STUDIES OF ELECTRODE CHARACTERISTICS OF p-AMINO BENZOATE ION SENSITIVE ELECTRODE

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Various silicone grease based electrodes have been prepared and tested for anion and cation determination [1]. Benzoic acid based electrode has been studied by Das [2]. An attempt has been made, therefore, to prepare electrode sensitive to p-amino benzoate ion (PABI) which is a constituent of vitamin B-complex.

EXPERIMENTAL

p-Amino benzoic acid (PABA) (E. Merck) was dissolved in normal sodium hydroxide solution till almost saturation and then mercuric chloride solution was added slowly drop by drop to get grey-white precipitate of mercuric p-amino benzoate which was washed thoroughly with distilled water to remove any contaminated mercuric chloride and PABA. The electrode from the precipitate of mercuric p-amino benzoate was prepared using silicone grease method as described by Sharma et al [1].

Temperatures were maintained using a bath as described by Chakravarti [3].

PL-52 Toshniwal potentiometer coupled with polyflex moving spot galvanometer has been used for potential measurement.

RESULTS AND DISCUSSION

Experiments were conducted to determine the accuracy of the potential measurement in terms of standard deviation, response time and durability. From Table 1, it is evident that the silicone grease based electrode is more accurate. The draw-back with this electrode is that its durability is quite less. The response time of this electrode has been found to be 5 minutes and has been stable up to 60 minutes. The silicone grease based electrode was studied further in aqueous p-amino benzoate solution-keeping pH 7 at 25°C. The potential of the electrode, E, vs log concentration p-amino benzoate ion satisfies the equation

$$E = 0.366 + 0.008 \log [PABI] \text{ at } 25^{\circ}C.$$

TABLE 1

CHARACTERISTICS OF P-AMINO BENZOATE ION SENSITIVE ELECTRODE

Sl. No.	Characteristics measured	Silicone grease based electrode	Pellet based electrode
1.	S.D.	8.3×10^{-4} volts	7×10^{-3} volts
2.	Response time	5 minutes	6 minutes
3.	Durability	8 days	1 month

Fifteen samples of PABI solutions of unknown strength in the concentration range 10 to 0.1 mM were taken and their strengths were determined potentiometrically using the above equation. The average error has been found to be of the order of 1%.

Addition of Oxalate, Acetate, Citrate, Tartarate, Succinate, Benzoate, Chloride and Sulphate ions in small concentrations to the PABI solution have been found not to affect the potential of the electrode indicating the electrode to be highly specific.

Various alcohol-water mixtures (25, 50 & 75%) were used as a medium for p-amino benzoate ions and their electrode potential satisfy the equations as

$$E = 0.388 + 0.010 \log [PABI] \quad \ldots 25\%$$

$$E = 0.380 + 0.0065 \log [PABI] \quad \ldots 50\%$$

$$E = 0.380 + 0.007 \log [PABI] \quad \ldots 75\%$$

The electrode has been found not to respond in media of alcohol higher than 75%.

The effect of pH has also been studied in the alkaline range from 8 to 14. The equations for the curves have been determined as

$$E = 0.363 + 0.0040 \log [PABI] \quad \ldots \text{pH } 8$$

$$E = 0.360 + 0.0030 \log [PABI] \quad \ldots \text{pH } 9$$

$$E = 0.346 + 0.0065 \log [PABI] \quad \ldots \text{pH } 11$$

$$E = 0.374 + 0.0030 \log [PABI] \quad \ldots \text{pH } 13$$

$$E = 0.385 + 0.0060 \log [PABI] \quad \ldots \text{pH } 14$$

It is somewhat strange to note that highly erratic and inconsistent potential readings have been obtained at pH 10-12.

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The temperature effect on the electrode potential has also been studied from 285°K to 301°K in aqueous, alcoholic and alkaline buffer media and has been found to be of the order of a few mV/degree. The electrode potential vs temperature, has been plotted in Figure 1 and 2. The temperature coefficients determined from these curves have been listed in Table 2.

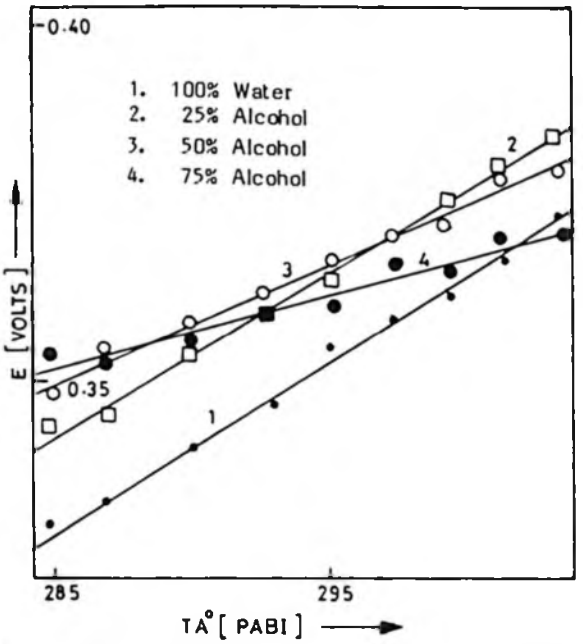


Fig. 1 Electrode potential vs temperature of p-amino benzoate ion in different media (Ethanol 0.25, 50 & 75%).

TABLE 2

TEMPERATURE GRADIENT OF P-AMINO BENZOATE ION SENSITIVE ELECTRODE PREPARED BY SILICONE GREASE METHOD IN DIFFERENT MEDIA.

Sl. No.	Medium of PABI ion	dE/dT (mv/degree)
1.	100% water	+ 2.4
2.	25% alcohol	+ 2.3
3.	50% alcohol	+ 1.7
4.	75% alcohol	+ 1.1
5.	8 pH	+ 1.2
6.	9 pH	+ 1.5
7.	11 pH	+ 0.8
8.	13 pH	+ 2.1
9.	14 pH	+ 0.9

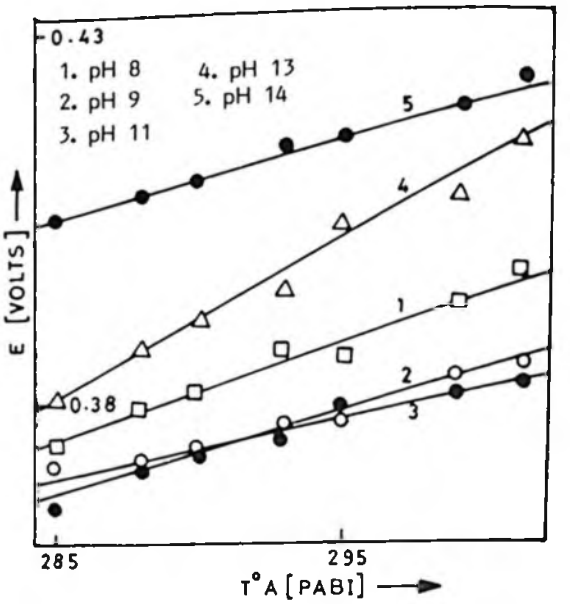


Fig. 2 Electrode potential vs temperature of p-amino bezoate ion at various pH in alkaline range (8-14).

From the above discussion it is evident that the electrodes highly specific in nature, but useful only in limited concentration range using emperical equations.

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