Determination of fluoride ion concentration in Colgate max fresh using the LED's

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Abstract- In this paper, we describe an application of LED's to the determination of fluoride ion concentration in Colgate max fresh. A Sample apparatus using LED's as light source is described. The advantages of this apparatus are its low cost, versatility, and easy to build characteristics.
Index terms: LED's, Fluoride ion concentration, Colgate max fresh

I. INTRODUCTION

Light emitting diodes (LED's) in different wavelengths have many applications in digital readout devices since they provide an inexpensive and easy to use light source in the visible region. Different types of emitting diodes are available in the market and there are different LED characteristics which include the colour light or wavelength, radiation, light intensity. LED's consume less energy.

In instrumental analysis, LED's have several advantages over other light sources. Such as, incandescent lamps, because they emit radiation in the visible region with a characteristic wavelength maximum and bandwidth. Therefore they can be used as visible light sources in provided by a battery, which strongly reduces instrumentation needs and costs. The long life time of LED's in comparison to that of conventional incandescent lamps and the fact that they can be modulated even in the Nano seconds range are further advantages of these light sources.

LED's have characteristic wavelengths emission maximum and band widths. In LED's can be a disadvantage, since without monochromatic or narrow band filters, the measured intensive are due to all the light reaching the deviator, regardless of its wave length. As is well known, this usually gives rise to deviations from the Beer's law.

LF356 IC specifications and information:

- Low input bias current: 30 PA
- Low input offset current: 3 PA
- Low input offset voltage: 1.0 mv
- Temp compensation of i/p offset voltage:3.0 v/c
- Low input noise current 0.001PA/HZ
- High input Impendence: 1012 Ω
- High common mode rejection ratio: 100 db
- Large DC voltage gain: 106 db

Applications: LF Series is suggested for all general purpose FET input amplifier requirements where precision and frequency response flexibility are of prime importance.

A present limitation of LED applications in the photometry is that LEDs for only a few visible wavelengths are available so that in principle only species absorbing these can be investigated.

II. EXPERIMENTAL PROCEDURE

For our instrument, a high brightness blue LED was obtained from a local supplier. A regulated 12V power supply together with a series combination of a 1000Ω resistor and a 10k Ω potentiometer was used as current source for the LED. The current can be adjusted in the 1-20 mA range, assuming a V_f=1.8v .A digital multimeter was included to adjust the current available and must always be included to avoid permanent damage to the LED due to an excessive current passing through it.

For a flexible operation, the emitted light was conducted through a fibre optic. A Polymeric type fibre with a 1 mm diameter was selected because of its low cost and low loss at the working wavelengths. The fibre is covered with a black polyethylene cladding. A homemade plastic coupling was used to join the fibre to the LED. The (fig2) indicates detector used was a light to voltage optical sensor this is a very small combining a photodiode and a trans impedance amplifier with a 37 M Ω integrated feedback resistor on a single IC (LF 356).The pin configuration of IC LF356 is shown in fig(3). In appearance it is similar to a conventional low power transistor also having three leads used as ground, power supply and output.

A block diagram of the photometer with kuvette (sample holder), LED, power supply and fibre optic is shown in fig (1). The voltage signal produced by the incident light on the photo diode was read by the digital multimeter. Thus intensity data are the primary data obtained. To transform these data into absorbance, a logarithmic transformation is needed. Taking into account the well-known relation of the primary data into the final absorbance values as shown in equation (1)

$$\mathbf{A = \log ((E_O - E_\infty) \div (E - E_\infty))} \quad \text{----- (1)}$$

E = is the potential measured with paste solution placed into cell holder. (Volts)

E_0= is the potential measured with the reference solution (volts). And

E_{∞} = is the potential in the absence of light (volts).

Preparation of Tooth Pastes Solution and Determination of Fluoride Ion Concentration:

0.5690 gm of tooth paste sample was weighed and dissolved in few CC'S of water in a beaker5 to 6 drops of con HN03 or sulphuric acid is added to the solution. The mixture is boiled thoroughly for few minutes and cooled. The solution is carefully transferred into 250 ml standard flask. The Contents in the breaker are washed and once again transferred & removed. The solution in the 250 ml standard flask is made up to the mark with double distilled water. Stopper is placed and the solution is shaken thoroughly to get a solution of uniform concentration. This solution is taken as reference standard solution of 0.1 M concentration Solutions of various concentrations are prepared by applying the principle of dilution. These solutions are taken in cuvettes. The voltage signal produced by the incident light on the photodiode was read by the digital multimeter, Thus intensity data are the primary data obtained. To transfer these data into absorbance a logarithmic transformation is needed. In fig (4) the experimental results are plotted as absorbance versus concentration. Absorbance data were calculated from the voltage measurements, and according to equation (1). A Good straight line is obtained in the tested interval indicating the method can be successfully follows the Beer's law, in spite of the fact that the deviation are expected when the radiation used is not monochromatic. The percentage of the fluoride ion concentration evaluated according to the graph. The same procedure is applied for all tooth pastes.

HAZARDS: There are no significant hazards associated with the use of LED's. LED's do not contain toxic material like mercury which is used in fluorescent lamps.

V.RESULTS AND DISCUSSION

We present here a low cost photometric apparatus based on LED technology and described an under graduate laboratory experiment for determining fluoride ion concentration in tooth paste (Colgate max fresh). Since LED research is an active in continuously expanding area, the implementation LED's in new instrumentation seems quite meaningful. In this experiment a calibration curve was created by plotting absorbance vs concentration in excel. The fluoride ion concentration in Colgate max fresh was experimentally determined to be 0.002gm

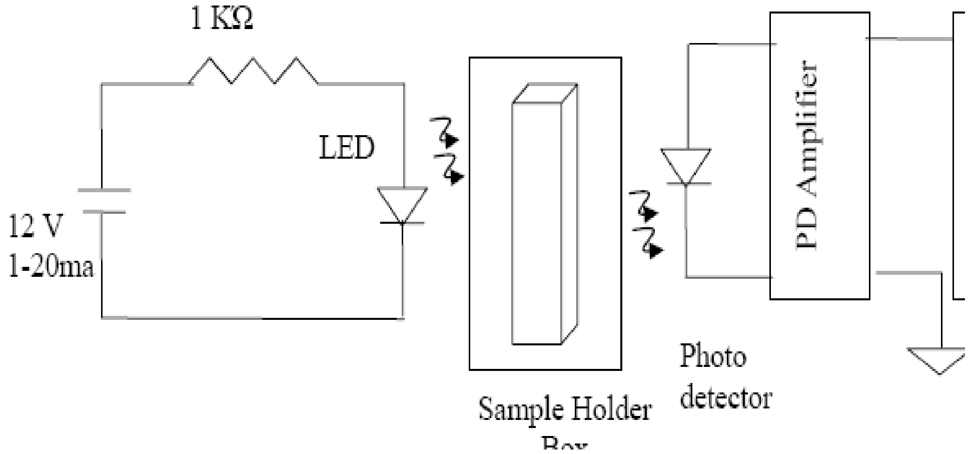

Figure (1): Block diagram me of the photo detector, LED, fibre optic and power supply

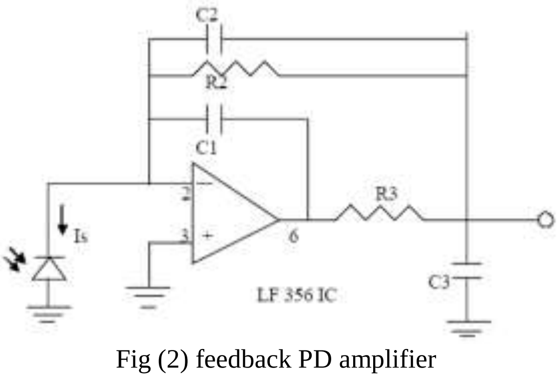

Fig (2) feedback PD amplifier
R2 = 37 MΩ; R3 = 1K Ω; C1 =C2 =0.5 pf; C3 =10 nf;

1, 5 – Off set null.
2. Inverting I/O
3. Non inverting I/O
4. V-
6. out put
7. V+
8 NC

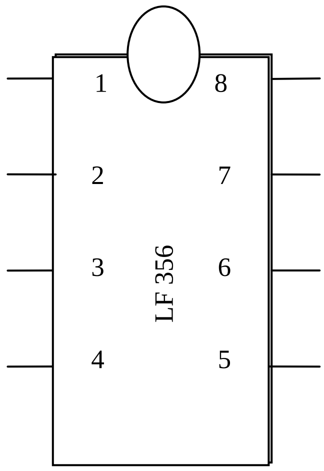

Fig (3) Pin diagram of LF 356 IC

Table 1

S.No	Molarity	Voltage(E)	Voltage (E_∞)	Absorbance
1.	0.01	-101.1	2	0.0309
2	0.02	-94.83	2	0.0726
3	0.03	-87.98	2	0.1085
4	0.04	-79.99	2	0.1465
5	0..05	-73.86	2	0.1811
6	0.06	-67.98	2	0.2172
7	0.07	-62.59	2	0.2531
8	0.08	-57.54	2	0.2896
9	0.09	-52.98	2	0.3254
10	0.1	-48.69	2	0.3621

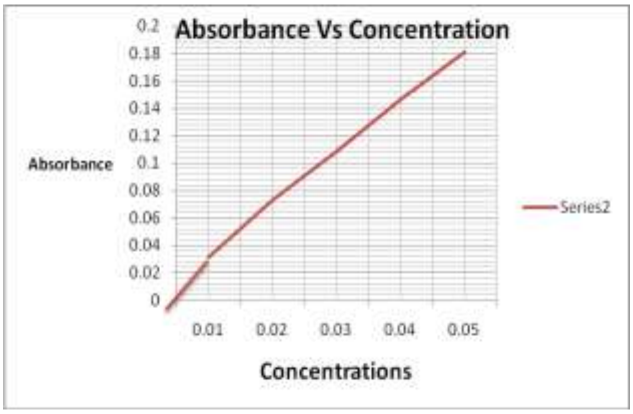

Fig 4. Graph of a Colgate max fresh

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