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THE REFRACTIVE INDICES OF ALCOHOL-WATER MIXTURES AT 25° C.

W. C. OELKE AND ROGER ARNOLD

The purpose of this project was to obtain a basis for the development of a laboratory experiment in Physical Chemistry on Minimum Boiling Mixtures. Alcohol and water were selected as the liquids to be used. The simplest and most accurate method for the determination of alcoholic percentage in such mixtures is by the means of refractive indices.

Previous work has been done on the refractive indices of alcohol-water mixtures by Leach and Lithgoe (JACS 27-964-1905) and Andrews (JACS 30-353-1908). Unfortunately the former investigators gave their results only in terms of Zeiss degrees for the dipping refractometer, their work being carried out at 20° for concentrations from 0-100% alcohol by weight. Since they did not indicate their procedure for making up the solutions, there was some question as to the correct interpretation of their results. Andrew's article, on the other hand, gives a detailed account of the methods which he used. The refractive indices and Zeiss scale readings are given only for the range between 70-100 per cent alcohol by weight, however, and for this reason, the data were not suitable for our use.

The absolute alcohol used in the present work was prepared by the usual quick lime process. After dehydration, the alcohol was twice redistilled from a twenty disc Young column, and the middle fraction, boiling at 78.5° was collected. The alcohol thus obtained gave a density of .78576 g/cm³ at 25° as compared to the value of .78506 g/cm³ from the International Critical Tables. The difference in density was probably due to a trace of water remaining, since it is known that calcium oxide will not completely dehydrate alcohol. This alcohol, however, gave a refractive index of 1.3609(9) at 20° C. comparing favorably with the International Critical Table value of 1.361. Because of the close proximity of these values, this alcohol was considered suitable for our work. The refractive index of this alcohol at 25° was 1.3595_D.

The water used was conductivity water, prepared by the alkaline permanganate method and twice distilled through a block tin condenser. It gave a refractive index of 1.3327_D at 25°.

The instrument employed was a Pulfrich refractometer, manufactured by Max Wolz, and readable to fractions of a minute. It was thermostated by circulating water from a large constant temperature bath, regulated to $\pm 0.01^\circ$.

The mixtures of alcohol and water were made up according to per cent by volume, using carefully calibrated burettes. These solutions were kept in Pyrex flasks which were stoppered and sealed until the readings were taken.

The results of the work were as follows:

Percentage Alcohol	Reading	$N_D^{25^\circ}$ vs air
0	67° 19'	1.3327
10	66° 20'	1.3373
20	65° 2'	1.3438
30	64° 0'	1.3490
40	63° 7'	1.3539
50	62° 20'	1.3578
60	61° 50'	1.3605
70	61° 30'	1.3628
75	61° 19'	1.3631
80	61° 20'	1.3630
90	61° 36'	1.3619
92	61° 37'	1.3616
94	61° 41'	1.3613
95	61° 46'	1.3611
96	61° 48'	1.3607
98	61° 51'	1.3604
100	62° 2'	1.3595

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