TABLE III
ACETONITRILE IN PETROLEUM ETHER

w_2	E	d	aE_1	bd_1
0.0000	2.031	0.6528		
.01236	2.277	.6543	19.90	0.121
.02151	2.458	.6558	19.85	.139
.02863	2.600	.6563	19.87	.122
.04211	2.868	.6580	19.87	.124
.05627	3.149	.6598	19.86	.124

Av. 19.87

TABLE IV
SOLVENT CONSTANTS

	Gasoline	Kerosene	Petroleum ether
$C(= 3/d_1(E_1 + 2)^2)$	0.2473	0.2235	0.2828
$p_1 = (E_1 - 1)/(E_1 + 2)d_1)$	.3392	.3354	.3918

The results of the experimental work are presented in Tables I, II, III and IV. The dielectric constant data are accurate to about 0.1%.

Taking the molecular weight of acetonitrile as 41.05 and using equation (4), the values of $P_{2(\infty)}$ are calculated to be 241, 243.8, 243.8 for acetonitrile dissolved in gasoline, kerosene and petroleum ether, respectively. For pure acetonitrile the deformation polarization

$$\left(P_{2D} = \frac{n^2 - 1}{n^2 + 2} \cdot \frac{M}{d}\right)$$

is calculated to be 11.12. Dipole moments are calculated by the formula

$$\mu = 0.01273 \times 10^{-18}\sqrt{(P_{2(\infty)} - P_{2D})T}$$

and the values obtained are 3.33, 3.35 and 3.35 $\times$ 10^{-18}

for acetonitrile dissolved in gasoline, kerosene and petroleum ether, respectively.

The value for the dipole moment of acetonitrile in benzene solution has been reported by Lewis and Smyth[5] to be 3.51 $\times$ 10^{-18}. We have recalculated their results using the extrapolation method of Hedestrand,[6] and found the dipole moment value to be 3.37 $\times$ 10$^{-18, 7}$ in agreement with the results we obtained using gasoline, kerosene and petroleum ether as solvents. Hedestrand's method was used because we found the dielectric constants and densities of the series of acetonitrile solutions in benzene to vary linearly with concentration. The dipole moment of acetonitrile in toluene, another solvent of known molecular weight, at 25°, as interpolated from the data of Lewis and Smyth, is found to be 3.38, again in agreement with our values using three different solvents of unknown molecular weights.

Summary

Data obtained indicate that dielectric constant and density of dilute solutions of polar solute in non-polar solvents of unknown molecular weights are linear functions of weight fractions of the solute. This suggests the use of non-polar solvents of unknown molecular weights for dipole moment determinations. Dipole moment values obtained for solutions of acetonitrile in gasoline, kerosene and petroleum ether are in close agreement with values obtained using nonpolar solvents of known molecular weights.

(5) Lewis and Smyth, *J. Chem. Phys.*, **7**, 1085 (1939).

(6) Hedestrand, *Z. physik. Chem.*, **B2**, 428 (1929).

(7) Subsequently Professor Smyth informed the senior author of this paper of the correctness of the recalculated value.

A Continuous Method for the Preparation of Cadet's Liquid[1]

BY REYNOLD C. FUSON AND WILLIAM SHIVE[2]

Cadet's liquid is for the most part a mixture of cacodyl oxide and cacodyl.[3] The original procedure[4] for its preparation, which has continued in use for nearly two centuries with little modification, consists in heating a mixture of potassium acetate and arsenic trioxide at temperatures in the neighborhood of 325° and affords yields of not more than 17%. We have found that much better yields can be obtained by passing a mixture of arsenic trioxide and acetic acid over an alkali metal acetate catalyst at temperatures of 300–400°. The new procedure has the additional advantage of being continuous except for occasional regeneration of the catalyst.

Experimental

Procedure.—The apparatus consisted of a Pyrex tube (60 cm. $\times$ 16 mm.) arranged and equipped as shown in

Fig. 1. The catalyst was placed in the portion of the tube surrounded by the electrical heating unit and held in place by an asbestos plug. The arsenic trioxide was placed just above the heating unit and extending along the tube for about 20 cm. · The jacket surrounding this portion of the tube was connected to a 200-ml. flask containing phenyl ether, which was maintained at a boiling rate sufficiently high to give condensing vapors in the condenser. After the entire apparatus was swept with carbon dioxide, heating of the arsenic trioxide and addition of acetic acid from a dropping funnel were begun simultaneously. When
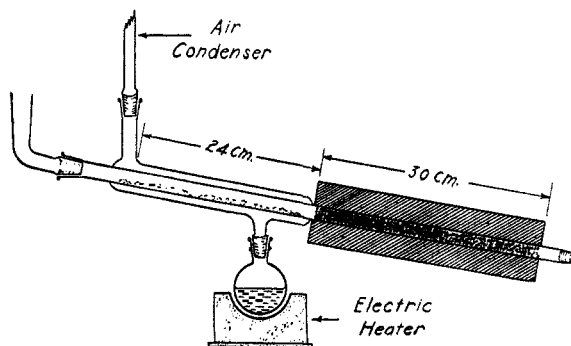

Fig. 1.

the catalyst was an alkali metal carbonate, passage of acetic acid over the catalyst before the initial arsenic trioxide vapors improved the yield by reducing the sudden evolution of carbon dioxide during the initial phases of the experiment. An asbestos plug just above the arsenic trioxide allowed a relatively constant rate of vaporization of the acetic acid. During the reaction period a slow stream of carbon dioxide was passed through the tube to prevent condensation of vapors in the upper part of the tube. The catalyst was maintained at an almost constant temperature during the course of the reaction. Acetic anhydride, glacial acetic acid and various strengths of aqueous acetic acid were tried, and it was found that the highest yields were obtained with 75% acetic acid. In a typical run 6.8 g. of arsenic trioxide and 31 ml. of 75% acetic acid were passed at 350° over potassium carbonate on no. 10 mesh pumice. Addition of water to the receiver before the experiment was begun often aided in protecting the product. The duration of the run was ten hours.

The yield was determined by conversion of the Cadet's liquid to cacodyl chloride by treatment with hydrochloric acid and ferric chloride by the method of Witten.[5] To the material in the receiver was added 60 ml. of concentrated hydrochloric acid containing 20 g. of ferric chloride, and the mixture was subjected to steam distillation. It was found desirable to maintain an atmosphere of carbon dioxide in the apparatus at the beginning of the distillation. The distillate was collected in a separatory funnel containing concentrated hydrochloric acid. Crude cacodyl chloride, after being washed with hydrochloric acid and dried over calcium chloride, was obtained in a 66% yield based on the arsenic trioxide. From 36 g. of crude product prepared in this manner, 30 g. of cacodyl chloride, b. p. 106–107°, was obtained by fractionation through a 25 × 1.2 cm. column packed with Berl saddles. No higher-boiling and only 1–2 g. of lower-boiling material was obtained.

Catalyst.—The catalyst was prepared by allowing the support, usually pumice, to stand for two hours in a concentrated solution of the catalytic compound. The excess solution was decanted, and the catalyst dried in a vacuum oven. In four runs in which cesium carbonate was

(5) Witten, report on file at the Edgewood Arsenal.

employed in place of potassium carbonate the yields varied from 66 to 77%. Lithium acetate, sodium carbonate and soda-lime gave much lower yields. In one run in which potassium carbonate was supported on asbestos in place of pumice the yield was 69%. The same catalysts were used continuously except for occasional regeneration by passing air through the tube at the reaction temperature.

Diethylchloroarsine.—By the use of propionic in place of acetic acid it was possible to prepare a mixture of ethyl cacodyl and ethyl cacodyl oxide. Arsenic trioxide (7.0 g.) and 30 ml. of 75% propionic acid were passed over pumice impregnated with potassium carbonate at 350° during twelve hours. Substantially no arsenic trioxide sublimed through the tube unchanged, and a relatively large amount of material separated at the bottom of the receiver from the excess propionic acid. From this, it appeared that the conversion to the arsenicals was almost as complete as in the case of the preparation of Cadet's liquid.

The product of the above reaction was treated with 60 ml. of concentrated hydrochloric acid containing 20 g. of ferric chloride which deposited the expected heavy oily liquid. When the receiver was opened to permit addition of the ferric chloride solution, the product gave an arsenic trioxide smoke, but not as rapidly as the corresponding product from acetic acid. By steam distillation of the reaction mixture, 1.1 g. of diethylchloroarsine was obtained; yield, 9.3% of the theoretical. The reaction of the product with ferric chloride and concentrated hydrochloric acid apparently gives several products since a large amount of black residue remained in the flask after steam distillation.

Summary

Cadet's liquid has been produced in good yields by passing a mixture of arsenic trioxide and acetic acid over a catalyst at temperatures of 300–400°.

The new method, when applied to propionic acid and arsenic trioxide, gave relatively high yields of a mixture of ethyl cacodyl and ethyl cacodyl oxide.

[CONTRIBUTION FROM THE LABORATORY OF E. A. H. FRIEDHEIM]

Organic Antimony Compounds Derived from s-Triazine with Therapeutic and Prophylactic Activity in Experimental Trypanosomiasis[1]

BY ERNST A. H. FRIEDHEIM, HENRY J. VOGEL AND ROSE L. BERMAN

It is well known[1a] that free phenylstibonic acids have a pronounced tendency to polymerize, in particular to trimerize, and to form colloidal solutions.

In the case of stibanilates, the polymerization was found to increase the tolerance, but to decrease the trypanocidal activity.[2]

In this paper we have described a new trypanocidal phenylstibonic acid derivative, i. e., sodium p-melaminylphenylstibonate (I).[3] In this case, polymerization yields an amorphous sodium salt

(1) Presented on the program of the Division of Medicinal Chemistry at the Chicago meeting of the American Chemical Society, September, 1946.

(1a) Schmidt, Ann., 421, 159 and 174 (1920).

(2) Fischl and Schlossberger, "Handbuch der Chemotherapie," Leipzig, 1934, p. 589.

(3) p-Melaminyl = p-(2,4-diamino-s-triazinyl-6)-amino.

(II) having, in comparison with the crystalline sodium salt (I), a greatly decreased toxicity, and surprisingly also an enhanced trypanocidal activity. This spells a rise of the therapeutic index (T. equiperdum infection of the mouse) from 3 for (I) to 200 for the polymer (II) (Table I).

TABLE I

COMPARATIVE DATA IN MICE: I. P. ACUTE TOXICITY AND TRYPANOCIDAL ACTIVITY (T. equiperdum) OF SODIUM p-MELAMINYLPHENYLSTIBONATE BEFORE AND AFTER POLYMERIZATION

Compound	Dose max. tol. g./kg. 50%	100%	Dose min. cur. 100% g./kg.	Therapeutic index
Cryst. sodium salt	0.24	0.15	0.05	3
Amorphous polymer	4.0	2.5	.0125	200