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A Review on Removal of Nitrtate and Phosphate from Wastewater

Dr. S. B. Thakare, Professor, APCOER, Pune, India.

Ms. Patil Poonam Satish, Student, APCOER, Pune, India, patilpoonam0901@gmail.com.

Abstract: **In modern days population increasing rapidly, due to increase population the usage of water is also increases and water is wasted in many ways. It is necessary to treat that wastewater and reuse it for various purposes. One of the way of wasting water is using water for washing cloth in large amount. Thus study of removal of water and making it harmless also making it reusable is very important and need of the day. We know that in detergent phosphate and nitrate is main component they are harmful to ecosystem, so it is necessary to remove it from wastewater. So in this paper we had carried out study of different methods to remove nitrate and phosphate from wastewater. We are studying low cost methods like by using different microalgae, wood and iron, bacterial culture etc. These materials are easily available. We are studying on different parameters for result like $B0D_5$, Nitrate and phosphate content, COD etc.We want to find out removing nitrate and phosphate from wastewater at maximum level and reuse it for various purposes.**

Keywords —Bacterial Culture, Detergent, Phosphate, Microalgae, Nitrate, Wastewater.

I. INTRODUCTION

One of the essential needs of human life is clean water to create healthy conditions for human life. For cleaning fabrics in the wash in laundry detergent product surfactant and other ingredients contains are used. To help the best to laundry cleaner, laundry detergent is added for first washing. Laundry detergents are available in two forms either in solid or in liquid but now a day's use of liquid laundry detergent is increased as compare to solid laundry detergents. We know the vary common examples of laundry detergent like various popular brands manufacture dissolvable packets and laundry soap in tablets form ,so it is necessary to eliminate the need to measure soap for each load of laundry. The rapid development of human activity is the result of increased nitrogen and phosphorous entering the groundwater and surface water resources. The removal of nitrogen and phosphorous from wastewater has become an emerging worldwide concern. Thus, it is necessary to have knowledge about removing nitrate and phosphate from waste water.

II. EASE OF USE

A. Avaibility of water

In this paper we have studied different methods for removal of nitrogen and phosphate. For the same reason we are focusing low cost treatment that are easily available in laboratory. Also we have studied three different methods. All three methods are used for removing nitrate and phosphate by using different easily available material like different plants, wood, iron, mixed microalgae and bacterial culture.

B. Availability of material

In this paper we are studying easily available materials like different plant those are available in wastewater treatment plant, woods and iron, cedar chips, chopsticks waste, Bacterial culture etc.

C. Avaibility of instruments

In this paper we are using easily available instruments like incubator, Spectrophotometer, trickling filter, Anoxic reactors, fluorescent lamps etc.

III. THEROTICAL CONTENT

A. Composition of laundry detergent.

Surface-active agent suggests that a heterogeneous and long-chain molecule containing each hydrophilic and hydrophobic moieties. By varying the hydrophobic and hydrophilic part of a surfactant, a number of properties may be adjusted, .g. wetting capacity, emulsifying capacity, dispersive capacity, foaming ability and foaming control ability. Surfactant having capacity to absorb at the surface/interfaces. One of the trademark highlights of the surfactant is their inclination to adsorb at the introduction of the surfactant atoms at the surface/interfaces, which thus decides how the surface/interface will be influenced by the adsorption of surfactant, it is possible that it will turn out to be more hydrophilic or hydrophobic. These properties give data on the sort and the system of collaborations including the surfactant particles at the surface/interface and its proficiency as a surface-dynamic specialist. The wetter or

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surface active is may be the foremost vital ingredients in each detergent formulation because:

1)Improves the wetting ability of water
2)Loosens and removes soil with the help of wash action
3) Emulsifies, solubilises

In laundry detergent nitrate and phosphate are main ingredient so we can understand that Nitrate and Phosphate are two main constituents of detergents which are very harmful to mankind and animals too. In this project we are mainly studying the elements and processes to eliminate or reduce Nitrate and Phosphate in water. We are mainly focusing on Municipal Wastewater and General Wastewater. In day to day lives huge amount of water in converted into wastewater due to various reasons. Thus, Cost is also a main constraint while studying the process of removal of Nitrate and Phosphate from water. We have studied on removal techniques like:

1. Chlorella Vulgaris, Spirulina Platensis & Scenedesmus Quadricauda
2. Bacterial Sulphate Reduction in an anoxic reaction,
3. Mixed Microalgae & Bacteria culture

IV. MATERIAL AND METHODS

A.

I. Sludge Collection[6]

For this research Sludge used was collected from the Indah Water Konsortium (IWK) wastewater treatment plant in Titiwangsa, Kuala Lumpur. The sludge transferred into a polymer container for storage but first sludge was filtered on-site with mesh. It can be obtained from the gravity thickener. .

II. Substrate Preparation[6]

The stored Sludge that was in a polymer container it can be at 4ºC. For use as substrate, the distilled water is used for dilution of to 20% the original concentration and transferred to 250 ml conical flasks (minireactors) for incubation. The substrate-containing minireactors were then autoclaved at 121ºC.

III. Algal Strains Culture[6]

For this research we are purchased plant from University of Malaya Algae Culture Collection (UMACC) like Chlorella vulgaris (CV), Spirulina platensis (SP) and Scenedesmus quadricauda (SQ).Chlorella vulgaris and Spirulina quadricauda were put in Bold's Basal Medium (BBM) while Sprirulina platensis was suspended in Kosaric medium .Incubator shaker used for the purchased culture at 37ºC and 150 rpm.

IV. Incubation[6]

After collection of strains transferred ten milliliters from each strain into the sterilized mini reactors in three section . The inoculated minireactors were then labelled as CV-1 , CV-2, CV-3 (C. vulgaris); SP-1, SP-2, SP-3 (S. platensis); and SQ-1, SQ-2, SQ-3 (S. quadricauda) while sterile sludge was used as control. After that The mini reactors were incubated in the incubator shaker at 150 rpm and 37ºC with an electric bulb as the light source for one week.

V. Data Collection and Analysis[6]

For nitrate and phosphorus content analysis .HACH DR/2400 spectrophotometer was used. By using the chromotropic acid method nitrate detection (mg/L,NO^{3-}N) was done, and for phosphate detection (mg/L,$PO^{4}_{3}{}^{-}$), the PhosVer TM 3 method. Absorbance for both tests was 410nm and 880 nm respectively. HACH DR/2400 used for testing of sample from each mini reactor was collected every 48 hours, and nitrate and phosphorus reading was taken. Maximum three times reading taken for both tests on each sample for accuracy.

VI. BOD5[6]

For 250 ml samples of wastewater sludge-one sterile and the others inoculated with an algal species each-were prepared for biochemical oxygen demand (BOD) analysis following incubation. All samples were saturated with oxygen using an air pump, and the initial dissolved oxygen (DO) level was taken using YSI 5000 DO meter for each sample. After 5 days of incubation in the dark, the final DO level was taken, and the difference between final and initial levels were recorded.

B.

Reactor and Experimental Procedure[3]

In this experimental procedure we are setup the trickling filter and anoxic reactors are shown in fig.1.By using the effluent from the final sedimentation basin of the conventional activated sludge process of the plant this reactor was operated and this reactor was located in sewage treatment plant (STP) in Kanazawa, Japan. for converting NH_4^+-N to NO_3^--N trickling filter packed with foam ceramics (Reactor 1) was used, for nitrification under aerobic conditions. Calcinations treatment of diatomaceous earth using iron and steel slag as waste materials is used for synthesized foam ceramics .The trickling filter prepared from round column having diameter 60 cm, 100 cm height and 283 liter total volume. Add cubes of the foam ceramics those having height, Length and width 5 cm up to top level of reactor. This foam ceramics working as a microbial supporting medium. The reactor was set up on a storage tank, and the effluent of the final sedimentation basin was supplied to the storage tank. The water in the storage tank trickled onto the reactor. The hydraulic retention time (HRT) of the reactor was 2.4 ± 1.8 h (mean ± SD). The recycle flow ratio was 8 ± 7.5 (mean ± SD).

Figure 1.Experimental set-up. The influent of Reactor 1 was the effluent from the final sedimentation basin of the conventional activated sludge process of the treatment plant. The influent of Reactor 2 was the effluent of Reactor 1. Reactor 2-1 was packed with cedar chips and iron. Reactor

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2-2 was packed with chopsticks waste (made of aspen wood) and iron.

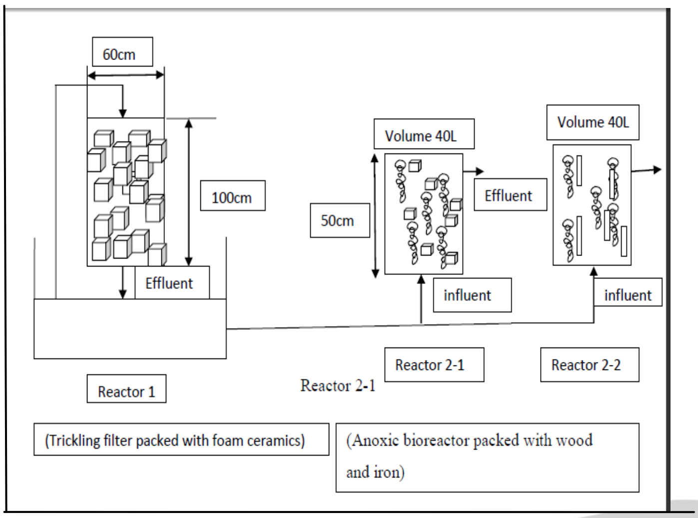


Fig.1Experimental set-up[3]

The anoxic reactors were used to convert NO3−-N to N2 for denitrification and to remove phosphate. The total volume of the 50-cm-high reactor was 40 L. The effluent of Reactor 1 was fed to the bottom of the anoxic reactors (Reactors 2-1 and 2-2). Reactor 2-1 was packed with 3.8 kg of cedar chips (10–30 mm wide, 5 mm thick) and 1.6 kg of iron coils (S55C, 0.5–1 mm wide, 0.1–0.2 mm thick). Reactor 2-2 was packed with 3.8 kg of chopsticks waste and 1.6 kg of iron coils. The chopsticks were made of aspen wood and had been used in restaurants and then discarded. The used chopsticks were rinsed with tap water and cut to approximately 100 mm high, 7 mm wide and 4 mm thick.

The return sludge collected from the STP was seeded in the reactors. Before the start of the experiment, Reactors 2-1 and 2-2 were operated under sulfidogenic conditions, in which 10 L of K2SO4 (300 mg/L of sulphate)-supplemented effluent from the final sedimentation basin was used as the medium. The medium was added to Reactors 2-1 and 2-2 once a week for 82 days. The HRTs of Reactors 2-1 and 2-2 were set at 6 to 24 h, depending on the nitrogen and phosphorus removal rates. Table 1 shows the HRTs of Reactors 2-1 and 2-2 during the present study's operational period. The influents and effluents of Reactors 1, 2-1 and 2-2 were collected once a week, at which time we measured the pH and the concentrations of sulphate, nitrate, nitrite, ammonium, organic acids, bicarbonate, total organic carbon (TOC), and total nitrogen (TN).

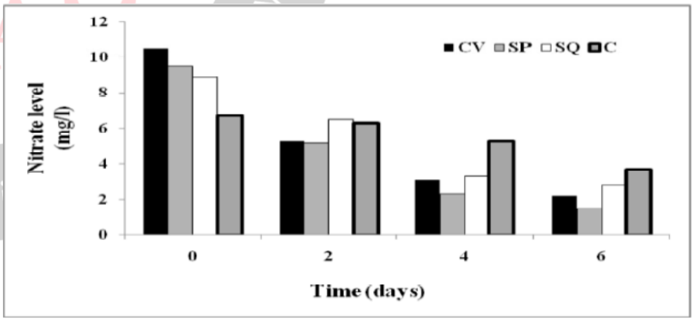
C.

[4]The microorganism biomass used in all group tests was acquired from a HRAP pilot plant in Pau (France).The microorganism like microalgae, microbes and other infinitesimal creatures gathered was initially permitted to acknowledge for two hr and consequently the settled solids were utilized as an "enhanced microorganism biomass inoculum".The wastewater gathered from another comparative pilot plant (Ouistreham France) was proceed through activity(2000g; ten min) used and utilized as a result of the nutrient medium for bunch experiments.

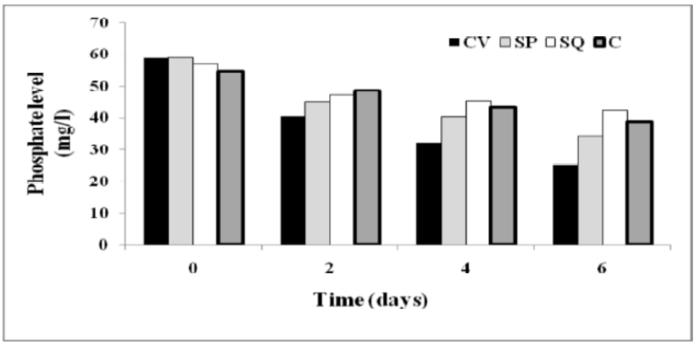
[4]The advanced microorganism biomass was accustomed inoculate (10% v/v) the processed supplement medium (2900 mL). This culture was consistently mixed (36-6 milimeter magnetic stirrer; hundred rpm) in an Erlenmeyer flask beneath continuous illumination (45 mmols-1m-2 at the culture surface with fluorescent lights, Biolux OSRAMJ 30W/ 965) and was kept at room temperature (approx. 20 °C). The constant mixing served to avoid geological phenomenon waste product characteristics. The municipal waste product (primary effluent) employed in the batch experiments was obtained from the body of water into the HRAP at Ouistreham (France).

V. EXPECTED RESULTS

A. After a week of incubation in MWS (pH 6, 37ºC, 150 rpm and 60 W lights) and four periodic readings, changes were observed in the nitrate and phosphate content of the mini reactors. Both nutrients displayed a general decrease in level within mini reactors inoculated with the three local strains CV, SP, SQ and C refer to Chlorella vulgaris, Spirulina platensis, Scenedesmus quadricauda, and Control respectively. Both Phosphate and Nitrate were decreased by 40 to 50 percent surveyed from the edge of progress from the underlying nitrate focus to the most reduced accomplished fixation in any of these smaller than normal reactors. After the observations (Graph I and II) showed that Spirulina platnsis showed better efficiency than others in nitrate removal and overall growth, for phosphorus removal Chlorella vulgaris gives better efficiency(shown in graph I and II).[6]



Graph I: Nitrate level in presence of different microalgae.



Graph II: Phosphate level in presence of different microalgae.

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B. The normal nitrification rate in the streaming channel was 0.17 kg N/m3·day and stayed at 0.11 kg N/m3·day notwithstanding when the water temperature was underneath 15 °C. The denitrification and phosphate expulsion rates in the bioreactor stuffed with aspen wood and iron were higher than those in the bioreactor pressed with cedar chips and iron. By using the bioreactor packed with aspen wood and iron easily remove nitrate and phosphate for >1200 days of operation. The nitrate removal activity of a biofilm attached to the aspen wood from the bioreactor after 784 days of operation was 0.42 g NO3-N/kg dry weight wood· day. There was no expansion in the measure of broke down natural issue in the outpouring from the bioreactors.[3]

C. Microalgae are able to change nutrients (nitrogen and phosphorus) from wastewater into biomass and bio-products, thus improving the sustainability of wastewater treatment. In High Rate Algal Ponds (HRAP), biomass productivity and water treatment efficiency are highly dependent on environmental parameters such as temperature, light intensity and photoperiod. The influence of temperature and photoperiod on biomass productivity and the removal of dissolved nitrogen and phosphorus from municipal wastewater by a native microalgae-bacteria consortium was assessed in batch cultures in view of the development of an HRAP at a larger scale.[4]

VI. CONCLUSION

It is concluded that in Detergent phosphorous and nitrogen are main component they are harmful to human and animal health so it is necessary to remove from water.

We can conclude that Spirulina platensis having more capacity to remove nitrate and showed those of others in nitrate, and in chlorella vulgaris having capacity to remove phosphorus. We can also concluded that Chlorella vulgaris and Spirulina platensis are working as leading species in basic nutrient treatment of wastewater, and the health, environmental and commercial benefits cannot simply be ignored. so we can said that these microalgae are ‘Waste to Wealth’ for our environment.

We evaluated the removal of phosphorus and nitrogen from the effluent of a sewage treatment, in an anoxic bioreactor over long-term operations. We examined the nitrification ability of a bioreactors packed with wood and iron as electron donors.

The influence of temperature and photoperiod on biomass productivity and by using native microalgae-bacteria consortium the removal of dissolved nitrogen and phosphorus from municipal wastewater was assessed in batch cultures in view of the development of an HRAP at a larger

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