739 Bags	310/bag	0	8,49,090	0
	coarse sand	137 m3	1580/m^3	0	2,16,460	0
	stone ballast	274 m3	1755/m^3	0	4,80,870	0
	steel, mild steel bars @ 2% @ 7.85 q/m3	160 q(L.S.)	3250/q	0	5,20,000	0
	Binding bars	50 kg	80/kg	0	4,000	0
				Total	**20,70,420**	**0**
2	**Labour**					
	mistri(head meason)	16.3	400/day	0	6,520	0
	meason	98	350/day	0	34,300	0
	majdoor(beldar)	326	250/day	0	81,500	0
	boy / women cully	652	220/day	0	1,43,440	0
	bhisti(including curing)	195	220/day	0	42,900	0
	sundries T.& P.	Lump sum	5000 LS	0	5,000	0
				Total	**3,13,660**	**0**
3	**bending , cranking & binding steel bars in position**					
	black smith(second class)	261	320/day	0	83,520	0
	majdoor	261	250/day	0	65,250	0
	T.%P.	Lump sum	4000	0	4,000	0

			total	**1,52,770 0**
4	**Centering and Shuttring (both erection & dismantling)**			
	Timber planks and ballies	Lump sum	10000 0	10,000 0
	Carpenter (second class)	326	320/day 0	1,04,320 0
	Majdoor	326	250/day 0	81,500 0
	Nails	Lump sum	1500 0	1,500 0
	T.&P.	Lump sum	2500 0	2,500 0
5	Concrete mixer	01 No.	300/m^3 0	97,800 0
	Concrete pump	01 No.	300/m^3 0	97,800 0
	Viberator	01 No.	200/m^3 0	65,200 0
			Total	**4,60,620 0**
6	**Total of materials labour cost**			**29,97,4700**
	Add 2% of water charges			5,99,494 0
	Add 8% of contingencies Charges			2,44,593 5
	Add 10% contractor profit			3,84,155 75
	Grand total cost			**54,93,42775**

RCC WORK (1 : 1.5 : 3) IN COMPLETE WATER TREATMENT PLANT = 326 CUM

11 RATE ANALYSIS

Material used

Material Rs.

Cement	310/bag
Sand (Coarse)	1580/m^3
Ballast (Stone, 20 mm)	1755/m^3
Steel (Mild steel bar)	3250/quintal
Binding wire	80/Kg

Labours

Head mason	400/day
Mason	350/day
Majdoor(Beldar)	250/day
Woman coolie 220/day	
Bhisti (including querying)	220/day
Blacksmith (second class)	320/day
Machinery	
Concrete mixture	300/m^3
Concrete pumping	300/m^3
Vibrator	200/m^3

CONCLUSION

Name of Project:

Rehashing Of Domestic Wastewater

Purpose of Project: to purify the wastewater of R.B.S. Engineering technical campus up to Irrigation water standards

Demand of Chlorine = 1.54kg/day

So Demand of Bleaching Powder = 5.1 kg/day

Demand of Sodium Aluminate = 24.2 kg/day

Total Installation Cost of Plant Is Approximately = RS. 60, 00,000.00

This thesis involves the treatment of domestic waste water taken from the water booths of R.B.S. Engineering Technical Campus Bichpuri Agra and water coming from the toilets of college hostels, mess kitchens, flush water as well as from bathroom water and also the water all type of wastewater effluent of campus is considered. Under this, the reutilization of water will take place for the watering purpose in gardens and in bathrooms for washing and bathing and also reusable in the kitchens for cattle washing.

The results obtained from the different tests made during the project passes the irrigation water standards so the water is definitely reusable for the irrigation purpose and by applying further RO system the water is reusable in the drinking. Much of that water comes from rivers, lakes and other surface water sources. Before it is delivered to our homes it is treated to remove chemicals, particulates (e.g., soot and silt) and bacteria. This clean, potable water is then used for cooking, drinking, cleaning, bathing, watering our lawns and so forth. Thus by the implementation of this project the the ground water table and the surface water may be conserved for long time to future.

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