International Journal of Engineering Research and Reviews ISSN 2348-697X (Online)
Vol. 3, Issue 3, pp: (16-19), Month: July - September 2015, Available at: www.researchpublish.com

Treatment of Dairy Wastewater using PVA Hydro-Gel

[1]Pawan G. Ramteke, [2]Omkar P. Gurav, [3]Karan N. Khirade

[12]B.Tech (Environmental Science and Technology), Department Of Technology, Shivaji University Kolhapur, India
[3]B.Tech (Chemical Technology), Department Of Technology, Shivaji University Kolhapur, India

Abstract: **In this article, treatment of dairy wastewater using PVA Hydro-Gel as a Moving Bed Bio-Mass Carrier has been discussed. Dairy industries have shown tremendous growth in size and number in most countries of the world. These industries discharge wastewater which is characterized by high C.O.D, B.O.D, nutrients, and organic and inorganic contents. Such wastewaters, if discharged without proper treatment, it will affect Environment as well as Human-Health[2]. The objective of the research was to evaluate the performance of a laboratory-scale biological treatment unit for dairy-industry Wastewater by using PVA-Gel. Pre-treatment was the first phase of PVA-Gel Treatment Unit. The aim of pre-treatment process was to let the biomass present in wastewater get attached on gel and grow inside gel. Pre-treatment was given to gel for 30 days. Second Phase of Treatment unit was Bio-Reactor. A Bio-Reactor was fabricated using Fiber glass with height 25cm, width 15cm and length 30cm & capacity 11 liters. One Liter Pre-treated Gel and 10 liter wastewater from primary clarifier was introduced in the Bio-Reactor. They were properly mixed and aerated using diffuser. Batch Process was adopted for treatment and the Batch samples taken for analysis had retention time of 8, 10, 12 hrs. The BOD & COD Level Reduction of samples having Retention Time 8, 10, & 12 hrs, a decline was observed for BOD from 1200mg/lit to 325, 150, & 75 mg/lit & for COD from 1700mg/lit to 500, 326, & 78 mg/lit. Reduction in biological treatment time with low Sludge volume production was observed.**

Keywords: **Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Moveing Bed Bio-Film Reactor (MBBR), Poly-Vinyl Alcohol (PVA).**

I. INTRODUCTION

Dairy is one of the industries producing wastewater characterized by high biological oxygen demand (BOD) and chemical oxygen demand (COD) concentrations, and generally contain fats, nutrients, lactose, as well as detergents and sanitizing agents. Dairy effluents decompose rapidly and deplete the dissolved oxygen level of the receiving streams immediately resulting in anaerobic conditions and release of strong foul odour due to nuisance conditions. The receiving water becomes breeding place for flies and a mosquitoes carrying malaria and other dangerous diseases like dengue fever, yellow fever etc and so as human health is compromised. It is also reported that higher concentration of dairy wastes are toxic to certain varieties of fish and algae. The casein precipitation from waste which decomposes further into a highly odorous black sludge at certain dilutions the dairy waste is found to be toxic to fish also. Dairy effluent contains soluble organics, suspended, solids, trace organics. They do increase & promote release of gases, causeing taste and odour, impart colour or turbidity, and promote eutrophication [2].

Dairy wastewaters are generally treated using biological methods such as Activated Sludge Process, Aerated lagoons, Trickling Filters, Sequencing Batch Reactor (SBR), Up Flow Anaerobic Sludge Blanket (UASB) reactor, Anaerobic Filters, Moveing Bed Bio-film Reactor (MBBR) etc. Oftentimes the post-treatment of dairy wastewater is also done using the physico-chemical treatment methods consisting of coagulation/flocculation by various inorganic and organic natural coagulants, and membrane processes like nano-filtration (NF) and/or reverse osmosis (RO). Membrane processes produce purified water without milk proteins and lactose and which could be recycled. At the same time the recovered proteins and lactose can be used for non-human consumption [2].

PVA Hydro-Gel is a Moveing Bed Media. PVA Gel is composed primarily of polyvinyl alcohol, PVA gel has a porous, reticulate structure that can trap and carry microorganisms. PVA gel is used for removal of common organic compounds. In addition, PVA gel technology can be effectively used for removal of Nitrogen and Phosphorus from the wastewater. It has very high water content due to its extensive porosity, thus allowing for favorable permeability of oxygen and nutrients to the bacteria colonized inside the beads. It has a network of minute pores about 20 microns in diameter. PVA gel media is excellent for sludge reduction due to lesser amount of biomass yield and higher endogenous decay rate of that sludge. PVA gel can also be used for nitrification and de-nitrification as well as treatment of various industrial pollutants. It consists of beads, each bead have a diameter of 4mm can hold up to 1 billion microorganisms. PVA gel is insoluble in water and is non-biodegradable. It has excellent fluidity in water and requires minimal energy for mixing. Each bead can hold up microorganisms up to 1 billion [7].

The main objective of this research was 1. To study the treatability of dairy industry wastewater using PVA Gel. 2. To reduce COD level. 3. To reduce BOD level. 4. To treat wastewater in less time (to reduce retention time).

II. MATERIALS AND METHODS

A. Materials:

The model used in this study was constructed of Fiber Glass and had an length of 30 cm, width of 15 cm. The height at which outlet was provided is 25 cm. The volume of tank is 11 liters. Outlet was provided with strainer so that gel does not get drained out of tank. The reactor was fitted with four Strip diffuser of 15 cm in length, attached to three compressors so that proper aeration can be provided to assure gel don't get settled at the bottom.

PVA gel is made up of polyvinyl alcohol. For experimental purpose PVA gel was provided by SBS Enviro Concepts Navi Mumbai. The PVA-gel beads used as the biomass carriers consisted of 4-mm diameter spheres with a solids content of about 10% and specific gravity of 1.025 (Kuraray Co., Osaka, Japan). Each bead has a diameter of 4mm.It has a specific gravity of 1.025±0.01. It has a network of minute pores about 20 microns in diameter. Each bead can hold up to 1 billion microorganisms. Other features of PVA Gel include Extensive Porosity, Oxygen Permeability. Water-insoluble, Fluidity in water, Non Bio-Degradable & also PVA gel has no effect on Temperature, Acid & Bases.

B. Methods:

B.1 Pretreatment

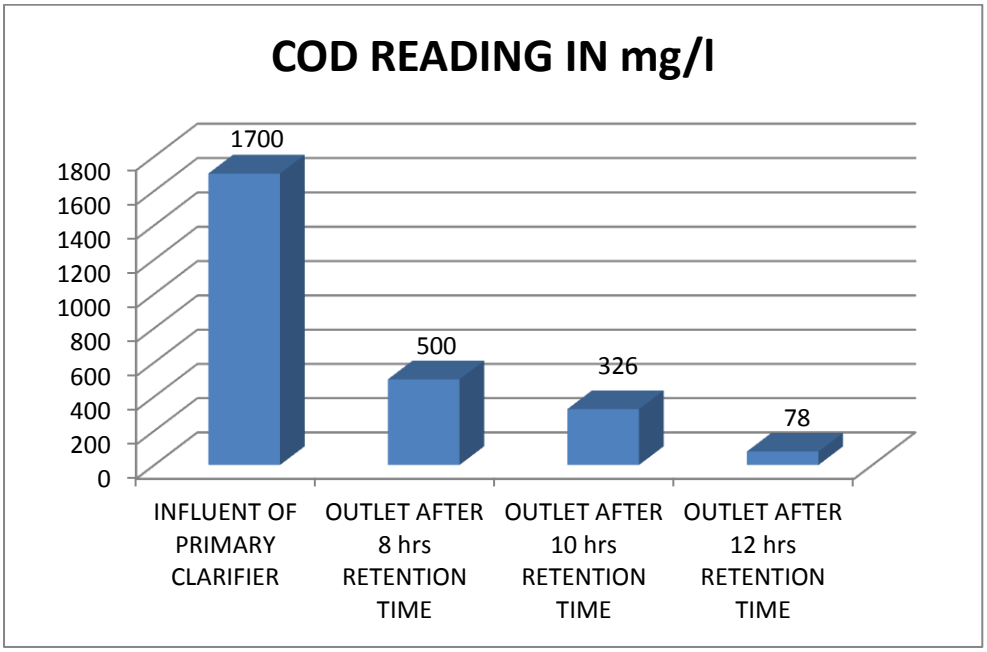
Pretreatment was the first phase of treatment unit. Pretreatment was done to increase the biomass and let the biomass get attached on gel. The aim of pretreatment process was to let the biomass present in wastewater get attached on gel and grow inside gel or both and to Reduced the actual Time-Span required by Biomass to grow & get attached on gel which is normally 3-4 months. In pretreatment phase the gel (PVA) and the wastewater sample from Gokul dairy Kolhapur was mixed and was introduced in a cylindrical container having capacity of 2.5 liters. One liter of gel in volume, two liter wastewater sample from primary clarifier and 250 ml of activated return sludge was mixed thoroughly and then introduced in the container. This mixture was aerated by using two compressor machines used in fish aquarium. Diffuse aeration was provided by using stones linked with compressor machines. The wastewater from container was changed partly everyday (after 24 hrs). Half wastewater volume from container was removed every day with the help of Strainer so that gel does not drain out from the container and refilled with primary w/w secondary w/w & activated sludge. Pretreatment was given to gel for 30 days. Colour of gel used before pretreatment was white and after pretreatment it changed into light brown in colour.

B.2 Bio Reactor

After pre-treatment phase the pre-treated gel was introduced in the reactor with10 liter wastewater volume from primary clarifier was introduced in Reactor. The Gel and Wastewater were properly mixed and aerated by using diffuser. Air mixing filter was used to create turbulence in water so that gel does not settle at the bottom. Tests of inlet sample were taken before introducing it in model. Batch Process was adopted for treatment and the Batch samples taken for analysis had retention time of 8, 10, 12 hrs. 8 liter sample from tank was removed after treatment time of 12 hrs & Tests were taken after treatment of 12 hrs. Again 8 litres sample of effluent of primary clarifier was introduced to reactor. Same process was repeated for treatment time of 10 hrs, 8 hrs.

III. RESULTS AND DISCUSSION

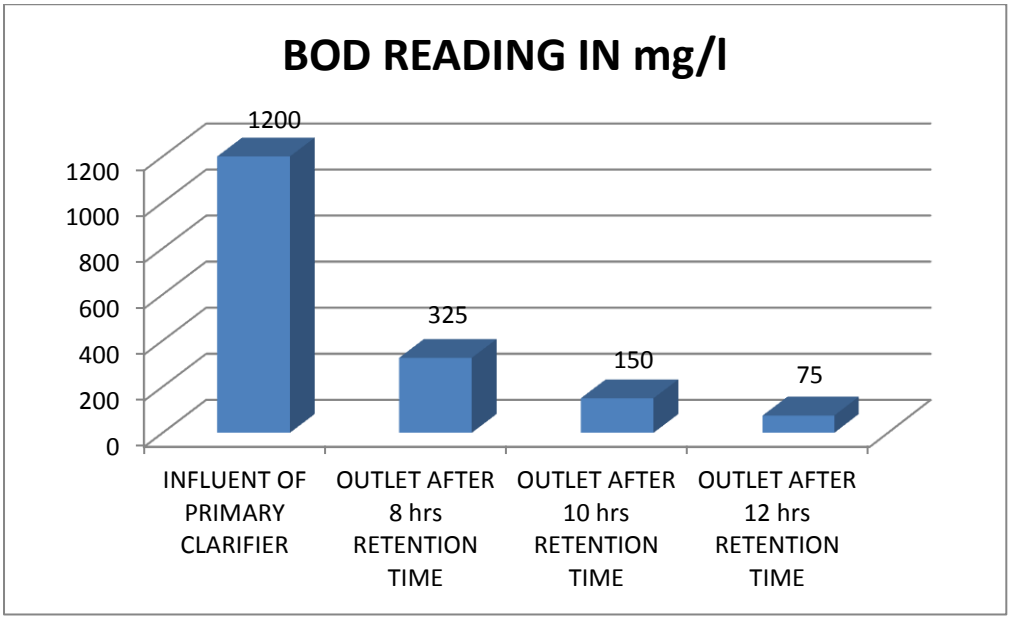
A. Reduction in C.O.D Level:



Graph no 1. C.O.D Readings

There was a drastic reduction in COD level after PVA Gel treatment was provided. After treatment the COD level of primary clarifier influent, which was 1700 mg/lit reduced considerably. It can seen in above graph that the COD of bioreactor outlet after 12 hrs retention time is 78 mg/lit. Analyzing above graph COD is efficiently removed in 12 hrs retention time as compared to 6, 8, & 10 hrs retention time.

B. Reduction in BOD level:



Graph no 2. B.O.D Readings

There was reduction in BOD level after PVA Gel treatment was provided. After PVA Gel treatment was given the BOD level of primary clarifier influent, which was 1200 mg /lit, reduced considerably. It can seen in above graph that the BOD level of bioreactor outlet after 12 hrs retention time is 75 mg/lit. Analyzing above graph BOD is efficiently removed in 12 hrs retention time as compared to 6, 8, & 10 hrs retention time.

IV. CONCLUSION

It was found that PVA Gel is an efficient technology for treating dairy wastewater as compared to other treatments in several aspects. Drastic reduction in B.O.D (Biological Oxygen Demand) level occurred and was found to be 75 mg/lit with removal of 90-95 percent. C.O.D (Chemical Oxygen Demand) level reduction was also observed to 78 mg/lit with removal of 95 percent in 12hrs retention time. Reduction in the retention time of wastewater can be achieved by using PVA Gel Treatment as compared to any Dairy Industry providing normal treatment. PVA Gel Treatment requires excess diffuse aeration to create turbulence so that gel does not settle at the bottom and move freely in the tank. Sludge volume production is low while giving PVA Gel Treatment. The actual time required for biomass growth on & in PVA Gel can be reduced by Pre-treatment. Pre-treatment led four months time span of culture growth on gel complete in one month.

REFERENCES

[1] Harush D. P. et al (2011)**,** "Treatment of dairy wastewater using aerobic biodegradation and coagulation" International Journal of Environmental Sciences and Research Vol. 1, No. 1, 2011, pp. 23-26.

[2] Mrs. Bharati S. Shete. et al (2013), "Comparative Study of Various Treatments For Dairy Industry Wastewater" IOSR Journal of Engineering (IOSRJEN) e-ISSN: 2250-3021, p-ISSN: 2278-8719 Vol. 3, Issue 8 (August. 2013), ||V4|| PP 42-47.

[3] Borkar R.P. et al (2013), "Moving Bed Bio-film Reactor – A New Perspective in Wastewater Treatment" IOSR Journal Of Environmental Science, Toxicology And Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p-ISSN: 2319-2399. Volume 6, Issue 6 (Nov. - Dec. 2013), PP 15-21.

[4] Brinkley John, "moving bed bio film reactor technology – a full-scale installation for treatment of pharmaceutical wastewater."

[5] Hideki Yamamoto. et al (2003), "Novel Treatment Process of Harmful Organic Materials in Waste Water Using Temperature-Sensitive Gel Synthesized from PVA" Materials Transactions, Vol. 44, No. 12 (2003) pp. 2436 to 2440 Special Issue on New Systems and Processes in Recycling and High Performance Waste Treatments @2003 The Japan Institute of Metals.

[6] Yang Qiqi. et al (2012), "Review on Moving Bed Bio-film Processes" Pakistan Journal of Nutrition 11 (9): 706-713, 2012 ISSN 1680-5194 @ Asian Network for Scientific Information, 2012.

[7] J.D. Rouse. et al (2005), " PVA Gel Beads as a Biomass Carrier for Anaerobic oxidation of ammonium in Packed Bed Reactor" HELECO '05, TEE, Αθήνα, 3-6 Φεβρουαρίου 2005.

[8] Dr. A. S. Kolhe, et al (2008), "Effluent of Dairy Waste & Technology" (International Research Journal)— ISSN-0974-2832 Vol. II, Issue-5 (Nov. 08- Jan. 09).

[9] Jai prakashkushwaha, et al (2011), "An Overview of Various Technologies for the Treatment of Dairy Wastewaters" Critical Reviews in Food Science and Nutrition, 51:442–452 (2011).

Books used:

[10] Metcalf and Eddy. (2004) Wastewater Engineering Treatment, Disposal and Reuse, 4th edn, McGraw-Hill New York. pp 704–16.

[11] Kanwaljit Kaur (2008) Handbook of Water and Wastewater Analysis, Mahalaxmi Publications Pune.