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Electrochemical process monitoring by microprocessor based data acquisition and processing unit

S Vincent, C Srividya Rajagopalan, A Sundara Raj, R Ravi
Central Electrochemical Research Institute, Karaikudi - 623 006, INDIA

and J Roopkumar
Alagappa Chettiar Govt. Arts College, Karaikudi - 623 006, INDIA

An 8085 microprocessor based system has been developed for acquisition of data through multichannels. The acquired data is analysed by linear least square technique for determining various parameters which characterise the process or data acquisition instruments connected to the input channels.

Key words: Linear least square technique, microprocessor, electrochemical process monitoring

INTRODUCTION

Direct potentiometry based on the relationship between the cell potential and the concentration of certain ionic species is widely used in analytical chemistry. Microprocessor (μP) or computer based instruments in this field are well known for their versatility. The designs for multichannel data acquisition, computing software and display of the measured results are discussed in detail. This paper displays a scheme using an 8 bit μP (Intel 8085) based instrument for ion concentration measurement.

SYSTEM DESCRIPTION

The ion selective electrode measures the corresponding voltages for various known concentrations of test solution. To this set of voltages and corresponding concentrations, the principle of least squares is applied to obtain two parameters which are said to be the slope and the intercept of the Nernst equation for the particular ion selective electrode (ISE).

Now the ISE is immersed in an unknown concentration and the μP based instrument reads out the corresponding electrode voltage through the interfaced multichannel A/D card. Substituting the value of this voltage along with the predetermined values of slope and intercept in the Nernst equation through a suitable software, the system gives out the display of the log concentration value.

CIRCUIT DESCRIPTION

Figure 1 shows the block diagram of the instrument. An interfacing unit consisting of a high input impedance opamp for impedance matching and multichannel AD convertor (AD 0809) for multielectrode measuring capability is incorporated between the ion selective electrode and the microprocessor. The 8-bit digital information from ADC 0809 is fetched by μP 8085 and displayed as electrode potential. Figure 2 shows the flow chart of the software developed to determine the system parameters from the Nernst equation. Using the values of slope (b1) and intercept (b0) which are system parameters determined during calibration procedure described above and the measured electrode potential (Y) in the solution of unknown concentration X and X is determined as (Y-b0)/b1.

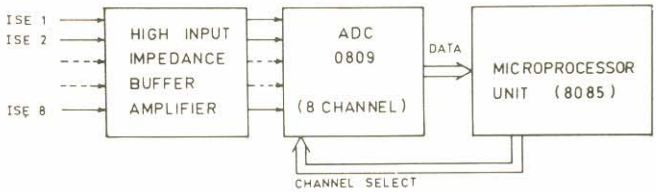

Fig. 1: Block diagram of the instrument

RESULTS AND DISCUSSION

The system performance was tested by measurement of Cu ion concentration using a Cu ISE. Measurements with both a standard multimeter and the system are compared for test solutions of copper in Table I.

Similar system for detection of various ions can be designed by properly choosing the ISE and introducing necessary changes in the software. The instrument described above can be used in industrial online determination and control of industrial processes.

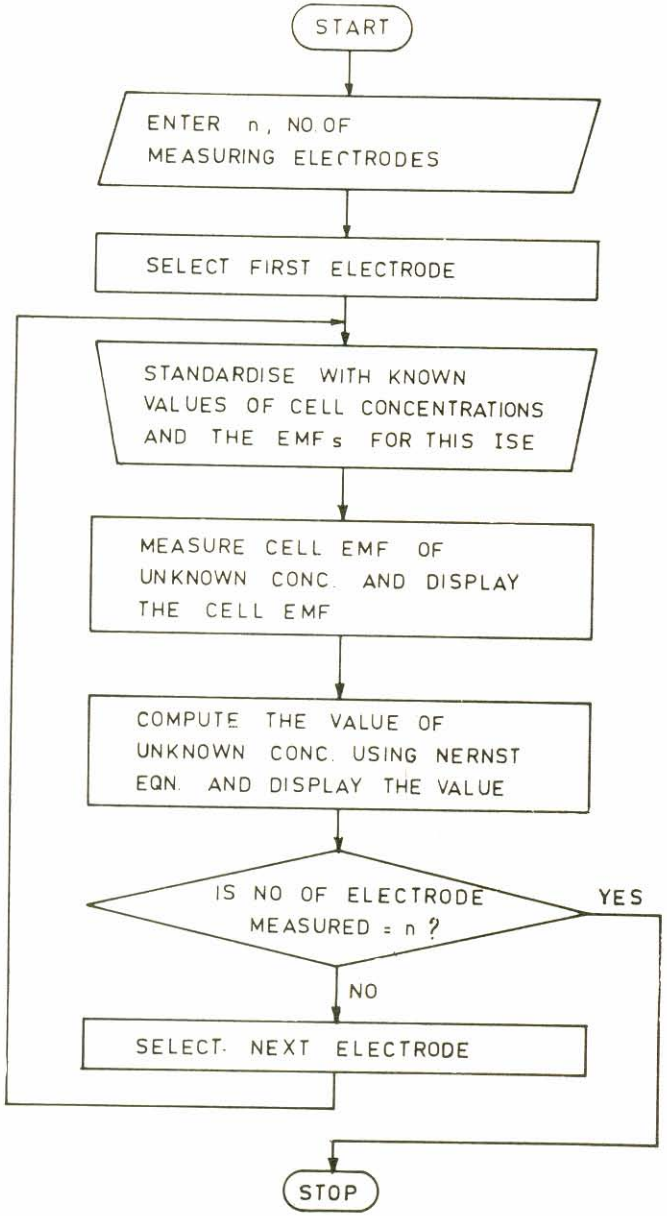

Fig. 2: Flow chart of the software

TABLE–I: Microprocessor readout for various concentrations

Sl. No.	Conc. (M)	Reading (mV)		log conc.	
		Meter	μP	Known	μP
1.	1×10^{-5}	196	194	−5.000	−4.9
2.	2×10^{-5}	202	202	−4.699	−4.6
3.	4×10^{-5}	214	213	−4.398	−4.4
4.	6×10^{-5}	219	220	−4.222	−4.2
5.	1×10^{-4}	226	228	−4.000	−3.9
6.	2×10^{-4}	236	237	−3.698	−3.6
7.	4×10^{-4}	247	247	−3.398	−3.4
8.	6×10^{-4}	251	252	−3.222	−3.2
9.	1×10^{-3}	259	260	−3.000	−3.0
10.	2×10^{-3}	268	270	−2.699	−2.7

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