Mechanical Operational Purification System

Nadshri Ladke, Abhimanyu Bhanot, Nishant Badlu, Purva Naktode, Khushi Pawar, Prof. Pallavi S.Chakole
Civil engineering, Yeshwantrao Chavan College of Engineering (YCCE), Nagpur

***Abstract*- Rotating Biological Contactors (RBCs) are an exclusive option for removing biodegradable materials and nitrogen due to their viability, ease of design and operation, quick startup, low need for land area, low energy consumption, low operating and maintenance costs, and treatment effectiveness. Emphasis on performance-affecting factors like rotational speed, organic and hydraulic loading rates, retention time, biofilm support media, staging, temperature, influent wastewater characteristics, biofilm characteristics, dissolved oxygen levels, effluent and solid recirculation, step-feeding, and medium submergence. There are also reports of operating issues, scale-up and design considerations, and comparisons with other wastewater treatment systems for RBCs. Microorganisms flourish on the disc's surface, where the biological breakdown of wastewater contaminants occurs. Increasing organic load can be handled by rotating biological contactors (RBCs). Microorganisms must have access to both oxygen and food for survival and growth. The rotating discs draw oxygen from the atmosphere. Growing microorganisms accumulate on the media until shear pressures from revolving sewage discs cause them to be sloughed off. The sloughed biological solids in suspension settle as sludge after being processed through a clarifier with the RBC's effluent.**

Keywords-biofilm support media, rotating biological contactors (RBCs), purification.

I. INTRODUCTION

A Rotating Biological Contactor (RBC) unit, also known as a Rotary Biofilter, is a fixed bearing containing a group of rotating discs mounted on a horizontal axis. They are partially submerged and rotate as wastewater flows through them. In wastewater treatment plants, they are used as a secondary treatment after the initial problem of domestic gray or black water or another biodegradable wastewater. Turning the microbial community into air and wastewater, "rotating biological contactor" tubing that decomposes dissolved organic pollutants and nutrients through aeration and assimilation has long been reliable and reliable for wastewater treatment, making us one of the leading manufacturers. In the last 30 years of the company's development, we have improved technology and constantly innovated products.

The Principle of the Rotating Biological contactor is such that “wastewater is treated using a microbial film attached to a disc. The disc rotates slowly so that about 40% of its surface flows above on the wastewater". The aerobic decomposition of pollutants is accomplished by the absorption of oxygen from the air and pollutants from the wastewater. As new microbes grow on the disc, old microbes with reduced activity fall off the disc. Rotating Biological Contactor or RBC is a biological treatment process used to treat wastewater after primary treatment. The main treatment is to remove impurities, suspended solids, dissolved solids, and turbidity from the screening process. The RBC process allows wastewater to enter a biofilm to remove contaminants from wastewater before it is released into the environment. The Rotary Bio-contactor is a secondary (biological) action toward the procedure. It consists of a series of interconnected columns attached to a rotating shaft that supports the wastewater surface. Bacteria thrive on the surface of the discs where wastewater biodegrades.The (RBC) can withstand fluctuations in organic load. To thrive, microbes need both oxygens to survive and food to grow. As the disk rotates, it takes oxygen from the air. As the bacteria grow, they are kept in the environment until they are sheared away from the rotating disc in the sewer system. The waste from the RBC is then passed through the clarifier, Bio solids arrive as suspended sludge.

II. RELATED WORK

[1] (P Kadu, A Badge, Y Rao 2013) Oxygen transferred through the water film developed in the rotating disc revealed that the oxygen transfer coefficient varies with the rotational speed of the disc and the location of the exposed surface of the rotating disc.

[2] (N Delgado, A Navarro, D Marino, Gustavo A Penuela, A Ronco.2016) For the success of the rotating biological contactor unit Micro-organisms need both oxygen to live and food to grow. As the rotating disc rotates the oxygen is obtained from the atmosphere. Microorganisms are built up on the media as they grow on the disc.

[3] (Aditya Kamath, Onkar Kharat, Rupesh Mehta, Shardul Kalsekar, Dipali Patil. 2018)The safe disposal of wastewater is carried out by minimizing the cost of the treatment process. The RBC system was experimented as an efficient process for treating high strength organic wastewater under fixed rotational speed of 4 rpm.

[4] (Ankul R.Ghume, Prof. Swati Jadhav, 2009)The results in these studies show that RBC is a superior technology for the aerobic oxidation process. The removal rate of COD for cotton clothes are in the range of more than 50-60%, and for scrubbers the removal rate of COD is in between more than 6-18 %.

5) (G.D. Najafpour, A. Ebrahimi and M. Asadi, 2009)The dairy wastewater is used specifically in this study to obtain the results. The 8mm thick acrylic transparent plastic sheet is used as media carry out the treatment.

6) (Prashant A. Kadu, Rajshree B. Landge and Y. R. M. Rao, 2013)The simplicity to maintain and operate, low energy consumption RBC is considered as an efficient method for the treatment.

7) (W. Blanken, M. Janssen, Z. Libor, 2014)Micro algae biofilm can be used as the production platform for the micro algae biomass. In this study a bioreactor referred to as micro algae grows in biofilm on vertically rotating disc partially such submerged.

8) (Anil Chavan, Suparna Mukherji,2008)The hydrocarbon rich industrial wastewater is treated using heterotrophic microorganism. The reactor can feed with oil degrading bacterium burkholderia cepacia and oil tolerant phototrophic microorganism.

9) (Sharjeel wakas,2021) The polyvinylidene membrane outperforms the polysulfone membrane during the treatment. High biological performances were achieved irrespective of the membrane materials. Dull scale energy consumption projection results show that the MRB's consume only one -fourth of the energy of a referenced membrane bioreactor.

10) (k. Egli, F bosshard, C. Werlen, H. Siegrest,2003)The huge amount of nitrogen losses was observed during the treatment using rotating biological contactor.The composition and spatial structure of microbial community biofilm on RBC was analyzed with specific attention.

11) (Mahetab A. Mohamed, Hanan A. Fouad, Rehab M. Hefny,2022)The conclusion from this research is obtained as the rotational speed is the key factor affecting the removal rates for COD,BOD and TSS at 5 RPM.

12) (S. CortezP. Teixeira R. Oliveira M. Mota,2008)In this research RBC media evolved considerably from its original design including several rotating discs into a unit filled with some lightweight packed supports.

III. METHODOLOGY

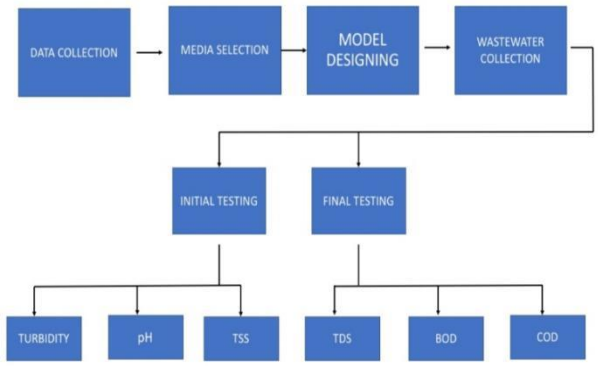

Fig no.3.1

In this project we have done comparison of four different medias to analyze their treatment capability and to identify better media to be used for the treatment of dairy wastewater using Rotating Biological contactor. The RBC unit model was designed in a very convenient way. The base of a model consists of the square shaped Iron tank, which is to be filled with dairy wastewater, two plastic rollers are fitted in the iron tank and the iron tank chamber is divided into four parts. Four different medias were attached to the plastic rollers in four different chambers for the treatment of a dairy wastewater.

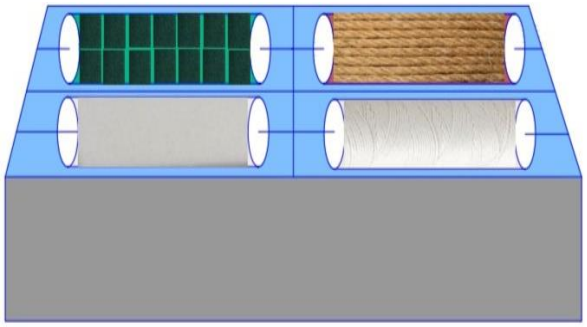

Fig no.3.2

The connecting wires and rotors are connected to the iron tank for the working and revolution of plastic rollers which gave revolution in the time of 5 rpm. The taps were attached to the square shaped tank for the outflow of a dairy wastewater. The dairy wastewater was collected from the small-scale Industry and was poured into the square shaped iron tank. Below initial testing was carried out on the dairy wastewater which showed that the wastewater was turbid, impure, and acidic in nature, The rotating biological contactor unit model was continuously working straight for 48 hours with continuous supply of electricity. After the stipulated time was finished, the final test got underway on four different water samples through four different media. These water samples were reviewed in the lab and

underwent several tests in order to compare and identify the most common media out of the four.

IV. TESTING

We have taken the dairy wastewater sample and conducted initial and final wastewater testing.The test was conducted in the laboratory, later we got the result of the test. Testing will categories into the bellow categories:

1. Initial Testing
- TURBIDITY
- PH
- TSS

2. Final Testing
- TDS
- BOD
- COD

The description of the testing is as follows:

1. pH Range of Acidic water: We provided the lab with dairy wastewater. Dairy waste water was initially tested, and the pH result showed that the wastewater sample was acidic in nature.

2. TDS: Total Dissolved Solids (TSD) is essentially a measurement of a molecule that is not HO dissolved in water. Because it is solid, when water encounters soluble solids, particles of these solids are absorbed into the water, causing the entire solution to dissolve.

3. TSS: Total Suspended Solids (TSS) are particles larger than 2 microns found in water columns that contain coarse particles such as clay, sand, minerals, and metals. They also contain bacteria and algae and can cause diseases. The removed items are large enough to settle inactively.

4. COD: Chemical oxygen demand (COD) is the amount of oxygen required to chemically oxidize organic and inorganic compounds in wastewater using oxidants such as potassium permanganate and potassium dichromate. The presence of COD facilitates the rapid oxidation of organic matter without additional equipment. This is the only method that can determine the organic load in wastewater.

5. BOD: - Biological Oxygen Demand (BOD) is defined as the amount of oxygen needed by bacteria in the sewage to decompose biodegradable substances under aerobic conditions. It is generally used to determine the organic quality of municipal or organic water.

6. TURBIDITY: We took the dairy wastewater to the laboratory and learned that there was turbidity first, the turbidity was removed from the wastewater by RBC treatment.

V. RESULT

Based on the study of the four different medias used in the rotating biological contactor unit, we have obtained the results of these four medias based on the different tests conducted on the wastewater sample. We have obtained the initial results of the different tests conducted on the dairy Wastewater. The different tests conducted are pH test, Total suspended solid test, biochemical oxygen demand test, Turbidity test,Total dissolved solid test and chemical oxygen demand test.

SR.NO	TESTS	Test Method	Unit of measurement	RESULTS
1.	pH	IS 3025(Part 11)-2022	-	5.27
2.	TSS	IS 3025(Part 17)-2022	mg/l	686 mg/L
3.	BOD	IS 3025(Part 44)-1993	mg/l	210 mg/L
4.	COD	US EPA 410.4	mg/l	1358 mg/L
5.	TURBIDITY	IS 3025(Part 10)-1984	NTU	780 NTU

Fig no. 5.1

The initial test results of the dairy Wastewater are, pH of the wastewater comes out to be 5.27 which indicates the wastewater is acidic in nature, the total suspended solids come out to be 686 mg/L. The biochemical oxygen demand comes out to be 210 mg/L. The chemical oxygen demand of the dairy wastewater comes out to be 1358 mg/L and the turbidity of the dairy wastewater comes out to be 780 NTU which indicated that the dairy waste water was turbid in nature and needs to be treated.

SR. NO	TESTS	Test Method	Unit of measurement	01 Fish filter	02 Scotch brite	03 Sack rope	04 Cotton thread
1.	pH	IS 3025(Part 11)	-	7.82	7.85	7.88	7.75
2.	TDS	IS 3025(Part 16)	mg/l	653	709	528	500
3.	TSS	IS 3025(Part 17)	mg/l	49.0	28.5	37.2	36.8
4.	COD	IS 3025(Part 58)	mg/l	320	328	192	236
5.	BOD	IS 3025(Part 44)	mg/l	150	140	80.0	100

Fig no.5.2

The final test results for the four different medias used in the rotating biological contactor unit comes out as the dairy wastewater treated by the sack rope is most basic in nature compared to the other three medias as the pH value is 7.88 which is greater than the pH value of the other three medias. The amount of total dissolved solids comes out greater for scotch brite media which is 709 mg/L.The total suspended solids are greater in fish filter media which comes out to be 49 mg/L. The chemical oxygen demand was more for scotch brite media which is 328 mg/L and the biochemical oxygen demand is more for the fish filter media which is 15mg/L.

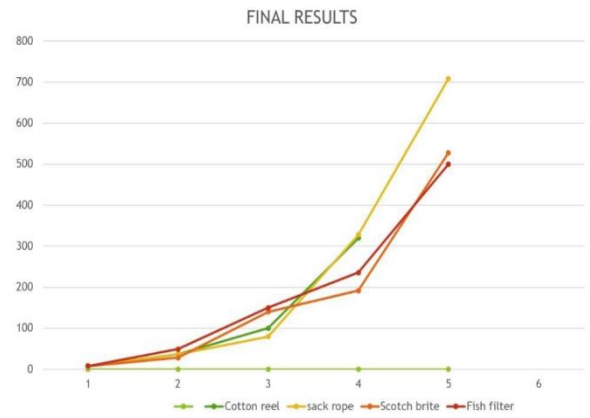

Fig no. 5.3

The outcome of the final result comes out as sack rope is one of the relevant and best media for the secondary treatment of a dairy wastewater among all the four medias used for the treatment.

VI. CONCLUSION

Rotating biological contactor unit have been used widely in different waste water treatment process. However, because of the complex pattern of flow where aeration, oxygen and nutrient mass transfer, growth attachment of biofilm and suspended biomass must be considered. Some models with many limitations have been proposed to elaborate the working of these type of reactors. This design of rotating biological contactor unit is not fully mastered, further studies on medias and biofilm properties should be carried out. Rotating biological contactor unit have been mainly used in the aerobic process.

In this unit the medias are evolved considering the original design of several rotors into a unit with some lightweight packed supports. As rotating biological contactor unit is relatively recent there are not many studies for the physical characteristics of the unit. Beside studying of the unit, the properties of all the medias also need to be studied and investigated for each type of medias. Much recently, submerged aerobic rotating biological contactors can be used successfully at full scale to treat wastewater for the secondary treatment including dairy Wastewater from small scale industry constituting a promising technology. Moreover, several improvements in the rotating biological contactor unit can be expected in terms of different medias. Until now few experiments were carried out for the treatment of wastewater using rotating biological contactor unit. On the other hand, laboratory scale studies of RBC unit have been showing much more nitrate removal efficiencies. The application of these force selected medias can have important role in secondary treatment of wastewater and must be encouraged. Several modifications can be expected regarding recycling to improve the performance of rotating biological contactor unit.

VII. FUTURE SCOPE

The rotating biological contactor can be used for secondary treatment of wastewater in various industries including small scale industries and segments,it is a treatment process which does not require any complex maintenance procedures and it does not have a higher cost of maintenance as well, it can be easily maintained and at a very minimal cost, apart from this, the Rotating Biological Contactor is as effective as the other counterparts that are currently being used in the secondary treatment of wastewater in various industries. Another key element of the Rotating Biological Contactor is that, unlike the other processes available to the industries, it gets better and more effective in the treatment procedure as more and more organic matter feeding bacteria reproduce on the media provided on the drum roller, whereas the counterparts tend to lose their effectiveness with passing of time and repetitive uses of the apparatus.

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