PRINCIPLE OF FLAME PHOTOMETRY

Basic concepts of Laboratory Techniques (PGS 504)

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Flame photometry is an atomic emission technique which may be regarded as the simplest of atomic spectroscopic methods and is very similar to the flame test which is applied for detection of alkali metals.

- Flame photometry is good only for elements that are easily excited and do not require very high temperatures (Na, K, Li, Ca are the most widely determined atoms by this technique).
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PRINCIPLE OF FLAME PHOTOMETRY

- Flame photometry is a method used for the determination of elements which can be easily excited for example, alkali and alkaline earth metals.

- This method is based upon the measurement of intensity of radiation emitted, in the visible region,when a metal or atom is introduced into a flame.

- The wavelength of the radiation (or the colour),emitted tells us what the element is, and the intensity of the radiation tells us how much of the element is present.

INSTRUMENTATION FOR FLAME PHOTOMETRY

- In flame photometry the sample introduced into a flame where in it undergoes a number of processes leading to the formation of excited atomic species which emit radiation.
- The radiation is then measured and suitably analysed by **flame photometer**
- it consists of the following basic components.

COMPONENTS.

- **Flame atomiser**
- **Nebuliser and mixing chamber**
- **Atomiser burner**
- **Monochromator (or filter)**
- **Detector**
- **Amplifier and Readout Device**

- **Flame atomiser**: It converts the sample into excited atomic species and consists of the following.
- **Nebuliser and mixing chamber**: It is a means of transporting a homogeneous solution into the flame at a steady rate.
- **Atomiser burner**: Here the fuel and oxidant burn to give a flame that can be maintained in a constant form and at a constant temperature.
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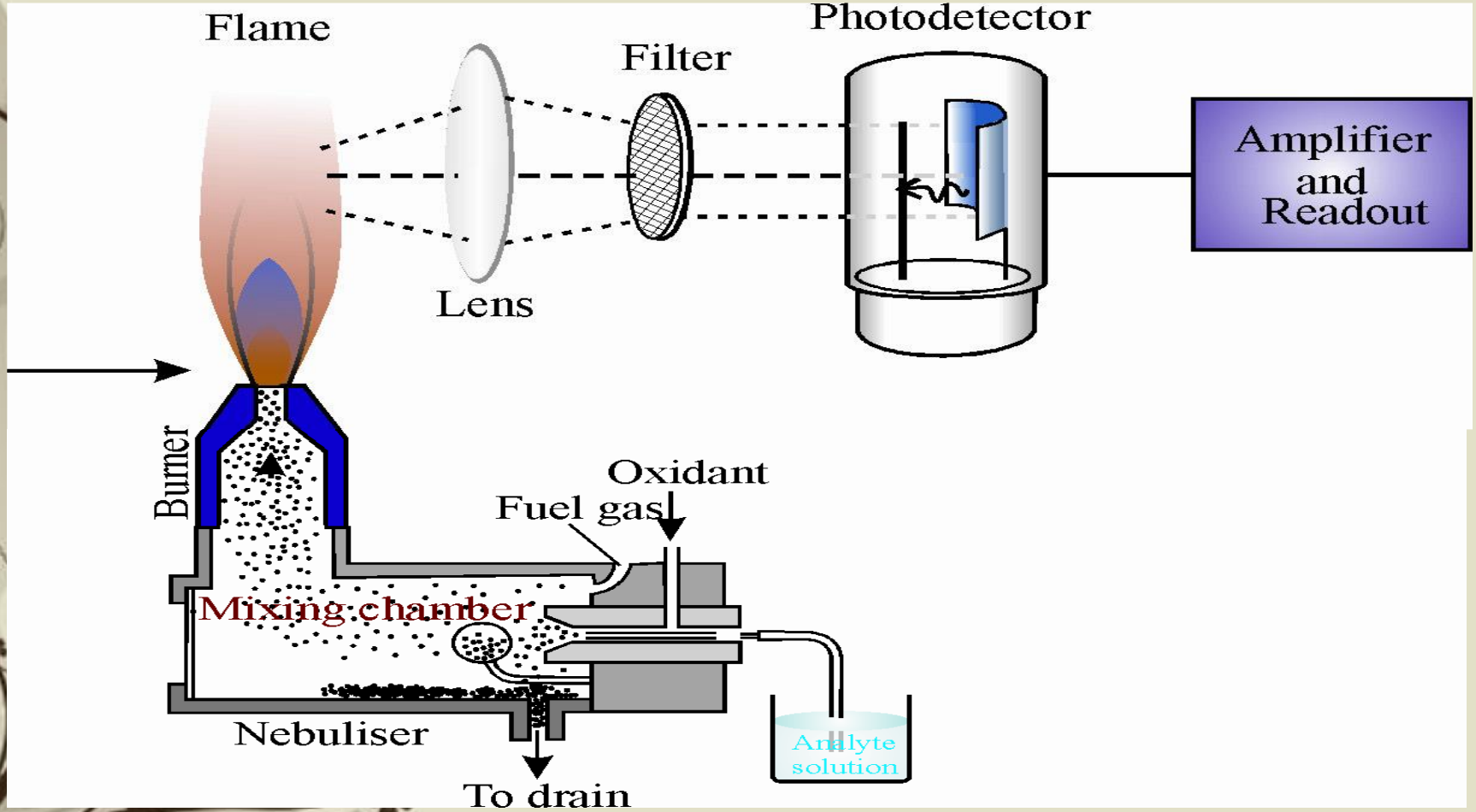
- **Monochromator (or filter)**: It isolates the light of the wavelength to be measured from that of extraneous emissions
- The role of themonochromator is to disperse the radiation coming from the flame and falling on it.
- **Detector**: It helps in measuring the intensity of radiation emitted by the flame.The function of a detector is to measure the intensity of radiation falling on it.
- **Amplifier and Readout Device**: It is used to amplify the signal and provides suitable output. The output from the detector is suitably amplified and displayed on a readout device like a meter or a digital display

The schematic diagram showing the layout of various components of a flame photometer



Methodology of Quantitative Analysis

- the general procedure in flame photometric determination involves
- preparation of the sample solution in a suitable solvent.
- aspirating it into the flame and measuring the intensity of the emitted radiation at the characteristic wavelength of the element.
- From the radiation intensity measured, the concentration of the element in the sample is then determined

Chemicals and Reagents

- **a. Provided**
- 1. Standard Na, solution (1000 ppm each).
- 2. Sample of unknown concentrations of Na,
- **b. Need Preparation**
- 1. Prepare standard Na, solution that are 1, 5, 10 ,20 30 ,40 ,50 ,60, 70, 80, 90, and 100 ppm of metal ion.

- **Apparatus**
  1. Flame photometer equipped with Na filter.
- **Procedure**:
- 1. Follow instructions for the correct operation of the flame photometer available.
- 2. Adjust the signal, using the Na filter, to zero using distilled deionized water.
- 3. Read the signal for the Na set of standards and then that of the unknown sample.
- 4. If the signal obtained for the sample is out of range, dilute a portion of the sample properly till a signal within the range is obtained.
- 5. Construct a calibration curve for Na in the sample and report your results in ppm.

Preparation of calibration curve

- The calibration curve is prepared by measuring the intensity of emission for a series of solutions of different conc. prepared by using a standard solution.
- Plotting a graph between emission intensity versus concentration of the ionic species.
- The concentration of the element in the unknown sample can then be found out from the standard plot.

calibration curve

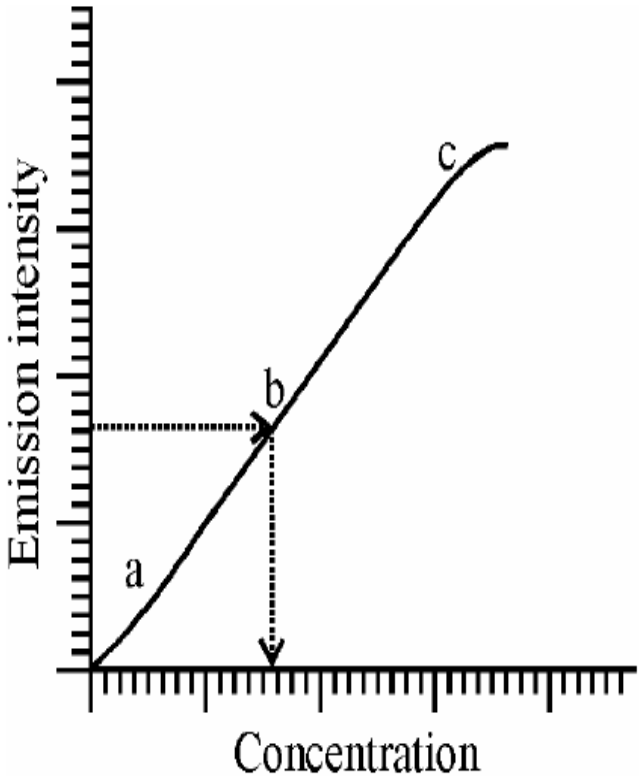


Fig. 7.12: Calibration plot: Emission intensity versus Concentration of the analyte

Flame photometric determination of salinity in processed foods

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Introduction

- Sodium chloride is the most important salt in human diet.
- For the purpose of promoting flavor and increasing shelf life,sodium chloride is an essential ingredient in all processed foods.
- Mohrs titration method is commonly accepted as one of the methods for the determination of salinity in foods.
- the salinity of food is calculated based on the concentration of chloride ion titrated with silver nitrate solution.

- flame photometry is a simple and relatively inexpensive method for direct detection of sodium ion concentration.
- Applications of this method in determination of sodium ion concentrations in a wide variety of samples have been reported (Biffen, 1950;
- the method has been used for quantification of sodium ion in many food samples(Balulescu, 1985; Folarin et al., 2001; Fulton et al.,

- The purpose of this investigation is to evaluate the feasibility of flame photometry in the determination of food salinity.
- The salinity of the food sample was calculated according to the amount of titrated chloride ion.

- Flame photometry was conducted according to Helrich (1990). A simple flame photometer (Model 410, Corning, Halstead, UK) with filters for lithium, sodium,and potassium was used.
- Standard curve with sodium concentration between 5 and 30 ppm was established daily and the signal of 30 ppm standard was checked occasionally during the analysis.
- The sodium content in appropriately diluted food sample was determined against the standard curve and the salinity of the original food sample was calculated.

- Forty-eight food samples were chosen to analyze the salt content in this study.
- The selection criteria were based on the consumer preference
- A portion of slurry (10 g) was sampled and mixed with double distilled water (40 mL) and centrifuged (15,000g, 4 C, 10 min; Centrifuge, Hitachi, Japan);and the supernatant was diluted and used in the analysis.
- For paste type foods, portion of sample (10g) and double distilled water (40 mL) were homogenized, centrifuged and diluted as mentioned above.

The list of salty processed foods used in this study

- 1 Pickled cabbage core (A)
- 2 Pickled cabbage core (B)
- 3 Pickled cabbage core (C)
- 4a Canned gluten (A)
- 5a Canned gluten (B)
- 6 Pickled cucumber (A)
- 7 Pickled cucumber (B)
- 8 Pickled cucumber (C)
- 9 Soft pickled cucumber (A)
- 10 Soft pickled cucumber (B)
- 11 Soft pickled cucumber (C)
- 12 Pickled black cucumber
- 13 Hou cucumber
- 14a Pickled bitter gourd (A)
- 15a Pickled bitter gourd (B)
- 16 Canned mushroom (A)
- 17 Canned mushroom (B)
- 18 Pickled onion
- 19a Canned peanut
- 20a Canned peas
- 21a Pickled pineapple (A)
- 22a Pickled pineapple (B)
- 23a Fermented black bean (A)
- 24a Fermented black bean (B)
- 25a Fermented bean curd
- 26 Soy sauce (A)
- 27 Soy sauce (B)
- 28a Spaghetti sauce
- 29 Vinegar
- 30a Chili sauce
- 31 Sweet osmanthus syrup (A)
- 32 Sweet osmanthus syrup (B)
- 33a Canned corn paste
- 34 Canned corn sprout (A)
- 35 Canned corn sprout (B)
- 36 Canned snail (A)
- 37 Canned snail (B)
- 38 Canned snail (C)
- 39 Pickled quail egg
- 40 Sausage (A)
- 41 Sausage (B)
- 42 Soup concentrate (A)
- 43 Soup concentrate (B)
- 44 Ox tail soup
- 46 Lobster soup
- 46a Dried scallop
- 47a Canned tuna
- 48a Shrimp paste

- The flame-photometrically determined salinities of food samples added with extra potassium and calcium ions were listed in
- While 0.1 ppm extra potassium did not interfere the determination of food salinity, 1 ppm extra potassium ion resulted in higher salinity in testing sample.

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Sawyer, Heineman, Beebe, Chemistry Experiments for Instrumental Methods, Wiley, New York, **1984**.

D. C. Harris Quantitative Chemical Analysis 4th Ed., W. H. Freeman and Company, New York **1995** Chapter 21

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thank'u'