Effluent treatment of newsprint mill by using coal ash

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SUMMARY

The present investigation reports the use of Coal ash as a very cheap method for decolouring the effluent from paper industry. Apart from colour removal, reduction in COD, BOD, dissolved and suspended Solids and increase in combustion value of Coal ash are also achieved by this method.

The Pulp and Paper industry is a very high water consuming one and much of its volume is discharged as effluent which contains a high pollution load of dissolved solids, suspended solids, BOD, COD and other organic matter. The colour of this effluent water is dark brown.

This enormous quantity of effluent is discharged into the adjoining river after desirable treatment, but the colour of the effluent is not removed. Although the pollution control board of India have no objection for the colour[1], but recently this problem has assumed lot of importance due to awakening in the masses and of late several studies have been taken on this subject. This still needs lot of research and investigation in order to develop a process which could be economically feasible and meets the prescribed limits.

The characteristic brown colour of the effluent is mainly due to the black liquor which contains high percentage of lignin and its derivatives. These compounds are highly resistant to biodegradation and escape the biological treatment unit employed for effluent treatment and pass into the river where they respond very slowly to stream self purification process. The other organic matter responsible for colour is biodegradable and does not create much problem.

NATURE OF THE EFFLUENT OF NEPAMILLS

Nepamills is the only industry in India which is producing newsprint to the extent of 15% of the total requirement of the country by using its own raw material. Average production of newsprint per day is nearly 170 to 180 M.T. The cost of paper is always a concern of primary importance in this industry and in view of this the following three processes are being employed for making newsprint in order to reduce maximum possible expenditure on Chemicals.

(i) Mechanical Pulp from Salai (*Bosewellia serrata*) and Mixed hardwood (33.3%)

(ii) Cold Soda Pulp by Salai and Bamboo, Semi chemical (33.3%)

(ii) Chemical Pulp from Bamboo (Kraft process (33.3%).

The processes involved in making newsprint are very much different from those used in making quality paper, consequently the nature of effluent in the present industry is very much different as the process of mechanical and semichemical pulping causes high pollution load.

The source and nature of the effluent of Nepamills from different grades are summarized in Table No. 1.

OBJECTIVES

(Coal ash as a substitute for activated carbon for colour removal)

Activated carbon treatment process is well known for colour removal of industrial effluent. Use of

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TABLE No. 1—POLLUTION LOAD OF DIFFERENT ACTIONS OF NEPAMILLS

Particulars	Grade I	Grade II and IV	Grade III	Mixed Polluted water.
Source	Paper Machine	Mech. Pulp & Cold soda Pulp	Chemical Pulp	Mix. effluent
Volume of	12 Mill. Ltrs.	28 Mill. Ltrs.	40 Mill. Ltrs.	80 Mill. Ltrs.
Total solid Mg/L	600 to 800	1500 to 2000	900 to 1000	1500
Total suspended solid Mg/L	300	400	250	300
BOD	80 to 100	600 to 700	70 to 80	250
COD	150 to 200	1600 to 2000	300 to 400	700

the activated carbon is not feasible on economic grounds and the regeneration of the used activated carbon is not possible.

On the same lines as those of activated carbon treatment, experiments were carried out using the coal containing some unburnt particles of coal for the treatment of effluent.

Nepamills captive power house uses about 300 tonnes of Coal (steam Coal grade E) per day discharging about 100 tonnes of coal ash, which contains 11-13% unburnt coal in it. The coal ash is being sold on a very cheap rate to the brick kiln and Sagol manufacturers. Reasons for the selection of coal ash for the experiment may be summarised as follows :

i) The ash discharged from power house boiler furnace contains about 11-13% unburnt coal and is activated to some extent.

ii) The coal ash is available in large quantities from the power house and cost is also almost negligible compared to activated carbon.

iii) The major constituent of colour in the effluent is lignin which has a high calorific value and when it passes through Coal ash, it will be adsorbed by it thereby increasing the combustion value of the coal ash and therefore it can be sold on a higher rate.

iv) For treatment purpose the beds of coal ash are made, which serve as filter bed for removing the suspended solids, mostly pulp fines and thereby increasing the combustion value of coal ash.

v) Most of the impurities are removed in the course of this process, so there will be a great reduction in BOD and COD values.

PREPARATION OF BED OR COLUMN

For experiments a M.S. column of length 140 cm. and diameter 8 cms. was prepared as shown in drawing.

The lower part about 20 cms. of the column was filled with coal ash and about 60 cms length was filled with fine, pulvarised ash (12 mesh) The total length of the packed column was about 80 cms. Fine ash was selected for better adsorption. The column was loosely packed to a volume of approximately 4.0 Litres and weighed about 3.6 Kg. The column was then washed with clean water in each case.

60 Litres of the effluent from each grade was passed from lower to upper end of the column for better adsorption. Flow rate of about one litre in four minutes was kept which was found to be best after several trials. Samples were collected in two parts.

a) Till clear effluent was obtained from the column.

b) After saturation of Coal ash column i.e. when there was no difference in colour of original effluent.

SELECTION OF THE EFFLUENT SAMPLES

The following effluent samples were selected for the experiments :

i) Grade II and IV—It contains the highest pollution load of suspended solids, BOD and COD.

ii) Grade III—This is the effluent of Chemical pulp and has the highest content of the lignine and is mainly responsible for the colour of effluent and is not biodegradable

iii) Final Effluent—This is the effluent which is sent to the river Tapti after treatment. It has got a brown colour.

OBSERVATIONS AND DISCUSSION

Effluents were studied under the following headings.

i) **Colur removal**

Colour of the effluent of each grade was reduced upto a satisfactory level after passing it from coal ash column. This method can be particularly helpful for removing the colour of chemical pulp effluent which is mostly due to lignins and is resistant to biological treatment.

The results obtained are recorded in Table No. II.

ii) **Reduction in dissolved and suspended solids**

Reduction in the dissolved and suspended solids[2] present in the effluent was observed to a great extent. Dissolved solids reduced by 60 to 80% and compared well with that of raw water, while the suspended solids reduced by 90 to 98% which equals filteration process.

The results obtained are recorded in Table No. III and IV respectively.

iii) **Reduction in COD and BOD values**

The COD and BOD values[2] reduced by 50-85% which is a great achievement of this method. The COD and BOD of Chemical pulp effluent, which is not easily reduced otherwise, came down by 70-80% by this method due to adsorption of lignins.

The results are recorded in Table No V and VI.

iv) **Increase in combustion value of Coal ash**

Increase in the combustion value of Coal ash was recorded from 10 to 30%. This enriched coal ash will prove more useful to brick Kiln and Sagol manufacturers.

The results are summarised in Table No. VII.

COAL ASH COLUMN

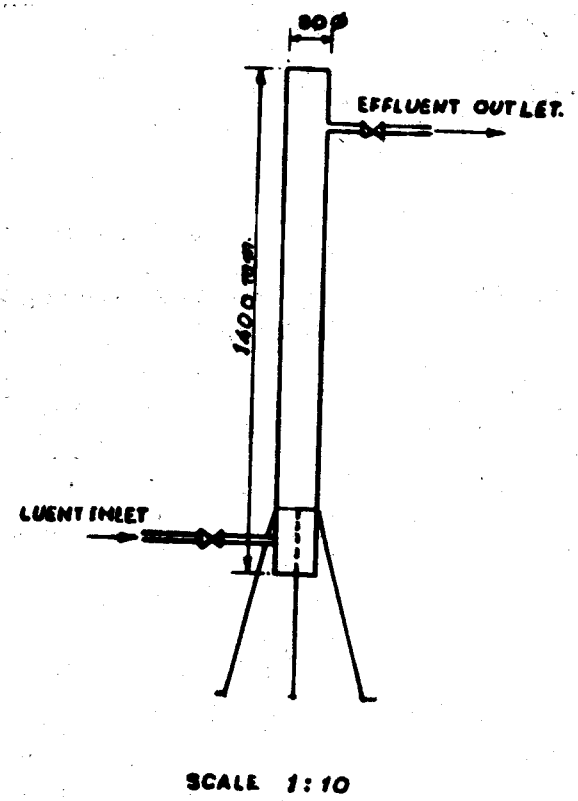

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TABLE No. 2—COLOUR REDUCTION OF THE EFFLUENT TILL THE SATURATION OF COLUMN

Colour observation	Vol. of Grade II and IV in Ltrs.	Vol. of Grade III in Ltrs.	Vol. of Final effluent in Ltrs.
Volume of effluent till no colour is observed (clear)	23.6	19.3	45.2
Volume of effluent till the saturation of column	31.6	28.70	56.50

TABLE No. 3—REDUCTION IN DISSOLVED SOLIDS

Grade of effluent	Initial dissolved solids Mg/L.	Dissolved solids after passing column till clearity Mg/L.	% decrease in dissolved solids	Dissolved solids after saturation of column Mg/L.	% decrease in dissolved solids
Raw Water	420	—	—	—	—
Grade II & IV	2540	640	74.80	980	61.41
Grade III	2308	450	80.50	808	64.94
Final effluent	1188	398	65.49	710	40.15

TABLE No. 4—REDUCTION IN SUSPENDED SOLIDS

Grade effluent	Initial suspended solids Mg/L.	Suspended solids after passing column till clearity Mg/L.	% decrease in suspended solids	Suspended solids after saturation of column Mg/L.	% decrease in suspended solids
Raw Water	8	—	—	—	—
Grade II & IV	600	10	98.33	42	93
Grade III	368	8	97.82	34	90.76
Final effluent	112	6	94.64	14	87.5

TABLE No. 5—REDUCTION OF COD VALUES

Grade of effluent	Initial COD Mg/L.	COD after passing column till clearity Mg/L.	% reduction in COD	COD after saturation of column Mg/L.	% reduction in COD
Grade II and IV	2240	408	81.78	1108	50.53
Grade III	480	60	87.50	248	48.33
Final effluent	260	42	83.84	138	46.92

TABLE No. 6—REDUCTION OF BOD VALUES

Grade of effluent	Initial BOD Mg/L	BOD after passing column till clearity Mg/L	% reduction in BOD	BOD after saturation of column Mg/L	% reduction in BOD
Grade II and IV	660	168	74.54	334	49.39
Grade III	112	28	75	54	51.78
Final effluent	48	14	70.83	26	45.83

CONCLUSION

The results of the experiments are quite encouraging and useful. The coal ash which is easily and cheaply available can be a very good raw material for the effluent treatment. By a simple and cheap method, the colour of effluent, dissolved and suspended solids, COD and BOD can be reduced upto a great extent. At the same time the combustion value of the coal ash increases fetching better price. This method has proved very successful especially in colour removal of chemical pulp effluent.

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