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Post-Treatment of UASB Effluent by Slow Sand Filtration

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Abstract: The study was carried out to evaluate the feasibility of slow sand filtration for the post treatment of rice mill effluent from a Up-flow Anaerobic Sludge Blanket reactor. The post treatment of UASB effluent is a necessity since the reactor can lower mainly BOD & suspended solids in waste water. Laboratory filter column of 10.7cm internal diameter and 53cm sand media depth was used in this study. In this study filtration is done using single media (sand) and dual media (sand+Rice Husk Ash). It was found that slow sand filtration is most effective at an head of 85cm and at a filtration rate of 0.1m/hr. It is capable of removing 72% of COD (single media) and 83.5% of COD (dual media) in the case of synthetic waste water & is capable of removing 65% of COD (single media) and 78.8% of COD (dual media) in the case of actual waste water.

I. INTRODUCTION

WATER is the most precious natural resource that exists on our planet without which human survival is impossible. About 97% of water on the earth is salt water, and only 3% is fresh water of which slightly over two thirds is frozen in glaciers and polar ice-caps. As human population goes on increasing, urbanization and industrialization also increases, hence the water resources are getting depleted at a faster rate. Conservation of the available water is the only solution for this great problem. When properly treated waste water effluent can become a feasible solution for various recreational purposes like gardening, irrigation as well as for safe discharge.

There are different methods for secondary treatment of waste water such as biological filtration, activated sludge process, rotating biological contactor, stabilization ponds and anaerobic stabilization units [3]-[6]. Up flow Anaerobic Sludge Blanket (UASB) reactor utilizes the principle of anaerobic treatment that requires no oxygen and therefore no energy input is required and the reactor in turns yields energy in the form of biogas.

The UASB effluent generated from a rice mill is having high pollution potential. Characteristics of the effluent are mainly its organic content, color and temperature. These effluents do not contain any toxic compounds. But continuous discharge of the same to soil or any water body may cause adverse environmental impact. The stagnant water emits off odour due to fermentation. The growth of natural flora can also get affected by the effluent. Since this effluent is rich in nutrients it encourages the growth of algae. Eutrophication results in low dissolved oxygen and quality of water is decreased which affects the aquatic life. Due to the color and turbidity of water, penetration of sunlight into water body decreases which affects the photosynthesis. Hence there is every chance of pollution of the receiving body if it is discharged without proper treatment. Hence post treatment of UASB reactor effluent helps the waste water to reach the discharge limits as specified in Indian standard.

Different post treatment methods for treating UASB effluent includes-rotating biological contactor[3], two stage floatation & ultra violet disinfection[4], activated sludge reactor[5], aeration by fine pore submerged diffusers[6] most of these process require high energy input, huge capital cost for operation and maintenance, large amount of sludge production and requires skilled supervision.

Comparing the factors such as operational simplicity, cost and effluent quality slow sand filtration can be considered as one of the most promising post treatment options [1]. The concept of utilization of one waste material to control pollution caused by another is of great significance in the remediation of environmental problems. Use of waste material is of great interest as these are available almost free of cost and cause major disposal problem. If the solid waste could be used as low cost adsorbents it will provide a twofold advantage to environmental pollution. Firstly the volume of waste materials could be partly reduced and secondly the low cost adsorbent if developed can reduce the pollution of waste water at a reasonable cost. Rice husk is a waste material generated from the rice mill disposal of which causes environmental problems. When rice husk is burned at a controlled temperature rice husk ash is generated which is eco-friendly and has many applications [2].

II. METHODOLOGY

A. Characteristic study of waste water

Waste water from pavizham Rice mill, kalady was taken for the study. Samples were collected initially for analysis and later for filtration through sand filter column. The waste water characteristics are listed in the Table 1

CHARACTERISTICS	VALUE
pH	6.31
Turbidity	133 NTU
Total suspended solids	538 mg/l
Total dissolved solids	1980 mg/l
Alkalinity	8000 mg/l
Chemical oxygen demand	336 mg/l
Biochemical oxygen demand	171 mg/l
Colour	Black

Table 1. Characteristics of UASB effluent from rice mill

B. Preparation of synthetic waste water

Synthetic waste water was prepared in the laboratory mimicking the characteristics of actual waste water by dissolving Sodium acetate trihydrate, D-Glucose anhydrous and kaolin in tap water. For the preparation of one litre waste water we require 400mg of Sodium acetate trihydrate, 300mg of D-Glucose anhydrous and 133mg of kaolin.

C. Filtration of waste water

Sand Filtration Column were constructed for testing the influence of sand in removing the dissolved biological load from the waste water and to check the possibility to enhance the removal efficiency using alternative material such as Rice husk Ash. PVC pipe having 10.7 cm inside diameter and height 120 cm was used for the study. An elevated reservoir delivers synthetic water via gravity through a needle valve used to control influent flow rate. The column consisted of approximately 10 cm gravel at the bottom and 53cm well graded sand above it. As per IS 11401 (part 2) the suitable depth of filter sand must lie in the range 0.5-0.6m so depth is taken as 53cm. Overflow taps were connected at 5 cm interval above sand bed to study the effect of varying head in the removal efficiency. The water level above the sand media is kept constant after fixing optimum head. The flow from the reservoir was turned on at time zero and the column were allowed to fill to the level at which the free out fall were set. After the treatment time the samples were collected and analyzed for Chemical Oxygen Demand, turbidity and suspended solids. Experimental setup for column study is shown in Figure 1.

Figure 1. Experimental setup for column study

III. RESULTS AND DISCUSSION

Some of the parameters which affect the COD removal efficiency using sand media were studied. They are

1. Effect of Head.

Variations in COD removal efficiency with different heads were studied. Different heads used were 70cm, 75cm, 80cm, 85cm, 90cm and 95cm. Maximum removal efficiency was obtained at 85cm head.

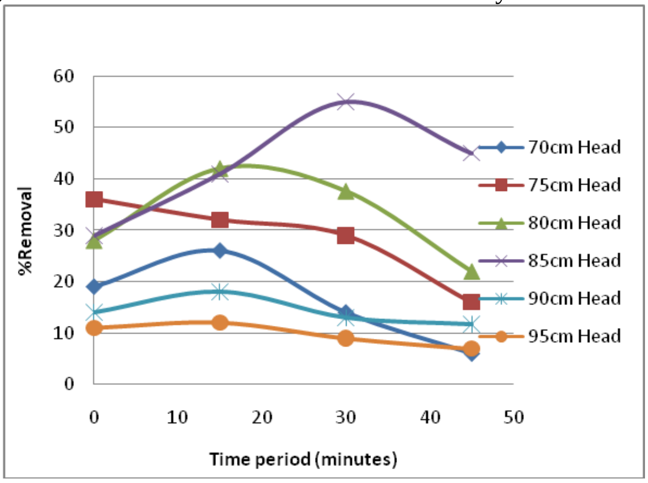

Figure 2. variations in the COD removal efficiency with different head

2. Effect of Filtration rate.

Variations in COD removal efficiency with different filtration rate were studied. As per IS 11401 (part 2) the suitable filtration rate for the operation of slow sand filter lies within the range 0.1-0.2m/hr. Different filtration rate used for column study were 0.1m/hr, 0.14m/hr and 0.19m/hr. Maximum removal efficiency was obtained at 0.1m/hr.

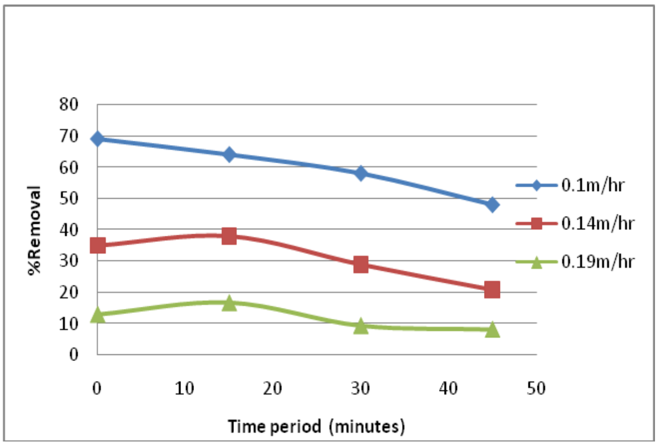

Figure 3. variations in the COD removal efficiency with different filtration rate

3. Effect of Rice Husk Ash (RHA) at different depths.

Effect of RHA on the COD removal efficiency was studied. RHA was used with sand at three proportions -at half the depth of sand, at one-third the depth of sand, at one-fourth the depth of sand. Maximum removal efficiency was obtained at the second combination.

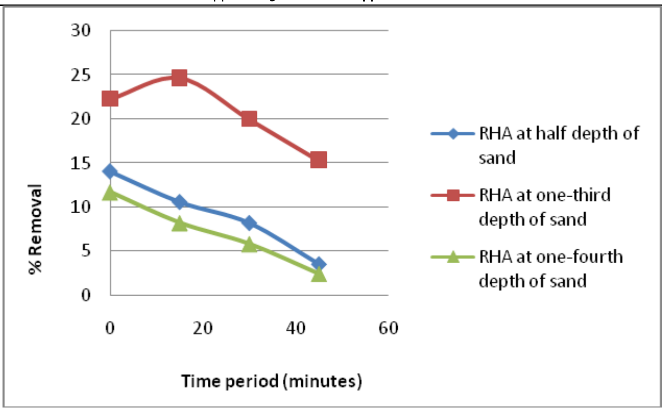

Figure 4. variation in the COD removal efficiency with RHA at different depth

4. Effect of pH along with RHA.

Effect of pH on the COD removal efficiency was studied. pH were adjusted in the range 2,3,4 and 5. Maximum removal efficiency was obtained at pH 4.

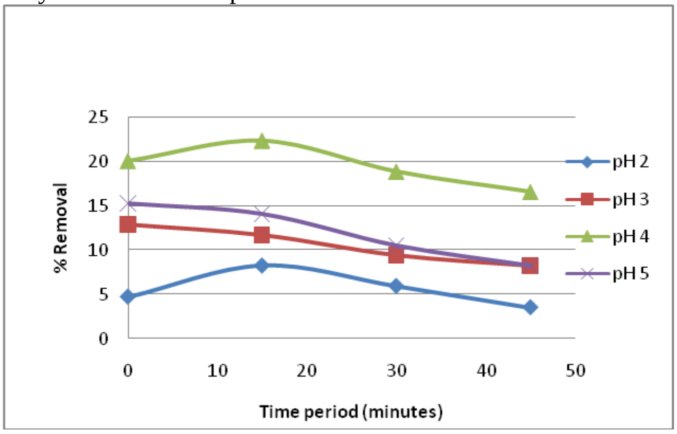

Figure 5. variations in the COD removal efficiency at different pH

5. Effect of sand with and without RHA in COD removal in synthetic waste water.

Variations in COD removal efficiency with and without RHA were also studied. The studies were conducted at different days continuously at optimum head, optimum filtration rate, optimum depth of RHA and optimum pH. Maximum removal efficiency was obtained during the third day. The result shows that the maximum removal efficiency was enhanced from 72% to 83.5% when RHA was used along with sand

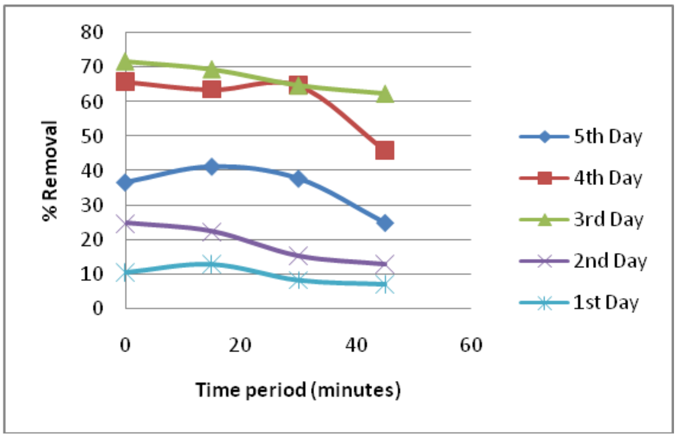

Figure 6. Variation in the COD removal efficiency without RHA in synthetic waste water

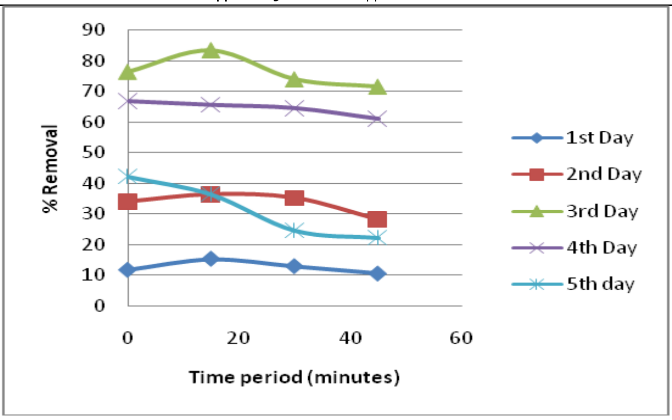

Figure 7. Variation in the COD removal efficiency with RHA in synthetic waste water

6. Effect of sand in Turbidity and Suspended Solids removal in actual waste water.

Industrial waste water was made to pass through the sand filter which is being operated under optimum conditions of head, filtration rate etc. The result shows that the maximum removal efficiency of 92.4% in the case of turbidity and 87.2% in the case of Suspended Solids at first run itself.

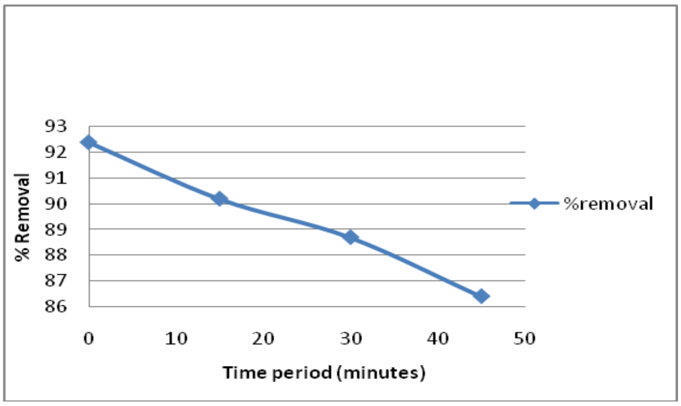

Figure 8. Variation in the turbidity removal efficiency with sand in actual waste water

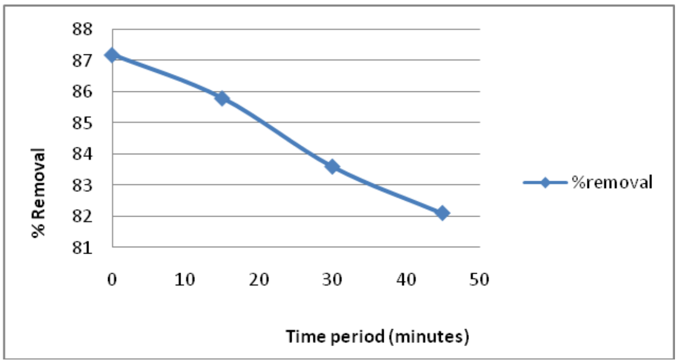

Figure 9. Variation in Suspended Solids removal efficiency with sand in actual waste water

7. Effect of sand with and without RHA in COD removal in actual waste water.

Industrial waste water was made to pass through the sand filter which is being operated under optimum head, optimum filtration rate, optimum depth of RHA and optimum pH. The result shows that the maximum removal efficiency was enhanced from 65% to 79% when RHA was used along with sand.

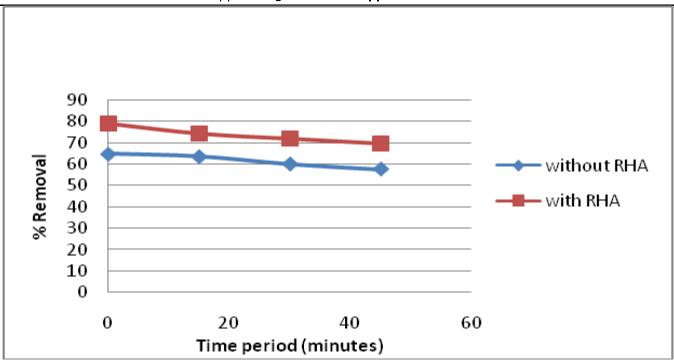

Figure 10. Variation in COD removal efficiency with & without RHA in actual waste water

IV. CONCLUSION

Sand is effective for removing the organic load of the rice mill effluent..Removal efficiency enhanced when RHA is used along with sand. Since the Rice Husk is a waste from the rice mill, two goals can be attained at same time i.e. both waste management and waste water treatment.

REFERENCES

[1] V.K.Tyagi , A.A .Khan, A.K .Chopra , ,"Slow sand filtration of UASB reactor effluent: promising post treatment technique", Desalination, 2009 vol.249, pp 571-576..
[2] P.K.Baburajan,"Treatment of rice mill waste by adsorption using rice husk ash", unpublished 2009.
[3] A.Tawfik ,G. Zeeman , G.Lettinga , "Treatment of domestic sewage in a combined UASB/RBC system", Water Sci. Technol 2003, vol. 48, pp 131–138
[4] F.Tessele , L.O..Monteggia ,J. Rubio , "Treatment of municipal waste water UASB reactor effluent by unconventional floatation and UV disinfection", Water Sci. Technol.2005, Vol 52, pp 315-322
[5] N.Musee , L Lorenzen .L, "Post-treatment of Distillery waste water after UASB using Aerobic techniques", S.Afr.J.Enol.Vitic.,2007,Vol. 28, No.1
[6] A.A.Khan .A.A, Kazmi , "Effect of Aeration on the quality of effluent from UASB reactor treating sewage", J.Environmental Eng. ASCE 2010 Vol. 137, pp 464-472