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RESEARCH ARTICLE

COMPARATIVE STUDY OF PHOTOGALVANIC EFFECT BY USING OF ROSE FLOWER EXTRACT AS PHOTOSENSITIZER WITH MANNITOL AND NTA AS REDUCTANT FOR SOLAR ENERGY CONVERSION AND STORAGE.

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Abstract

The Photogalvanic effect has been studied in two systems using Photogalvanic Cells: Nitrilotriacetic Acid (NTA) - Rose Flower Extract and Mannitol- Rose Flower Extract systems. The Photopotential and Photocurrent generated by two systems were 872 and 850 mV and 176 and 170 μ A, respectively. The effects of different parameters on the electrical outputs of the cell have been observed and current-voltage characteristics of the cell have been studied. A mechanism has been proposed for the generation of photocurrent in photogalvanic cells. The Conversion Efficiencies for Nitrilotriacetic Acid (NTA) - Rose Flower Extract and Mannitol- Rose Flower Extract were 0.7901% and 0.8384% and storage capacities were 200 and 180 min, respectively.

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Introduction:-

Modern life has very high energy demands. Accordingly renewable energy resources are attracting a great deal of attention, and solar energy is one of the most promising future energy resources solar energy is unlimited sources of regenerative energy. Solar cells convert sunlight directly to electricity with acceptable conversion efficiency. The photo effects in electrochemical systems were first reported by Becquerel [1]. It has been reported that only negative Photopotential should be obtained with carbonyl compounds. The photo galvanic effect was first observed by Rideal and Williams [2], but it was systematically investigated by Rabinowitch[3] The photogalvanic effect studied with help of aqueous ethylene blue Ni mesh by Bayer et al. [4] . It was followed by various scientists [5-8] time to time. Photogalvanic cells containing reductants, surfactants and photosensitizers were reported by Yadav et al. [9-12].

Experimental:-

A known amount of the solutions of the Rose Flower Extract as Natural Photosensitizer from Rose flower petals, Nitrilotriacetic acid (Himedia) and Mannitol (Himedia) as Reductant and sodium hydroxide (Himedia) were used in the present work. The stock solutions of all chemicals were prepared by direct weighing, in doubly distilled water and were kept in colored container to protect them from light. The system was systematically set for photogalvanic studies, which consists of electrochemically treated platinum as electrode and saturated calomel electrodes as a reference electrode. A tungsten lamp was used as light source. Water filter was used to cut-off IR radiations. Solutions of dye, reductant, and sodium hydroxide were taken in an H type glass tube. A platinum electrode (1.0 x 1.0 cm²) was immersed into one arm of H-tube and a saturated calomel electrode (SCE) was kept in the other. The whole system was first placed in dark till a stable potential was obtained and then, the arm containing the SCE was kept in the dark and the platinum electrode was exposed to a 200 W tungsten lamp. A water-filter was used to cut off

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infrared radiations. A digital pH meter and a microammeter were used to measure the potential and current generated by the system, respectively. The experimental set-up of photogalvanic cell is given in Figure 1

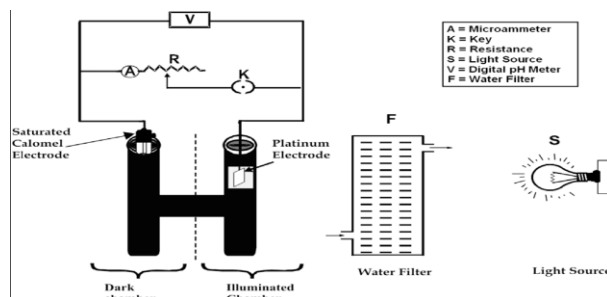


Figure 1:- Experimental set up of photogalvanic cell

Results and Discussions:-

3.1 i-V Characteristics of the Cell:-

A digital pH meter (keeping the other circuit open) was used to measure the open circuit voltage (V_{oc}) whereas short circuit current (i_{sc}) (keeping the other circuit closed) was measured by micro-ammeter. The electrical parameters between these two extreme values (V_{oc} and i_{sc}) were determined with the help of a carbon pot (log 470K) connected in the circuit of micro-ammeter, through which an external load was applied. The corresponding values of potential with respect to current values for the two systems have been given in table in Table 3.1. It was observed that in the two systems i-V curves deviated from their expected regular rectangular shapes. The power point (a point on the curve where the product of potential and current was maximum) in i-V curves were determined and their fill factors were also calculated. These data are summarized in table 3.1.

Table 3.1:- i-V Characteristics of the Photogalvanic Cells.

Systems	V_{oc} (mV)	i_{sc} (A)	V_{pp} (mV)	i_{pp} (A)	η
Rose Flower Extract-Mannitol System	1078.0	170.0	545.0	160.0	0.47%
Rose Flower Extract-NTA System	998.0	176.0	587.0	140.0	0.46%

3.2 Performance of the Cell:-

The results obtained have been given in the table 3.2. All the two system were studied by applying the desired external load to have the potential and current corresponding to power point. The time $t_{1/2}$ was determined after removing the source of light. It is the time taken in reaching half the value of power. The performances of cells were studied and comparative values are summarized in the table 3.2.

Table 3.2:- Performance of the Photogalvanic Cells in Dark.

Systems	Power (μW)	$t_{1/2}$ (min)
Rose Flower Extract-Mannitol System	87.20	55.0
Rose Flower Extract-NTA System	82.18	42.0

3.3 Conversion Efficiency of the Cell:-

The conversion efficiency of two systems was calculated using the output at power point and the power of incident radiations. The systems (at the optimum conditions) were also exposed to sunlight. The conversion efficiency and sunlight conversion data for these two systems are reported in table 3.3.

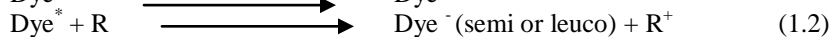
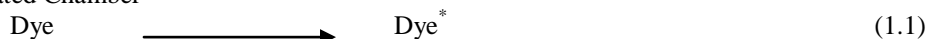
Table 3.3:- Conversion Efficiency and Sunlight Conversion Data

Systems	Fill Factor (n)	Conversion Efficiency (%)	Sunlight Conversion Data	
			Photo potential (mV)	Photo current (μA)
Rose Flower Extract-Mannitol System	0.47	0.83	850	170
Rose Flower Extract-NTA System	0.46	0.79	872	176

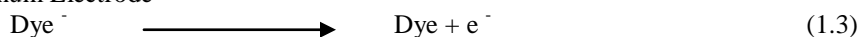
Mechanism:-

On the basis of these observations, a mechanism is suggested for the generation of photocurrent in the photogalvanic cell as:

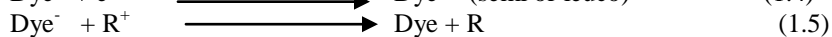
Illuminated Chamber



At Platinum Electrode



Dark Chamber



Where Dye, Dye*, Dye⁻, R and R⁺ are the excited form of dye, semi or leuco dye, reductant and oxidized form of the reductant, respectively.

Conclusion:-

In the present investigation, Mannitol and NTA have been used as reductant and Rose Flower Extract have been used as photosensitizer comprising two systems like Rose Extract-Mannitol System and Rose Flower Extract-NTA System in photogalvanic cells. On the basis of the observed data, the Rose Extract-Mannitol System is most efficient from the power point of view (solar energy conversion), highest conversion efficiency, Fill Factor and also from the performance point of view (solar energy storage). This indication very clearly that the cost as well as viability in all the respect may be achieved if the work is handled with full attention and photogalvanic cell may have their superiority in the field of solar energy conversion and storage. Recently, some efficient and viable photogalvanic cells have been prepared using some Reductant and Photosensitizer in them and found to be stable also. The investigator still feels a room to reduce the cost and enhance the performance and hence one reductant and one photosensitizer have been selected and two efficient systems have been matched to the requirement.

On the basis of observation, it can be concluded that the field has still a scope to give viability in the direction of solar energy conversion and storage. The more systems may be found out with better electrical output, good performance and storage capacity.

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