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PRESSURE TREATMENT OF *EUCALYPTUS CAMALDULENSIS* POLES WITH OIL – BORNE PRESERVATIVE

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ABSTRACT

Eucalyptus camaldulensis poles were treated with 50 : 50 creosote – light diesel oil mixture. The pole size round *E. camaldulensis* was found to contain an average of 53.85% sapwood, which is readily persihable by wood destroying organisms. *Eucalypt* poles were treated by the Bethel Full-Cell process using varying pressure and duration to evaluate the effect on penetration and retention of the preservative mixture. It was found that with the increase of both treating pressure and time, the increase in penetration was not found to be statistically significant. Only treating pressure had highly significant effect on increasing the retention of preservative in the sapwood.

The coefficient of variations of penetration and retention within the individual poles and the same between the poles were calculated. A penetration of 3.5 cm with retention of 318.45 kg/m^3 in the treated sapwood could be obtained by using 10.57 kg/cm^2 pressure for 3 hrs. This penetration is considered adequate to protect the sapwood region of the pole.

INTRODUCTION

Eucalyptus camaldulensis is widely distributed on main land Australia and occurs in all states except Tasmania. *Eucalyptus* plantations are being raised over an area of 10 million acres (4 million hectares) in the world and many are managed under a coppice system (Das, 1984; Turnbull and Pryor, 1984). *Eucalyptus* have been planted in may countries in preference over local species because of their fast growth, adaptability to a wide range of sites and numerous uses. Assuming average present world-wide yields of about 10-12 m^3/ha/yr and basic density of about 450 kg/m^3 , annual *Eucalypt* wood production is in the order of 27-30 million dry metric tones (60-72 million m^3). Over 58 countries now are carrying on significant afforestation and reforestation programme using *Eucalyptus* sp. (Anon, 1981; Davidson and Das, 1985).

Eucalyptus is one of the fast growing pecies use for plantations in Bangladesh. The species grows in poor and dry soil and is resistant to drought and fire. The Forest Department first started planting *Eucalyptus* on a commercial scale in the Forest of Sylhet, Chittagong, Cittagong Hill Tracts and Cox's Bazar Forest Divisions (Das, 1984). Attempts have also been made to grow it in the northern districts of Bangladesh. It is not only fast growing, but it has also various uses depending on the quality of the species. It may be used for fire wood, pulp and paper, constructional timber, electric poles, cross-bars and railway sleepers, laminated wood, plywood and veneer, particle board, charcoal production, etc. Besides, oil and tannin are

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extracted from some species (Turnbull & Pryor, 1984, and Prasad, 1987).

Strength of a *Eucalyptus* pole in service is greatly reduced as its sapwood at the ground line zone perishes in a year or two. Untreated *Eucalypt* sapwood is susceptible to decay and termite attack and often to lyctus borer damage during or after drying (Tamblyn, 1984), but in most species it is not difficult to treat with preservatives to requisite levels of penetration and retention. The sapwood is usually narrow and in many species is liable to considerable checking.

Treated sapwood gives the pole, as a whole, an increased service life by 3 to 4 times (Latif *et. al.* 1981 & 1982). Poles used for power transmission and electrification, need to be treated to get the sapwood completely penetrated by and saturated with preservative. An average of 150 to 218 kilogram of 50 : 50 creosote-light diesel oil mixture per cubic meter is considered to be satisfactory. The present study was, therefore, undertaken to determine the optimum treating schedule utilizing the pressure process with the above formulation.

MATERIALS AND METHODS

Seventeen *Eucalyptus camaldulensis* poles of about 7.62 to 8.3 m long were collected from a 12 year old plantation of the Silvicultural Research Station, Charaljani, Dinajpur. Both the outer and the inner barks of the poles were removed. It was necessary to scrape the poles with a metal scraper to remove the inner bark (Hunt and Garratt, 1967). The poles were then stacked for air drying in an open shed to reduce the moisture content of the poles by up to 20-25 percent. Before treatment all the poles were sized into requisite length i.e. 3m long and were physically examined to determine the average thickness of sapwood, heart wood, diameter, percentage of sapwood and heart wood zone (Table 1).

Table1. Characteristic of 27 *E. camaldulensis* poles under stundy

1	Average diameter of pole	:	17.07 cm
2	Average heart wood zone	:	11.60 cm
3	Average thickness of sapwood zone	:	2.70 cm
4	Thickness of sapwood zone maximum	:	3.26 cm
5	Thickness of sapwood zone minimum	:	2.16 cm
6	Average length	:	3.00 cm
7	Average percentage of sapwood zone	:	53.85 %
8	Average percentage of heart wood zone	:	46.15 %

A mixture of creosote and light diesel oil in the ratio of 50 : 50 was used as a preservative in this study. Sufficient quantity of this mixture was made and stored in the Rueping tank of the treating plant and then surged for several hours for thorough mixing. Before each charge, the preservative was preheated in the Rueping tank to about 85°C with a view to maintain its temperature at 82°C after it was transferred to the treating cylinder.

The pre-dried pole samples were first weighed and then treated by the Bethel Full-Cell process (Findlay, 1985; Hunt and Garratt, 1967). In each treatment three pole samples were subjected to an initial vacuum of 508 mm mercury for an hour. Three treatment pressures and three treatment times were designed factorialy and the temperature was kept fixed at 82 °C (Table 2). On completion of the treatment, the samples were finally weighed.

In another study variation in the treatability of *Eucalyptus* poles was determined. This experiment was designed to establish treating schedules for *Eucalyptus* poles for 160.33 to 320.66 kg/cm^3 retention of preservative mixture in the treated zone or 96.20 to 192.40 kg/cm^3 of the poles. In the second phase of the study eight different *Eucalyptus* poles were subjected to preservative treatment in the eight charges. Each charge had three pole samples made from a single pole. All charges were run with a pre-determined fixed treating schedule having one hour initial vacuum or 508 mm mercury, preservative temperature of 82°C, treating pressure of 8.80 kg/cm^3 at 3 hours treating time. All treatments were carried out in the pilot plant of the Institute.

RESULTS

The difference between the final and the initial weights of a pole sample was the amount of preservative mixture in that pole sample (Table 3).

At least three cores were bored from each pole sample and the depth of penetration of preservative into the wood was measured. The treated pole samples were also ripped lengthwise to determine the depth of penetration (Table 4).

Table 2. Treating schedules of *Eucalyptus camaldulensis* poles

Charge No.	Treating pressure (kg/cm^3)	Treating time (hour)
1	7.04	1
2	8.80	1
3	10.57	1
4	7.04	2
5	8.80	2
6	10.57	2
7	7.04	3
8	8.80	3
9	10.57	3

Table 3. Retention of preservative in *Eucalyptus camaldulensis* poles

Pressure (kg/cm^2)	Retention (kg/cm^3)		
	Time 1 hr	Time 2 hrs	Time 3 hrs
7.04	105.50	63.81	126.02
	142.40	170.43	136.28
	108.40	125.21	140.33
8.80	125.50	63.30	128.05
	201.40	100.20	140.21
	139.30	122.50	145.51
10.57	143.01	206.20	145.44
	205.22	218.05	218.45
	217.08	203.87	208.50

Table 4. Penetration of preservative in *Eucalyptus camaldulensis* poles

Pressure (kg/cm^2)	Penetration (cm)		
	Time 1 hr	Time 2 hrs	Time 3 hrs
7.04	2.67	2.67	3.00
	2.92	3.17	3.31
	2.81	3.01	3.04
8.80	3.50	3.25	2.50
	2.67	3.33	2.40
	2.92	3.50	3.25
10.57	3.40	3.25	3.00
	3.08	3.25	2.50
	3.25	3.50	3.25

The penetration and retention in both the phases of study were statistically analysed to evaluate the significance of the effect of treating pressure, treating time and pole characteristics. The results of the statistical analysis are given in Tables 5, 6, 7 and 8.

Table 5. Analysis of variance of retention of preservative in the sapwood of *Eucalyptus camaldulensis*

SV	F	SS	MSS	F (cal)
Pressure (P)	2	28,938.339	14,469.170	12.64 *
Period (T)	2	974.968	487.480	0.43 ns
P X T	4	5,988.145	1,497.040	1.31 ns
Residual	18	18,308.164	1,144.260	
Total	**26**	**54,209.616**		

* Significant at 1% level; ns = not significant

Table 6. Analysis of variance of penetration of preservative in the sapwood of *Eucalyptus camaldulensis*

SV	F	SS	MSS	F (cal)
Pressure (P)	2	0.2000	0.1000	1.258 ns
Period (T)	2	0.4090	0.2045	2.573 ns
P X T	4	0.6500	0.1625	2.045 ns
Residual	18	1.4310	0.0795	
Total	**26**	**2.6896**		

ns = not significant

Table 7. Average thickness of sapwood in eight *Eucalyptus camaldulensis* poles and the coeffecient of variation of penetration and retention within the individual poles

Pole no.	Average Thickness of sapwood (cm)	Mean retention (kg/cm^3)	Coefficient of variation in retention (%)	Mean penetration (cm)	Coefficient of variation in penetration (%)
1	2.43	144.24	16.19 (23.25)	3.16	4.90 (0.16)
2	3.33	172.19	23.96 (41.27)	3.37	5.22 (0.18)
3	2.78	137.92	6.29 (8.95)	2.72	17.06 (0.46)
4	2.22	103.90	37.83 (39.31)	2.75	5.24 (0.14)
5	2.86	95.33	31.36 (29.90)	3.36	3.78 (0.13)
6	2.90	187.21	22.37 (41.89)	3.04	1.16 (0.35)
7	2.12	190.81	20.75 (39.60)	2.92	13.04 (0.38)
8	2.91	209.40	3.63 (7.61)	3.33	4.32 (0.14)

Note : The figure in parenthesis is the standard deviation

Table 8. **Coefficient of variation of penetration and retention among the eight *Eucalyptus camaldulensis***

Coefficient of variation among the mean values of eight different poles retention (%)	Coefficient of Variation among The mean values of eight different poles penetration (%)	Correlation between sapwood and retention	Correlation between sapwood and penetration
26.86	9.31	0.20	0.63

DISCUSSION

From the literature and from previous experience it can been seen that penetration of *Eucalypt* heartwood is typically difficult or very difficult using preservatives applied by a conventional pressure treatment. *Eucalypt* sapwood is not difficult to treat with preservatives to requisite levels of penetration and retention. The *Eucalypt* poles under study were found to have a ring of sapwood with an average thickness of 2.71 cm surrounding a heartwood with an average diameter of 11.6 cm and occupying 54 percent of its total volume on the average (Table 1.)

Although the average thickness of sapwood was 2.71 cm, almost all the poles under study had a sapwood zone over 2.50 cm thick. If 2.50 cm was taken as the optimum depth of penetration for an *Eucalypt* pole, 100 percent of the poles would be treated as per specifications of Bangladesh Standard on Code of Practice of Wood Preservation (Anon, 1975). To achieve a penetration of average 2.97 cm, the upper limit of process variables were set for treating pressure upto 7.04 kg/cm^2 and for treatment time of 3 hours.

Penetration and retention data were analysed statistically to evaluate the effect of treating pressure and treatment time. From Tables 5 and 6 it was seen that the effect of treating pressure did not show any significant result on increasing the penetration of preservative into the sapwood, but the treating pressure has highly significant effect on increasing the retention of preservative in the sapwood.

In Tables 3 and 4 it can be seen that some pole samples showed low amenability to preservative treatment. This led to the possibility of existence of pole to pole variation in respect of treatability.

A separate study with eight individual poles was conducted and the results were analysed statistically. It can be from Table 7 that the treatability of *Eucalypt* poles in respect of penetration and retention varies from pole to pole significantly. They are, however, less variable within a pole than among poles. The coefficient of variations of retention and penetration within the individual poles are in the range of 3.63 to 37.83 and 1.16 to 17.06 percent respectively. The coefficient of variation in respect of penetration and retention are 9.31 and 26.86 percent respectively among pole variation. The variation in these characteristics of the poles may not be considered as disadvantageous, because the penetration and retention were directly correlated to the thickness of sapwood zone as evident from Table 8. The correlation coefficient between thickness of sapwood zone and penetration and between thickness of sapwood zone and retention were 0.63 and 0.20 respectively. These indicate that both the penetration and the retention increased with the increase of the thickness of sapwood zone. The entire thickness of the sapwood zone was found to be penetrated. Therefore, an inference may be drawn that sapwood of all *Eucalypt* poles is possible to treat by pressure process.

Seasoned *Eucalyptus camaldulensis* pole without subjecting to any pretreatment condition could be treated to achieve 3.5 cm penetration and 318.45 kg/cm^3 retention in the sapwood after using a treating schedule of 10.57 kg/cm^2 treating pressure and 3 hours treating time. This amount of penetration and retention may be considered adequate for a poles to be used for power transmission lines in Bangladesh (Anon, 1975).

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