

Solubility of Sodium Azide and Alpha-Lead Azide

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Solubility data of sodium azide and alpha-lead azide are reported at different temperatures in several solvents.

INFORMATION in the literature on the solubility of metallic azides is rather limited. Such data are of value for crystal growth and various physical studies of inorganic azides. In this communication, studies are reported on the solubility of sodium azide and alpha-lead azide in a variety of solvents in the temperature range 5° to 45° C.

EXPERIMENTAL

The solubility of sodium azide was determined in water and in 40, 60, 80, and 95.5% ethanol-water mixtures, respectively. The solubilities were first determined by a synthetic method (2) which involved the preparation of a solution of known composition, the saturation point of which was determined by varying the temperature. The colorimetric method employing the 462-m μ band of the ferric azide complex (1) was not useful in this case because of the dependence of the absorbance values on pH. A precise control of the pH was necessary, and the method was applicable only in aqueous media. A gravimetric procedure involving the evaporation of the solvent and baking of the residue was the most reliable and accurate method for the determination of the solubility of sodium azide in the solvents used. The flame photometric method gave results in agreement with the gravimetric procedure.

The solubility of alpha-lead azide was determined in water and in 5, 10, and 15% sodium and ammonium acetate solutions, respectively. The spectrophotometric procedure (1) was employed in view of the extreme thermal sensitivity of lead azide. Care was taken to keep the pH constant at 2.2.

RESULTS AND DISCUSSION

Hudswell, Nairn, and Gadsby (3) reported that the solubility of sodium azide at 25° C. was less than 0.005 gram per 100 ml. of solution in acetone, chloroform, hexane, cyclohexane, carbon tetrachloride, trichloroethylene, and ethylacetate. The solubility in methanol was 2.48 grams, per 100 ml. of solution. The solubility of sodium azide in water and water-alcohol mixtures at several temperatures has now been examined.

In Table I, the solubility data for sodium azide in different solvents at 25° C. are summarized along with the temperature coefficients of solubility. The solubility as well as the temperature coefficient decreases in ethanolic solvents. The solubility is a linear function of temperature in all the solvents studied in the temperature range of 5° to 40° C.

Lead azide is only slightly soluble ($K_{sp} = 2.58 \times 10^{-9}$) in water (4), and the solubility of alpha-lead azide in water is approximately 0.020 % at 25° C. The solubility in water was a linear function of temperature. However, the solubility in

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Table I. Solubility of Sodium Azide

Solvent	Synthetic Method		Gravimetric Method ^a	
	Solubility ^b	Temp. Coefficient ^c	Solubility ^a	Temp. Coefficient ^c
Water	43.60	0.16	—	—
40% ethanol	17.95	0.08	18.19	0.12
60% ethanol	11.17	0.08	10.48	0.07
80% ethanol	—	—	4.21	0.04
95.5% ethanol ^d	0.81	0.03	1.05	0.007

^a 95% confidence limits of mean value of quadruplicate measurements.

^b At 25° C. in grams of sodium azide in 100 grams of solvent.

^c In grams of sodium azide in 100 grams of solvent per degree.

^d The flame photometric method gave a solubility of 1.04 grams in 100 grams of 95.5% ethanol at 25° C. with a temperature coefficient of 0.008.

Table II. Solubility of Alpha-Lead Azide

Solvent	Solubility ^a at		
	25° C.	35° C.	45° C.
Water	0.022	0.035	0.047
5% sodium acetate	0.12	0.35	0.68
10% sodium acetate	0.19	0.56	1.02
15% sodium acetate	0.24	0.55	1.27
5% ammonium acetate	0.31	0.36	0.60
10% ammonium acetate	0.41	0.65	0.90
15% ammonium acetate	0.52	0.76	1.06

^a In grams of lead azide in 100 grams of solvent.

ammonium or sodium acetate solutions was not linear with temperature, possibly indicating complexation of some kind. The solubility data for alpha-lead azide at 25°, 35°, and 45° C. are summarized in Table II. The solubility is considerably greater in acetate solutions than in water.

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