

## KERALA FOREST DEPARTMENT

V4-4567/96.

Forest Head Quarters,  
Thiruvananthapuram,  
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### TECHNICAL NOTE ATTACHED TO CIRCULAR NO.12/97

Sub:- Issues relating to smuggling of sandal wood and extraction of sandal Oil in sandal oil factories.

1. Sandal wood tree (Santalum album) is one of the most precious tree of our country. It occupies an important place in the ecological, cultural and spiritual heritage of India. India accounts for nearly 99% of sandal oil production in the world. It is estimated that in Indian Sandal is distributed over 9040 Sq.Km. area. The distribution of sandal in different states is given below:-

1. Karnataka	-	52.45 Sq.Km.
2. Tamil Nadu	-	3040 “
3. Andhra Pradesh	-	175 “
4. Kerala	-	63 “
5. Madhya Pradesh	-	33 “
6. Orissa	-	25 “
7. Maharashtra	-	8 “

2. Sandal tree is mainly exploited for its scented heartwood from hole and roots which yields fragrant sandal oil. Sandal heart wood is generally yellow to brown in color and pleasantly scented. It is the most valuable part of sandal tree. The heart wood commences to form only at the age of about 20 years and is at its prime between the age of 30 to 60 years when they attained 40-60cm in girth. Sandal wood is usually exploited in the basis of physical rotation i.e., the extraction is done only when the trees die. Sandal wood is extracted by up rooting slice root is the richest in terms of oil content. Oil contents in sandal wood vary from locality to locality, tree to tree and from one part to another with in the same tree. Researches have shown that oil content is maximum in the heart wood obtained from root. Sandal oil content decreases along the length of the tree from root to tip and across the diameter of heart wood from core to periphery. Generally, there is decrease of about 15% in oil content from root to tip and about 20% from core to periphery. The heart wood of rest portion roughly contains 3.5 to 6.3%, heart wood from stem contains 3-5% and heart wood from branches contains 1-3% of oil.

3. Oil can be extracted from sandal heart wood by any of the following three methods:

1. Steam distillation.
2. Solvent extraction and stem distillation.
3. Solvent extraction and vacuum Distillation.

4. Steam distillation is the most widely used method. In the sandal wood oil industry, steam distillation is the process adopted for extracting sandal wood oil because it is less expensive. But it offers some losses due to hydro solubility of certain components of the oil. Moreover, an appreciable quantity of oil remains in the interstices of the wood, and it is not available for extraction by steam distillation. Due to the low volatility of the oil and high boiling constituents, the distillation is slow and consequently requires large quantities of steam to vaporize it from wood. Hence distillation has to be continuously done for 100-120 hr.

5. In the case of the other two methods, organized solvent is used to extract sandal oil, and hence these processes are prohibitively expensive to be used in industrial extraction. The salvation of sandal oil in organic solvent is distilled either by steam distillation or by vacuum distillation.

6. Sapwood of sandal is white to whitish yellow in colour and is unscented. It is reported in the "The Essential Oils" by Earnest Annetter Ph.D. published by D. Van Nostrand Company, Inc 1952 that the soft white outer layer, then so called sapwood, contains essential oil and is therefore removed and discarded." In "Studies on Angio-peraie Parasite" pp69, it is said "The sapwood which is the white outer layer contains practically no oil and therefore removed and discarded". It is reported in "Chemistry and Utilization of sandal" by K.E. Sankara Narayanan, R.A. Sreemathi and E.R. Venkatesan in the book namely Recent Advances in Research and Management of Sandal in India published by Associated Publishing Company, 1955, that sapwood does not contain much extractable oil components. The following reports also reiterate the finding that sapwood does not contain sandal oil.

- i) Indian Forest Utilization Vol. I, compiled and written by the Editorial Board, Forest Research Institute and Colleges, Dehradun in 1972, page 672
- ii) Recent advances in Research and Management of Sandal in India 1995 edited by B.A. Srimathi, E.D. Kulkarni and K.R. Venkatesan published by Associated Publishing Company, New Delhi.
- iii) "Sandal wood, its cultivation and Utilisation" in the book namely cultivation and Utilisation of Aromatic plants" by P.K.Sen, Sarma Forest Research Laboratory, C.S.I.R., Samma, page 403
- iv) "Sandal wood" published by Wood Science Technology, Bangalore under I.C.F.R.E. page 95.

7. Further it is very clearly specified in the publication namely "The Wealth of India" on page 216, that the white sapwood obtained by stripping is burnt at the site and that meticulous observance of these details is insisted upon to eliminate possible malpractices. The rules relating to extraction of sandal wood in Kerala which is published as Appendix – VI in volume III of Kerala Forest code do also contain provisions to the effect that portion of sandal tree with no heart wood as well as sapwood and sapwood chips should be destroyed by the Divisional Forest Officer or his

gazetted assistant. The specific provisions relating to destruction of sap wood are contained in Rule 13, Rule 15, Rule 25 etc .

8. From the foregoing paras, it may be seen that no sandal oil is extractable from sap wood of sandal by steam distillation method. The Karnataka soaps and detergents Ltd., a Government of Karnataka undertaking has reported to the Divisional Forest Officer, Special Division in a letter KSDL/To/972/86-85 dated 8<sup>th</sup> December, 1986, that they are not extracting oil from sap wood. Now sap wood and sap wood chips are utilized in preparation of agarbathies seasoned sap wood can be used for making curios, caroms sofa, toys, etc. But, private sandal oil factory owners contend that sandal oil can be extracted from sandal sap wood basing on a report namely sandal Forests of Madhya Pradesh by Shri J.K. Chaturvedi published in 1956. In the said paper, it is seen reported that sandal wood samples from Rajgarh range of shore division in Madhya Pradesh gave the following results.

Name of Part	Sound heart wood	Oil content at zero moisture (%)
Bole wood	Sound heart wood	6.18
Bole wood	Heart wood	3.59
Bole wood	Sap wood	0.14
Bottom wood	Heart wood	0.39
Bottom wood	Heart wood	3.16
Branch wood	All sap wood	0.16
Stem wood	Sound heart wood	4.34
Stem wood	Follow & Rotten heart wood	1.72
Steam wood	Sap wood	0.08
Main root	Heart wood	2.52
Main root	Sap wood with formation of heart wood	1.93
Side root	Sap wood	0.18
Side root	Sap wood	0.06
Side root	Heart wood	2.45

9. From the above table, it may be seen that the oil content in sap wood varies from 0.18% in the sap wood of roots to 0.08% in the sap wood of stem and 0.06% in the sap wood of side roots. This is too small an oil content to be available in steam distillation since in the interstices of wood retains small quantities of oil. Sap wood of main root with heart wood is reported to have yielded 1.93% of sandal oil. But this has no application to the distillation of sap wood purchase from Government depots by private sandal oil factory owners for the following reasons:

10. The uprooted tree with root is brought to depot, as it is or after cross cutting if it is difficult to transport the whole tree along with branches. After cross cutting the tree formation; the pieces are measured and weighed. Thereafter, desapping is done to remove the outer layers of sap wood. This sap wood used to be destroyed in the past as per the rules. Not it is collected and sold. After desapping, the sandal wood pieces are subjected to rough cleaning by removal of inner layer of sap wood by chipping. The

chips would contain small bite of heart wood and hence it is called mixed chips. After rough cleaning there will not be any sap wood on the heart wood piece. Thereafter, the piece is subjected to final cleaning by smoothening the surface using sharp knives. This process yields shavings and chips of outer layer of heart wood which is called heart wood chips commercially known as cheriya. Hence it may be seen that the cleaning process to get clean heart wood of sandal yields the following which are also sold in auction.

1. Sap wood (with no heart wood)
2. mixed chips (with traces of heart wood)
3. heartwood chips (cheriya) (outer layer of heart wood)

11. The sap wood sold from Government Depots do not contain any heart wood and hence it cannot yield sandal oil on steam distillation. The results published by Shri. I.K. Chaturvedi were from laboratory experiments using sandal sap wood with some heart wood in it. It has been well established by subsequent research studies that sandal sap wood does not contain sandal oil extractable by steam distillation method. It has also been established by research studies that even the trace of oil content in sap wood does not possess the required quality and fragrance of commercial sandal oil. Further, the biomass of that tree is only a small portion of the total biomass of that tree. Hence the percentage of sap wood from roots would only be a very small which compared to the total sap wood available from any tree. Therefore the percentage of sandal oil content in the roots with sap wood and heart wood in it cannot be applied to extraction of sandal oil by distillation of sap wood in factories. The sample which showed 1.93% of sandal oil content was a mixture of sap wood and heart wood in the root without specifying the ratio of sap wood to heart wood. Hence, the above percentage cannot be applied to the yield of sandal oil obtained by steam distillation of sap wood in the private sandal oil factories since, sandal wood sold from Government sandal depot does not contain any heart wood. It has also been clarified by Karnataka Soap and Detergents Ltd., that sandal oil is not available from sap wood in steam distillation process when sap wood does not yield sandal oil in scientific experiments and in Government sandal oil factory, it cannot yield sandal oil in private factories.

12. As already indicated Kerala has only a very small extent of sandal Area that too mainly in Marayoor. The annual yield of sandal heart wood from the forest of our state is below 100 MT. An abstract of sales of sandal wood dated 30-08-1995 and 28-2-1996 is given below:

Class	Name	Quantity (in KG) 30-8-199	Sold on 28-2-1996
V	Chat badla	14331.600	19718.200
VI	Bagraded	18823.700	20498.200
VII	Root 1 <sup>st</sup>	2584.300	3375.900
VIII	Root 2 <sup>nd</sup>	2120.100	1810.500
IX	Root 3 <sup>rd</sup>	2402.600	1263.800
X	Jaipookal	3318.100	5267.200

XI	Cheria	3506.900	2947.700
XII	Mixed Chips	19987.200	10265.100
XIII	Saw dust	454.400	124.800
	Sandal Sap wood	15 MT	31.88 MT

13. As already indicated sap wood contains no extractable sandal oil, Mixed chips contain small quantity of sandal oil due to the presence of small bite of heart wood and heart wood chips (cheriya) contain sandal oil, since it is outer layer of heart wood. The heart wood after cleaning is classified and sold. The rate fetched by various classes of heart wood and other produce are tabulated below.

#### AVERAGE SALE RATE OF SANDAL WOOD AND SAP WOOD

Sl. No.	Class	Dates (Rs. per MT)					
		1988-89	1989-90	1990-91	1992-93	1993-94	1995-96
1	I	129000	-	-	-	-	-
2	II	113005	202100	202200	-	310000	-
3	III	90030	198200	-	-	-	310000
4	IV	90000	199700	202200	203200	310000	311000
5	V	96387	172823	194300	204030	351992	381000
6	VI	85767	-	-	192334	313450	326000
7	VII	105695	-	174160	175700	308339	337000
8	VIII	108110	-	160254	183400	308403	338000
9	IX	117960	-	152350	155100	320595	340000
10	X	106354	-	170482	176468	306048	305000
11	XI	83788	-	90300	39640	178310	238000
12	XII	30100	-	65300	79397	99625	152000
13	XIII	5003	6562	-	19270	14000	11910

#### AVERAGE VALUE OF SANDAL WOOD

Cheria (heart wood chips)	Rs.267/Kg.
Mixed Chips	Rs.180/Kg.
Saw dust	Rs.151/Kg.
Sap wood	Rs/14/Kg.

14. From the above, it may be seen that value of sandal wood depends on quality and oil content in it. Sap wood is sold only at very low rate since there is no oil content in it and it is used only for making agarbathies, toys etc. Had there been oil content up to 1.9% in the sap wood, it would have fetched at least 25 to 40% of rate for heart wood as is evident from the rates for cheriya, mixed chips and saw dust.

All these facts prove beyond doubt that sandal sap wood does not contain sandal oil. This issue has been discussed and decided in the council of chief Conservators on 3-

7-1997. This technical note is issued as per the decision of the CCFs' Council dated 3-7-1997.

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Sd/-

ELECTRICAL CHIEF CONSERVATOR OF FORESTS (G)