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Autobrinometer

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An instrument developed for the rapid and accurate measurement of brine concentrations during blanching without disturbing the routine blanching operation is described. The concentration is sensed by a platinum electrode conductivity cell and displayed in a moving coil meter after conversion of the electrical signals into D. C. voltage. The instrument can measure in the range 5 to 12% with an accuracy of ±1%. The errors caused mostly are those due to wide temperature variations of the brine between 95 to 102°C and the unknown quantities of protein.

Blanching is one of the most important steps in canning of prawns to bring down the moisture of the product to the required level, to coagulate proteins and to provide proper texture, shape and characteristic pink colour to the meat. Chief factors controlling the drained weight in canned prawns are concentration of brine and the duration of blanching. Usually the same blanching liquor is used for repeated blanchings each time making up the concentration to the original level manually through guess work. Certain factories use hydrometers for rough estimations of the concentration by density measurements.

There are no rapid methods or devices available for continuous monitoring of the concentration of blanching liquid. The usual method of salt estimation by analytical method is time consuming. A suitable device for direct and continuous measurement of salt content of blanching solutions designed and developed by the authors is reported.

Methods

Principle

The important method of finding the resistance of an electrolyte in which no polarisation effects are produced is Kohlransch's method which makes use of a Wheatstone bridge arrangement. Instead of D.C. source, an A.C. source of sinusoidal alternating current was employed for energising the network eliminating polarisation effect on the cell. The frequency of the alternating current needed for the same was produced from an oscillator.

If X = resistance of the column of length L of the liquid,
A = area of cross section,
P = specific resistance of the liquid,

$$X = P \times \frac{L}{A}$$

$$\text{Specific conductivity } K = \frac{1}{P}$$

If an electrolytic solution contains c gram equivalents per litre and if the specific resistance of the solution be P, conductivity K of the solution is $\frac{1}{P}$

$$\text{Equivalent conductivity} = \frac{\text{conductivity}}{\text{concentration}} = \frac{K}{C}$$

When concentration increases conductivity decreases and for dilute solutions of many electrolytes the specific conductivity is almost exactly proportional to the concentration, namely, $K \propto C$. In general the conductivity of an electrolyte increases with rise of temperature also.

Instrument

The instrument (Fig. 6) consists of a sensor and an electronic display meter. Sivadas (1981) has used a platinum electrode sensor for finding the salinity of sea water. The sensor is a glass tube 15 cm length and 10mm diameter, wherein two platinum electrodes are embeded inside, 5 cm apart. The whole tube containing the electrodes is

enclosed inside a PVC tube, filling the inter space with araldite for making it rugged and insulated (Fig. 1). The instrument was fabricated out of indigenous components.

Electronics

The electronic circuit consists of an oscillator, a bridge circuit, an operational ampli-

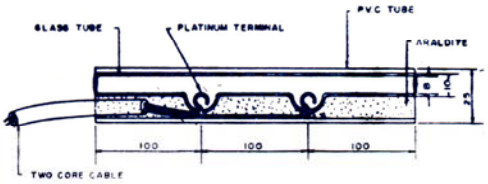

Fig. 1. The cross section of the conductivity cell

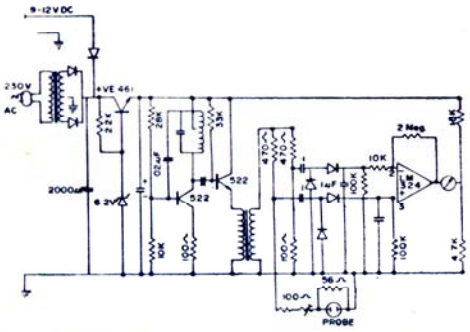

Fig. 2. The electronic circuit used in this instrument

fier and a display meter as given in Fig. 2. The oscillator produces sinusoidal waves at 1000 Hz. These oscillations are buffer amplified and given to a Wheatstone bridge net work. The sensor forms one of the four arms of the bridge. The bridge output will be the modulated signals with carrier from the oscillator and the intelligence from the transducer. The two outputs of the bridge are separately detected and filtered to produce steady D.C. proportional to the signals. These are fed to the two inputs of an operational amplifier working in differential mode to eliminate errors due to ambient temperature changes, slight change of the power supply and frequency instability of the oscillator. The output of the operational amplifier gives the information in D.C. voltage between 0 to 5. The D.C. voltage is converted to the required information in engineering units by proper potential division.

Calibration

The meter was calibrated by comparing the meter reading for known salt concentration in the range 5 to 12% containing 0.2% citric acid at 98 ±2° C with the values obtained by chemical analysis of these solutions, taking into consideration the conductivity errors caused by the dissolved proteins leaching from prawns into the blanching liquor. The effect of dissolved proteins on the electrical conductivity measurements was studied by Rao (1974). It was found that this error was proportionally less at

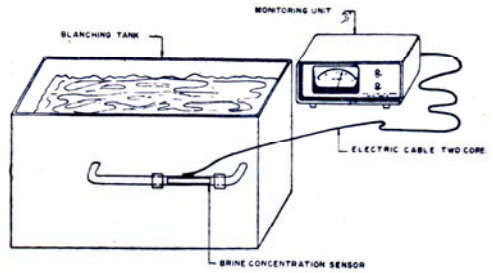

Fig. 3. The installation of the sensor outside the blanching tank

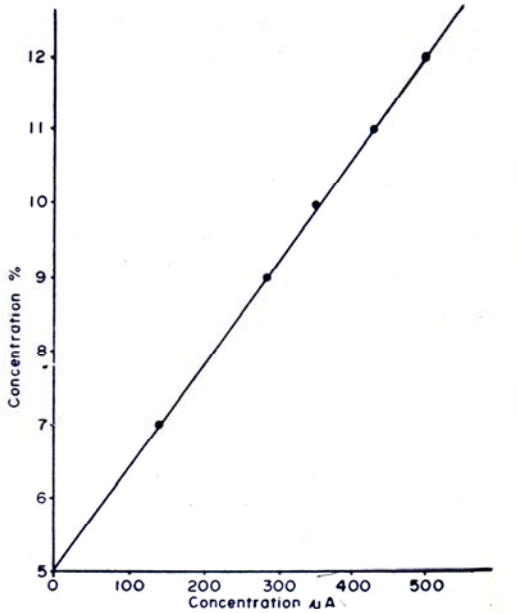

Fig. 4. The relation between estimated concentration of brine and concentration indicated by the meter

elevated temperatures and fairly constant irrespective of protein concentration due to repeated blanchings. The error in the meter reading due to protein content and temperature of the blanching solution was estimated to be about 1%.

Results and Discussion

The relation between brine concentration and meter reading was studied and it was found to be fairly linear. The linearity was obtained by shunting the probe by a very low resistance (Fig. 4). The effect of temperature over conductivity was studied for the temperatures from 95 to 102° C and the error due to this was estimated to be about 1% (Fig. 5).

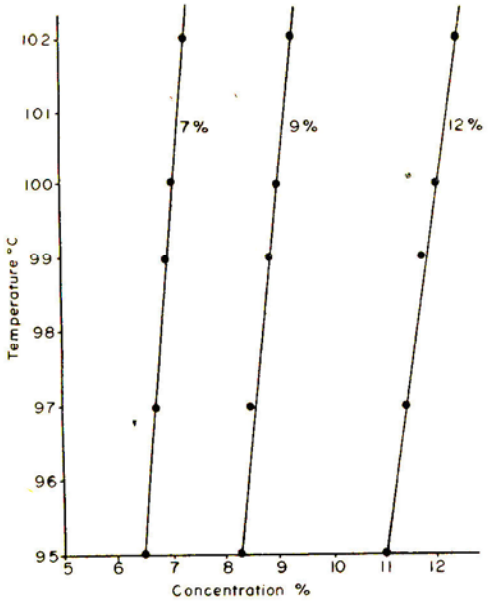

Fig. 5. The variation of concentration with temperature from 95°C to 102°C

The sensor made of platinum electrodes and fused to glass can withstand very high temperatures. The interspace between the glass tube and PVC tube is filled fully with araldite which could withstand the temperature of blanching solution. The sensor can be mounted permanently outside the blanching tank with inlets and outlets connected for salt solution to circulate through the transducer tube (Fig. 3). The transducer can also be mounted temporarily inside the blanching tank as and when the measurements are to be taken.

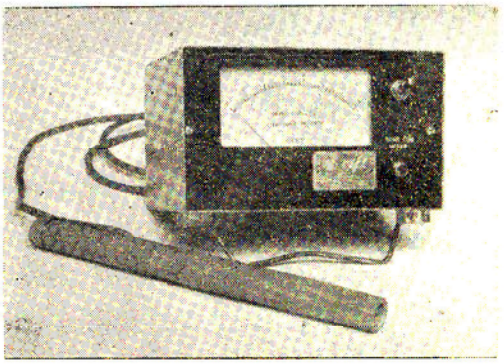

Fig. 6. The photograph of the instrument with its sensor

The following are main features of this instrument:-

Range	:	5–12% (other ranges are possible)
Accuracy	:	±1%
Power supply	:	9 VD. C./230 VA.C.
Power consumption	:	30 mA at 9V
Approximate cost	:	Rs. 4,000/-

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