NOTE ON THE DETERMINATION OF ALCOHOL IN ETHER AND CHLOROFORM.

By ALFRED H. ALLEN, F.C.S.

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SEVERAL chemists have pointed out that crystallized fuchsine (acetate of rosaniline,) was insoluble in pure anhydrous ether or chloroform, but that it imparted more or less colour to these liquids when alcohol was present.

On making the experiment I found that fuchsine readily coloured a sample of commercial ether. When the same sample was well agitated with dry chloride of calcium to remove alcohol and water, it lost the power of dissolving fuchsine, becoming tinged only very faintly, when shaken with the dye.

To employ the above facts for the determination of alcohol in a sample of ether, I operate in the following manner:—

A minute quantity of powdered fuchsine is placed at the bottom of a narrow test-tube, 10 c.c. of the sample of ether added, the tube corked and the whole agitated. If the ether be pure and anhydrous the coloration of the liquid will be almost *nil*. If the coloration be considerable, 10 c.c. of ether which has been treated with chloride of calcium, is placed in another tube of the same bore as the first, adding fuchsine as before. $\frac{1}{10}$ c.c. of alcohol is then added to it from a finely divided burette, and the whole is shaken. If this quantity of alcohol is insufficient to produce a coloration of the liquid equal to that of the sample to be tested, a further addition of alcohol must be made until the liquids have the same depth of colour. The tint is best observed by holding the two tubes side by side in front of a window and looking through them transversely. The use of a piece of wet filter paper behind them facilitates the observation. It is well to permit the alcohol to drop right into the ether, and not allow it to run down the sides of the tube, as in the latter case it will dissolve any adherent particles of fuchsine, forming a solution which will be precipitated on admixture with the ether. For a similar reason it is not convenient to dilute the sample with pure ether so as to reduce the colour to that of a standard tint. In practice, each $\frac{1}{10}$ c.c. of alcohol added from the burette may be considered as indicating 1 per cent. of impurity in the sample. Of course this assumption is not strictly correct, but the error introduced is insignificant when the percentage of alcohol is small. The method is very suitable for small proportions of alcohol, but becomes difficult to apply when the latter exceeds 5 per cent. of the sample, owing to the intensity of the colour. The results are within $\frac{1}{4}$ per cent. of the truth. Occasionally the tints of the two liquids are not readily comparable, but on placing the tubes for a few minutes in cold water, this difficulty is overcome.

In attempting to apply the above method to the determination of alcohol in chloroform, I found that the latter liquid still dissolved fuchsine after treatment with chloride of calcium. By shaking with concentrated sulphuric acid it could be entirely purified from alcohol and water, but the product retained so much acid that it could not be directly tested with fuchsine. The acid could be got rid of by agitation with carbonate of potassium, but the chloroform so treated retained sufficient alkali to prevent the coloration by fuchsine. By employing dry precipitated carbonate of barium to eliminate the sulphuric acid, the chloroform was obtained so pure as to give only a very slight coloration with fuchsine, but the addition of a small proportion of alcohol readily caused

solution of the dye with production of the characteristic colour.*

The method commonly described for determining the proportion of alcohol in ether is the agitation of the sample with water, with subsequent observation of the diminution in the bulk of the ether. This method appeared very unpromising in presence of much alcohol, but on investigating it, I was agreeably surprised to find that with certain precautions, it was possessed of considerable accuracy. The following are the details of the procedure I have found preferable.

A small quantity of fuchsin is placed in a Mohr's burette furnished with a glass tap, which is then filled with water and a small proportion of ether, a cork is next introduced, and the whole agitated. By this means a coloured etherized water is obtained, in which ether is quite insoluble, while alcohol readily dissolves. 10 c.c. of the etherized water are run into a glass tube holding about 25 c.c., and having divisions of $\frac{1}{10}$ c.c., 10 c.c. of the sample of ether are next added, the tube corked, and the whole well shaken.

On the ether rising to the surface, its volume can be easily read off. Any reduction in its volume is due to admixture of alcohol. Thus each 0.1 c.c. lost, represents 1 per cent. of alcohol. If the proportion of alcohol in the sample did not exceed 20 per cent., the ether will be colorless, and the result of the experiment is correct; but if the proportion of alcohol is much above 20 per cent., the layer of ether is coloured, and the result is below the truth. The absence of colour therefore indicates the accuracy of the experiment. If the layer of ether be coloured, an accurate result can still be obtained by adding 5 c.c. of anhydrous ether, and again agitating. It is better, however, to dilute a fresh portion of the sample with an equal bulk of pure ether, and use the diluted sample instead of the original. By proceeding in this manner, the proportion of alcohol in mixtures of that liquid with ether can be ascertained within 1 or 2 per cent. with great facility. The process has been verified up to 60 per cent. of alcohol.

In all cases the proportion of alcohol must be deducted from the reduction in the volume of the ether, and not from the increase in that of the aqueous liquid. Care must be taken to prevent any volatilization of the ether.

* In attempting to find a coloring agent more suitable than fuchsin for use with chloroform, methyl-aniline-violet was tried, with the curious discovery that this substance is exceedingly soluble in chloroform, with intense violet colour. So great is the affinity of methyl-aniline violet for chloroform, that this liquid readily removes it from its aqueous solution, when agitated with it.

Mr. G. Jarman informs me that he has observed the same fact, and has employed it for detecting the adulteration of indigo with methyl-aniline violet.