Effective Utilisation of "Fly Ash" in Plantation of Acacia Auriculiformis

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ABSTRACT

This paper deals with Plantation of Acacia Auriculiformis on normal soil and Fly Ash dump. Five years after the plantation, the growth pulping and paper making properties, were studied in both cases. The pulping and paper making characteristic of this species in both conditions have found to be identical. Based on this study, it can be concluded that fly ash can be effectively utilised for such plantation purpose. This will encourage the utilisation of fly ash during plantation of various paper making raw material species vis-a-vis biological stabilisation of fly ash dumps.

INTRODUCTION

In a bid to improve the boiler efficiency, many modifications in the boiler design were made and finally Fluidised Bed Combuction Boilers (FBC) were found to be efficient. FBCs are being used throughout the world, but use of these types of boilers produce a global problem of **"Fly Ash".** The hygienic & safe disposal/ utilisation of fly ash is assuming a large proportion. It will grow more and more in future if an alternative use in mass outlets are not quickly explored.

In India alone, more than 40 million tons of fly ash is produced per annum from thermal power plant and other industries (1). The contribution of The West Coast Paper Mills Ltd. is approximately 30,000 tons per annum.

In the initial stages, the dumping of fly ash was done in pits, waste lands and abandoned mines. Soon this way was found to be inadequate due to their filling up and exploring new sites for dumping involved costly transportation of fly ash to the alternative sites. Man-made lagoons were made for disposal of fly ash. Fly ash is dumped in a slurry form in these lagoons and to keep the surface area wet, the water is sprayed intermittently so that the dry fly ash will not fly and produce environmental problems. Such lagoons which are fly ash beds are becoming like a barren land without vegetation.

Today, several agencies are engaged in R&D efforts to utilise fly ash in diverse area such as

(1) Agricultural & Plantation;

(2) Manufacture of Pozzolina Cement;

(3) Bricks & Hollow Cement Blocks;

(4) Roads;

(5) Value added products like glazed tiles and pottery.

At the West Coast Paper Mill's Research Centre, work on fly ash utilisation was taken up in various above mentioned fields.

Fly ash produced at the West Coast Paper Mills Ltd. has a composition as given in Table -1.

AGRICULTURAL FIELDS TRIALS

Two common cash crops in North Canara district were selected for these trials (2).

(1) Sugarcane

The West Coast Paper Mills Ltd.,
Bangur Nagar,
Dandeli-581 325 (Karnataka)

(2) Cotton

Table-1

Analysis of Fly-Ash Sample by Central Power Research Institute, Bangalore		
Elements	:	% by weight
Al_2O_3	:	22.90
SiO_2	:	5835
Fe_2O_3+Fe_3O_4	:	05.72
CaO	:	02.77
TiO_2	:	01.34
MgO	:	00.48
MnO	:	00.16
SO_3 (Sulfur as SO_3)	:	00.48
K_2O + Na_2O	:	02.20
Loss on ignition	:	08.00
Moisture	:	00.30
Other Elements	:	Traces

For Sugarcane, two plots were made with -

(a) Soil plus farm manure;

(b) 25% fly ash on top soil plus soil and farm manure.

In both plots same variety of sugarcane were grown for two seasons. The fly ash plot shown 25-30% higher growths & larger girth of sugarcane.

For cotton 33% of fly ash was added on top soil. Again it was found that about 25% higher yield was obtained.

EXPERIMENTAL

Present paper deals with a study of growth of Acacia Auriculiformis on 100% fly ash dump. As can be seen from Table-1, fly ash has all the nutrients required for the plant growth except nitrogen. Acacia species being a leguminous plant, it can adopt to soil devoid of nitrogen. About 100 saplings of Acacia Auriculiformis were selected from the nursery of the West Coast Paper Mills having similar height and leaf count. Half of the saplings were planted on the normal ground and the other half were planted on fly ash dump, which was almost 25 feet deep. These saplings were planted in the month of April/May, 1995. Fly ash dump were covered by 6" thick soil layer to avoid fly ing of fly ash. About 1 kg of ETP sludge was added to each pit dump during planting.

Table-2

Particulars	Normal Plant	Fly Ash Dump
Avg. height/tree mts.	9.25	7.50
Avt. weight/tree kgs.	62.00	54.00
Avg. moisture %	49.25	48.00
Avg. bark %	24.00	20.00

To ensure better establishment of these saplings intermittent watering was done. It was found that the requirement of watering was slightly more on fly ash dump when compared to that for normal plantation plot. This may be due to easy percolation of water through porous fly ash bed. Once the rain set in, watering was stopped.

The growth pattern of plants on both plots were studied by height measurement. After 6 months of plantation, the average height was about 1½ mts. tall with profused branching. These branches were trimmed to allow the plant to grow straight. After 1 year of plantation, the average height on both the plots were 3.25 mts. At the end of 5th year about 4 trees were selected from each plantation for pulping studies, whose girth at the chest height was about 35 cms.

In each case, the average height, weight, moisture content and bark % were measured which are given below (Table -2).

After debarking the logs, the same were chipped in pallmann chipper. Chips were collected separately. Chips size classification was carried out in Willlam's Chips classifier. The results are tabulated in Table-3.

Proximate analysis was carried out according to Tappi standard and the results are tabulated in Table-4.

After removal of + 32 & -3 fraction, chips were dried to about 15% moisture levels and bulk densities were determined.

These air dried chips were cooked in rotary digester maintaining identical pulping conditions. The unbleached pulp was screened using Willey flat screen. Pulp yields, Kappa No., Black liquor R.A.A. were determined. Cooking parameters & pulp results are tabulated in Table-5.

Pulp was beaten in Hollander Valley beater to 30° SR and strength properties of unbleached pulps were

Table-3

Chips Classification

Particulars		Normal Acacia % fraction	Fly Ash Acacia % fraction
+ 32	↔	4.0	9.0
- 32 +25	↔	15.7	18.3
- 25 + 22	↔	11.3	10.3
- 22 + 19	↔	12.9	12.7
- 19 + 16	↔	16.2	14.2
- 16 + 13	↔	12.5	11.9
- 13 + 6	↔	20.9	17 8
- 6 + 3	↔	4.4	3.5
- 3	↔	2.1	2.3

Table-4

Proxymate Analysis of Acacia Auriculiformis

Particulars		Plants grown on Normal Soil	Plants grown on Fly Ash bed
1% NaOH solubility	%	15.8	17.3
Alcohol Benzene Solubility	%	5.3	5.5
Ash	%	0.49	0.57
Holocellulose	%	78.5	76.3
Lignin	%	27.4	27.1

Table-5

Pulping Results

Particulars	Acacia grown on Normal soil	Acacia grown on Fly Ash bed
Bulk density, kg/m^3	255	255
Chemicals added as		
Na_2O, % on chips	15.0	15.0
Unbleached pulp yield, %	52.4	52.8
Unbleached pulp Kappa No.	18.4	18.0
Rejects, %	0.9	0.9
R.A.A., gpl.	7.4	8.0

Constant conditions

Bath Ratio = 1:3

AQ % on chips = 0.05

Cooking Schedule

70-120 °C - 45 min.

At 120 °C - 45 min.

120-170 °C - 90 min.

At 170 °C - 60 min.

Table-6

Strength properties of unbleached pulps (Hand sheets of 60 ± 2 gsm at 30° SR)

Particulars	Acacia grown on Normal soil	Acacia grown on Fly Ash bed
Bulk cm^3/g	1.46	1.46
Braking length km.	4.98	5.06
Double Folds (MIT)	110	115
Burst Factor	44.2	43.8
Tear Factor	80.0	81.7
Strength Index	1933	1946

determined. The results are tabulated in Table - 6.

Bleaching of these pulps and black liquor studies are in progress.

The fibre classification was carried out in Bauer MacNett Classifier & fibre length in each case was determined. The results are as given in Table -7.

RESULTS & DISCUSSIONS

From table-1, it can be seen that fly ash contains mostly Silica (58-62%) and Alumina (20-25%), 5-6% Iron and Calcium, Sodium & Potassium. Rest traces elements are in micro quantity. All these elements are essential for plant growth. Fly ash is devoid of nitrogen is essential for plant growth. Because of this, leguminous species were selected for this experiments.

From table No-2, it can be seen that the average height of normal Acacia is more when compared to that of Acacia grown on fly ash dump. But the bark percent of fly ash grown species is less by about 4%.

The chipping characteristics of both acacia are similar as it can be seen from table No.3 which gives the chips classification.

The pulping, paper making & strength properties of both Acacia are comparable as may be seen from table No. 4, 5 & 6. The Baur MacNett classification & microscopic fiber length distribution (Table - 7) confirm the above facts because both the pulps are similar in nature.

Table-7

Baur MacNett's Fiber classification of unbleached pulps.

Mesh	% Fraction	
	Acacia (Normal Soil)	Acacia (Fly Ash bed)
+ 35	27.1	25.7
- 35 + 50	25.8	24.8
- 50 + 100	20.5	21.6
- 100	26.6	27.9
Average fibre length, mm	0.74	0.72

REMARKS

Both the samples are identical in all respects except in height and weight where acacia grown on 100% fly ash dump has less height and weight. If soil can be amended with part of fly ash, as in case of Sugar cane and Cotton crops, the growth factor may be equal or better when compared with that of normal soil. These experiments are in progress. In this way fly ash can be effectively utilised in plantation of vaious paper making species.

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REFERENCES

(1) Looking Back to Think Ahead - TERI Publication.

(2) Unpublished work from Research Centre.