Sustainable and Green emerging trend for generation of electricity by using dyes

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ABSTRACT-- *Photogalvanic cells have affinity to solar energy renovation and storage. It can be efficient energy resource for future scenario, if its electrical performance is increased up to mark by using suitable combination of dyes, reductants & surfactants. In this research, the Photogalvanic cell contains Victoriaa Blue (VB) dye as photo sensitizer, Ethylene diamine tetra acetic acid (EDTA) as reluctant, Cetyl Trimethyl Ammonium Bromide (CTAB) as surfactant and Sodium hydroxide (NaOH) is used as an alkaline medium to enhance the electrical performance of batteries. The reported cell efficiency is fundamentally elevated as well. The system has conservation efficiency 1.01% and can be used in the dark for 68 Mins. Assorted parameter on which efficiency of solar energy conversion is reliant are also deliberate and account here.*

Keywords-- *Photosensitizer, Reluctant, surfactant, Fill Factor, Potential at power point, Rate of generation, Power & Charging time.*

I. INTRODUCTION

The world's demand for energy is highly dependent on conventional and non-renewable fuels. Most of the power generation is carried out through traditional and non-renewable energy sources, such as fossil fuels, biological, synthetic fuels and mineral oil-based power plants, which have made huge contributions to greenhouse gas emissions and are still the most important One of the challenges for the scientific community. Most developed countries use solar energy as one of the main renewable energy sources as a better alternative energy source. The theoretical efficiency (18%) of the photovoltaic cell has never reached the standard, which is caused by reverse electron transfer, low stability and aggregation of the dye molecules around the electrode molecules. The power generation of light has attracted the attention of researchers because it is a feasible solar energy conversion medium and has a broad prospect. The photo galvanic effect was reported by Clark & Eckert but systematically investigated by W. J. Albery and M. D. Archer et al. Later on R. Tamilarasan, P. Natarajan et al have reported some fascinating photo galvanic system.

II. Effect of Photosensitizer:

As the concentration of Victoria Blue (photosensitizer) increases, it is found that the light potential and photocurrent increase to the peak, and as the concentration further increases, the battery's electrical output decreases, because in the photosensitizer in the lower light concentration range, The number of photosensitizer molecules is limited to absorb most of the light in this path, and the number of electrons reaching the platinum electrode is also small. The results are summarized in Figure 1

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III. Study of Reductant:

The value of photopotential & photocurrent reaches to maximum value with increase the concentration of the reductant [EDTA] and the reduction is then reduced because the higher amount of reducing agent molecules prevents the dye molecules from reaching the electrode within the required time limit. The effects of this disparity of EDTA concentration over the photopotential and photocurrent of Victoria Blue – EDTA-Cetyl Trimethyl Ammonium Bromide System are graphically represented in Figure-2.

IV. Effect of Surfactant:

As on increase in concentration of the Surfactant [Cetyl Trimethyl Ammonium Bromide], it is observed that the value of the light potential increases until it reaches a peak. The concentration of Cetyl Trimethyl is further increased Ammonium Bromide, a shrink in the value of photopotential and photocurrent of the cell was noted, its due to availability slighter concentration & privileged concentration of surfactant at electrode. The effect of the variation of the Cetyl Trimethyl Ammonium Bromide concentration on the photopotential and photocurrent of Victoria Blue – EDTA-Cetyl Trimethyl Ammonium Bromide System is graphically represented in Figure-3.

V. Consequence of pH :

The system containing Victoria Blue – EDTA-Cetyl Trimethyl Ammonium Bromide System was observed that it is very much receptive to the pH. It was experimental that there was a raise in the photopotential with the increase in the pH (in the alkaline medium). At pH 13.7 a optimum value of photopotential & current were acquired. When the pH value further increases, its value will decrease, the results of pH on photopotential and photocurrent are shown in Figure 4.

VI. Consequence of Photopotential and Photocurrent:

Use a digital pH meter (leave the other circuit open). With the help of log470K connected to the multimeter, the current (isc) and potential (Voc) values between these two extreme values are reported, and the external load is applied through this value. The i-V characteristics of a cell containing Victoria Blue – EDTA-Cetyl Trimethyl Ammonium Bromide System is graphically shown in figure – 5.

According to reports, the i-V curve turns from its regular rectangular shape. A point in the i-V curve is expressed as the power point (pp), at which point the current and potential results are the largest, and the fill factor is calculated by the following method:

$$\text{Fill Factor} = V_{pp} \times i_{pp} / V_{oc} \times i_{sc} \quad (1)$$

Here Vpp and ipp represents the significance of potential and current at power point, correspondingly.

VII. Performance of the Cell :

The performance of the photoelectric primary cell is measured by the peripheral load required only by the current at the power point after the lighting is terminated after the potential reaches a stable value. Calculate the performance and storage capacity of the battery according to t1/2, that is, the time required to reduce the power to half at the power point in the dark. After measurement, the device can be used in the dark for 68.0 minutes. It is represented graphically in Figure 5

VIII. Conversion Efficiency of the Cell :

The conversion efficiency of the Photo galvanic cell can be calculated by given formula -

Conversion Efficiency = Vpp × ipp 100/10.4mWcm-2 (2)

Here Vpp and ipp are indicating the potential and current at power point and 10.4 mw/Cm2 is power of incident radiation.

Mechanism: The photocurrent generation in the photogalvanic device can be mechanized as follows-

Illuminated Chamber

$$D \xrightarrow{h\nu} D^*(S) \xrightarrow{ISC} Dye^*(T) \quad (3)$$

$$D^*(T) + R \longrightarrow \bar{D}\ (\text{semi or leuco}) + R^+ \quad (4)$$

At Platinum Electrode

$$D^- \longrightarrow \bar{D} + e \quad (5)$$

Dark Chamber

$$D + e^- \longrightarrow D^-\ (\text{semi or leuco}) \quad (6)$$

$$D^- + R^+ \longrightarrow D + R \quad (7)$$

Here D, D*, D , R , R+ S, T and ISC are the excited form of dye, semi or leuco dye, reductant, oxidized form of the reductant, singlet excited dye, triplet excited dye and inter-system crossing, correspondingly .

IX. Results and Discussion:

Table 1: Victoria Blue – EDTA-Cetyl Trimethyl Ammonium Bromide System

[Victoria Blue]=5.8×10-6M [EDTA]=2.8×10-3M

[Cetyl Trimethyl Ammonium Bromide]= 3.5×10^{-3}M

pH=13.7 Light Intensity=10.4mW cm^{-2}

S. No.	Observations	Values
1	Photopotential (V)	995.0 mV
2	Short circuit current (isc)	174.0 μ A
3	Current at power point (ipp)	130.0 μ A
4	Potential at power point (Vpp)	880.0 μ A
5	Power at power point	98.5 μ W
6	Rate of Generation	20.7 μ A min-1
7	Conversion Efficiency	1.0153 %
8	Charging Time	190 min.
9	$t_{1/2}$	68 min.
10	Fill factor (n)	0.63

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Figure-1

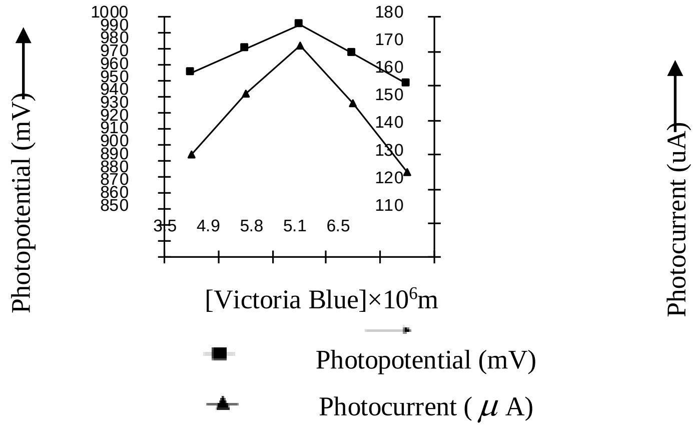

Figure-2

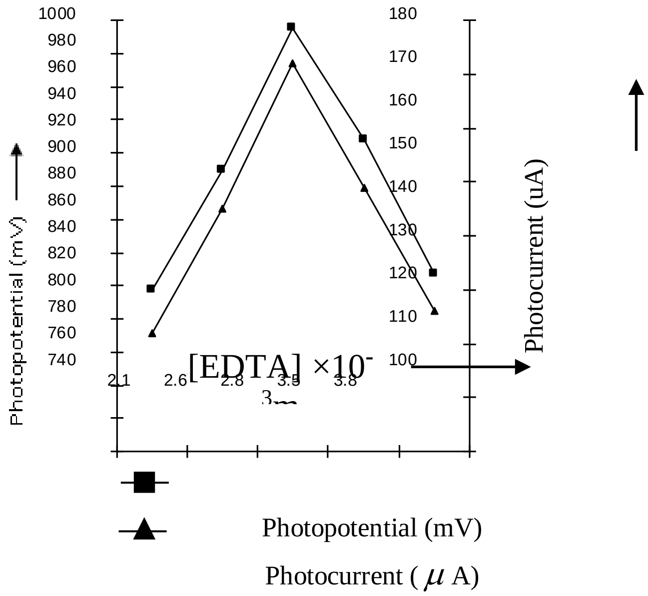

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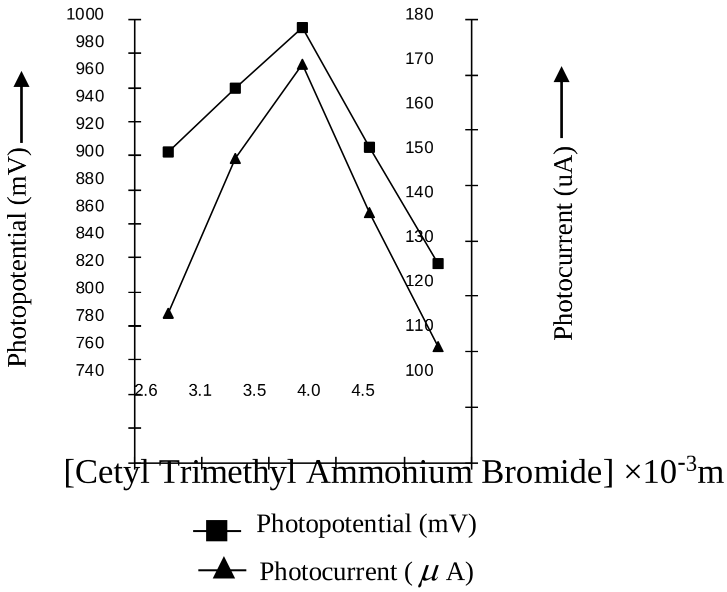
Figure-3



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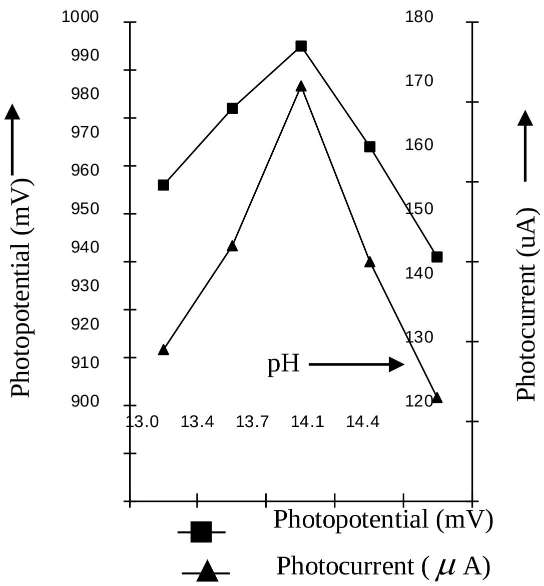

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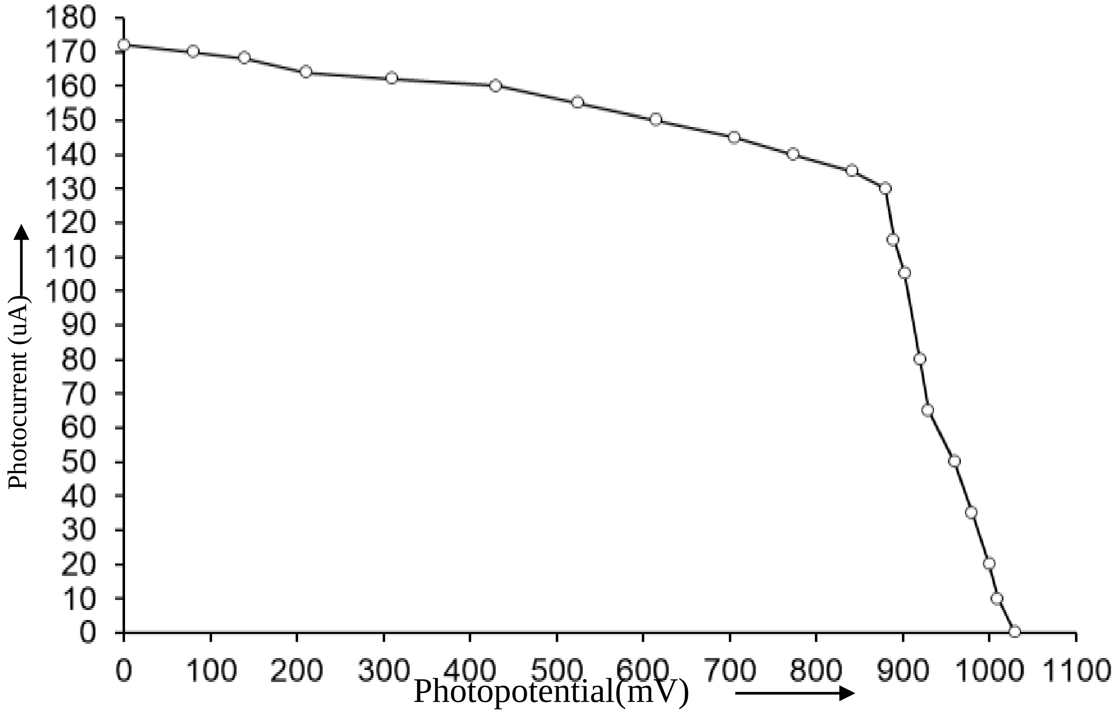
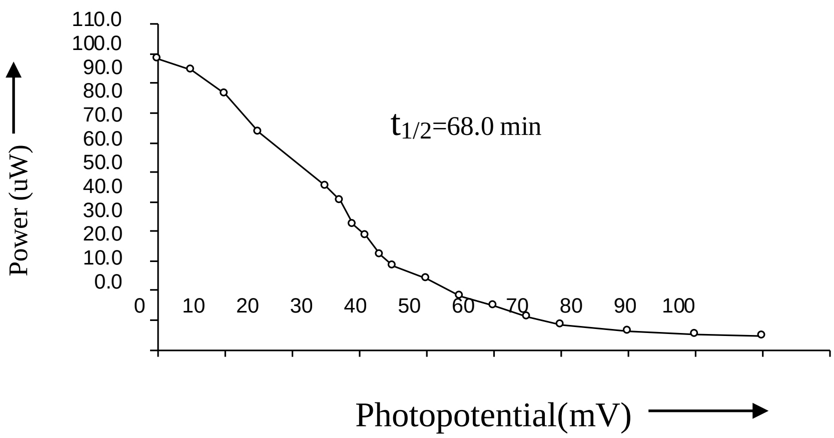


Figure-6



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