

Shellac removers

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"THIS study was aimed at developing a solvent mixture which would dissolve shallac more rapidly than the conventional denatured or rectified spirit, for use for the cleaning of printing rollers after use with shellac based inks. A mixture of denatured alcohol and butyl acetate in the ratio of 75:25 by volume was found to be the most satisfactory. This mixture dissolves shellac about six times as rapidly as spirit alone and has also negligible action on rubber. Water upto 20 per cent by volume in the mixture has no effect on the rapidity of the dissolution and helps to reduce the ratio of evaporation. A mixture of spirit, trichloroethylene and methyl acetate (45:40:15), or spirit, trichloroethylene and 85% formic acid (40:40:20) dissolves shellac even more rapidly (2-3 times as fast) but has pronounced effect on rubber."

The present study was undertaken mainly to find out a suitable solvent or solvent mixture in which shellac will dissolve instantly or in the minimum possible time and if possible, without swelling. Such a mixture is called for particularly for use in the cleaning of surfaces and sides of printing rollers after use with shellac based inks. Literature¹ provides the three compositions for shellac removers (Table A).

TABLE A

Materials	Parts by weight in composition		
	I	II	III
Benzol	30	30	—
Petroleum naphtha	—	—	30
Anhydrous methanol	50	70	70
Isopropyl alcohol	—	—	5
Lugosol	20	—	—
Paraffin wax	2	2	2
Powdered KOH	1	1	0.9

It will be seen that all the three contain caustic soda, a material difficult to remove and consequently better avoided, if possible. Moreover, they also contain benzol or petroleum naphtha, both of which are powerful attackers of rubber². Advantages of removers entirely based on solvents and preferably not containing hydrocarbon solvents are thus obvious.

Among the traditional solvents, pyridine³ is the best but is discarded because of its obnoxious smell. Then comes methyl and ethyl alcohol or more commonly rectified spirit or denatured spirit which are the most common solvents for shellac, being both convenient and economic. In these alcohols, however, shellac takes time to dissolve as, in contact

TABLE I

DISSOLUTION OF SHELLAC IN COMMON SOLVENTS

Weight of lac taken — 10 gm.; Vol. of solvent used — 100 ml; Temperature 22°C

Sl. No.	Solvents used	Time for dissolution		Swelling if any	Remarks
		of lac (m)			
1.	Methyl alcohol (pure)	23-24		Swells	Presence of water upto 10% does not make any difference in the time of dissolution of lac in denatured alcohol redistilled.
2.	Ethyl alcohol 97%*	26-27		—do—	
3.	Ethyl alcohol 95%	26-27		—do—	
4.	Ethyl alcohol 93%	26-27		—do—	
5.	Ethyl alcohol 90%	26-27		—do—	
6.	Ethyl alcohol 85%	28-30		—do—	
7.	Ethyl alcohol 80%	32-35		—do—	
8.	Isopropyl alcohol (pure)	34-35		—do—	
9.	Butyl alcohol (pure)	40		—do—	

† Retired Director.

* Ethyl alcohol, denatured, redistilled

with these, it first swells and then only goes into solution.

As is well known, often a single solvent is not as effective as a mixture⁴ of two or more solvents, the latter bringing about more rapid dissolution. Therefore, known solvents and their mixtures were tried. In all cases, shellac powdered to 30 mesh, was taken and a 10% (w/v) solution with the appropriate solvent/mixture was attempted by vigorous shaking by

hand. First, the solvent mixtures were tried, with the constituents in the (arbitrary) proportions of 50:50 by volume. The most promising ones were then re-examined in different proportions. Times taken for complete dissolution and swelling, if any, were noted in each case.

The results obtained with various solvents/mixtures are indicated in tables I and II.

TABLE II
DISSOLUTION OF SHELLAC IN SOLVENT MIXTURES

Weight of lac taken 10 g; Volume of mixture used 100 ml; Temperature 22°C

Sl No.	Solvents used	Ratio of solvents in the mixture (V/v)	Time for dissolution of lac (M)	Swelling if any	Remarks
1	2	3	4	5	6
1.	*Spirit + acetone	50:50	20	Swells	Colour darkens
2.	Spirit + carbon-tetrachloride	50:50	20	Swells heavily	good col.
3.	Spirit + chloroform	50:50	8	—	after dissolution
4.	Spirit + isopropyl alcohol	50:50	15	Swells	
5.	Spirit + butyl alcohol	50:50	17	Swells	
6.	Spirit + ethyl acetate	50:50	25	Swells heavily	
7.	Spirit + methyl alcohol	50:50	15		
8.	Spirit + toluene	50:50	8		
9.	Spirit + acetic acid	50:50	15		good colour after diss.
10.	Spirit + pyridine	50:50	4		
11.	Spirit + dioxane	50:50	25	Swells	
12.	Spirit + benzene	50:50	8		
13.	Spirit + trichloroethylene	50:50	5		
14.	Spirit + aniline	50:50	15		
15.	Spirit + formic acid	50:50	12		
16.	Spirit + amyl alcohol	50:50	20	Swells	
17.	Spirit + diethylene glycol	50:50	22		
18.	Spirit + xylene	50:50	25	Swells heavily	
19.	Spirit + acetaldehyde	50:50	7		
20.	Spirit + fusel oil	50:50	23		
21.	Spirit + butyl cellosolve	50:50	10		
22.	Spirit + butyl acetate	50:50	5		
23.	Hexane + butanol	50:50	12	Swells heavily	
24.	Isopropyl alcohol + butyl acetate	50:50	7		
25.	Diacetone alcohol + ethyl acetate	50:50	8	Swells	
26.	Diacetone alcohol + butyl acetate	50:50	12	Swells	
27.	Isopropyl alcohol + formic acid 85%	80:20	3		
28.	Spirit + toluene	90:10	8	Swells	
29.	—do—	80:20	8	—do—	
30.	—do—	75:25	8	—do—	
31.	do—	50:50	8	—do—	
32.	Spirit + benzene	90:10	10	—do—	
33.	—do—	80:20	9	—do—	
34.	—do—	75:25	10	—do—	
35.	—do—	50:50	8	—do—	
36.	Spirit + trichloroethylene	90:10	10		

* Ethyl alcohol (denatured) 93%

1	2	3	4	5	6
37.	Spirit + trichloroethylene	80:20	8		
38.	—do—	75:25	6		
39.	—do—	50:50	5		
40.	Spirit + Chloroform	90:10	15		
41.	—do—	80:20	12		
42.	—do—	75:25	8		
43.	—do—	50:50	8		
44.	Spirit + acetaldehyde	90:10	10		
45.	—do—	80:20	10		
46.	—do—	75:25	8		
47.	—do—	50:50	7		
48.	Spirit + carbon tetrachloride	90:10	22	Swells heavily	
49.	—do—	80:20	22	—do—	
50.	—do—	75:25	20	—do—	
51.	—do—	50:50	20	—do—	
52.	Spirit + butylacetate	90:10	6		
53.	—do—	80:20	5		
54.	—do—	75:25	4.5		
55.	—do—	50:50	5		
56.	—do—	60:40	5		
57.	Spirit + n-butanol + formic acid 85%	40:40:20	5		
58.	Spirit + isopropyl alcohol + hexane	10:80:10	11	Swells	
59.	Spirit + n-butanol + aniline	40:40:20	8		
60.	Spirit + n-butanol + acetone	40:40:20	9	Swells	
61.	Spirit + n-butanol + toluene	40:40:20	5		
62.	Spirit + n-butanol + formaldehyde	40:40:20	8		
63.	Spirit + n-butanol + ethylacetate	40:40:20	6		
64.	Spirit + trichloroethylene + methyl acetate	50:20:30	5	Wax settles down after some time.	
65.	Spirit + trichloroethylene + methyl acetate	40:40:20	3	Wax floats on surface	
66.	Spirit + trichloroethylene + methyl acetate	45:40:15	2	Small quantity of wax in the case of bhatta shellac floats on surface after some time.	
67.	Spirit + trichloroethylene + methyl acetate	70:10:20	5		
68.	Spirit + hexane + trichloroethylene	60:30:10	6		
69.	Isopropyl alcohol + hexane + solvent ether	80:10:10	—	Swells heavily	
70.	Spirit + ether + triethanolamine	80:20:1	8		
71.	Spirit + isopropyl alcohol + methyl acetate	45:40:15	6	Swells	
72.	Spirit + hexane + triethanolamine	80:20:10	—	Swells heavily	

1	2	3	4	5	6
73.	Spirit + trichloroethylene + ethyl acetate	40:40:20	4		
74.	Spirit + trichloro-ethylene + isopropyl alcohol	40:40:20	3		
75.	Spirit + trichloroethylene + fusel oil	40:40:20	6		
76.	Isopropyl alcohol + butyl alcohol + petroleum ether	40:40:20	10		
77.	Isopropyl alcohol + spirit + petroleum ether	40:40:20	8		
78.	Isopropyl alcohol + acetone + petroleum ether	40:40:20	6	Swells	
79	Isopropyl alcohol + methyl alcohol + petroleum ether	40:40:20	6		
80:	Isopropyl alcohol + formic acid 85% + petroleum ether	60:20:20			
81.	Isopropyl alcohol + toluene + formic acid 85%	75:20:5	3		
82.	Isopropyl alcohol + toluene + phosphoric acid	75:20:5	6		
83.	Isopropyl alcohol + toluene + methyl acetate	60:20:20	5		
84.	Isopropyl alcohol + toluene + methyl acetate	50:20:30	7		
	Shellac removers (referred to earlier)		5		
	I	2-3			
	II	2-3			
	III	2-3			

TABLE IV

Water content of the mixture %	Evaporation rate (minutes)	Time for dissolution of lac (minutes)	Remarks
2	—	4-5	clear solution
5	34	4-5	
7	—	4-5	
10	42	4-5	
15	—	4-5	
20	48	4-5	
25	—	6	Solution-turbid
27	—	6	Solution-turbid
30	48	6	Solution-turbid
40	—	—	Very turbid solution large part of lac insoluble.

For comparison, evaporation rates of solvent ether under the same conditions was 4 minutes, ethyl alcohol 95 percent, 30 minutes.

In Table III below are indicated, the quickest dissolving solvent mixtures among the above arranged in decreasing order of efficiency. Time taken by these mixtures for dissolving increased proportions of lac are also indicated.

Effect on rubber

As mentioned earlier, these mixtures are intended for the cleaning of printing rollers after use with shellac based inks. Therefore, their effects on rubber were also studied. The swelling (increase in weight) produced on immersion of vulcanised rubber in these for 30 minutes and 18 hours were determined and are brought out in columns 9 and 10 of table III.

It will be seen that solvent mixture of ethyl alcohol and butyl acetate (in the ratio of 75:25) is clearly the first in this regard and is almost as efficient as the rest with higher proportions of lac. Obviously this can be regarded as the best shellac remover with the least effect on rubber.

The effect of water content of such a mixture on the time of dissolution was also examined as well as its evaporation rates⁵ with various proportions of water. The results are brought out in table IV.

It will be clear that as in the case of ethyl alcohol, water present in the mixture also has hardly any effect on the time of dissolution of lac and that 20% of water can safely be present without affecting its utility. Further, such a mixture is also less volatile than when the water content is less so that a mixture containing ethyl alcohol (water free basis) 60 parts, butyl acetate 20 parts and water 20 parts by volume may be considered as the most desirable shellac remover.

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TABLE III

Sl no.	Solvent mixture	Ratio of solvents in the mixture (v/v)	Time for dissolution of different quantities of lac in 100 ml solvent (minutes)					Effect on rubber increase % in wt of rubber on immersion in the mixture (30 minutes) (18 hours)	Remarks
			10 gm	20 gm	30 gm	50 gm	100 gm		
1	Spirit + trichloroethylene + methyl acetate	45:40:15	2	4-5	6	8	13	54	123.2
2	Spirit + trichloroethylene + formic acid 85%	40:40:20	2	4	4-5	6-7	10-11	53.2	119.7
3	Isopropyl alcohol + formic acid	80:20	3	6	6-7	8	14	2.5	12.4
4	Isopropyl alcohol + petroleum ether + formic acid	60:20:20	3	6-7	7	8	14-15	16.4	80.1
5	Spirit 95% + pyridine	50:50	4	7	8	10	16-17	6.3	39.1
6	Spirit 95% + butyl acetate	75:25	4-5	7	8	9-10	15-16	2.6	13.1
7	Isopropyl alcohol + toluene + phosphoric acid	75:20:5	5	10-11	11-12	15	20-21	16.0	87.3
8	Spirit + trichloroethylene	50:50	5	6-7	7	8-9	14-15	51.1	192.2
9	Isopropyl alcohol + toluene + methyl acetate	60:20:20	5	6-7	7-8	8-9	14	14.6	68.4