BOD REMOVAL FROM MARIGOLD WASTE USING DIFFERENT ADSORBENTS

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ABSTRACT

In present scenario many industries use Marigold flower as raw material in manufacturing of paints, cosmetics, perfumes, medicines etc.., the waste produced from marigold processing unit is in liquid form, which possess problems with excess BOD. The treatment facilities available in the existing unit does not meet the disposal standards. The raw wastes from marigold processing unit was collected and analyzed for initial characteristics. Reduction of BOD from marigold wastes was studied by using low cost adsorbents like laterite, charcoal and rice husk. The experiment was carried out using the process of adsorption. Since laterite, charcoal and rice husk are cheaply, easily and locally available materials, it works out to by an economical methodology. The Whole study of adsorption characteristics of above pollution parameters are done in column study. To see the performance evaluation by varying rate of flow, constant rate of flow and to compare the result of Removal efficiency of laterite and Charcoal and rice husk. The efficiency of BOD removal was found to be dependent on various parameters like flow rate (l/m), depth of adsorbent, contact area and contact period and by knowing the initial and final concentration, the percentage of removal was calculated. The results obtained were positive, quite encouraging and interesting.

Key words: Marigold waste, Laterite, Charcoal, Rice husk and Adsorption.

INTRODUCTION

Due to rapid increase in industrialization, there is a major impact on the environment. In order to reduce rapid degradation, it is necessary to adopt developed technologies. Pollution refers to contamination of the environment by harmful and waste materials, which brings about a significant change in the quality of the surrounding atmosphere .Water pollution signifies contamination of water bodies, which make them unfit for drinking and other uses. Although, 70% of the Earth is covered by water, the water of the seas and the oceans is saline and hence, cannot be used for drinking, agriculture and industrial uses. Only the water bodies like lakes, ponds, rivers, reservoirs and streams provide us with fresh water.

The Mari gold processing unit in Hassan industrial area is “OMNICON INDUSTRIES LTD”, which processes Mari gold in producing dehydrated powder which is used for variety of purposes.. The waste generated from marigold processing unit is in liquid form which possess problems with excess BOD, COD, pH, Chlorides, Turbidity and Total solids. The treatment facilities available in this unit don’t meet the disposal standards.

BOD is amount of organic matter that can be oxidized by microbes by utilizing oxygen as their source of survival. BOD in Marigold processing unit is mainly constituted because of waste generated from processing of Marigold flowers used as raw material. Such waste is highly organic in nature. If not properly treated and disposed, it will create lot of problems on receiving bodies. If this waste is disposed on water bodies, results in the death of aquatic animals as a result of lowering in DO levels, as the DO value of 4ppm is necessary for survival of fishes and aquatic animals. As most of the industries dispose their waste normally in nearby water bodies, if the same water is used for drinking purposes it results in health hazards to residents who are living nearby. Large BOD means large amount of organic matter, if not properly treated and disposed, may create following problems like Organic shock loading on waste water treatment plant and deadly effect on aquatic life when disposed in water bodies.

Adsorption is a process that uses special solids (called adsorbent) to remove substances from either gaseous or liquid mixtures. The term adsorption was first coined in the late 19th century, but the process itself was not widely used until the 1940s and 50s when activated carbon was first used for municipal water treatment. It is different from absorption, in which a substance diffuses into a liquid or solid to form a solution. The term adsorption encompasses both processes, while adsorption is the reverse process. Adsorption is operative in most natural physical, biological, and chemical systems, and is widely used in industrial applications such as activated charcoal, synthetic resins and water purification. Adsorption, ion exchange and chromatography are sorption process in which certain adsorptive are selectively transferred from the fluid phase to the surface of insoluble, rigid particles suspended in a vessel or packed in a column. Atom or molecules of solid surface behave as surface molecules of a liquid. These are not surrounded all sides by atoms or molecules of their kind and hence posses unbalanced attractive residual forces similar to valiancy forces. These forces attack the molecules of the adsorbent that comes in contact with the solid. Due to adsorption, the residual forces decreases and, therefore the surface energy gets decreased considerably. This energy is lost in the form of heat energy. Thus adsorption is always accompanied by evolution of heat. Adsorption is effective for purifications. Adsorption is also used for recovery of certain constituents (solvents from air), preventing pollution, purifying materials that will react, and so on.

The term laterite was first introduced by Buchanan (1807) while on a journey through Malabar and Kanara in India described it as ferruginous, vesicular, Unstratified and porous material with yellow orchids due to high iron content. The freshly dug material was soft enough to be readily cut into brick blocks but it rapidly hardens on exposure to air and became remarkably resistant to the weathering effect of climate. This material was locally used as brick for building and became remarkably resistant to the weathering effect of climate, and hence called 'laterite' from the Latin word 'later means brick. Laterite is a type of soil, red in color, which is mainly found in the tropics. Aquarist, travelers will always notice it occurring in the vicinity of tropical waters. Whereas laterite is considered as an infertile soil for the purposes of agriculture, it is of elementary importance for bodies of water and thus also for submerse growing plants. Under reduction conditions, which are in the absence of oxygen, bivalent iron is dissolved from laterite in ground water. Such seepage spots close to water courses are also referred to as 'nutrient sources' because analysis have shown high contents of nutrients suitable for aquatic plants present in the seepage water.

Charcoal is the solid carbon residue following the pyrolyis(carbonization or destructive distillation) of carbonaceous material. The entry of air during the carbonization process is controlled so that the organic material does not turn to ash, as in a conventional fire, but decompose to form Charcoal. The most common variety of charcoal, wood charcoal, was formerly prepared by piling wood into stacks, covering it with earth or turf, and setting it on fire. Wood charcoal is a component of gun powder. In some instances, its manufacture may be considered as a solid waste disposal technique. Wood charcoal can remove coloring agent from solution. Charcoal is often used in blacksmithing for cooking and for other industrial applications.

Rice hulls or (Rice husks) are the hard protecting coverings of grains of rice. In addition to protecting rice during the growing season, Rice hulls can be put to use as building material fertilizer insulation material or fuel. Each kg of milled white rice results in roughly 0.28kg of rice husk as a byproduct of rice and the uses of rice husk are continually growing today. It is increasingly used as biomass to fuel and co-fuel power plants. Husk is used as fuel in rice mills to generate steam for the parboiling process. Rice husk as low-value agricultural by-product can be made into sorbent materials which are used in heavy metal and dye removal. It has been investigated as a replacement for currently expensive methods of heavy metal removal from solutions. Currently, the study of rice husk as a low cost sorbent for removing heavy metal. It is also being used to treat textile dyes.

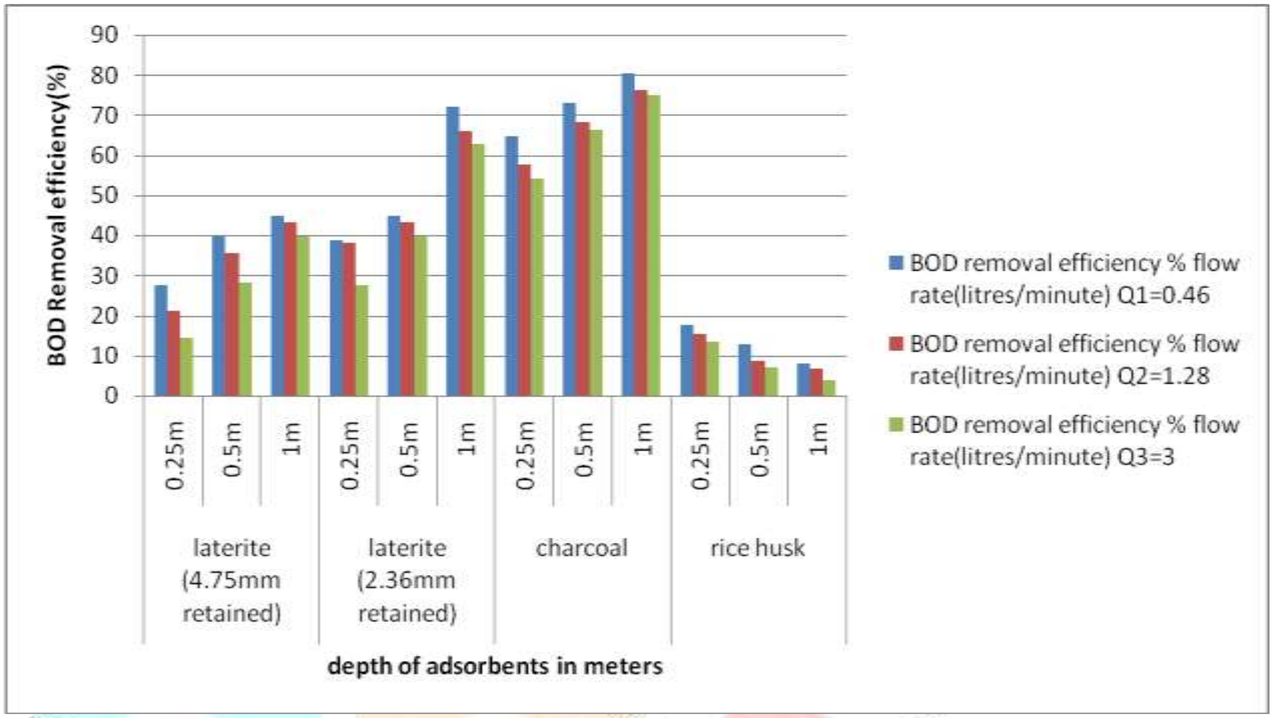
METHODOLOGY

The experiment was carried out using the process of adsorption in which laterite, charcoal and rice husk materials are used as an adsorbents. The study was done by passing the wastewater in a straight path and flow rate (l/m), varying depth, contact area and contact period are considered and efficiency of percentage removal was observed. Through polyvinyl pipe with laterite, Rice husk and charcoal. the study was done for sample from marigold processing unit using laterite of grain size passing 4.75mm sieve and retained on 2.36mm sieve. The analysis also includes the depth of the filter media of 0.25m, 0.5m and 1m . Various parameters such as varying flow rate(l/m), varying depth, contact area and contact period are considered and efficiency of percentage removal was observed. The experimental set up is shown in the figure(1).

Figure(1) Photographic view of experimental setup

Table(1) BOD removal efficiencies for different adsorbents

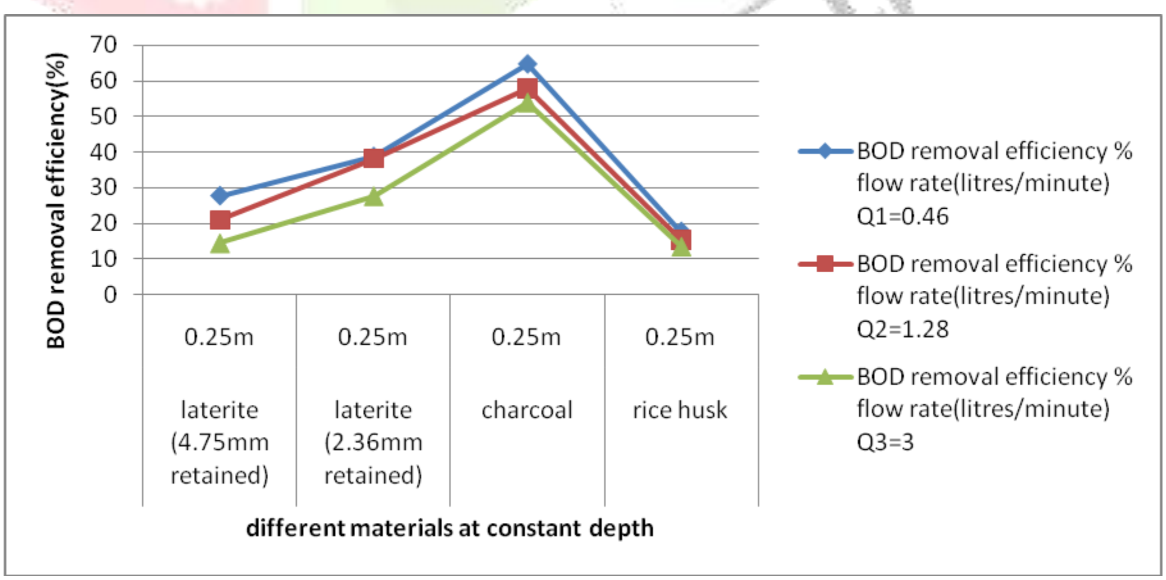
different adsorbents	depth of adsorbent in meters	BOD removal efficiency in percentage		
		flow rate(litres/minute)		
		Q1=0.46	Q2=1.28	Q3=3
laterite (4.75mm retained) Grain size	0.25m	27.65	21.02	14.38
	0.5m	39.82	35.4	28.21
	1m	44.8	43.14	39.82
laterite (2.36mm retained) Grain size	0.25m	38.71	38.16	27.65
	0.5m	44.8	43.14	39.82
	1m	71.91	65.84	62.72
charcoal	0.25m	64.76	57.79	53.98
	0.5m	73.17	68.3	66.37
	1m	80.25	76.38	74.94
rice husk	0.25m	17.59	15.38	13.44
	0.5m	12.83	8.57	7.19
	1m	8.08	6.8	3.87



Figure(2) Removal efficiencies for different adsorbents

Above graph shows different adsorbents are used for varying depths and varying flow rates. In two laterite grain sizes bigger size shows less removal efficiency than smaller grain size. That means smaller grain size increased the contact area thus removal is efficient. Charcoal is the another adsorbent used, compared to both the grain sizes of laterite and charcoal, charcoal removes nearly twice the laterite. In the same way rice husk is also used as an adsorbent but this gave less removal efficiency than charcoal and laterite. This shows rice husk has less removal efficiency. Here charcoal proves to be an efficient adsorbent.

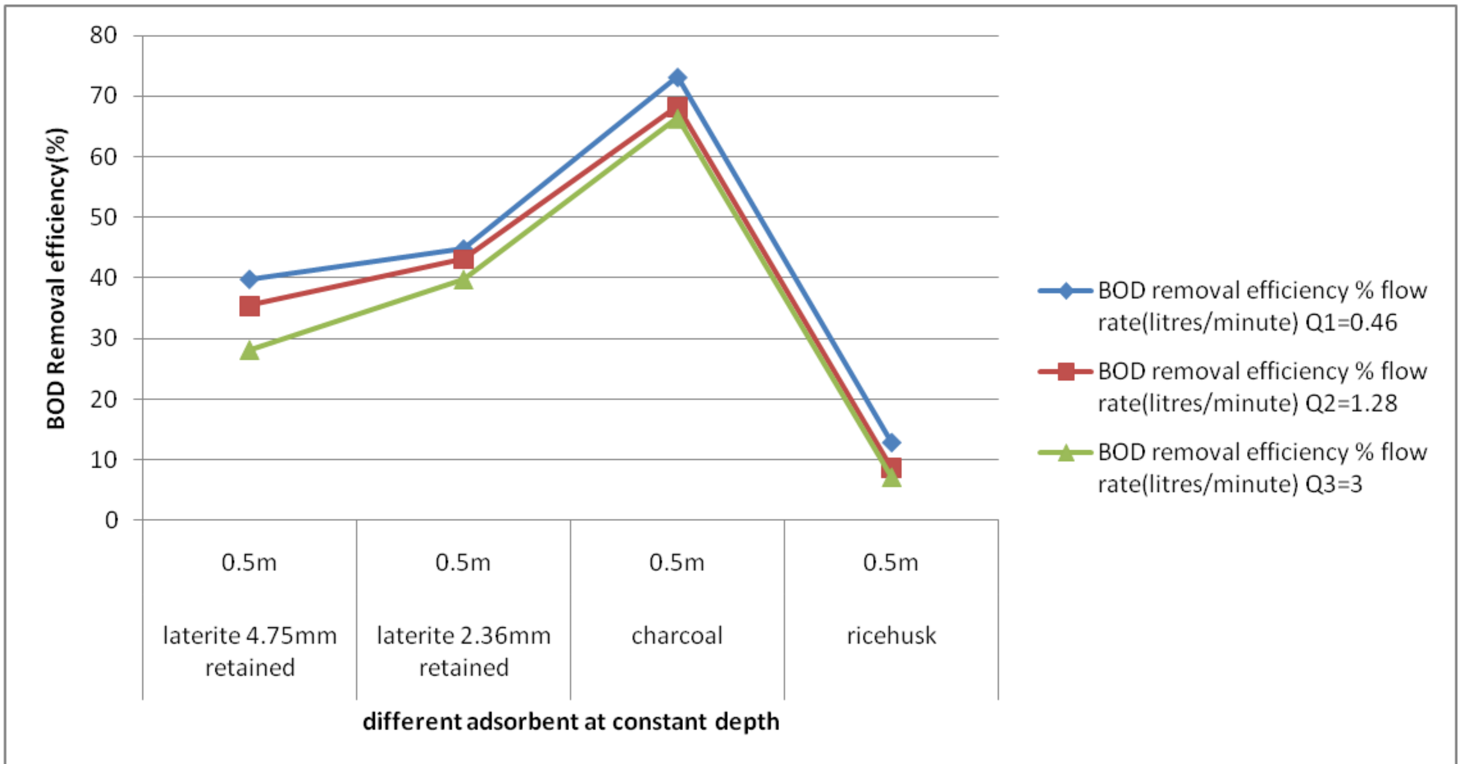
Removal efficiency for different adsorbents at constant depth 0.25m



Figure(3)Removal efficiency at 0.25m depth for different adsorbents

Figure(3) shows different adsorbents used, at 0.25m depth was taken as constant for the varying flow rates. For slower flow rate charcoal removes 64.76% and rice husk removes 17.59%. for medium flow rate charcoal removes 57.79% and rice husk removes 15.38%. For faster flow rates charcoal removes 53.98% and rice husk removes 13.44%. As the flow rate slows down contact time increases thus removal efficiency also increased. Here it proved that charcoal is more efficient than laterite and rice husk as adsorbents.

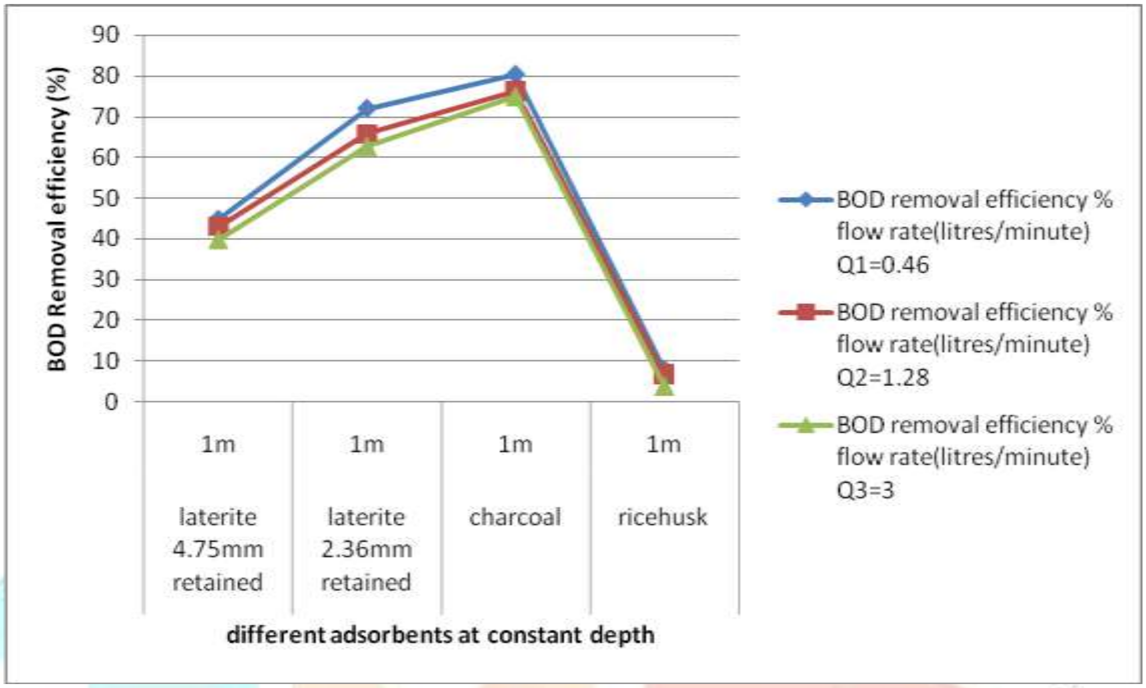
Removal efficiency for different adsorbents at constant depth 0.5m



Figure(4) Removal efficiency at 0.5m depth for different adsorbent

It was observed that, at 0.5m depth of different adsorbents and varying flow rates are taken, for slower flow rates charcoal removes nearly twice the laterite and 5 times more than the rice husk. For medium flow rate charcoal removes nearly twice the laterite and 9 times more than the rice husk. For faster flow rate charcoal removes nearly twice the laterite and 10 times more than the rice husk. This shows that charcoal is more efficient than laterite and rice husk. As the slower flow rate, increased contact time thus removal efficiency also increased.

Removal efficiency for different adsorbents at constant depth 1m

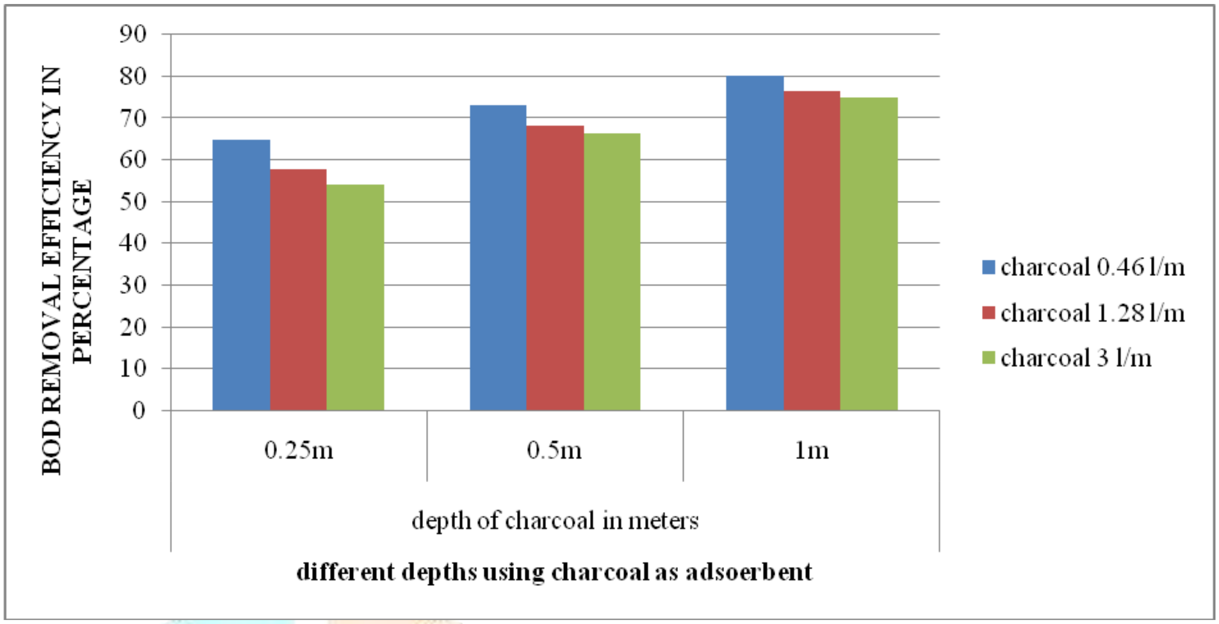


Figure(5) Removal efficiency at 1m depth for different adsorbent

Figure(5) shows that, different adsorbents are used for varying flow rates and constant depth of 1m. For slower flow rate, charcoal removes 80.25% and laterite of smaller grain size removes 71.91% nearly same but the rice husk removes 8.08% nearly 10 times less than that of the laterite and charcoal. For medium flow rate, charcoal removes 76.38% and laterite of smaller grain size removes 65.84% nearly same but the rice husk removes 6.8% nearly 10-11 times less than that of the laterite and charcoal. For faster flow rate, charcoal removes 74.94% and laterite of smaller grain size removes 62.72% nearly same but the rice husk removes 3.87% and this shows that charcoal and laterite of smaller grain size is more efficient than rice husk. Here contact time increased thus removal efficiency also increased for slower flow rate.

Table(2)removal efficiency using Charcoal with different depths

adsorbent	flow rates in litres per minute	depth of charcoal in meters		
		0.25m	0.5m	1m
charcoal	0.46 l/m	64.76	73.17	80.25
	1.28 l/m	57.79	68.3	76.38
	3 l/m	53.98	66.37	74.94



Figure(6) Removal efficiency for different depths using charcoal as adsorbent

CONCLUSION

Based on the experimental data, it is quite evident that charcoal is a powerful adsorbing medium than laterite and rice husk. laterite of smaller grain sizes and slower flow rates, the contact period and contact time with the adsorbent increased and the efficiency also increased. In addition as the depth of column increased efficiency also increased. thus optimum results may be obtained for slower flow rates, smaller grain sizes and higher column depth.

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REFERENCES

1) S.K.Garg, sewage Disposal and Air Pollution Engineering, Khanna Publishers, 1918,pp.79-81.

2) Ajitha H "Studies on Oil and Grease removal from Wastewater Using Laterite as an adsorbent" A Thesis submitted for the Award of the Degree of Msc(Engg) by Research to vishveshwaraya Technological University.

3) Rama rao g.v and sheshagiri rao m v 2003 high performance concrete with rice husk ash as mineral ad-mixture ici journal 17-22[8].

4) H.H. Lowry, and G.A.Hulett.J.Am. chem.. studies in the adsorption by charcoal. i. the relation of service time to adsorption and absorption. Soc., 1920, 42 (7), pp 1393-1408.doi: 10.1021/ja01452a013.

5) Gidigasu, M.D.(1976). Laterite soil engineering, Development in geotechnical engineering. Elsevier scientific publishing company.

6) Jayantha, K.S., Ranjana, G.R., Sheela, H.R., Modang Ritu and Shivananni, y.s., "Defluoridization studies using Laterite material", J, Environmental science and Engg.,2004, vol, 46,pp,282-288.

7) Jayantha, K.S., Santhosh Ingalagi, Sushma Prashanth B.s., "Oil nad Grease removal using Laterite column: A case study", processing of International Conference on Business, Environment, International competitiveness and Sustainable Development of the Asia Pacific Economics, held on December 3-4, 2007 at Malaysia.