Waste Water Treatment (Treatment and Re-use of Waste water)

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Abstract - *Waste water, is any water that has been adversely affected in quality by anthropogenic influence. The sewage from colonies as well effluent from industrial units has been identified as main cause for water pollution across our country. Sewage is a water-carried waste, in solution or suspension that is intended to be removed from a community. Also known as wastewater, it is more than 99% water & is characterized by volume or rate of flow, physical condition, chemical constituents and the bacteriological organisms that it contains. During recent years, there has been an increasing awareness and concern about water conservation all over the world. Hence, new approaches towards achieving sustainable development of water resources have been developed internationally. The BOD, COD, TS concentration of Sewage Mahesh Nager Ranges 30-30.0050mg/L from 250-280.15mg/L & 500-250-312mg/L respectively. Under this research paper, a cut to suit treatment technology has been developed to treat sewage. Treatment technologies adopted are activated sludge process, chlorination & filtration. The results were very encouraging. The treatment system achieved Sitapura, Jaipur 93% BOD, 78% COD and 50% TS Total coliform removal respectively. The treated sewage can be reused for various purpose like cooling water make up, gardening , landscape development, toilet flushing, road washing etc. thus leading towards water conservation.*

Key Words: **Activated Sludge Process, BOD, Chlorination, COD, Dual Media Filtration, Reuse, Sewage, TS.**

Introduction

Wastewater treatment is a process used to convert wastewater into an effluent (out flowing of water to a receiving body of water) that can be returned to the water cycle with minimal impact on the environment or directly reused. The latter is called water reclamation because treated wastewater can then be used for other purposes. The treatment process takes place in a wastewater treatment plant often referred to as a Water Resource Recovery Facility or a sewage treatment plant. Pollutants in municipal wastewater (households and small industries) are removed or broken down.

The treatment of wastewater is part of the overarching field of sanitation. Sanitation also includes the management of human waste and solid waste as well as storm water (drainage) management.[1] By-products from wastewater treatment plants, such as screenings, grit and sewage sludge may also be treated in a wastewater treatment plant.

In a developing urban society, the wastewater generation usually averages 30- 70 cubic meters per person per year. In a city of one million people, the wastewater generated would be sufficient to irrigate approximately 1500-3500 hectare. This urban epidemic needs to be tackled ecologically because of so many pressing issues that are afflicting our waste management process:

- New immigrants to cities have low incomes and cannot afford municipal amenities like waste disposal and sanitary functions;
- In developing countries, approximately 300 million urban residents have no access to sanitation.
- Approximately two-thirds of the population in the developing world has no hygienic means of disposing excreta and an even greater number lack adequate means of disposing of total waste water;
- It is often an acceptable practice to discharge untreated sewage directly into the bodies of water.
- According to the World Bank, "The greatest challenge in the water and sanitation sector over the next two decades will be the implementation of low cost sewage treatment that will at the same time permit selective reuse of treated effluents for agricultural and industrial purposes" (Green Arth, 2012). It is crucial that sanitation systems have high levels of hygienic standards to prevent the spread of disease. Other treatment goals include: The recovery of nutrient and water resources for reuse in agricultural production; o Reducing the overall user-demand for water resources. Industrial development has always been afflicted with the issue of residue disposal, and it has become accepted by all bodies of knowledge that industrial effluents are one of the largest sources of water pollution and one with the m ost lethal composition of toxins. The most popular and widespread industrial pollutants include: *Asbestos*: It is carcinogenic and its fibres can be inhaled and cause illnesses such as Asbestosis, mesothelioma, lung cancer, intestinal cancer, and liver cancer.
- *Lead*: It is non-biodegradable and is hard to get rid of once it has permeated our environment. Lead is

harmful as it can inhibit the action of bodily enzymes.

- *Mercury*: It is also non-biodegradable, and mercury poisoning is a serious health hazard for humans and livestock.
- *Nitrates & Phosphates*: It is one of the most common components in fertilizers and is often washed from the soil and into rivers and lakes. This can cause eutrophication, which can be very problematic to marine environments.
- *Sulpher*: It is extremely harmful for algae and other marine life.
- *Oils*: Oil does not dissolve in water; instead it forms a thick layer on the water surface. This can prevent marine plants from receiving enough light for photosynthesis. It is also harmful for fish and marine birds.
- Implemented installations were later abandoned due to the high cost of running the
- *Petrochemicals*: These are formed from gas or petrol and can be toxic to marine life.

The problem with the current treatment technologies is that they are not sustainable. The conventional centralized system flushes pathogenic bacteria out of the residential area, using large amounts of water, and often combines the domestic wastewater with rainwater, causing the flow of large volumes of pathogenic wastewater. In fact, the conventional sanitary system simply transforms a concentrated domestic health problem into a diffuse health problem for the entire settlement and/or region. In turn, the wastewater must be treated where the cost of treatment increases as the flow increases. The abuse of water use for diluting human excreta and transporting them away from settled areas is increasingly questioned and being considered unsustainable.

Primary Treatment

In the primary sedimentation stage, sewage flows through large tanks, commonly called "pre-settling basins", "primary sedimentation tanks" or "primary clarifiers". The tanks are used to settle sludge while grease and oils rise to the surface and are skimmed off. Primary settling tanks are usually equipped with mechanically driven scrapers that continually drive the collected sludge towards a hopper in the base of the tank where it is pumped to sludge treatment facilities. Grease and oil from the floating material can sometimes be recovered for saponification (soap making).


(Primary treatment tanks)

There are four methods of primary treatment: chlorination; ozone treatment; ultraviolet treatment; and membrane filtration.

Chlorination: Fresh or sea water can be chlorinated using either chlorine gas or hypochlorites. Chlorinated water minimizes slime development on working surfaces and helps control odour.
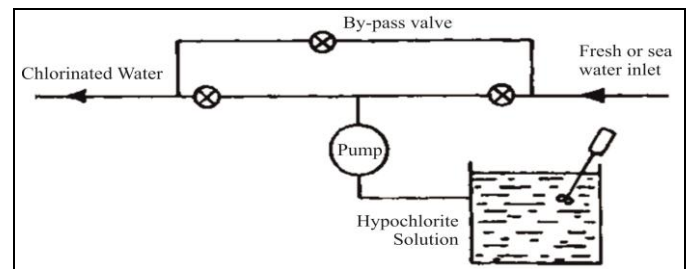
Ozone treatment: Though the principle is relatively simple, this method needs special equipment, supply of pure oxygen and trained operators. Ozone is generated by passing pure oxygen through an ozone generator. It is then bubbled through a gas diffuser at the bottom of an absorption column, in a direction opposite to the flow of raw water. Retention or contact time is critical and the size of the absorption column depends on the water flow.
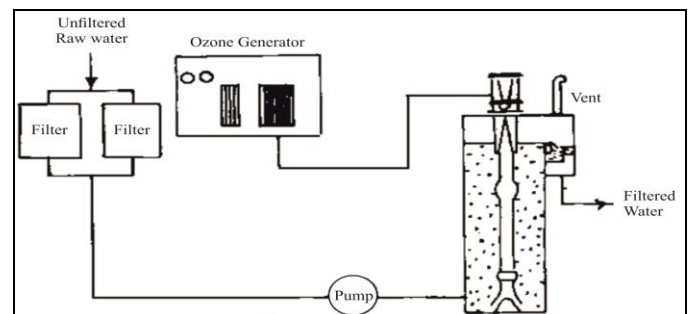
Ultraviolet irradiation treatment: This method is often used to treat drinking water. Successful commercial installations have been made to purify sea water in large fish processing plants.
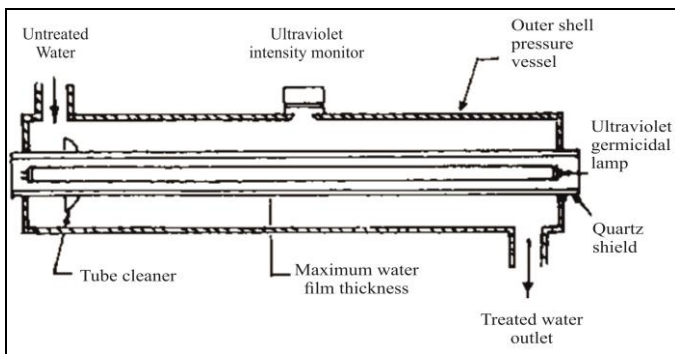
Membrane filtration: Osmotic membrane treatment methods are generally expensive for commercial scale installations. Combinations of membrane treatment with U-V treatment units are available for domestic use.

Secondary Treatment

Secondary treatment is designed to substantially degrade the biological content of the sewage which are derived from human waste, food waste, soaps and detergent. The majority of municipal plants treat the settled sewage liquor using aerobic biological processes. To be effective, the biota require both oxygen and food to live. The bacteria and protozoaconsume biodegradable soluble organic contaminants (e.g. sugars, fats, organic short-chain carbon molecules, etc.) and bind much of the less soluble fractions into floc.

Secondary treatment systems are classified as fixed-film or suspended-growth systems.

- Fixed-film or attached growth systems include trickling filters, constructed wetlands, bio-towers, and rotating biological contactors, where the biomass grows on media and the sewage passes over its surface. The fixed-film principle has further developed into Moving Bed Biofilm Reactors (MBBR) and Integrated Fixed-Film Activated Sludge (IFAS) processes. An MBBR system typically requires a smaller footprint than suspended-growth systems.
- Suspended-growth systems include activated sludge, where the biomass is mixed with the sewage and can be operated in a smaller space than trickling filters that treat the same amount of water. However, fixed-film systems are more able to cope with drastic changes in the amount of biological material and can provide higher removal rates for organic material and suspended solids than suspended growth systems.

(Secondary clarifier at a rural treatment plant)

Some secondary treatment methods include a secondary clarifier to settle out and separate biological floc or filter material grown in the secondary treatment bioreactor.

Secondary treatment of water consists of sedimentation and filtration followed by chlorination. Sedimentation can be carried out by holding the raw water in ponds or tanks. The four basic types of filtration are cartridge filtration, rapid sand filtration, multimedia sand filtration, and up-flow filtration.

Cartridge filtration: This system is designed to handle waters of low turbidity and will remove solids in the 5 to 100 micron range.

Rapid sand filtration: This system consists of a layer of gravel with layers of sand of decreasing coarseness above the gravel. As solids build up on top, flow decreases until it stops. This is corrected by back-flushing the system to remove the solid build up on top.
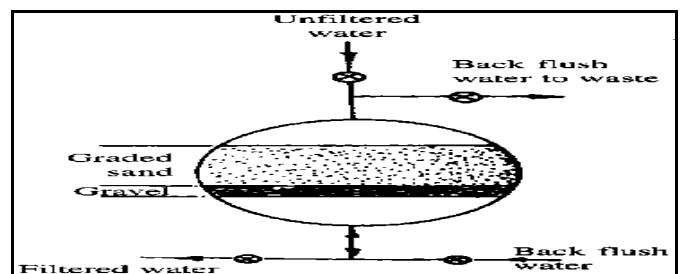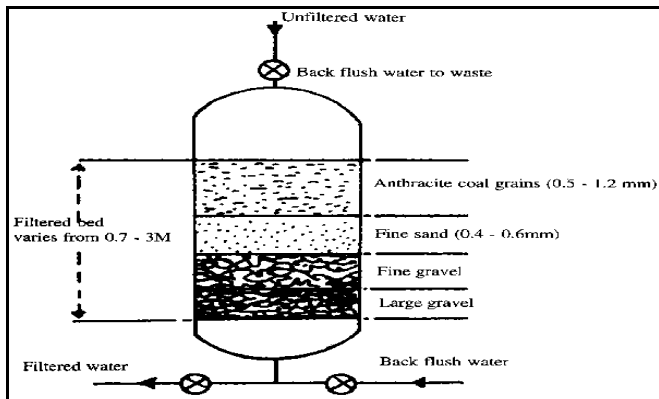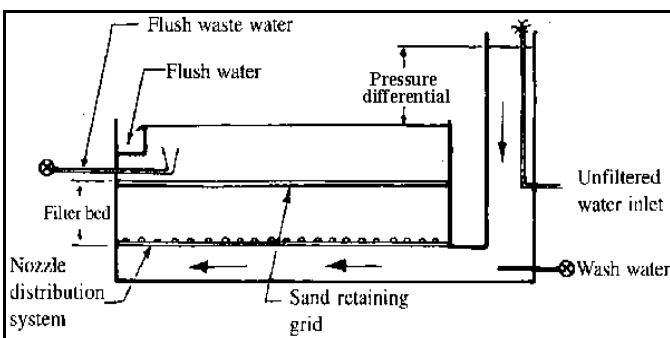

(Rapid Sand Filtration)
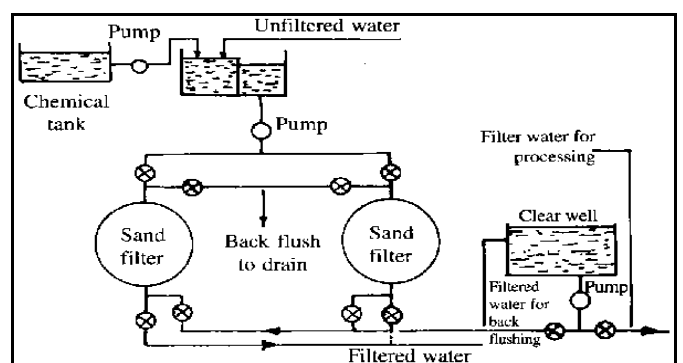
(Conventional Sand Filtration)

Multimedia sand filtration: This system is similar to the rapid sand filtration method.
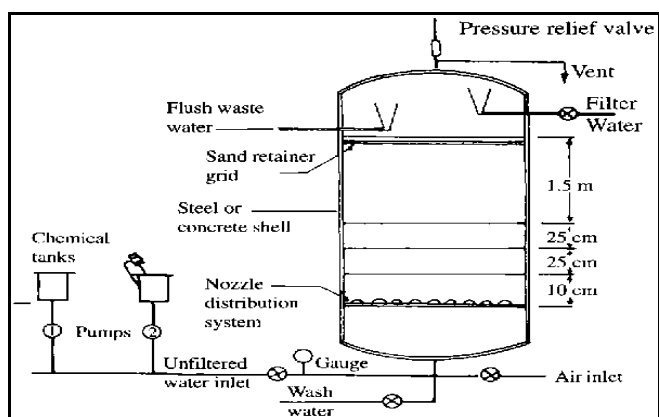

(Multi-Media Sand Filtration)

Up-flow filtration: Filtration can be at atmospheric pressure or by using a pressurised system.

(Atmospheric Pressure Up-Flow Filter)

(Pressure Type Up-Flow Filter)

Phase separation

Phase separation transfers impurities into a non-aqueous phase. Phase separation may occur at intermediate points in a treatment sequence to remove solids generated during oxidation or polishing. Grease and oil may be recovered for fuel or saponification. Solids often require dewatering of sludge in a wastewater treatment plant. Disposal options for dried solids vary with the type and concentration of impurities removed from water.

Production of waste brine, however, may discourage wastewater treatment removing dissolved inorganic solids from water by methods like ion exchange, reverse osmosis, and distillation.

Sedimentation

Solids and non-polar liquids may be removed from wastewater by gravity when density differences are sufficient to overcome dispersion by turbulence. Gravity separation of solids is the primary treatment of sewage, where the unit process is called "primary settling tanks" or "primary sedimentation tanks". It is also widely used for the treatment of other wastewaters. Solids that are heavier than water will accumulate at the bottom of quiescent settling basins. More complex clarifiers also have skimmers to simultaneously remove floating grease like soap scum and solids like feathers or wood chips. Containers like the API oil-water separator are specifically designed to separate non-polar liquids.

(Primary settling tank of wastewater treatment plant)

Filtration

Colloidal suspensions of fine solids may be removed by filtration through fine physical barriers distinguished from coarser screens or sievesby the ability to remove particles smaller than the openings through which the water passes. Other types of water filters remove impurities by chemical or biological processes described below.

Oxidation

Oxidation reduces the biochemical oxygen demand of wastewater, and may reduce the toxicity of some impurities. Secondary treatment converts organic compounds into carbon dioxide, water, and biosolids. Chemical oxidation is widely used for disinfection.

(Aeration tank of an activated sludge process at the wastewater treatment plant)

Biochemical oxidation

Secondary treatment by biochemical oxidation of dissolved and colloidal organic compounds is widely used in sewage treatment and is applicable to some agricultural and industrial wastewaters. Biological oxidation will preferentially remove organic compounds useful as a food supply for the treatment ecosystem. Concentration of some less digestible compounds may be reduced by co-metabolism. Removal efficiency is limited by the minimum food concentration required to sustain the treatment ecosystem.

Chemical oxidation

Chemical oxidation may remove some persistent organic pollutants and concentrations remaining after biochemical oxidation. Disinfection by chemical oxidation kills bacteria and microbial pathogens by adding ozone, chlorine or hypochlorite to wastewater.

Polishing

Polishing refers to treatments made following the above methods. These treatments may also be used independently for some industrial wastewater. Chemical reduction or PH adjustment minimizes chemical reactivity of wastewater following chemical oxidation. Carbon filtering removes remaining contaminants and impurities by chemical absorption onto activated carbon. Filtration through sand (calcium carbonate) or fabric filters is the most common method used in municipal wastewater treatment.

After treatment at a wastewater treatment plant, the treated wastewater (also called effluent) is discharged to a receiving water body. The terms "wastewater reuse" or "water reclamation" apply if the treated waste is used for another purpose. Wastewater that is discharged to the environment without suitable treatment causes water pollution.
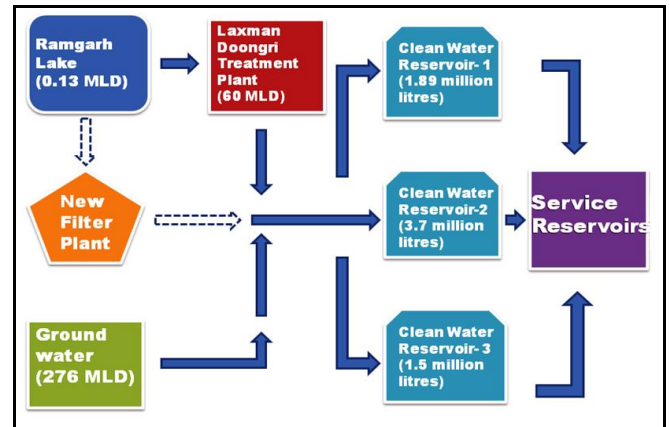
In developing countries and in rural areas with low population densities, wastewater is often treated by various on-site sanitation systems and not conveyed in sewers. These systems include septic tanks connected to drain fields, on-site sewage systems (OSS), vermifilter systems and many more.

Location Sewage Waste Water Treatment

The state of Rajasthan is located in the northwestern part of the Indian subcontinent. In Rajasthan a large area is recognized as arid region (desert), and one of the driest states in India, particularly in the western areas, known as the Great Indian Desert or the Thar Desert. Jaipur, the capital city of Rajasthan state, was established in 1727 by the Rajput ruler Study Area 22 Sawai Jai Singh II, who moved the capital of his kingdom from Amber because of acute water shortage. Unlike many other old cities of the period, Jaipur is characterized by carefully planned land use and an adequate water supply system. The city is at an altitude of 431 meters, with a flat topography and well-planned layout of streets and roads on a grid pattern. Jaipur is located of 26° 55' north latitude and 75° 49' east longitude. Its urban boundary extends from 26° 38' and 13" north latitude to 27° 11' north latitude and 75° 27' and 12" east longitude to 76° 58' and 21" east longitude. The climate of Jaipur is semiarid, and average annual rainfall is only 650 mm (26 inches). Most rain occurs during the monsoon season between June and September, when heavy rains and thunder storms are common.

The temperature in Jaipur varies from 25° C to 45°C in summer months and from 8° C to 22° C during winter. As of 2011, Jaipur had a population of 3,073,350. The Population of the Jaipur Metropolitan area is 3,646,590. Jaipur is the 10th largest city of India according to census of 2011. Figure 1 shows the location of Jaipur in Rajasthan. Figure 2 shows the location of Delawas sewage treatment plant at Pratap Nagar in Jaipur city. Figure – 1 Location of Jaipur in Rajasthan Study Area 23 Figure-2 Location of Delawas Sewage Treatment Plant DELAWAS STP Study Area 24 There are two water sources Ramgarh dam and Bisalpur water supply, providing about two-thirds of the drinking and irrigation water to the city. In recent years, water levels in these lakes have dropped due to variable rainfall in the catchment. Jaipur also depends on a chain of 1,826 deep, large diameter tube wells drilled by the PHED. The entire city of Jaipur lies within a "dark" zone on the hydrological map of the region, meaning that the area is over exploited. Groundwater levels have been declining rapidly in recent years due to overdraft—withdrawal beyond the safe yield (Jethoo, 2011). It is estimated that the water table is falling at the rate of between 1.5 to 3 meters per year due to over exploitation, and is now between 65 to 70 meters below ground in most areas. The withdrawal level is estimated to be 600% of the safe yield (Sunda, 2012). Lack of coordination among competing uses, and the absence of effective regulation have caused this situation. The fact that

water is not priced according to its cost has only further promoted the misuse of water resources. Many industries have their own tube wells to augment their PHED provided water supply to ensure that their factories continue to operate. Figure-3 Shows the sewerage network coverage in Jaipur city. There are fiv Study Area 25 The entire area under the Jaipur Municipal Corporation (JMC) is served by the wastewater collection network and two wastewater treatment plants in the north at Brahampuri and Jaisinghpura Khor on Delhi road, and at Delwas in south Jaipur. In addition, JMC has given Man Sagar Lake on lease for a period of 99 years to the Kothari Group, a business enterprise that has established a water treatment plant for its own use, and also supports conservation of the lake. JDA also plans to increase the capacity of the Vidhyadhar Nagar STP, and proposes a new plant in Vaishali Nagar. However, the tributary areas of Bambala Pulia and Kho Nagoriyan are not served with a wastewater treatment facility. Figure - 3 Sewage Network Coverage in Jaipur City Study Area 26 Conventional wastewater treatment consists of a combination of physical, chemical, and biological processes and operations to remove solids, organic matter and, sometimes, nutrients from wastewater. General terms used to describe different degrees of treatment, in order of increasing treatment level, are preliminary, primary, secondary, and tertiary and/or advanced wastewater treatment.

Locations of sampling Aminshaya sewage are:

1. Mahesh Nagar
2. Sanganer
3. Sitapura Industrial Area.

(A simplified pictorial representation of the drinking water supply system of Jaipur city)

(Administrative Divisions For Water Supply In Jaipur)

Effect of Polluted Water on Humans

How does water pollution affect humans? Try drinking untreated water nowadays and your body will immediately react to it. You will get a stomach ache at the least. Water-borne diseases account for the deaths of 3,575,000 people a year! That's equivalent to a jumbo jet crashing every hour, and the majority of these are children.

Infectious diseases can be spread through contaminated water. Some of these water-borne diseases are *Typhoid, Cholera, Paratyphoid Fever, Dysentery, Jaundice, Amoebiasis and Malaria.*

Chemicals in the water also have negative effects on our health.

Pesticides – can damage the nervous system and cause cancer because of the carbonates and organophosphates that they contain. Chlorides can cause reproductive and endocrinal damage.

Nitrates – are especially dangerous to babies that drink formula milk. It restricts the amount of oxygen in the brain and cause the "blue baby" syndrome.

Lead – can accumulate in the body and damage the central nervous system.

Arsenic – causes liver damage, skin cancer and vascular diseases

Flourides - in excessive amounts can make your teeth yellow and cause damage to the spinal cord.

Petrochemicals – even with very low exposure, can cause cancer

KILLER PARTICLES

Sewage is a hidden but deadly killer of marine life. Although Greater Vancouver sewage outfalls have often proven to be acutely toxic to fish, killing test subjects outright over a couple of days, this may not be the worst impact. Research is now showing that lower concentrations of the worst toxins can have disastrous effects over the long term. SLOW DEATH FOR MARINE LIFE Even small amounts of the most hazardous chemicals found in sewage can cause irreparable harm to fish, particularly juveniles. The result is not immediate and visible like the aftermath of an oil spill. There are no fish floating dead on the surface. It is a quiet, unseen death over time. Dead and dying fish are simply eaten by other marine organisms. Death comes in a variety of ways. Some chemicals suppress the immune system allowing the onset of disease. Heavy metals, pesticides, persistent organ chlorines, plastics, surfactants and aromatic hydrocarbons can disrupt the endocrine system interfering with sexual and bone development. There is evidence that these chemicals can also disrupt the complex hormonal processes as juvenile salmon acclimatize to the saltwater ocean environment. This is bad news for the billions of juvenile salmon that spend months in the shallow waters around Vancouver. Many juvenile salmon simply will not make it. The toxins found in sewage can also change fish behavior, inhibiting normal swimming, schooling and migration in ways that significantly reduce their chances for survival. BIOACCUMULATION some heavy metals and persistent chemicals that stay in the body biomagnify as they work their way up the food chain. Larger fish eating large numbers of contaminated smaller fish can end up with thousands or millions of times the level of toxins than the organisms that first absorbed them. A poisonous brew of harmful chemicals makes sewage a hidden but deadly killer of sea life. 3 Toxic chemicals under the kitchen sink and in the workshop often end up down the drain, and then out to sea.

SAMPLING

Sampling was conducted for every 72 hours for a period of 15 days between 5:30 pm to 6:30 pm. Grab samples were collected in plastic cans rinsed with distilled water. Sample was collected from the open drain channels, in Jaipur area of City and the treatment process was carried out.

METHODOLOGY TEST PROCEDURE

Sample Ware Analysis For The Following Parameters;

1. Bod (Bio Chemaical Oxygen Demand)
2. Cod (Chemical Oxygen Demand)
3. Do (Dissolved Oxygen)
4. Hardness
5. Colour
6. Conductivity
7. Chloride
8. Sulphate
9. Nitrate
10. Nirite
11. Ph
12. Floride
13. Temprature
14. Total Solids
15. Tds (Total Dissolved Solids)

Biochemical oxygen demand (BOD) test

This process involves the measurement of dissolved oxygen used by the micro organism in the biochemical oxidation of organic matter.

The permissible for a domestic sewage is as follows:

- Strong waste - 400mg/L Medium waste - 220mg/L
- Weak waste - 110mg/L
-

If sufficient oxygen is available, the aerobic biological decomposition of an organic waste will continue until all of the waste is consumed.

The more or less distinct activities occur.
First, a portion of waste is oxidized to end product to obtain energy for cell maintenance and the synthesis of new cell tissue. Simultaneously, some of the waste is converted into new cell tissue using part of the energy released during oxidation. Finally, when the organic matter is used up, the new cells begin to consume their own cell tissue to obtain energy for cell maintenance. The third process is called endogenous respiration.

Chemical oxygen demand (COD) test

This test is used to measure the oxygen equivalent of the organic material in waste water that can be oxidized chemically using dichromate in the solution.

Like the BOD test, oxygen is used to oxidize the organics to carbon dioxide and water. However, instead of free dissolved oxygen, chemically bound oxygen in potassium dichromate

$K_2Cr_2O_7$ is used to oxidize the organics. As the potassium dichromate is used up the Cr^{+3} ion is produced. The amount of dichromate used is proportional to the amount of organics present. Likewise, the amount of Cr^{+3} ion present is proportional to the amount of organics digested.

Organics + $K_2Cr_2O_7$ □ Cr^{+3} (Orange) (Green) Most labs use the Hach Method to measure COD. This method uses test tubes with premeasured amounts of potassium dichromate, sulfuric acid, and catalyst. For the digestion to occur, the reaction needs acid, heat, and a catalyst. The acid is sulfuric acid and is already in the tube. The sample will get very hot when the sample is added to the acid and mixed. Be sure the cap is on tight before mixing.

DO (DISOLVED OXYGEN)

Theory: It is based on oxidation of potassium iodide. The liberated iodine is titrated against standard hypo solution using starch as a final indicator. Since oxygen in water is in molecular state and not capable to react with KI, an oxygen carrier manganese hydroxide is used to bring about the reaction between KI and O_2.Manganous hydroxide is produced by the action of potassium hydroxide and manganous sulphate.

Chemical reaction: $Mn(OH)_2+K_2SO_4 \lozenge 2KOH+MnSO_4$ $2MnO(OH)_2 \lozenge 2Mn(OH)_2+O_2$ $MnSO_4+2H_2O+[O] \lozenge MnO(OH)_2+H_2SO_4$ $K_2SO_4+H_2O+I_2$ $\lozenge 2KI+H_2SO_4+[O]$ $2NaI+Na_2S_4O_6 \lozenge I_2+2Na_2S_2O_3$ Sodium tetrathionate Starch iodide complex $\lozenge Starch+I_2$ (Blue in colour)

HARDNESS

Hardness of water can be defined as that property of water, which prevents the lathering of soap. Hardness occurs mainly due to the presence of calcium and magnesium ions in the water. Heavy metal ions, and higher valent cations when present in water also cause hardness but to a lesser degree. Hence, in practice the hardness of water is taken as a measure of its Ca^{2+} and Mg^{2+} content. Mono-valent cations of alkali metals never produce hardness. Total hardness is due to the summation of permanent & temporary hardness .The Total hardness of water can be determined by complexo-metric titration. EDTA used as complexing agent & Eriochrome Black T (EBT) as indicator at a pH of 9—10.

COLOUR

Many surface waters are coloured, due primarily to decomposition of organics, metallic salts or coloured clays. This colour is considered as "apparent colour" as it is seen in the presence of suspended matter, whereas "true colour" is derived only from dissolved inorganic and organic matters. Samples can be centrifuged and/or filtered to remove turbidity in order to measure true colour. Waters which obtain their colour from natural organic matter usually pose

no health hazard. However, because of the yellowish brown appearance of such waters, the consumers may not find the water aesthetically acceptable. Consumers of highly coloured but already properly treated water may not believe the water is in fact properly treated. Many processing industries require low coloured water. PUB requires drinking water to meet the "highest desirable" World Health Organisation (WHO) standards of less than 5 colour units. One standard colour unit is defined as a 1 mg/L concentration of platinum in the form of potassium chloroplatinate K_2PtCl_6. Measurement of colour is by comparison of the sample with standard colour solutions using a spectrophotometer. A straight line calibration curve is initially developed by plotting absorbance versus platinum-cobalt colour standard. In practice, the absorbance of a sample is determined and corresponding concentration is read off the calibrated curve. When measuring true colour, pre-treatment has to be carried out to remove turbidity. Unfortunately, either centrifugation or filtration has some effect on true colour. So when reporting the true colour value, specify the details of the pre-treatment method and its operating conditions. Likewise, the colour value of water is extremely pH dependent, too, and invariably increases as the pH of the water is raised. When reporting a colour value, specify the pH at which colour is determined.

CONDUCTIVITY

Conductivity is a parameter which is simple to measure and can easily be measured with continuous measurement device. This parameter is a general indicator of water quality, especially a function of the amount of dissolved salt, and can be used to monitor processes in the wastewater treatment that causes changes in total salt concentration and thus changes the conductivity. The salt content can be determined by analyzing samples in laboratory. However, using laboratory analyzing the analyze result will available with a delay which makes it less useful for controlling the treatment process. Conductivity can be measured directly in the process and give values can be obtained directly and therefore can be used to monitor and control the process. Chemical analyzing can be made on line with electrodes or computerized analyzing devices. The cost for this is however high, which can make on line conductivity measuring an interesting alternative. This work will try to identify where in the treatment process conductivity can be used to monitor and thereby control the process

Many municipalities requires that industries and similar enterprises which discharges sewage to the wastewater net, measure conductivity and that it is not allowed to be higher than 500 mS/m (Eskilstuna et al, 2002, Hellström et al, 2001). To high conductivity causes corrosion problem in the sewage pipe network. Otherwise conductivity measurement in not so much used in the wastewater treatment. The variation of conductivity in the wastewater can be caused by variation of the ion content. Ions that cause conductivity are hydrogen H^+ , hydroxide OH^- and nutrients such as

phosphate and nitrate. The hydrogen and hydroxide ion contribution to conductivity is a function of pH: $[H+] = 10^{(-pH)}$ mol/liter $= 10^{(-pH+3)}$ mole/m3 $= 10^{(-pH+3)}$ g/m3 $[OH-] = 10^{(pH-14)}$ mol/liter $= 10^{(pH-11)}$ mol/m3 $= 10^{(pH-11)}/17$ g/m3 For H+ the molar conductivity per concentration unit is $350 \cdot 10^{-4}$ Sm2 /mol (CRC Handbook, 1999): KH $= 10^{(-pH+3)}$ mol/m3 x $350 \cdot 10^{-4}$ Sm2 /mol $= 35 \cdot 10^{(-pH)}$ S/m For OH- the molar conductivity per concentration unit is $198 \cdot 10^{-4}$ Sm2 /mol (CRC Handbook, 1999): KOH $= 10^{(pH-11)}$ mol/m3 x $198 \cdot 10^{-4}$ Sm2 /mol $= 198 \cdot 10^{(pH-15)}$ S/m $= 1.98 \cdot 10^{(pH-7)}$ µS/m Phosphate ion contribution to conductivity depends on pH-level. For pH > 2.15 and < 7.20 the phosphate ion is H2PO4 - , the molar conductivity per concentration unit is 3.3 mSm2 /mol (CRC Handbook, 1999) and the conductivity is: CP g P/m3 x $33 \cdot 10^{-4}$ Sm2 /mole KH2PO4 - = 31g/mole = CP x 107 µS/m if the concentration CP is given in mg PO4-P/liter (1mg/liter=1g/m3). For pH > 7.20 and < 12.02 phosphate ion is HPO4 2-, the molar conductivity per concentration unit is 3.3 mSm2 /mol (CRC Handbook, 1999) and the conductivity is: CP g P/m3 x $66 \cdot 10^{-4}$ Sm2 /mole KHPO4 2- = 31g/mole = CP x 213 µS/m if the concentration CP is given in mg PO4-P/liter (1mg/liter=1g/m3). At pH=7.2 some phosphate ions are H2PO4 - and other are HPO4 2-, which gives that the conductivity depends on pH. An increase of pH gives that conductivity increases from a low level of 107 x CP µS/m below pH=7.2 to a high level of 213 x CP µS/m above pH = 7.2. CONDUCTIVITY CHANGES THROUGH BIOLOGICAL PHOSPHORUS REMOVAL The main processes that reduces conductivity in wastewater treatment are biological nutrient removal. Conductivity measurement can be used for control of a sequential batch process SBR for biological phosphorus removal (Aguado et al. 2006, Maurer och Gujer, 1995).

CHLORIDE

Chlorides are present in water usually as NaCl, MgCl2 and CaCl2. Although chlorides are not harmful as such, their concentration over 250ppm imparts a peculiar taste to the water thus rendering the water unacceptable for drinking purpose.

Further existence of unusually high concentrations of chloride in a water sample indicates pollution from domestic sewage or from industrial waste waters. Salts like MgCl2 may undergo hydrolysis under the high pressure and temperature prevailing in the boiler, generating hydrochloric acid which causes corrosion in boiler parts chlorides in the form of MgCl2 and CaCl2 cause Permanent hardness & area source of trouble not only at our house hold but also in industries.

By Argentometric method, chlorides in a water sample which is neutral or slightly acidic can be determined by it against standard silver nitrate solution using potassium chromate. The pH should be in between 7-8

Ag+ + OH- = AgOH

And at lower pH,
K2CrO4 indicator is converted to K2Cr2O7.
2K2 CrO4 + 2 HCL = 2KHCrO4 + K2Cr2O7 + H2O
(Pot. Chromate) (Pot. dichromate)

KHCrO4 is weak in nature. Concentration of CrO4- decreases & therefore higher concentration of Ag+ is needed for the soluble Ag reacts with Cl- and CrO4+ when AgNO3 solution is released from the burette to the sample solution which as Cl-
Ag + + Cl = AgCl (white ppt)
2 Ag + + CrO4 = Ag2CrO7 (red ppt)

Red colour formed because of formation of silver chromate disappears as the solution contains high concentration of Cl-.
Ag2 CrO7 + 2 Cl = 2AgCl + CrO42-

When the concentration of chloride ions has decreased the red colur starts disappearing slowly and slowly on shaking and a stage is reached when all the chloride ions have formed AgCl. One extra drop of AgNO3 at this point reacts with potassium chromate and reddish coloured silver chromate is formed.

2 AgNO3 + K2CrO4 = Ag2CrO4 + 2KNO3
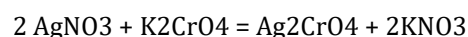
NITRATE

The tests described here are used to measure the concentration of nitrate ions, NO3 – , in a water sample. The concentration of nitrate will be expressed throughout this section in units of mg/L NO3 – -N. The unit, NO3 – -N, means simply "nitrogen that is in the form of nitrate." Nitrate ions found in freshwater samples result from a variety of natural and manmade sources. Nitrates are an important source of nitrogen necessary for plants and animals to synthesize amino acids and proteins. Most nitrogen on earth is found in the atmosphere in the form of nitrogen gas, N2. Through a process called the nitrogen cycle, 1 nitrogen gas is changed into forms that are useable by plants and animals. These conversions include industrial production of fertilizers, as well as natural processes, such as legume-plant nitrogen fixation, plant and animal decomposition, and animal waste. Sources of Nitrate Ions • Agriculture runoff • Urban runoff • Animal feedlots and barnyards • Municipal and industrial wastewater • Automobile and industrial emissions • Decomposition of plants and animals Although nitrate levels in freshwater are usually less than 1 mg/L, manmade sources of nitrate may elevate levels above 3 mg/L. These sources include animal feedlots, runoff from fertilized fields, or treated municipal wastewater being returned to streams. Levels above 10 mg/L in drinking water can cause a potentially fatal disease in infants called methemoglobinemia, or Blue-Baby Syndrome. In this disease, nitrate converts hemoglobin into a form that can no longer transport oxygen. High nitrate concentrations also contribute to a condition in lakes and ponds called eutrophication, the excessive growth of aquatic plants and algae. Unpleasant odor and taste of water, as well as reduced

clarity, often accompany this process. Eventually, dead biomass accumulates in the bottom of the lake, where it decays and compounds the problem by recycling nutrients. If other necessary nutrients are present, algal blooms can occur in a lake with as little as 0.50 mg/L NO3 – -N. Nitrate pollution of surface and groundwater has become a major ecological problem in some agricultural areas. Although fertilizer in runoff is most often blamed, there is evidence that concentration of livestock in feedlots is now the major source of agricultural nitrate pollution. Runoff from fertilized fields is still a significant source of nitrate, although fertilizer use peaked in 1981 and has remained fairly constant since. Expected Levels The nitrate level in freshwater is usually found in the range of 0.1 to 4 mg/L NO3 – -N. Unpolluted waters generally have nitrate levels below 1 mg/L. The effluent of some sewage treatment plants may have levels in excess of 20 mg/L. Westminster College – SIM 1 of 11 In a study based on 344 USGS sites throughout the United States,2 80% of the sites reported nitrate levels less than 1 mg/L, 16% were in the range of 1–3 mg/L, and 4% were greater than 2 U.S. Geological Survey, National Water Summary 1990–91, Hydrologic Events and Stream Water Quality, Water-Supply Paper 2400, United States Government Printing Office, 1993, 122–123. Westminster College – SIM 2 of 11 3 mg/L. The percentage of various land types reporting greater than 1 mg/L of nitrate were range land.

NITRITE

Procedure Preparation of reduction column Insert a glass wool plug in the end of the chromatographic column. Then, close the stopcock and fill the tube with reagent water to prevent entrapment of air bubbles during filling. Pour the copper-cadmium granules into the column until a column height of 18.5 cm is created. Tap the sides of the column gently to release any trapped air bubbles. Wash the column with about 200 mL of dilute ammonium chloride-EDTA solution. Do not allow any air to enter the column. Before using the column for analysis, activate by passing through the column 100 mL of a solution consisting of 25 mL of 1.0 mg/L nitrate (NO3) standard and 75 mL dilute ammonium chloride-EDTA solution (Section 7.14.2) at a flow rate of 7-10 mL/min. Sample Preparation Aqueous samples—Mix the sample thoroughly. Using a 0.45 µm membrane filter, filter up to 25 mL of the sample into a volumetric flask. Record the amount collected. Solid samples—Thoroughly homogenize the sample. Weigh 5 g into a 500 mL Erlenmeyer flask. Add 100 mL reagent water. Seal the flask with a stopper, secured with a small portion of PTFE thread sealing tape, and place in the shaker. Shake the samples for 4 hours. Once the shaking is complete, remove the flasks from the assembly and allow any suspended sediment to settle out. Using a 0.45 µm membrane filter, filter up to 25 mL of the extracted sample into a volumetric flask. Record the amount of filtered extract collected. If FOG removal is necessary, adjust the pH of the extract to 2 by addition of concentrated HCl. Remove the FOG by serial extraction with hexane or a 80%/20%

hexane/methyl t-butyl ether mixture in a separatory funnel. Proceed with filtration. Reduction of nitrate to nitrite Check the pH of the filtrates. If any are above 9 or below 5, adjust to between 5 and 9 with concentrated HCl or concentrated NH4OH. Add 75 mL of dilute ammonium chloride-EDTA solution to 25 mL of sample extract or sample extract diluted to 25 mL. Draft, January 2001 11 Method 1686 Pass the sample through the reduction column at a rate of 7-10 mL/min. Discard the first 25 mL of eluent, then collect the rest in the sample flask. Do not allow the reduced samples to sit for more than 15 minutes before analysis. Analysis Add 2 mL of color reagent to 50.0 mL of sample. Allow ten minutes for the color to develop, then measure the absorbance of the sample at 540 nm. Developed color is accurate for two hours afer the reagent addition. Generate a calibration curve as detailed in Section 10. Once a curve meeting the requirements in Section 10 is created, set up the samples so that every tenth sample measured is a calibration verification standard. Compare the sample absorbance to the calibration curve. If the absorbance exceeds that of the highest concentration standard, use the remaining reduced filtrate to prepare a dilution of the sample extract, and re-run the diluted sample. The solid sample dry weight/wet weight ratio must be determined separatel.

pH

The ionic product of water and hydrogen ion concentration are related from the dissociation of water molecule as follows.
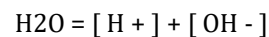
$H_2O = [H +] + [OH -]$
$Ka = [H +] [OH -] = 10^{-14}$
At neutral point, $[H +] = [OH -] = 10^{-7}$

The no. of gram ions of hydrogen present in 1 lit of solution is known as hydrogen ion concentration. If hydrogen ion concentration is more than 10^{-7} then the solution is acidic, if it is less than 10^{-7} then it is basic. Sorenson (1909) introduced the term pH and suggested its use to express the acidity or alkalinity of solution which is defined as the negative logarithm of the hydrogen ion concentration.

$PH = - \log [H+]$
For pure water, $pH = - \log [H+] = - \log 10[10^{-7}] = 7$
For acidic solution, $pH < 7$
For basic solution $pH > 7$

FLORIDE

North East Water (N.E.W.) commissioned a FSA dosing plant at Wangaratta in August 07. MB calculations manage the system, with the daily SPADNS test and in-line analyser used to verify F- concentrations. Weekly testing was completed by both new and an external laboratory service. The spadans test is an inverse colorimetric reaction (range of 0.02 to 2.00mg/L F-). As spectrophotometers were on hand, spadns was the preferred method. Duplicate samples and a 1-ppm

standard were tested for proficiency purposes following the correct reaction procedures. The results obtained in Wangaratta showed inconsistencies between MB calculations, external laboratory service and the regularly new spadns testing. Operations staff became less confident in the testing procedure leading to further investigation. Literature investigation suggested research into an ISE was necessary. ISE testing measures ion activity over the probe face. The addition of tisab buffer solution creates a uniform ionic strength background, adjusts pH and breaks up F-complexes to restrict interferences. 2.0 discussion 2.1 Data Text research identified error margins with the spadns method, a sample of F- was tested in 53 laboratories and the results gave an average relative error of ± 1.2% Mary 71st Annual Victorian Water Industry Engineers & Operators Conference Page No. 88 Exhibition Centre – Bendigo, 2 to 4 September, 2008 Ann H. Franson; M; 1992. This error would cause a 1ppm sample to produce a result between 1.012ppm and 0.988ppm. The range suggested could not resolve the irregularly results. 2.2 Sample Temperatures spadns suppliers and text methodologies advised the sample and blank to be within ±1 degree Celsius. During colder month's temperature differences between external samples and internally stored blank water increased to approximately six degrees. To maintain a constant laboratory temperature a reverse cycle air conditioner was installed. This insured a constant Temperature of 23oc in the laboratory. No effect was observed as the temperature differential between the external samples and blank was still present. The initial trial involved immersing vials containing blank, sample and standard into hot water baths.

Hot water was used to decrease the equalization time, therefore reducing possible fluoride glass etching. Raising the temperature above standard laboratory reaction temperature increasing the reaction rate negatively affecting the results. The second trial involved equalizing the blank under a flowing sample tap. Equalizing the blank as an alternative to the sample reduced possible glass etching. Once equalized 10ml of sample was tested. This process had a positive affect reducing the error. The preparation required extended periods of time and become inefficient.

TEMPERATURE

Temperature measurement in wastewater applications provides an important back up to measurements such as pH, Dissolved Oxygen, Suspended Solids and Turbidity. In Final Effluent many discharge consents are waived when the temperature reaches a low level of around 4⁰C and by using a verifiable temperature measurement device such as the WaterTechw² D062 the operator can avoid issues with regulators.

In activated sludge the ability of the process to treat the effluent is greatly affected by temperature, the bugs present in the process eat more and reproduce more when the temperature increases. It is estimated that every 10° C increase in temperature doubles the bug reproduction rate up to a limiting maximum, with optimum efficiency being between 10° and 40°. The more bugs that are present the more Dissolved Oxygen is required.

TOTAL SOLIDS

Residue left after the evaporation and subsequent drying in oven at specific temperature 103-105°C of a known volume of sample are total solids. Total solids include "Total suspected solids" (TSS) and "Total dissolved solids" (TDS). Whereas loss in weight on ignition of the same sample at 500°C, 50°C, in which organic matter is converted to CO2 volatilization of inorganic matter as much as consistent with complete oxidation of organic matter, are volatile solids.

TDS (TOTAL DISSOLVED SOLIDS)

The filterable residue is the material that passes through a standard glass filter disk and remains after evaporation and drying at 180°C.

SAMPLING TEST TABLE 1: Mahesh Nagar, Jaipur

S. NO.	PARAMETER CHAMICAL/ PHYSICAL	UNIT	REQUI-RMENT	SAMPLE MAHESH NAGAR
1	BOD	mg/lit	30	450.04
2	COD	mg/lit	250	1220.8
3	DO	mg/lit	7	0
4	HARDNESS	mg/lit	60-120	471.5
5	COLOUR		15	7
6	CONDUCTIVITY	mS/m	5-50	120.22
7	CHLORIDE	mg/lit	250	1.20
8	SULPHATE	mg/lit	400	300

| 9	NITRATE	mg/lit	10	6
10	NIRITE	mg/lit	1	0.8
11	PH		6.5-8.5	7.28
12	FLORIDE	mg/lit farenite	1.5	1
13	TEMPRATURE	mg/lit mg/lit	39	30
14	TOTAL SOLIDS		500	1300
15	TDS		300	400
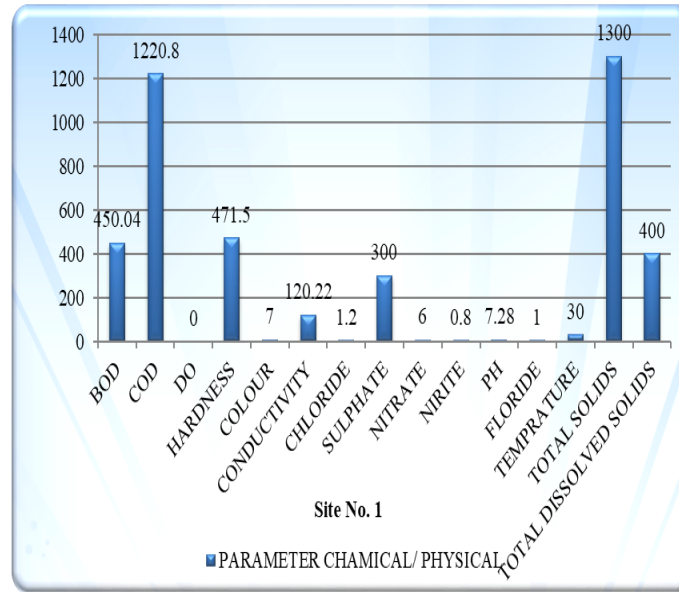
Graph 1: Mahesh Nagar, Jaipur

SAMPLING TEST TABLE 2: Sanganer, Jaipur

S. NO.	PARAMETER CHAMICAL/ PHYSICAL	UNIT	REQUI-RMENT	SAMPLE SANGANER
1	BOD	mg/lit	30	400.08
2	COD	mg/lit	250	820.1
3	DO	mg/lit	7	0
4	HARDNESS	mg/lit	60-120	346.15
5	COLOUR		15	7
6	CONDUCTIVITY	mS/m	5-50	82.8
7	CHLORIDE	mg/lit	250	0.35
8	SULPHATE	mg/lit	400	200
9	NITRATE	mg/lit	10	5.2
10	NIRITE	mg/lit	1	0.5
11	PH		6.5-8.5	7.72

12	FLORIDE	mg/lit	1.5	1.1
13	TEMPRATURE	farenite	39	30
14	TOTAL SOLIDS	mg/lit	500	1050
15	TDS	mg/lit	300	500
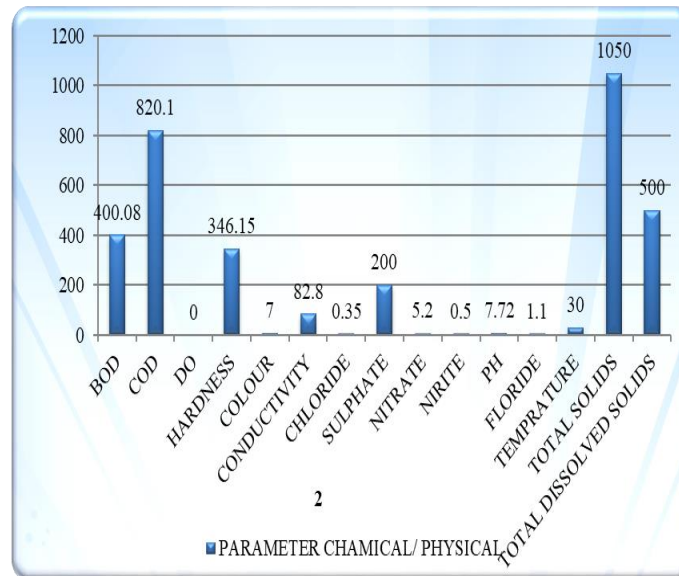
Graph 2: Sanganer, Jaipur

SAMPLING TEST TABLE 3: Sitapur, Jaipur

| S. NO.	PARAMETER CHAMICAL/ PHYSICAL	UNIT	REQUI-MENT	SAMPLE SITAPURA
1	BOD	mg/lit	30	340.09
2	COD	mg/lit	250	540.7
3	DO	mg/lit	7	0
4	HARDNESS	mg/lit	60-120	365.38
5	COLOUR		15	7
6	CONDUCTIVITY	mS/m	5-50	42.1
7	CHLORIDE	mg/lit	250	0.40
8	SULPHATE	mg/lit	400	150
9	NITRATE	mg/lit	10	4.8
10	NIRITE	mg/lit	1	0.2
11	PH		6.5-8.5	7.83
12	FLORIDE	mg/lit	1.5	2
13	TEMPRATURE	farenite	39	30
14	TOTALSOLIDS	mg/lit	500	1000
15	TDS	mg/lit	300	500
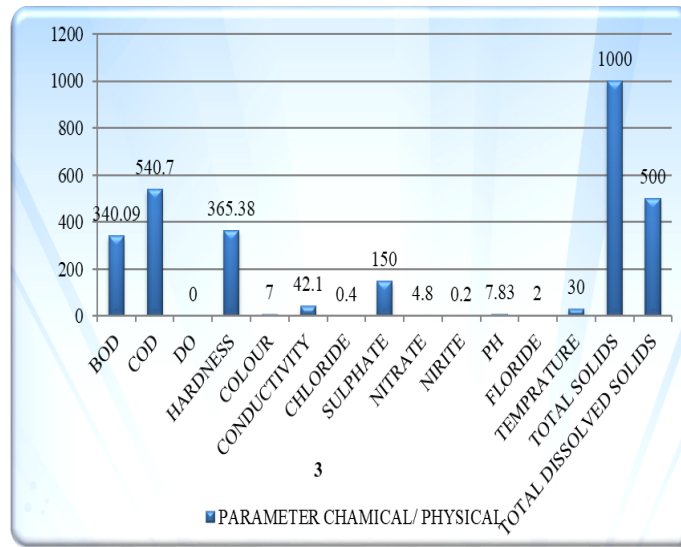
Graph 3: Sitapur, Jaipur

RESULTS

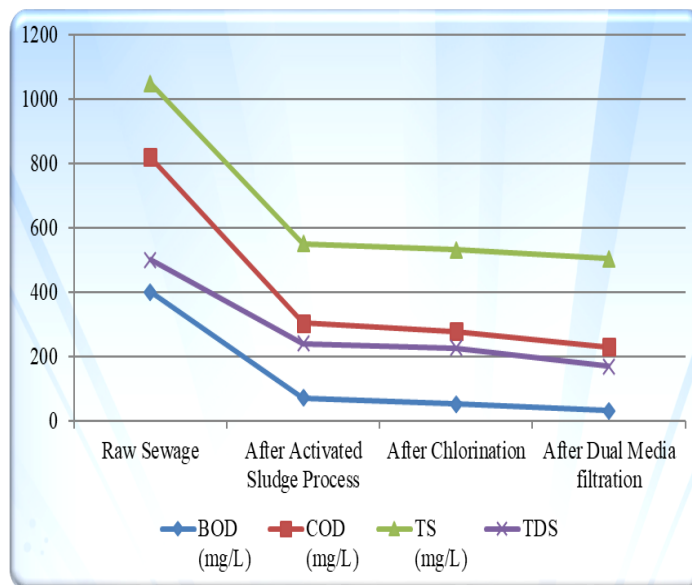**Table 4: Stage wise reduction in BOD, COD, TS and TDS by various treatments, Mahesh Nagar**

S. No.	Treatment	Initial characteristics					Reduction percentage from initial values			
		pH	BOD (mg/L)	COD (mg/L)	TS (mg/L)	TDS	% BOD Reduction	% COD Reduction	% TS Reduction	% TDS Reduction
1	Raw Sewage	7.28	450.4	1220.8	1300	400				
2	After Activated Sludge Process	7.28	90.08	488.32	780	200	80%	60%	40%	50%
3	After Chlorination	7.28	67.58	268.58	650	180	85%	78%	50%	55%
4	After Dual Media filtration	7.28	30.050	280	312	160	90%	83%	66%	57%
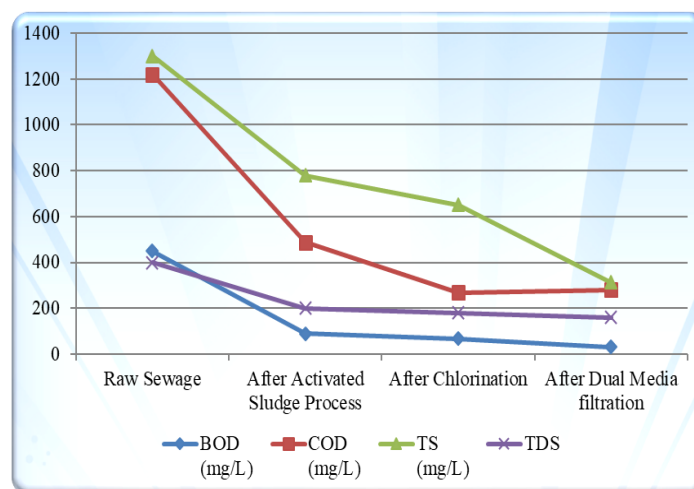
Graph 4: Stage wise reduction in BOD, COD, TS and TDS by various treatments, Mahesh Nagar

Table 5: Stage wise reduction in BOD, COD, TS and TDS by various treatments at Sanganer, Jaipur

S.No.	Treatment	Initial characteristics					Reduction percentage from initial values			
		pH	BOD (mg/L)	COD (mg/L)	TS (mg/L)	TDS	% BOD Reduction	% COD Reduction	% TS Reduction	% TDS Reduction
1	Raw Sewage	7.72	400.08	820.1	1050	500				
2	After Activated Sludge Process	7.72	72.01	303.40	551.25	240.50	82%	63%	47.5%	51.9%
3	After Chlorination	7.72	52.01	278.34	532.56	227	87%	66%	50%	55%
4	After Dual Media filtration	7.72	32.064	230.12	504.21	170	72%	80%	52%	66%

Graph 5: Stage wise reduction in BOD, COD, TS and TDS by various treatments at Sanganer, Jaipur

Table 6: Stage wise reduction in BOD, COD, TS and TDS by various treatments at Sitapura, Jaipur

| S.No.	Treatment	Initial characteristics					Reduction percentage from initial values			
		pH	BOD (mg/L)	COD (mg/L)	TS (mg/L)	TDS	% BOD Reduction	% COD Reduction	% TS Reduction	% TDS Reduction
1	Raw Sewage	7.83	340.09	540.07	1000	600				
2	After Activated Sludge Process	7.83	54.41	189.24	550	270	84%	65%	45%	55%
3	After Chlorination	7.83	37.40	167.52	412	186.36	89%	69%	58%	68%
4	After Dual Media filtration	7.83	33.10	250	510	180	93%	78%	50%	60%
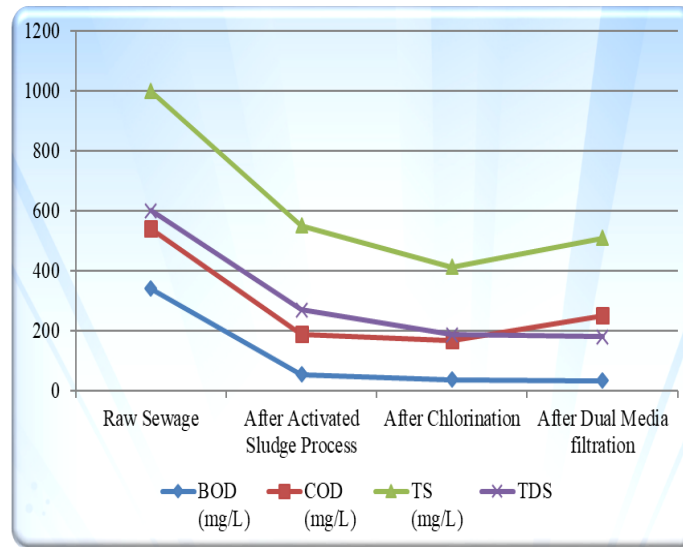
Graph 6: Stage wise reduction in BOD, COD, TS and TDS by various treatments at Sitapura, Jaipur

Comparison between who and double filtration
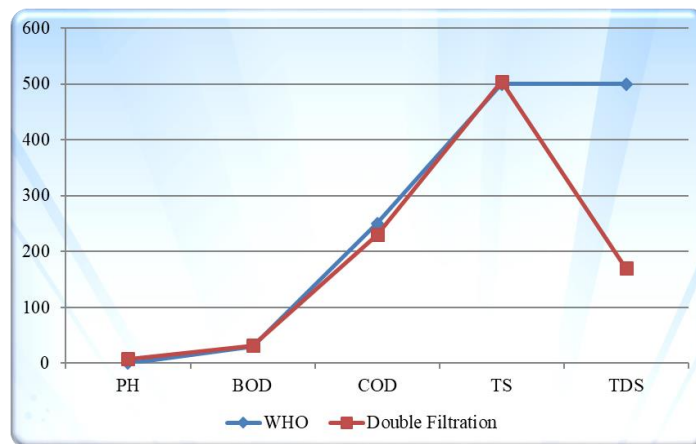
Table 7: Parameters Limit WHO requirement, Mahesh Nagar

Parameters	Unit	WHO	Double Filtration
PH	pt co scale	6.5 - 8.5	7.28
BOD	mg/L	30	30.0050
COD	mg/L	250	280.15
TS	mg/L	500	312
TDS	mg/L	500	160
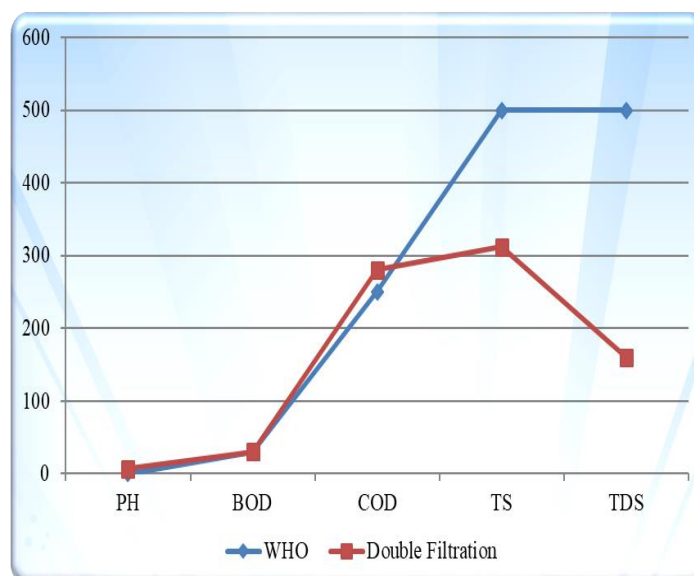
Graph 7: Parameters Limit WHO requirement, Mahesh Nagar

Table 8: Parameters Limit WHO requirement, Sanganer
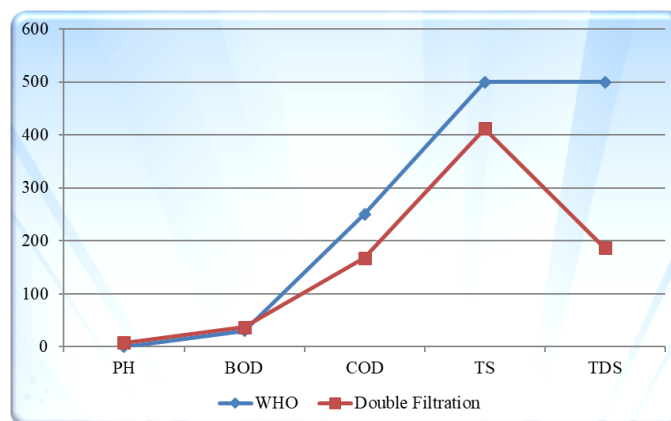
Parameters	Unit	WHO	Double Filtration
PH	pt co scale	6.5 - 8.5	7.72
BOD	mg/L	30	32.0064
COD	mg/L	250	230.120
TS	mg/L	500	504.21
TDS	mg/L	500	170

Graph 8: Parameters Limit WHO requirement, Sanganer

Table 9: Parameters Limit WHO requirement, Sitapura

Parameters	Unit	WHO	Double Filtration
PH	pt co scale	6.5 - 8.5	7.83
BOD	mg/L	30	37.040
COD	mg/L	250	167.52
TS	mg/L	500	412
TDS	mg/L	500	186.56

Graph 9: Parameters Limit WHO requirement, sitapura

CONCLUSIONS

- Ongoing destination point from starting the PH of water continuously increase from 7.28 to 7.83 scale.
- The BOD parameter also increase from 30.005 to 37.04 mg/l.
- COD contain reduse from 280.15 to 167.52 ppm.
- T.S gives the negative effect increase continuously from 312 to 412 mg/l.
- TDS also increase from 160 to 186.56 mg/l.
- From all the results we can conclude that the biodegradable contain increase and non – biodegradable contain reduce after treatment at each phase.

FUTURE SCOPE

- Without using any chemical we can treat more waste water so this is more efficient.
- More economical and less human effort.
- After treatment we can use H2O for plantation agriculture purpose use without any adverse effect.

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