COMPARATIVE ANALYSIS OF SUITABILITY OF FLY ASH AND COCONUT HUSK FOR REMOVAL OF TURBIDITY AND COLOR FROM PAPER MILL WASH WATER

Lomesh S. Mahajan[1], Aakash S.Pawar[2], S.R.Bhagat[3]

[1,2]Civil Engineering department, North Maharashtra University, Jalgaon, (India)

*[3]Civil Engineering department, DBATU, Lonere, Dist. Raigad, (India)

ABSTRACT

From last 2 decades as the population has grown to an apparently extent, there is an increase in requirement of paper mills due to market development. Today's industrial environment is competitive, it is well known fact that paper mill wastes causes so many destruction and produces bad impacts on nations economics. Though it is almost impossible to fully recoup the damage caused by Turbidity, it is possible to minimize the potential risks. Last couple of year's some difficulties comes in to picture which results in development of country. Color is main factor of environment pollution.

The waste by product obtained from thermal power station is residue from combustion of pulverized coal is known as fly ash. The aim of this project is to study to find out an adsorbent for the removal of lignin from paper mill wastes using fly ash and coconut husks. Find out best suitable material among of these. The use of such technique helps to provide the controlling lignin waste strength and for the improvement of treatment on lignin to provide valuable empirical data and further protect environment with the use of unproductive waste like coconut husk and fly ash.

Keywords: Coconut husk, Fly ash, Turbidity and color

I. INTRODUCTION

An increasing global pollution has forced many researchers to find more eco- friendly methods for waste elimination. The highly concentrated, toxic in nature are the causes of industrial waste waters. Also Phosphorus and nitrogen are also released into wastewaters. The raw material such as wood is the main source of nutrients, nitrogen, and phosphorus compounds. The use of ozone, peroxide and other chemicals in bleaching makes it necessary to use a strong agent for heavy metals such as manganese. Lignin can be removed by using Coconut husk and fly ash, which themselves are waste materials.

Paper mills discharge in large quantities of overly colored effluents into receiving streams. Color in natural waterway has been considered undesirable mainly from an esthetics viewpoint. The color discharged from Kraft mills is economically undesirable is released. Removal of color in downstream waters is also detrimental to fishing and tourist industries.

The reduction of the oxygen demand of pulp mill effluents is done by biological treatment, which is not effective for color removal. The compounds related with lignin are the major contributors to color in Kraft pulp and paper mill effluents. These compounds are difficult to degrade biologically. Although lignin related compounds have been found to be toxic to few aquatic species, the colors they add to receiving steams interfere with transmission of sunlight and hinder the growth of oxygen producing algae. Thus, color material indirectly imposes an oxygen demand on downstream reservoirs. If the color is severe enough, the dissolve content of the oxygen in the reservoir may go down below a level necessary to sustain aquatic life.

A material suitable for removing color from pulp and paper mill effluents would have to be cheap and readily available. Fly and Coconut husk are such a material. Coconut Husk powder is manufactured by various stages by crushing coconut shells in hammer mills. Coconut shells are taken as raw material from coconut processing industries. Husk and shells are separated from the coconut manually. It normally takes 3-4 minutes. The separated coconut shells are put in to the crushing machine which is provided with press rollers, so that through crushing coarse shell are produced.

There is a huge scope of commercial utilization of coir and coir dust, with their own or in combination with different raw materials, to produce the products like mat and matting, brush, twine and rope, rubberized coir, particle board, fertilizer and applications such as upholstery cushioning, pad and carpet underlay. Fly ash is a waste product of the electric power generating industry, and is produced wherever coal is used for thermal generation of electricity. With the high demand of coal consumption, it is important to meet future energy demands; an abundant supply of low cost fly ash is assured. In this study, an effluent from a caustics extraction stage of a Kraft pulp mill was used to determine the color removal effectiveness of a fly ash produced from lignite.

II. LITERATURE REVIEW

Concrete mixes having fly-ash as CRM have lesser cement content, adverse effects related to higher cement content, such as shrinkage, excessive rate of heat development etc., are minimized in the concrete. Use of fly-ash as cement replacement material for low strength concrete beyond 30% level can have enhanced durability and hence long service life. Reinforced concrete structures and the products of pre-casting made with concrete having fly-ash as CRM would; therefore have long, maintenance-free service life [1].

The replacement of high lime fly ash concrete generally increases the ultimate strength of concrete. It is possible that even higher percentile replacement of cement would still be able to provide the number of fly-ash is added to concrete, a decrease in the rate of strength is gained [2].

The influence of fly-ash of water demand is not same for different fly-ash and the content of different fly-ash. The fly-ash with bigger particle does not increase the surface layer water, and their water demand cannot be reduced because its flying and lubrication roles are very weak. The fly-ash with smaller particle mat reduces flying water and has a stronger lubrication role but it will increase the surface layer too. An increase in the content of the super plasticizer may reduce the surface layer water[3.9].

The use of fly-ash in concrete as a partial replacement of cement is achieving so much importance today, due to the improvement of the long term durability of concrete combined with their ecological benefits. The studies have been conducted on concrete mixes for the particle replacement of cement by fly-ash with 300 to 500 kg/cum with cementing material at 20%, 30%, 40% and 50% replacement level. By using rapid chloride permeability test workability, setting time, modules of elasticity shrinkage, air content, permeability, compressive strength and density for the effect of fly-ash are studied [4].

The effect of fly-ash on the properties of concrete for M25 grade of concrete are as w/c ratio of concrete increases the slump loss of concrete increases and the ultimate compressive strength of concrete goes on decreasing and the increasing in the quality of fly-ash increases the slump loss of concrete. 10% to 20% replacement of cement with fly-ash in concrete shows good compressive strength while 30% replacement decreases the ultimate compressive strength of concrete [5].

The use of coconut husk in cement concrete helps in reducing waste and pollution. The use of waste products can be used as a construction material in the low costing house. They can be used in rural areas and places where coconut is available in large amount and may also use in where aggregates are costly. Coconut husk are mostly suitable for low strength giving light weight aggregate as a replacement to common coarse aggregate in concrete production [6].

The addition of coconut husk decreases the workability while the addition of fly-ash as cement replacement or as a aggregate replacement increases the workability of coconut husk concrete. The densities of concrete decreases as increase in the percentage of coconut husk. The strength properties of coconut husk concrete depend on the aggregate properties of coconut husk and on its strength characteristics. To calculate the strength of coconut husk experiments on impact and crushing value is done [7].

Coconut husk may be used as a full replacement to other conventional aggregate in concrete construction. Coconut husk concrete shows 65% of compressive strength of regular concrete. Coconut husk requires more resistance against impact, crushing and abrasion compared to normal concrete [8, 10].

III. NATURE OF LIGNIN

Lignin is available in all vascular plants, mostly between the cells, and also within the cells and the cell walls. It helps in making the vegetables firm and crunchy, and gives us the "fiber" in our food. It is hold together with strong chemical bonds due to resistant to degradation in nature; and it also appears to have a lot of internal H bonds. It is bonded in complex and number of different ways to carbohydrates (hemicelluloses) in wood.

Lignin is an organic substance binding together the fibers, cells and vessels which forms wood and the lignified elements of plants. It is highly available renewable carbon source on Earth after cellulose. Between 40 and 50 million tons per annum are produced worldwide as a mostly noncommercial.

3.1 Lignin Compounds

The majority of the color in Kraft pulp and paper mill effluents comes from the caustics extraction stages of the bleaching plant. It has been estimated that effluents from the caustics extraction stages contribute 60 to 80 % of the colored material in the total discharge from Kraft mills. Since color reduction was the major concern in this study, a caustic extract was used.

It has been found that lignin, degradation products of lignin, and products of chemical reaction with lignin are the major contributors to color in bleaching effluents. Only limited information is available about the structure of lignin and lignin related compounds. The National council of the Paper Industry for air and Stream

Improvement (NCASI) showed that the solids in caustics extraction stages effluents consist of chlorine-substituted acidic materials.

The organic material in caustic extract and for unrecompensed Kraft lignin can be determined by empirical formulae and molecular weight. The result is shown in table 1, from the table it can be seen that the solids in caustic extraction stage effluents have empirical formulae similar to that of Kraft lignin. The average molecular weights of the effluents solids are relatively less than the molecular weight of Kraft lignin, indicating that solids are for the most part degradation products of lignin.

Table 1 Element Analysis of Solids in a Caustic Extract

Content	**Empirical Formula**	**Average molecular weight**
Lime perceptible solids	C9H8.2 O6.2 CL0.47 (OCH3)0.10	495
Lime non-perceptible solids	C9H10.05 O10.3 CL0.95 (OCH3)0.92	210
Pipe Kraft lignin	C9h7.7 o2.0 (OCH3)0.92	1600

The NCASI study found that approximately 70% to 80 % of the acidity of the solids in caustic extraction stage effluents is caused by carboxylic acids. The reminder of the acidity is caused by steel weaker acidic groups and phenols.

It has been found that the chromophores in the lignin related compounds in caustic extraction stage effluents are aromatic and nuclei, and carbonyl and ethylic groups, and that the auxocromes present are hydroxyl group. The color of the lignin related compounds is affected by ionization of the acidic groups in the compounds. Ionization of the acidic groups increases the color intensity so that the color of the effluent increases with increases with an increase in PH.

3.2 Fly Ash

3.2.1 Sources of Fly Ash

Fly ash is a waste product of the electric power generating industry. It is removing from the flue gases of coal burning power station in order to prevent serious air pollution problems. Fly ash is formed from the incombustible component in the fuel and from material unburdened because of incomplete combustion. The majority of fly ash collected is coal –derived, but fly ash may also be produced by the combustion of wood. According to a recent survey of coal consumption and ash production, the present production rate of fly ash is our 30 million tons / yr. in the united State alone and it is estimated that the production rate will increase to 40 million tons / yr. by 1980, from pollution abatement to comment manufacture, but the majority of fly ash produced is stock-pilled. As a solid disposal problem exists.

3.3 Coconut Husk

3.3.1 Sources of Coconut Husk

Coconut husk are nothing but the exterior shells of the coconut. The liquid found within the exterior shell of the coconut husk can be used in many ways such as in creating enriched potting soil and as chips which are used to provide ground cover for flower beds. The mass produced coconut husk products can be purchased or it can also make at home by using the shells of fresh coconuts. A very straightforward process is used to husk a coconut at home. The materials required are a fresh coconut and a long stick sharpened at one end. The opposite end of the stick must be buried below the ground, with the sharpened end straight upward. This helps in creating the basic framework for the removal of the coconut husk.

IV. EXPERIMENTAL

4.1 Treatment of paper mill waste water using fly ash and coconut husk (Column study)

The set up used for the treatment of paper mill waste water (lignin removal) is shown in figure 3.1 and photograph no.3.2. The glass column of the setup had a size of 30 mm diameter and 60 cm height. It was filled with fly ash obtained from Deep nagar thermal power station and the glass column of the set up was filled with coconut husk obtained from Ranker Nursery. Initially the fly ash and coconut husk bed height was maintained at 25 mm. The paper mill waste water was passed through this bed from the overhead storage at a flow rate of 0.3 liter/hr. for 30 minutes. The treated effluent was collected in a collector. The same procedure was repeated by varying the bed height as 35mm, 45mm, and 55mm and contact times 60minutes, 90 minutes and 120minutes. For each of this treated effluent was collected.

4.2 Analysis of effluent from fly ash column

Analysis of the various samples collected by passing through fly ash bed of different heights was carried out for the parameters of pH, turbidity as per APHA (American public health association) methods.

4.3Analysis of effluent from coconut husk column

The paper mill waste water sample was passed through coconut husk column and filtered waste water analyzed for following tests.

PH

Turbidity

Color

V. RESULT

5.1 Characteristics of paper mill waste water

Characterization of paper mill waste water for the parameters pH, turbidity, is given in table 2.

Table 2 Characterization of paper mill waste water

Sr. No.	Parameters	Initial Concentration of Effluent used in this study
01	pH	8.5
02	Turbidity	320 NTU
03	Color	5065 UNITS

The results observed after the physio-chemical analysis of the wastewater as depicted in table: 2 showed that the paper mill waste water is highly polluted with the organic load. Organic load is depicted in terms of pH and Turbidity values. The Turbidity concentration is much higher than the permissible limit. The effluents used in this study had very high color content, turbid. This was due to the high concentration of non-biodegradable lignin related compounds in the effluents. The effluent contained very less suspended settle-able solids. For this reason, no removal of contaminates could be obtained by primary sedimentation.

5.2 Coconut husk size

Husk size was determined by sieve analysis. It was found that average particle size of coconut husk was between 300 microns to 150 microns. Due to very fine size the particles have a larger surface area with high area/volume ratio. This is desirable from adsorption point of view.

5.3 Column study of fly ash and coconut husk

The final treated effluent characteristics after various runs as described in 3 are given as follows in table (3) to (7). The table (3) to (6) is for batch study in which the wastewater is filled in the glass tube of experimental set up for a fixed contact period and then effluent is drawn for further analysis. The table (7) to (10) are for continuous flow study in which various flow rates are maintained and effluent collected from bottom outlet is analyzed. The sorbent (fly ash) bed depth is varied:

Table 3 Effect of bed depth on removal of impurities using fly ash

Sr. No.	Parameter	Time of Contact- 30min.			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.5	8.45	8.4	8.3
2	Turbidity in NTU	65	60	50	45
33	Color	56	48	40	32

Table 4 Effect of bed depth on removal of impurities using fly ash

Sr. No.	Parameter	Time of Contact- 60min.			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.4	8.35	8.30	8.2
2	Turbidity in NTU	60	55	50	40
3	Color	52	45	36	28

Table 5 Effect of bed depth on removal of impurities using fly ash

Sr. No.	Parameter	Time of Contact- 90min.			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.35	8.25	8.2	8.1
2	Turbidity in NTU	50	45	45	40
3	Color	43	39	32	25

Table 6 Effect of bed depth on removal of impurities using fly ash

Sr. no.	Parameter	Time of Contact- 120 min			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.25	9.15	8.0	8.0
2	Turbidity in NTU	45	45	40	35
3	Color	40	35	26	20

Table 7 Effect of bed depth on removal of impurities using coconut husk

Sr. no.	Parameter	Time of Contact- 30 min			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.5	8.45	8.45	8.4
2	Turbidity in NTU	85	80	70	60
3	Color	52	42	38	32

Table 8 Effect of bed depth on removal of impurities using coconut husk

Sr. no.	Parameter	Time of Contact- 60 min			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.45	8.4	8.35	8.3
2	Turbidity in NTU	75	65	60	50
3	Color	50	41	35	30

Table 9 Effect of bed depth on removal of impurities using coconut husk

Sr. no.	Parameter	Time of Contact- 90 min			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.35	8.25	8.25	8.2
2	Turbidity in NTU	60	55	50	45
3	Color	45	40	35	28

Table 10 Effect of bed depth on removal of impurities using coconut husk

Sr. no.	Parameter	Time of Contact- 120 min			
		Bed Height			
		25cm	35cm	45cm	55cm
1	pH	8.25	8.20	8.20	8.0
2	Turbidity in NTU	5	45	45	40
3	Color	43	39	32	25

5.4 Discussion

It can be seen that:

Fly ash is acting as a better absorbent as compared to the coconut husk.

With the increase in bed thickness (depth) the removal of impurities is enhanced.

After adsorption by fly ash or by coconut husk, the pH which is slightly alkaline initially gets neutralized almost.

 ISBN: 978-81-932074-7-5

Thus it can be postulated that fly ash as well as coconut husk both are effective low cost adsorbents for treatment of paper mill effluents. They have tremendous potential to remove the Turbidity from the wastewater that is not removed by other biological or physic-chemical methods.

Graphical Representation of Removal Rates

In the present study, two adsorbents are used and their performances are compared over various parameters. The removal of various pollution parameters is graphically represented in the following section:

5.4.1. pH Removal Rates

Fig (1) and (2) represent the removal (neutralization) efficiencies of fly ash and coconut husk respectively for pH.

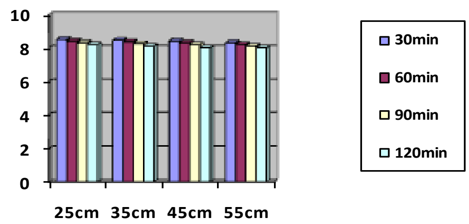

Fig 1. pH neutralization efficiency of fly ash: effect of bed depth and contact time.

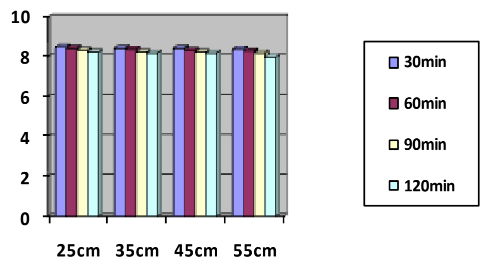

Fig . 2 pH neutralization efficiency of coconut husk: effect of bed depth and contact time

5.4.2 Turbidity Rates

Fig (3) to (4) represent the removal (neutralization) efficiencies of fly ash and coconut husk respectively for turbidity.

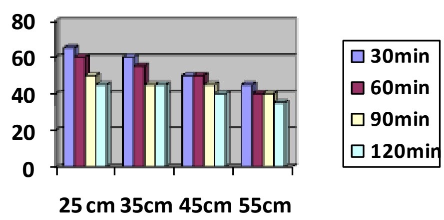

Fig. 3 Turbidity neutralization efficiency of fly ash: effect of bed depth and contact time

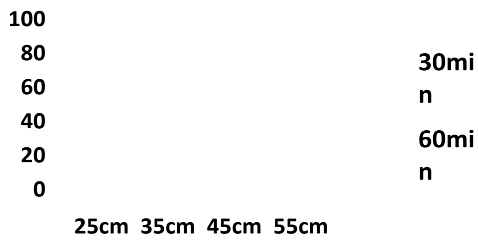

Fig. 4 Turbidity neutralization efficiency of coconut husk: effect of bed depth and contact time

VI. CONCLUSION

With reference to the result obtained, from the experiments conducted in the laboratory concerning to the factors affecting the adsorption of lignin, following have been derived. Fly ash is more suitable as compare with coconut husk. If the bed height of column of adsorption material (fly ash, coconut husk) has increases, the percentage of removal of turbidity also increases. Finally concluded that fly ash has more adsorption capacity as compare with coconut husk for removal of turbidity and neutralize pH.

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