[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY OF THE UNIVERSITY OF DELAWARE]

Densities of Mixtures of Benzene with Phenylethyl Alcohol and with Methyl Salicylate

BY RAYMOND C. GLOWASKI AND CECIL C. LYNCH, JR.

In a study of volume relations in mixtures of non-polar liquids it was observed that there were no data available on densities for two of the binary mixtures studied: namely, benzene–phenylethyl alcohol and benzene–methyl salicylate. The present investigation was undertaken to determine at 25° densities of these binary mixtures at various concentrations.

Materials.—Benzene C. P. and phenylethyl alcohol from the Eastman Kodak Company were allowed to stand over anhydrous calcium chloride for about a week and then fractionally distilled at 761 mm. The fraction of benzene boiling between 79.7 and 80.0° and that of phenylethyl alcohol boiling between 217–219° were collected and showed densities of 0.8724 and 1.0160, respectively, at 25°. Repeated distillations failed to alter the density. These densities agreed well with values obtained by Tyrer and by Washburn and Read,[1] for benzene, and by Szamatolski for phenylethyl alcohol.[2]

Methyl salicylate (artificial oil of wintergreen from Eimer and Amend), after the passage through it of dry air for several hours at its boiling point, was fractionally distilled at 18–19 mm. The definitive fraction was collected between 106.9 and 108.1° and showed a density of 1.080 at 25° in good agreement with the values given by Umney.[3]

Density Measurements.—The solutions were prepared by direct weighing of the components into tared glass-stoppered bottles, the more

TABLE I

DENSITIES OF BINARY MIXTURES AT 25°

Benzene–phenylethyl alcohol			Benzene–methyl salicylate		
Mol. frac. alcohol	% Alcohol by wt.	d_4^{25}	Mol. frac. ester	% Ester by wt.	d_4^{25}
0.0000	0.00	0.8724	0.0000	0.00	0.8724
.0931	13.83	.8898	.1016	18.06	.9136
.2000	28.11	.9096	.1800	29.96	.9434
.3066	40.89	.9277	.2907	44.40	.9838
.4125	52.34	.9437	.3947	55.95	1.0188
.5016	61.13	.9569	.5139	67.34	1.0551
.6068	70.71	.9705	.5980	74.34	1.0796
.7402	81.68	.9882	.7061	82.40	1.1089
.8202	87.71	.9972	.8136	89.48	1.1337
.9335	95.64	1.0092	1.0000	100.00	1.1798
1.0000	100.00	1.0160			

(1) Tyrer, *J. Chem. Soc.*, **97**, 2620 (1910); Washburn and Read, THIS JOURNAL, **41**, 729 (1919).
(2) Szamatolski, *Ind. Eng. Chem., News Ed.*, **11**, 114 (1933).
(3) Umney, *Perf. Essent. Oil Record*, **7**, 344 (1916), from *C. A.*, **11**, 866 (1917).

volatile benzene being added last. The samples were then well shaken and placed in a thermostat at 25.00 ± 0.05° for four to six hours. Pycnometers (of 5 or 25 cc. volume) which had been carefully standardized with distilled water were then filled with the mixtures and kept in the thermostat for two hours. The liquids were in all cases completely miscible.

The densities given in the table are all means of at least three determinations which never differed from one another by six units in the fourth decimal place. The average deviation of these measurements from the means for all the observations was one unit in the fourth decimal place.

Summary

Densities of mixtures of benzene and phenylethyl alcohol and of benzene and methyl salicylate have been determined over the entire range of concentration.

NEWARK, DELAWARE RECEIVED JUNE 16, 1933
PUBLISHED OCTOBER 6, 1933

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CALIFORNIA]

The Induced Oxidation of Anthracene in the Autoxidation of Benzaldehyde

BY G. E. K. BRANCH, H. J. ALMQUIST AND E. C. GOLDSWORTHY

Introduction

It is well known that inhibition of the autoxidation of benzaldehyde by anthracene is temporary. When small quantities of anthracene are added to a benzaldehyde–oxygen mixture, there is a slow absorption of oxygen, which accelerates until the normal rate of absorption of oxygen by benzaldehyde is reached. At this stage the anthracene has been almost entirely oxidized to anthraquinone. This oxidation is an induced reaction, for it does not occur in an inert solvent.

The most likely mechanisms for oxidations of inhibitors are (1) that the inhibitor is oxidized by a link in the autoxidation chain, the products of this reaction being incapable of carrying on the chain, and (2) that the inhibitor is oxidized by the peroxide molecules that are dropped out of the autoxidation chain.

Alyea and Bäckström[1] have conclusively shown that in the inhibition of the autoxidation of sodium sulfite by several alcohols the breaking of the autoxidation chain and the induced oxidation are a single process. Bäckström and Beatty[2] have assumed the same to be true of the autoxidation of benzaldehyde inhibited by anthracene. The evidence was that measure-

(1) Alyea and Bäckström, THIS JOURNAL, **51**, 90 (1929).
(2) Bäckström and Beatty, *J. Phys. Chem.*, **35**, 2530 (1931).