

## NOTES ON REFRACTIVE INDEX LIQUIDS

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Butler (1) described a set of immersion liquids of intermediate refraction using a kerosene fraction and  $\alpha$ -monochloronaphthalene. The fractionation is briefly discussed, but with the exception of stressing the fractionation ranges and the need to redistill, few details are given for the preparation of this paraffin mixture. In this short note I intend to show that redistillation is unnecessary, that the preparation is comparatively simple and that liquids prepared in this way are stable for a period of years.

1. *Fractionation of paraffin*

It was found that only the finest grade of illuminating paraffins or kerosenes yielding distillates having a fairly pleasant odour were of any value. Many were tried and those giving fractions of unpleasant odour almost invariably gave sulphurous, gelatinous precipitates on mixing with the naphthalenes.

The process was carried out in an ordinary distilling flash with Liebig condenser attached. In Table 1 the refractive indices of a satisfactory kerosene are given, together with the indices of the various fractions. In Table 2 some data on the yields of several liquids are given.

TABLE 1

$N_d$  of original kerosene = 1.4466 at 23.2°C.

Fraction	$N_d$
below 150°	1.4288
150-170°	1.4324
170-190°	1.4360
190-210°	1.4409
210-220°	1.4443
220-230°	1.4478
230-240°	1.4502
240-250°	1.4555
residue	1.4569

} 23°C.

TABLE 2

SAMPLE No. 1

$N_d$  of sample = 1.4373 at 14.3°C.

Fraction	% by volume	$N_d$	Temperature °C.
150-210°	59.2	1.4319	14.5
210-240°	32.6	1.4413	14.5
240°	7.3	1.4502	14.5
	99.1		

## SAMPLE NO. 2

 $N_d$  of sample = 1.4453 at 20.7°C.

140–210°	38.2	1.4369	25.7
210–240°	29.8	1.4471	21.8
Residue	30.9	1.4553	25.7
	98.9		

TABLE 3

Fraction	% by volume	$N_d$	Temperature °C.
210–240°	29.8	1.4471	21.8
210–240°	30.7	1.4473	26.0
210–240°	31.0	1.4464	26.0
220–250°	32.0	1.4501	26.5
210–250°	36.5	1.4498	22.8

In the case of sample 1 it was found that even redistilling the 210°–240° fraction and using only the 210–230° portion, the liquid had a very pungent odour, although it was colourless. This sample was found to be quite unsatisfactory.

Work was confined to sample 2 and the results of five distillations are given in Table 3. These distillates were finally combined and used in making up several sets of liquids.

The 210–250° fractions were found to be miscible in all proportions with  $\alpha$ -chloronaphthalene and  $\alpha$ -bromnaphthalene and phenyldiiodoarsine, giving colourless to pale yellow and yellow liquids in the first two cases and reddish brown in the third case. However, different samples of phenyldiiodoarsine (R.I. 1.8496 at 20°C) had different colours, some were canary yellow and one sample a rather deep red. Apparently the lighter colour is the purer and was found to be more stable. At a later date, however, it is hoped to investigate this more fully.

## 2. Stability of liquids

Results are available for two sets of liquids, one the kerosene fraction— $\alpha$ -chloronaphthalene, and another kerosene fraction— $\alpha$ -bromnaphthalene. From many observations, the ideal set of liquids for the range 1.44 to 1.85 is kerosene fraction— $\alpha$ -bromnaphthalene—phenyldiiodoarsine. The latter is rather expensive but the greater stability, lower dispersion and lower colour intensity compared with other liquids more than offsets the high initial cost.

In table 4 the observations over nearly three years are given. No adjustments were made at any period, for accurate work aliquot proportions being removed and corrected to the refractive index required. Moreover the liquids were kept in transparent bottles and no precautions

TABLE 4

Nominal Refrac- tive Index	Prepared			Tested			Tested		
	Date	$N_d$	Temper- ature	Date	$N_d$	Temper- ature	Date	$N_d$	Temper- ature
1.45	May 1936	1.4503	18°C.	3-6-36	1.4511	18°C.	4-10-39	1.4512	19°C.
1.47		1.4703	18°C.	3-6-36	1.4711	18°C.		1.4711	19°C.
1.50		1.5001	18°C.					1.5006	19°C.
1.54		1.5399	18°C.	3-4-38	1.5409	19°C.		1.5408	19°C.
1.57	June 1937	1.5697	19°C.	3-6-36	1.5675	—		1.5688	19°C.
1.60		1.6004	19°C.	3-6-36	1.6029	18°C.		1.6025	19°C.
1.62		1.6205	15.5°C.	3-4-38	1.6175	19.5°C.		1.6191	19°C.
1.66	Septem- ber 1937	1.6585	15.5°C.	3-4-38	1.6588	19°C.		1.6568	19°C.

*Note.* Liquids of higher refractive index were made up, but the record only extends over a few months.

were taken against light. The higher liquids are not as stable as the  $\alpha$ -chlornaphthalene (and  $\alpha$ -bromnaphthalene)—kerosene series, but this may be due to the inferior quality of some of the phenyldiiodoarsine. As the paraffin is miscible in all proportions with the phenyldiiodoarsine these two liquids should suffice for a set of immersion oils. The naphthalenes were only used as a measure of economy.

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## REFERENCE

1. BUTLER, R. D., Immersion liquids of intermediate refraction (1.450-1.630). *Am. Mineral.*, **18**, 386-401 (1933).