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Improvement in Lac Processing Techniques: Part I—Production of Shellac Directly from Sticklac

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The conventional processes for the production of shellac from sticklac by the seedlac route involve loss of about 25% lac resin in the form of byproducts. A simple and economical process for the production of shellac directly from sticklac using alcohol (at 20°C) or acetone (at 40°C) as the solvent is described. The process gives not only waxy and dewaxed shellac but also decolorized shellac with superior life, flow and colour index. The decolorized waxy shellac will be a new addition to the existing shellacs of commerce.

THE conventional method for refining sticklac to shellac is a two-stage operation resulting in a few unavoidable lac-containing byproducts[1]. Briefly, the process consists in crushing sticklac to 8-10 mesh and after sieving out the fines, known as lac dust, washing the crushed lac with water either mechanically in a washing barrel or manually in a *naad* to produce seedlac. The different byproducts obtained during this washing process are *molamma* and *gunghi*. The dried seedlac is sieved to remove the finer lac grains known as *kunhi* and then processed into shellac mostly by hot filtration in a *bhatta* or a hydraulic press or an autoclave. Here again byproducts like *kiri* and *passewa* are obtained. The alternative solvent method of making shellac also uses seedlac, but here there are no byproducts like *kiri* or *passewa*.

The loss of lac resin in the above processes amounts to about 25%. Elimination of this loss, if possible, will naturally improve the economy of the industry. Attempts were, therefore, made to convert the conventional two-stage refining process into a one-stage operation using a suitable solvent, so as to obtain shellac directly from sticklac, eliminating the intermediate seedlac stage. The encouraging results obtained are reported in this paper.

The lac resin in sticklac remains associated with wax, water-soluble and water-insoluble dyes, an odoriferous principle, insect bodies, sugars, albuminous matter, dust, sand, woody matter, etc. Wax, water-insoluble dyes (erythrolaccin, *iso*-erythrolaccin and desoxy-erythrolaccin) and the odoriferous principle

form an integral part of shellac and these are soluble in all solvents of lac resin. Hence, in choosing the solvents, careful consideration needs to be given to the fact that the impurities (other than wax, the water-insoluble dye and the odoriferous principle) should not go into solution during the extraction of the resin from crushed sticklac.

The water-soluble dye is present in sticklac as the sodium/potassium salt and is insoluble in alcohol and acetone[2]. An improved method for the preparation of the water-soluble dye (laccaic acid) was claimed by Fowler and O'Meara[2]. The lac resin is dissolved out with alcohol or acetone, in hot or cold condition, and the dye recovered from the residue. In the present method, we have taken advantage of this finding and tried commercial solvents, viz. rectified or methylated spirit and acetone for the preparation of shellac directly from sticklac.

Experimental procedure

To find out the optimun conditions for the extraction of the resin and its recovery, some preliminary experiments were carried out with *Rangeeni* sticklac. Shellac possessing satisfactory properties was obtained by extracting the sticklac with rectified spirit at or below room temperature and with acetone at 40°C and recovering the resin either by distilling off the solvent or by precipitating the resin with 1% aqueous salt solution. The method was next standardized by carrying out a number of experiments with different varieties of sticklac.

Sticklac, crushed to 8-10 mesh, is agitated for about 4 hr at room temperature or at 18-20°C with 94-95% alcohol (7 litres per kg of the lac content in sticklac) or with commercial acetone containing not more than 5% water at 40°C. The extract is then filtered through drill cloth, preferably in a filter press, and the residue washed with fresh solvent (1 litre/kg). Requisite quantity of activated carbon, preferably Norrit, and a few drops of acetic acid (2-3 drops/kg) are added, the contents stirred for 1 hr, filtered and washed. The filtrate, along with the washings, is gradually added in a thin stream, with efficient stirring, into an equal volume of 1% sodium chloride solution in water, when the lac gets precipitated. Alternatively, 50-60% of the solvent may be recovered from the filtrate under low pressure and the residual material poured into salt solution. After half an hour, the lac, which by this time has settled down as a spongy mass, is taken out, washed twice with water and kept in boiling water for 15-20 min to remove the last traces of solvent and water-solubles. The material is then cooked in a steam-heated pan and the molten lac drawn into sheets.

Results and discussion

The properties and yield of shellac obtained from different types of sticklac (7 kg lots) are given in Table 1. Corresponding data for shellac prepared by the conventional *bhatta* method from seedlac from the same source are also included for comparison. It is seen that the yield of shellac obtained by the new process is higher than that obtained by the *bhatta* method and the life and flow of the

Table 1 — Yield and properties of shellac produced directly from sticklac and by *bhatta* process

Sl No.	Sticklac used	Method of extraction	Yield of shellac %	Colour index	Life at 125°C min	Flow mm	Wax %
1	*Ber*	Acetone at 40°C	76·4	22	45	104	4·4
	do	Alcohol at 20°C	72	21	48	106	0·16
	do	*Bhatta*	60	14	43	83	4·4
2	*Palas*	Acetone at 40°C	72	26	44	104	4·1
	do	Alcohol at 20°C	69	24	46	104	0·14
	do	*Bhatta*	54·6	17	41	81	4·3
3	*Kusmi*	Acetone at 40°C	84	13	46	103	4·2
	do	Alcohol at 20°C	80	11·5	47	105	0·12
	do	*Bhatta*	61	10	45	95	4·4

product are distinctly superior. Though the hue of the shellac is not different from that of the *bhatta* shellac, the colour index is higher by 7-9 units in the case of *ber* and *palas* and by 2-3 units in the case of *Kusmi* shellac.

To remove the dark colour, absorbents such as zinc carbonate, magnesium carbonate, calcium carbonate, caprolactam powder and activated carbon were tried. Of these, activated carbon was found to be the best and the colour index could be easily improved to any desired extent without any appreciable change in the properties of shellac. With the use of 8-10% carbon (on the weight of lac) in the case of *Rangeeni* and 4-5% for *Kusmi* sticklacs, the colour of the shellacs becomes identical with that of *bhatta* shellac. The carbon, together with a few drops of acetic acid, is added to the lac solution, kept stirred for 1 hr and processed as described earlier. The results obtained with carbon are given in Table 2. It is seen that the use of carbon has improved the colour index, which is rather on the lower side compared to that of *bhatta* shellac. The shellacs have also better life and flow.

Table 2 — Effect of activated carbon on decolorization

Sticklac used	Method of extraction	Carbon used %	Yield of shellac %	Colour index	Life at 150°C min	Flow mm	Wax %
Rangeeni	Alcohol at 20°C	0	73	18	43	104	0·17
	do	10	70	10·5	42	102	0·15
	do	100	63	1·4	42	103	0·13
	Acetone at 40°C	0	77	18	42	104	4·2
	do	10	74	11	42	103	4·0
	do	100	66	1·6	41	103	3·8
	Bhatta	—	58	12	40	88	4·4
Kusmi	Alcohol at 20°C	0	80	11·5	38	100	0·16
	do	4	78	8·5	37	98	0·14
	do	100	71	1·2	36	98	0·12
	Acetone at 40°C	0	84	11·5	40	100	4·1
	do	4	81	8·0	38	99	4·0
	do	100	74	1·3	37	98	3·9
	Bhatta	—	61	10	36	82	4·4
Angelo's Blonde[3]	Solvent process	—	—	1·6	30	—	Nil (limit 0·2)
Angelo's Super-blonde[3]	do	—	—	0·8	30	—	do

Table 3 — Yield and properties of shellacs produced from commercial sticklac by the conventional and the new method

Sticklac used	Process	Yield of shellac %	Colour index	Life at 150°C min	Flow mm	Wax %
Ber	Acetone at 40°C	80·4	14·0	55	104	4·40
do	Alcohol at 18-20°C	76·0	14·0	58	106	0·16
do	*Bhatta*	58·2	14·5	43	83	4·60
Palas	Acetone at 40°C	74·2	16·2	48	102	4·20
do	Alcohol at 18-20°C	70·0	16·0	49	104	0·14
do	*Bhatta*	54·6	17·0	41	81	4·50
Kusmi	Acetone at 40°C	82·2	8·5	58	106	4·80
do	Alcohol at 18-20°C	78·4	8·5	60	106	0·12
do	*Bhatta*	63·0	9·5	52	92	4·60
Lemon (Angelo)[3]	Heat process	—	9	50	80	4·5
Dewaxed Lemon (Angelo)[3]	Solvent process	—	8·0	35	55	0·2

The absorption process, however, brings down the yield of shellac by 2-3%, which is still higher than that obtained in the conventional method.

Further increase in the proportion of carbon reduces the colour of the shellac still further. When 100% carbon is used in two instalments (which may be used after partial replacement), products of colour index as low as 1·2 could be obtained. The loss in these cases was of the order of 8-10%.

The reproducibility of the process was tried on 10 and 20 kg lots of commercial *Rangeeni* and *Kusmi* sticklacs and was found satisfactory (Table 3).

Advantages

The process not only produces waxy or dewaxed shellac directly from sticklac in higher yields with better life, flow and colour index, but can also produce decolorized dewaxed as well as waxy shellacs. The decolorized waxy shellac will be a new addition to the existing shellacs of commerce.

The residue left over from solvent extraction of sticklac contains the full complement of wax and dye along with insect debris, sand and other insoluble impurities. The wax and the water-soluble dye (20-25% and about 4% respectively on the weight of the residue) may be obtained from the residue easily by extraction with *n*-hexane and water respectively. Good quality clean wax is thus obtained and the dye retains its solubility in water indefinitely. The residue contains high percentage of nitrogen and can be used as a manure.

The process lends itself to adoption in a small compact factory where the products will be waxy/dewaxed regular or decolorized shellac, lac wax, water-soluble lac dye and a nitrogenous residue suitable for use as a manure. There will thus be no non-saleable byproducts and no objectionable effluents, as are obtained in the currently used processing methods. The shellacs produced will be free from any residual solvent and hence the blocking tendency will be negligible. The equipment required is all conventional and should be easily available/fabricated indigenously.

Scheme 1 — Production of shellac directly from sticklac and by country *(bhatta)* process — Cost estimates

(*Basis*: 100 *kg per charge per day*; 300 *days a year*)

INVESTMENT	NEW PROCESS Rs	*Bhatta* PROCESS Rs
Factory shed	5,000.00	5,000.00
Machineries	25,000.00	5,000.00
Working capital to cover cost of raw material, solvent, etc., based on 3 months' expenditure	30,000.00	25,000.00
Total capital outlay	60,000.00	35,000.00
Production costs (per month of 25 days)		
DIRECT COSTS		
Raw material		
Sticklac 25 quintals @ Rs 250/quintal*	6,250.00	6,250.00
Alcohol/acetone, 560/600 litres, of which 520/560 litres are recoverable; hence, loss of 40 litres per charge @ Re 1.00/litre	1,000.00	—
Activated charcoal, 2 quintals @ Rs 200/quintal	400.00	—
Common salt, 25 kg @ Re 0.40/kg	10.00	—
Utilities		
Water, power and steam	50.00	Processing cost† @ Re 0.75/kg of sticklac
Labour and supervision		
Supervision @ Rs 10/day	250.00	1,875.00
Unskilled labourer: 2 @ Rs 4/day	200.00	
Maintenance	25.00	
INDIRECT COSTS		
Depreciation on machinery @ 10%	208.50	41.65
Interest on total capital outlay @ 6%	300.00	175.00
Total	8,693.50	8,341.65
say	8,700.00	8,350.00

(*Contd*)

Scheme 1 — Production of shellac directly from sticklac and by country (*bhatta*) process — Cost estimates (*Contd*)

INVESTMENT	NEW PROCESS Rs	*Bhatta* PROCESS Rs
Total cost of production for 1750 (70×25) kg of dewaxed lac (alcohol method) or 1850(74×25) kg of waxy lac (acetone method)	8,700.00	1350(54×25)kg of waxy lac 8,350.00
Cost of production per kg of		
(i) Dewaxed lac	4.97	
(ii) Waxy lac	4.70	6.19

*There is at present wide fluctuation in the price of sticklac. However, the cost of production will vary proportionately in both the processes with change in price.

†This is the present rate adopted by the lac manufacturers which covers all the refining operations, such as washing of sticklac to seedlac, melting of seedlac to shellac, etc.

Since there is no loss of lac as byproducts and the processing cost is lower than in the conventional procedures, a better return is ensured for the manufacturer.

As mentioned earlier, 50-60% of the solvent may be recovered under low pressure before pouring the lac solution into saline water. The rest of the solvent is to be recovered by rectification and reused. The recovery is simpler in the case of acetone than with alcohol, as the former distils off from the aqueous solution easily. After drying over lime, the acetone can be reused.

The shellacs produced by this process have superior properties compared to those obtained by the conventional and the solvent processes.

Economics

Based on the experimental findings, cost estimate for the production of 70-74 kg shellac from 100 kg *Rangeeni* sticklac per day has been prepared. The cost has been compared with that of the conventional country process in the absence of data for the commercial machine (hydraulic press) and solvent processes. In the latter processes, seedlac is used and in the solvent process, the recovery of lac resin is almost cent per cent and the variety is a dewaxed one. The comparative cost of production by the last process has also been calculated. The cost per kg for dewaxed and/or waxy shellacs, on the basis of 55 and 59% yield (yield by the new process minus the loss of 15% during processing of sticklac to seedlac), comes to Rs 6·33 and Rs 5·90 respectively. It is thus evident that the cost of production by the new process is much lower than that in the processes currently in use (Scheme 1).

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