A CASE STUDY ABOUT TREATMENT OF POLLUTANTS OF DYEING INDUSTRY

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ABSTRACT

Water resource shortage and pollution has seriously threatened the survival and development of developing countries. Because of India's specific economic and social circumstances, complete adoption of developed countries experience is unrealistic. At present, India needs to create techniques and innovations in source water contamination control and mechanical and city natural remediation that grasp the nation's particular need to fight the water asset issue. This study deals with water recycling and reuse which has become one of the most promising alternatives to overcome the needs for supply of fresh water as well as to minimize increasing problems linked to the contamination of fresh water due to pollution. Industrial water pollution is mainly caused by textile dyeing industries in most part of the world. Dyeing industries pollutes about 14-16% of the water throughout the world. The waste water let out from dyeing industry is a major environmental hazard. The water from the dyeing industry is collected and the most significant parameters pH, TDS, BOD, COD, Sulphates and chlorides are monitored through the study. The raw effluent sample is tested on each stage of effluent treatment so as to derive the degree of improvement of the effluent in each process. The treated water is let into the carbon and sand filter followed by reverse osmosis after which maximum physical, chemical and biological contaminants are removed giving out the recycled water which can be reused by the industries for their process.

Keywords: Dyeing industry, Anaerobic, Aerobic Treatment, Reverse Osmosis, COD, BOD

1.0 INTRODUCTION

Pollution of water due to dyeing industry is the matter of great concern since large quantity of effluent is discharged into the water bodies. Central pollution control board has recorded the dyeing industry as one of the seriously polluting industries [2]. The dye effluent is highly toxic in nature as it contains high suspended solid, COD, dye and chemicals along with high concentration of heavy metals like Cu, Cd, Zn Ni and Pb. The colour gushing degrades the surface and ground water, along these lines, making it unfit for water system and drinking [3]. The colour gushing involves firm synthetic substances that may be dangerous, cancer-causing to living creatures. [4]. Limit of the colouring units release the untreated gushing into the land which in the long run contaminates the ground water and makes it pointless for drinking. Water contamination because of effluents from material colouring industry is a reason of genuine alert. The strategies for finding of colours are cost escalated and useless since the colours experience substance varieties under natural conditions and the change items might be more poisonous and cancer-causing than the parent atom. The primary target of the present examination was to survey the change in characteristics of water and to assess the treatment strategy that can be pursued to lessen the contamination from the dye industry.

2.0 EXPERIMENTAL METHODS

The Steps involved in treatment of the dyeing effluent are as follows

- Raw effluent collection tank
- Primary settling tank
- Anaerobic digester tank
- Aeration tank
- Secondary settling tank
- Final collection tank
- Sand filtering
- Carbon filtering
- Reverse osmosis

Raw effluent collection tank

The raw effluent collection tank shown in fig 2.1 is the one where the effluent untreated waste water from the industry is collected or stored, tank is connected to the effluent outlet from the industry.

This tank is a very important part of the process because if any of the other machineries fail in doing the work the tank should be capable enough to hold excess amount of effluent from the industry even the double the amount of the effluent treated per day , that is if the industry produces 20000 litres of effluent per day to be processed then the tank must be capable of holding 30000litres or above, by this the tank can store effluent without letting it into the river or ground surface until the machinery is ready for processing. The total capacity of the tank in the industry that we visited had a capacity of about 50000 litres approximately

The total amount of effluent that comes out from the industry into the collection tank for processing is 40000 litres approximately. In that industry the amount of effluent collected in the tank per hour is 5000 litres. that is 84 litres of water will be pumped into the tank every minute. Thus the total working hour of the treatment plant per day is 8 hours. The industry thus processes 40,000 litres of raw effluent water by the end of the day .in the raw effluent collection tank the waters condition in very poor and un-usable.

This is where the process starts the water is now pumped from the collection tank into the primary settling tank, the water is pumped using high powered pump and motors. there are two pumps submerged into the tank , where only one works and the other pump is placed as a failsafe, that is if the running pump fails to function or gets repaired then the second pump starts pumping the effluents thus giving a nonstop functionality of the collection tank throughout the day without any obstructions .



Fig 2.1 Raw effluent collection tank

Primary settling tank

The raw untreated effluent water from the raw effluent collection tank is pumped into the primary settling tank using the motor pump provided the main process of the primary

settling tank is the stabilization of pH and the deduction of colour from the coloured effluent, that is the colour in the water is removed. These processes are carried out mainly by the addition of certain chemicals into the tank such as ferrous sulphate (feso4), lime and poly electrolyte. At first the water from the collection tank is pumped into the settling tank which is placed at a higher level this helps in mixing the chemicals with effluent.

There are three main sections in this tank. In each section one chemical is added that is one part ferrous sulphate is added and in another part lime is added and on the third section poly electrolyte is added. Ferrous and lime helps in removal of colour and increase in pH by reacting with effluent. Where polyelectrolyte forms a web like structure which helps in settling down of the suspended solids which are present in the effluent.



Fig 2.2 primary settling tank

Anaerobic digester tank

Anaerobic absorption is a assembly of actions by which microorganisms separate biodegradable material without oxygen. The procedure is utilized for mechanical or household purposes to oversee squander and additionally to deliver fills. A great part of the aging utilized mechanically to create nourishment and drink items, just as home aging, utilizes anaerobic digestion. Anaerobic absorption likewise happens normally in a few soils and in lake and maritime bowl dregs, where it is typically alluded to as "anaerobic action".

This is the source of marsh gas methane as discovered by Volta in 1776. The digestion process begins with bacterial hydrolysis of the input materials. Insoluble natural polymers, for example, starches, are separated to dissolvable subordinates that wind up accessible for other microorganisms. Acidogenic microorganisms at that point convert the sugars and amino acids into carbon dioxide, hydrogen, smelling salts, and natural acids. These microscopic organisms

convert these subsequent natural acids into acidic corrosive, alongside extra smelling salts, hydrogen, and carbon dioxide.

Finally, methanogens convert these products to methane and carbon dioxide. The methanogenicarchaea populations play an indispensable role in anaerobic wastewater treatments. It is used as part of the process to treat biodegradable waste and sewage sludge. As part of an integrated waste management system, anaerobic digestion reduces the emission of landfill gas into the atmosphere. Anaerobic digesters can also be fed with purpose-grown energy crops, such as maize. Anaerobic digestion is widely used as a source of renewable energy. The process produces a biogas, consisting of methane, carbon dioxide and traces of other 'contaminant' gases.

This biogas can be utilized specifically as fuel, in joined warmth and power gas motors or moved up to flammable gas quality biomethane. The supplement rich digestate additionally created can be utilized as compost. With the re-utilization of waste as an asset and new mechanical methodologies which have brought down capital costs, anaerobic absorption has as of late gotten expanded consideration among governments in a number of countries, among these the United Kingdom (2011), Germany and Denmark (2011). in this process the microorganisms help in breaking down the biodegradable material in the absence of air. The pH level in the primary settling tank is increased so as the activated sludge could react with the effluent. the activated sludge is an biological sludge which is formed at the bottom of the tank created by the addition of cow dunk & urea. the tank is sealed so that no air enters it.



Fig 2.3 Anaerobic digester tank

Aeration tank

The procedure includes air or oxygen being brought into a blend of screened, and essential treated sewage or mechanical (wastewater) joined with life forms to build up a natural floc which diminishes the natural substance of the sewage. This material, which in solid muck is a dark coloured floc, is to a great extent made out of saprotrophic microscopic organisms yet additionally has a critical protozoan greenery mostly made out of amoebae, Spirotrichs, Peritrichs including Vorticellids and a scope of other channel bolstering species. Other critical constituents incorporate motile and inactive Rotifers. In inadequately overseen enacted ooze, a scope of adhesive filamentous microorganisms can create including Sphaerotilusnatans which delivers a slime that is hard to settle and can result in the slop cover emptying over the weirs in the settlement tank to extremely debase the last gushing quality. This material is regularly depicted as sewage organism yet obvious contagious networks are generally uncommon. The blend of wastewater and natural mass is ordinarily known as blended alcohol. In all enacted slop plants, when the wastewater has gotten adequate treatment, abundance blended alcohol is released into settling tanks and the treated supernatant is kept running off to experience further treatment before release. Some portion of the settled material, the muck, is come back to the leader of the aeration system to re-seed the new wastewater entering the tank.

Excess sludge is called *surplus activated sludge* (S.A.S.) or *waste activated sludge* (W.A.S). W.A.S is removed from the treatment process to keep the ratio of biomass to food supplied in the wastewater in balance, and is further treated by digestion, either under anaerobic or aerobic conditions prior to disposal. The space required for a sewage treatment plant can be reduced by using a membrane bioreactor to remove some of the wastewater from the mixed liquor prior to treatment. This outcomes in an increasingly thought waste item that would then be able to be dealt with utilizing the initiated slime process. Numerous sewage treatment plants utilize pivotal stream siphons to exchange nitrified blended alcohol from the air circulation zone to the anoxic zone for denitrification. These siphons are frequently alluded to as inside blended alcohol reuse siphons (IMLR siphons). The crude sewage, the RAS, and the nitrified blended alcohol are blended by submersible blenders in the anoxic zones so as to

accomplish de nitrification. Activated ooze is likewise the name given to the dynamic natural material delivered by enacted slop plants.

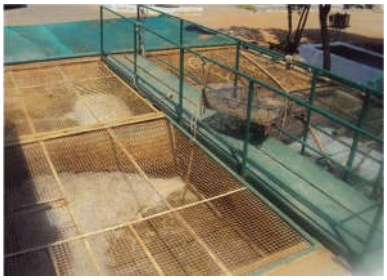

Fig 2.4 Aeration tank

Secondary settling tank

The effluent water from the aeration tank now enters the secondary settling tank this water may contain biological slag and suspended particles. The effluent is allowed to settle down the secondary settling tank after the effluent water comes from the primary settling tank the TDS level that is the total dissolved solids level increases due to the addition of ferrous sulphate and lime the most part of these chemicals are removed after the aeration process and the lesser amount of chemicals gets settle down in the secondary settling tank and are removed and disposed as slurry. Then the water passes through the pipe which has many holes in it the water free falls inside a tank thus having contact with air thus helping in reduction of bad odour. Then the water passes on through the final settling tank.



Fig 2.5 Secondary settling tank

Final settling tank

The process in the final settling tank is very simple the water from the secondary settling tank passes through the aerated pipe and reaches the final settling tank .The final settling tank has a micro pore mesh screen this screen is very small in size .when the effluent passes through the mesh screen the minor suspended solids which are entering the final settling tank with the effluent water gets trapped in the micro mesh screen.



Fig 2.6 final collection tank

3.0 RESULTS AND DISCUSSIONS

Improvisation which can be undertaken in effluent treatment techniques and results.

3.1 Zero Water Outlet System

This can be achieved by the addition of the following purification techniques they are as follow

- High Pressure Sand Filtering
- Carbon Filtering
- Reverse Osmosis Purification Technique
- Solar Pans

High pressure sand filtering

The water from the final settling tank is let into the highly pressurised sand filter. This filtering is nothing but a tank filled with fine grained soil , the water is pressure forced into the tank this process helps a lot in purification of the effluent water .then the soil filtering equipment is cleaned using reverse methods that is the water will be passed in a reversed

method so the sand gets cleaned and the dirt goes into the secondary settling tank and removed as slag.



Fig 3.1 High pressure sand filter

Carbon filtering

The water after getting cleaned in the high pressure sand filter enters the carbon filter , this is a important method that is the carbon filter contains a material called activated carbon. This activated carbon helps in the complete removal of bad odour from the effluent water ,the activated carbon filter helps in removal of sulphates and chloride content in the effluents. Then the water is passed on to the r. o. feed sump



Fig 3.2 carbon filtering

Reverse osmosis

Reverse osmosis (RO) is a water purification technology that uses a semipermeable membrane. This membrane technology is not properly a filtration method. In reverse osmosis, an applied pressure is utilized to defeat osmotic pressure, a colligative assets, that is driven by synthetical potential which is a thermodynamic parameter.

Reverse osmosis can remove many types of molecule sand ions from solutions, and is used in both industrial processes and producing potable water. The result is the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side.

In the typical osmosis process, the dissolvable normally moves from a region of low solute fixation (high water potential), through a layer, to a zone of high solute focus (low water potential). The development of an unadulterated dissolvable is headed to lessen the free vitality of the framework by evening out solute fixations on each side of a film, creating osmotic weight. Applying an outer strain to turn around the normal stream of unadulterated dissolvable, consequently, is switch assimilation. The procedure is like other film innovation applications. Be that as it may, key contrasts are found between turn around assimilation and filtration.

The overwhelming evacuation component in film filtration is stressing, or estimate rejection, so the procedure can hypothetically accomplish ideal prohibition of particles paying little respect to operational parameters, for example, influent weight and focus. Also, turn around assimilation includes a diffusive instrument, with the goal that partition productivity is reliant on solute focus, weight, and water motion rate. Turn around assimilation is most usually known for its utilization in drinking water filtration from seawater, expelling the salt and different effluent materials from the water particles.

Procedure

Osmosis is a normal process. When two liquids with different concentrations of a solute are separated by a semipermeable membrane, the fluid has a tendency to move from low to high solute concentrations for chemical potential equilibrium.

Formally, RO procedure is the way toward compelling a dissolvable from a locale of high solute focus through a semipermeable layer to an area of low solute fixation by applying a weight in overabundance of the osmotic weight. The biggest and most imperative utilization of this assimilation is the partition of unadulterated water from seawater and harsh waters; seawater or bitter water is pressurized against one surface of the film, causing transport of salt-exhausted water over the layer and rise of consumable drinking water from the low-weight side.

The layers utilized for invert assimilation have a thick layer in the polymer network either the skin of a irregular layer or an interfacially polymerized layer inside a slender film-composite film where the detachment happens. As a rule, the film is intended to enable just water to go through this thick layer, while keeping the section of solutes, (for example, salt particles). This procedure necessitates that a high weight be applied on the high fixation side of the film, typically 2– 17 bar (30– 250 psi) for crisp and salty water, and 40– 82 bar (600– 1200 psi) for seawater, which has around 27 bar (390 psi) normal osmotic weight that must be survived. This process is best known for its use in desalination (removing the salt and other minerals from sea water to get fresh water), but since the early 1970s, it has also been used to purify fresh water for medical, industrial, and domestic applications.



Fig 3.3 Reverse osmosis purification equipment

Solar dry pans

The rejected water from the R O purifier is now let into the solar drying pans this is a vast area the water is let to dry in the direct sun light and get evaporated. thus by this method there will be no water left to let into the rivers.



Fig 3.4 Solar dry pans 12000 sq.ft.

Table 3.1 Standard units for dyeing (by TNPCB)

S.NO.	PARAMETER	RANGE VALUE
1	pH	5.5-9.0
2	Total dissolved solids	2100 ppm
3	Chlorides	1000 ppm
4	Sulphate	1000 ppm
5	BOD	30 ppm
6	COD	250 ppm

Table 3.5 Total Comparison Of The Process

s.no.	Name of the process	pH	TDS (ppm)	BOD (ppm)	COD (ppm)	Chlorides (ppm)	Sulphates (ppm)
1.	TNPCB norms	5.5-9.0	2100	30	250	1000	1000
2.	Collection tank	2	8000-16000	6000	8000	250	100
3.	Primary settling tank	7-9	10000-18000	6000	8000	300	150
4.	Anaerobic digester tank	7-9	10000-18000	40-45	280-300	300	150
5.	Aeration tank	7-8	10000-18000	25-28	240-250	250-280	120-140
6.	Secondary settling	7-8	6000-10000	25-28	240-250	250-280	120-140
7.	Reverse Osmosis tank	7	50-100	25-27	240-245	240-270	120-140

4.0 SUMMARY

The raw effluent collection tank is the one where the effluent untreated waste water from the industry is collected. The total capacity of the tank in the industry that we visited had a capacity of about 50000 litres approximately. The water is now pumped into the primary settling tank. The raw untreated effluent water from the raw effluent collection tank is pumped into the primary settling tank using the motor pump provided. The main process of the primary settling tank is the stabilization of pH and the deduction of colour from the coloured effluent, that is the colour in the water is removed. For this process to take place chemicals such as ferrous sulphate (feso4), lime and poly electrolyte are added into the settling tank which is placed at a higher level this helps in mixing the chemicals with effluent.

Anaerobic adaptation is a gathering of procedures by which microorganisms separate biodegradable material without oxygen. The absorption procedure starts with bacterial hydrolysis of the information materials. Insoluble natural polymers, for example, starches, are separated to solvent subsidiaries that end up accessible for other microscopic organisms. Acidogenic microbes at that point convert the sugars and amino acids into carbon dioxide, hydrogen, alkali, and natural acids. These microorganisms convert these subsequent natural acids into acidic corrosive, alongside extra alkali, hydrogen, and carbon dioxide. The methanogenicarchaea populaces assume a crucial job in anaerobic wastewater medications. It is utilized as a major aspect of the procedure to treat biodegradable waste and sewage muck. In this procedure the microorganisms helps in separating the biodegradable material without air. the pH level in the essential settling tank is expanded so as the initiated slop could respond with the gushing. the initiated slime is a natural ooze which is shaped at the base of the tank made by the expansion of dairy animals dunk & urea. The tank is fixed so no air enters it.

Aeration process includes air or oxygen being brought into a blend essential treated sewage joined with creatures to build up a natural floc which lessens the natural substance of the sewage. This material, which in solid ooze is a dark colored floc, is to a great extent made out of saprotrophic microorganisms yet additionally has a critical protozoan vegetation mostly made out of amoebae, Spirotrichs, Peritrichs including Vorticellids and a scope of other channel encouraging species. In inadequately overseen initiated slop, a scope of adhesive

filamentous microscopic organisms can create including Sphaerotilusnatans which delivers a muck that is hard to settle and can result in the slime cover.

The effluent water from the aeration tank now enters the secondary settling which may contain biological slag and suspended particles. The effluent is allowed to settle down the secondary settling tank after the effluent water comes from the primary settling tank the TDS level that is the total dissolved solids level increases due to the addition of ferrous sulphate and lime the most part of these chemicals are removed after the aeration process and the lesser amount of chemicals gets settle down in the secondary settling tank and are removed and disposed as slurry.

The process in the final settling tank is very simple the water from the secondary settling tank passes through the aerated pipe and reaches the final settling tank .The final settling tank has a micro pore mesh screen this screen is very small in size .when the effluent passes through the mesh screen the minor suspended solids which are entering the final settling tank with the effluent water gets trapped in the micro mesh screen.

The water from the final settling tank is let into the highly pressurised sand filter. This filtering is nothing but a tank filled with fine grained soil, the water is pressure forced into the tank this process helps a lot in purification of the effluent water.Then the soil filtering equipment is cleaned using reverse methods that is the water will be passed in a reversed method so the sand gets cleaned and the dirt goes into the secondary settling tank and removed as slag

The water after getting cleaned in the high pressure sand filter enters the carbon filter , this is a important method that is the carbon filter contains a material called activated carbon. This activated carbon helps in the complete removal of bad odour from the effluent water ,the activated carbon filter helps in removal of sulphates and chloride content in the effluents. Then the water is passed on to the r. o. feed sump

Reverse osmosis is the process of forcing a solvent from a region of high solute concentration through a semipermeable membrane to a region of low solute concentration by

applying a pressure in excess of the osmotic pressure. The largest and most important application of reverse osmosis is the separation of pure water from effluents.

The layers used for RO consume a solid layer in the polymer matrix moreover the skin of an uneven membrane or an inter-facially polymerized layer inside a light film compound layer where the departure occurs. In most cases, the membrane is designed to allow only water to pass through this dense layer, while preventing the passage of effluent waste. This procedure needs a high pressure that used on the high concentration side of the layer, usually 2–17 bar (30–250 psi) aimed at waste water, and 40–82 bar (600–1200 psi) used for seawater, which has about 27 bar (390 psi) normal osmotic pressure was necessity be overcome. There are two outlets in the RO process where one outlet gives treated water and the other outlet gives the waste from the treatment.

The rejected water from the RO purifier is now let into the solar drying pans this is a vast area the water is let to dry in the direct sun light and get evaporated. thus by this method there will be no water left to let into the rivers

4.2 CONCLUSION

The purpose of this study was to better understand environmental impacts of our actions on the local streams and rivers, the scientific studies of water quality and the understanding is to make the significance of the results. Water examination and analysing regularly is a very significant feature of water preservation and safety. Water is a vital resource that runs more quickly over time. To ensure continued supply of safe, clean drinking water, we must work together as a community to protect and to this vital resource by implementation of the above methods the water quality is very much improved that the water can be reused .Thus reducing the water requirement for the industry at a high scale. Since there is zero discharge of water into the river the water pollution from the dye industry is completely reduced. By introducing this techniques in dyeing industries water pollution can be reduced at larger rate and the requirement of water in industries is greatly minimised.

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