Treatment of HKE's M.A.M. Hostel Wastewater by Three Stage Rotating Biological Contactor (RBC)

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Abstract— Due to global civilization and industrialization, there is a great demand for the water. A small fraction of the same is utilized and rest is being generated as wastewater. The disposal of such wastewater into water courses creates an adverse impact on the human health, flora and fauna. With the introduction of precise effluent standards it is the responsibility of wastewater engineer to treat the wastewater to satisfy the requirements of receiving body. Hence the safe disposal of such wastewater either on land or water bodies is the most challenging task before the engineers. This project is study to show the general wastewater characteristics collected from the HKE'S M.A.M, hostel and also to treat by attach growth process. The attach growth process considered for treating wastewater is Rotating Biological Contactor (RBC) model. Result showed removal efficiency for 40% submerged Rotating Biological Contactor (RBC) for Biochemical Oxygen Demand was efficient for rotational speed of disc at 4rpm after treatment and are within desirable limits of effluent standards as per CPCB, New Delhi.

Key words: Rotating Biological Contactor (RBC), Water

I. INTRODUCTION

P.D.A College of Engineering earlier known as H.K.E'S Engineering College, Kalaburagi was established in the year 1958. Great Educationist, Founder and then President of H.K.E Society, Late Shri Mahadevappa Rampure, felt the need of boy's hostel for the students of the college premises. He established Moulana Azad Memorial hostel in the year 1959 with financial assistance from Government of India. The foundation stone of the hostel was laid by Shri.Humayunkabir, Hon.minister for S.R& C.A.Government of India on 1st November 1959.The massive building, a marvel of architecture, having three floors in the stone masonry, measuring a plinth area of 53,000Sq.Feet having 200 rooms to accommodate 400 students was constructed in a land stretching to the extent of 30 acres adjacent to P.D.A College of engineering. The building was declared open on 5th February 1963 by Shri.S.Nijalingappa Honorable Chief Minister, Government of Mysore.

Hostel has well-furnished Dining Hall located near the main building surrounded by beautiful garden and lush green trees. A Mess to provide healthy food, Newspaper reading room ,Internet & computer center, Internet connectivity to the rooms, well-furnished Gymnasium, canteen and provisional Store, Telephone Booth, Basketball ground ,Shuttle Badminton court, Volleyball grounds. Table-tennis hall, double bar, roman rings etc. are the added features of the hostel [1].

Wastewater, also written as waste water, is any water that has been adversely affected in quality by anthropogenic influence. Wastewater can originate from a combination of domestic, industrial, commercial or agricultural activities, surface runoff or storm water, and from sewer inflow or infiltration. Municipal wastewater (also called sewage) is usually conveyed in a combined sewer or sanitary sewer, and treated at a wastewater treatment plant. Treated wastewater is discharged into receiving water via an effluent pipe. Wastewaters generated in areas without access to centralized sewer systems rely on on-site wastewater systems. These typically comprise a septic tank, drain field, and optionally an on-site treatment unit. All the wastes from food preparation, dishwashing garbage, toilets, baths, showers and sinks are the domestic wastewater. Therefore, the domestic wastewater, also called sewage, is the effluent from residential, institutional, and commercial. However, the wastewater is the complex mixture of liquid waste flused down sweres by residential, commercial, institutional and industrial sources[2].Wastewater can come from Human excreta (feces and urine) often mixed with used toilet paper or wipes; this is known as black water if it is collected with flush toilets. Washing water (personal, clothes, floors, dishes, cars, etc.), also known as greywater or sullage. Surplus manufactured liquids from domestic sources (drinks, cooking oil, pesticides, lubricating oil, paint, cleaning liquids etc.).Urban rainfall runoff from roads, car parks, roofs, Sidewalks/pavements (contains oils, animal feces, litter, gasoline/petrol, diesel or rubber residues from tires, soap scum, metals from vehicle exhausts, etc.) Highway drainage (oil, de-icing agents, rubber residues, particularly from tires). Storm drains (may include trash). Manmade liquids (illegal disposal of pesticides, used oils, etc.) Industrial waste. Industrial site drainage (silt, sand, alkali, oil, chemical residues). The disposal of such wastewater into water courses creates an ad-verse impact on the human health, flora and fauna. Hence the safe disposal of such wastewater either on land or water bodies is the most challenging task before the engineers [3].

II. MATERIALS AND METHODOLOGY

A. Sampling

The wastewater sample was collected from HKE's M.A.M Hostel, Kalaburagi, Karnataka. The wastewater sample was collected from the manhole (Fig 1).Wastewater is generated from the processes like food preparation, garbage grinding, dishwashing, showers, baths, sinks and toilets. Grab sampling of wastewater was carried out daily in the morning around 8am to 9am.Characterization of wastewater sample was conducted immediately after the sample arrived to the laboratory.

Fig. 1: Sampling point

B. Characteristics of Wastewater from Hostel

Wastewater was collected from HKE's M.A.M Hostel, Kalaburagi, and analyzed in college laboratory. The wastewater was treated using Rotating Biological Contactor. The Characteristics of wastewater used in the study are given (Table 1).

Sl. No	Parameter	Unit	Values Obtained
1	pH	-	8.34
2	BOD_5	mg/L	270

Table 1: Initial Characteristics of wastewater

C. Design of Reactor

The reactor fabricated works on the principle of attach growth process. The reactor is fabricated from material that is non corrosive, non-reactive and hence acrylic sheets of 3mm thickness were used. The individual tanks were created with an outer dimension 21×21×22.5 cm and inner dimension 20×20×21.5 cm. The reactor was provided with a groove opening of 3×2 cm and which is at a height of 20.5 cm from the bottom of the reactor. The inlet and outlet hole of the reactor was provided at a height of 18cm from the bottom and of 1cm diameter. A gap of 13cm was provided between two tanks of the reactor and the frame size is 110×22cm was provided to support the disc over shaft. The size of shaft is 2.5cm diameter which was supported along the frame with bushing and bearings on either side. There are 6 discs mounted over the shaft for each tank with the size of disc 18cm diameter and spacing of 1cm between two discs. To increase the surface area acrylic beads of size 0.5×0.5×0.5cm was provided on inner side of the disc and other four discs are plain without any acrylic beads. As disc was constructed with acrylic sheet it had smooth surface area to make it rough surface and for the attachment and growth of microorganisms it was provided with polyester cloth on four discs i.e. two plain discs for biofilm development and two discs modified with acrylic beads to increase the surface area and two with door mat material for biofilm development. Therefore, it was provided with total six discs for each tank of the reactor similarly in the same sequence the other two tank was constructed and was operated in series [4]. The cloth used is non-biodegradable material and DC motor was provided for rotation of discs (Fig 2).

Fig. 2: Fabrication of Three Stage RBC Reactor

D. Reactor Operation

The reactor was inoculated with 25% of cow dung in each tank. The wastewater was fed to feed tank with initial COD concentration 100mg/L later wastewater was released from outlet of feed tank to inlet of reactor and kept it for acclimatization for some period with disc continuously rotating with the help of motor. Disc was made to rotate so that microorganisms in biofilm should get acclimatized for 100mg/L of COD concentration. Later the reactor was operated for constant submergence of 40% with varying speed of 2rpm and 4rpm

III. Analysis

Samples from rotating biological contactor were collected and tested for pH, temperature, BOD. The analysis of wastewater was carried out according to standards prescribed by APHA and AWWA[7]

IV. Results and Discussion

A. Removal Efficiency (%) for 40% Submergence at a Rotational Speed of the disc at 2rpm:

During the study, 96.4% of BOD_5 reduction was observed at an optimum concentration of 640mg/L as shown (Fig 3).

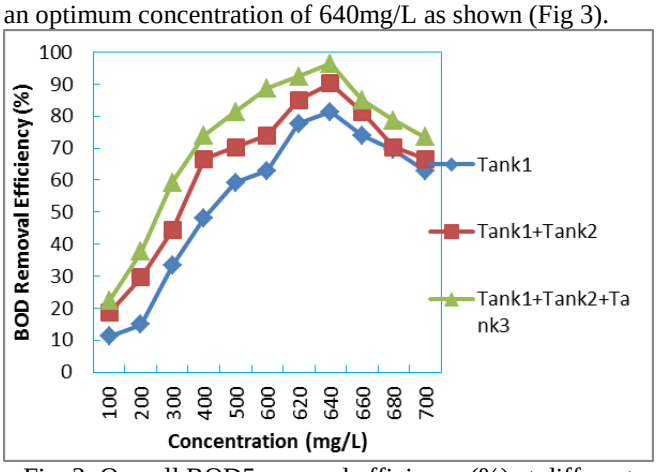

Fig. 3: Overall BOD5 removal efficiency (%) at different concentrations

B. Removal Efficiency (%) for 40% Submergence at a Rotational Speed of the disc at 4rpm:

During the study, 97.3% of BOD5 reduction was observed at an optimum concentration of 520mg/L as shown (Fig 4).

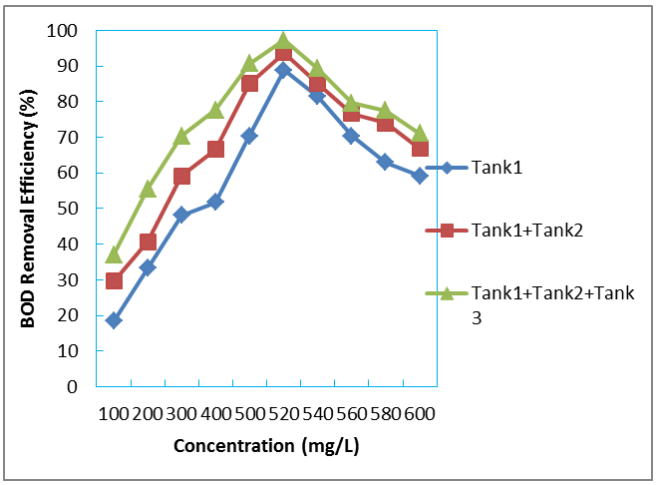

Fig. 4: Overall BOD_5 removal efficiency (%) at different concentrations

V. CONCLUSIONS

The following conclusions were obtained from the study carried out on "Treatment of HKE's M.A.M Hostel Wastewater by Three Stage Rotating Biological Reactor (RBC)".

At a rotational speed of the disc at 2rpm with 40%submergence:

1) At optimum BOD_5 concentration of 640mg/l at 2hrs HRT,the removal efficiency of BOD for the three stage RBC was 81.4%-Tank1, 90.2%- Tank1+Tank2and 96.4%-Tank1+Tank2+Tank3.

At a rotational speed of the disc at 4rpm with 40% submergence:

1) At optimum BOD_5 concentration of 520mg/L at 1hrs HRT, the removal efficiency of BOD for the three stage RBC was 88.8%- Tank1, 93.7% -Tank1+Tank2and 97.3%Tank1+Tank2+Tank3.
2) By comparing both the rotational speed of the disc with 40% constant submergence, it concludes that treatment of wastewater for physico-chemical parameters of 4rpm was efficient than 2rpm.
3) For small Sewage Treatment Plant (STP) three stage RBC reactor can be adopted in smaller dwellings like hostels, institutes and small scale industries.
4) The effluent can be used for many purposes like gardening, recreational activities etc. so it reduces the stress on water resources.

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