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Effect of various cells on voltage generation from xerophytes

Dr. Gajanan S. Wajire

Professor in Electronics,
Shri Shivaji College of Arts, Commerce and Science Akola, India
Email : gsw.741@gmail.com

Abstract : In day-to-day life of human being, electricity is playing a major and indispensable role. Therefore, the demand of electrical energy is an emergent problem which is creating several threats in the earth's environment. To treat with this situation, various types of non-conventional and renewable energy sources are being developed throughout the world.

In the presented research papers, an influence is given to generate small amount of DC voltage, from xerophytic living plants. Such kind of energy source is eco-friendly, non-conventional and renewable type of energy source. Likewise, the current research work of electricity generation from living plants has wide future scope for development in the field of renewable and non-conventional energy sources. The undertaken research work describes the design aspect of low power energy source wherein various xerophytic living plants are utilized as natural electrolytes with modified electrodes and cells. These electrodes and cells are designed and developed by studying various electrical parameters of conducting materials. Particularly, Silver-Zinc (Ag-Zn) cells of various structures like normal, corrugated and grooved are used. The comparative performance of these cells has been studied and presented throughout this research paper.

Index Terms **- Non-conventional, xerophyte, eco-friendly, sap-flow, Silver-Zinc electrode and cells.**

I. INTRODUCTION

Due to the inadequacy of electricity, human being is facing the problem of load shading. For electricity generation, various non-conventional methods are being researched and developed by different agencies, boards, firms & companies. On some extend, every scientific crew is contributing its share in the field of electricity generation.

Throughout this research work, the researcher is trying to use nonconventional method of generation of electricity by using xerophytic types of living plants. The word xerophyte = xero (i.e. dry) + phyte (i.e. plant), means a species of plant that has adaptations to survive in an environment with little water such as desert, salty or artic regions. After generation of the electricity it was successfully utilized as a new kind of voltage source for the operation of small electronic circuits, devices & gadgets. This stood as one of the renewable emerging source of energy for the circuits such as small Digital watch, LED circuit, 12 and ½ digit Calculator, Musical sound circuit, Quartz wall clock, Timer IC 555 circuit, Tiny DC motor, Small toy, Remotes of CD player, Tiny torch and so on. This type of low voltage source was generated without polluting any environmental parameters and without creating any waste/raw materials.

II. DESIGNING OF ELECTRODES AND CELLS

By observing physical characteristics, chemical properties and sap-flow of different xerophytic plants, various shape and size of the electrodes and cells were tested practically for optimum values of output voltage, current and power. The output responses of various xerophytic plants such as Aloe vera, Opuntia dillennii, Euphorbia neriifolia, Cereus hildmannianus, Euphorbia antiquorem, Agave vivipara, Opuntia stricta and Euphorbia lactea were studied practically for the generation of potential difference (or voltage). Also, different conducting materials like Copper, Aluminum, Zinc, Platinum, Iron, Silver, Gold, Carbon, Iron, Magnesium and Stainless Steel were used to design and developed these electrodes and cells. For designing particular kind, shape and structure of cells, only Silver-Zinc (Ag-Zn) electrode materials and related parameters have been taken into consideration. Photographs of typical 'Corrugated and Grooved strip electrodes' of different materials have been shown in following figure (1).

Figure (1): Photograph of Corrugated and Grooved strip electrodes

A 'Cell' is proper combination and arrangement of two or more separate electrodes. Also, number of cells can be connected either in series or parallel way, depending upon the requirements. Proper arrangement of these cells was done so suitably that the output voltage, output current or output power could increase upto an appreciable level. Single cell is combination of two electrodes, while a double cell is the combination of four electrodes. Following figure (2) shows a photograph of an assembly of single and double cells of different materials.

Figure (2): Photograph of Single and double Cells of different materials

III. COMPARATIVE RESPONSE FOR OUTPUT VOLTAGE OF DIFFERENT CELLS

The response of various xerophytic plants such as Aloe vera, Opuntia dillennii, Euphorbia neriifolia, Cereus hildmannianus, Euphorbia antiquorem, Agave vivipara, Opuntia stricta and Euphorbia lactea were studied practically for the generation of potential difference (or voltage). But the only plants with good potential difference and output current are considered. The five regular plants such as Aloe vera, Opuntia dillennii, Euphorbia neriifolia, Cereus hildmannianus and Agave vivipara has been studied using Silver-Zinc (Ag-Zn) cells of different structures. The observations for the output voltages are noted in following table (1).

Table (1): Comparative response of output voltage across Normal, Corrugated and Grooved Silver-Zinc Cells

S. N.	Name of the Xerophytes used	Output voltage of Normal Cell	Output voltage of Corrugated Cell	Output voltage of Grooved Cell
1)	Aloe vera	0.957	1.083	1.142
2)	Opuntia dillennii	0.835	0.861	0.907
3)	Euphorbia neriifolia	0.753	0.772	0.802
4)	Cereus hildmannianus	0.762	0.783	0.813
5)	Agave vivipara	0.847	0.894	0.925

From above table it is found that in most of plants the grooved cells produces highest potential difference of 1.142 volts. It is due to the fact that in case of the grooved cells, being comparatively less surface area, the sap flow of the plant reaches to more interior region of the cell, and thus it gets spread there properly. In case of corrugated cells, being comparatively more surface area, the sap flow of the plant does not reaches to the interior region of the cell, and thus it does not spread properly. Therefore the voltage generated across it is less than the grooved cells. Similarly, the normal cell produces lowest potential difference in the

range, which is due to the less surface area over which the sap flow is spread. Following figure (3) shows the graphical comparison and analysis of the potential difference generated across these three cells for various xerophytic plants.

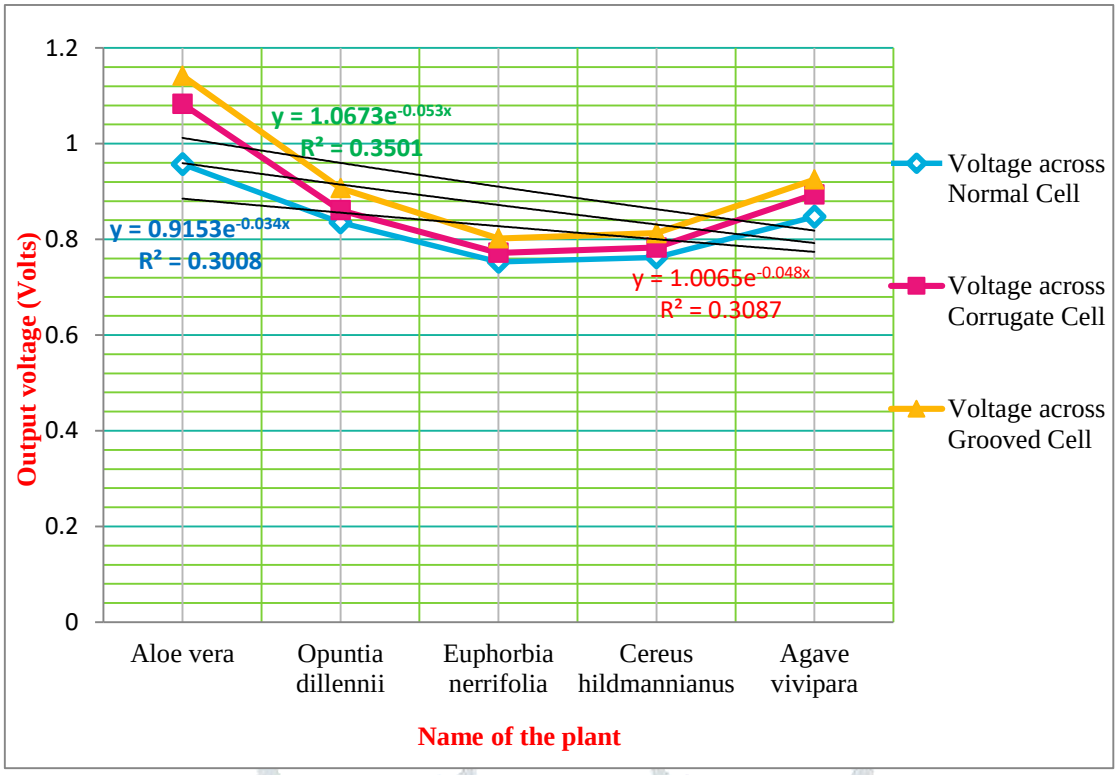

Figure (3): Comparison of voltage across Normal, Corrugated and Grooved cells for various xerophytes

As shown in above figure, the trendlines along with their equations and R-squared values are drawn for output voltage generated across normal, corrugated and grooved cells for different plants. It is observed that maximum output voltage is generated for Aloe vera plant and there is decline in exponential curve for other plants. The equation of line $y = 1.067 * e^{-0.05x}$ with R-squared value, $R^2 = 0.350$ of exponential curve for output voltage generated across grooved cell shows that more voltage get generated and the decline rate is high with respect to other two electrodes set. The decline rate for output voltage generated across corrugated cell with line equation $y = 1.006 * e^{-0.04x}$ with R-squared value, $R^2 = 0.308$ shows that the voltage generated is moderate and the decline rate is also moderate with respect to other two electrodes set. Whereas, the decline rate for output voltage generated across normal cell with line equation $y = 0.915 * e^{-0.03x}$ with R-squared value, $R^2 = 0.300$ shows that the voltage generated is lower and the decline rate is also low with respect to other two electrodes set. Thus, after the overall analysis of above graph of figure (3), it is observed that the response of grooved cell for output voltage is good but decline rate is more, whereas in case of corrugated cell the voltage response is moderate with moderate decline rate. In case of normal cell, decline rate is low but at the cost of less voltage.

IV. CONCLUSION

It was found that due to the simultaneous reduction and oxidation reactions across the electrodes and cells, it generates typical voltage, current and power. It was found that the normal cell using Silver-Zinc (Ag-Zn) electrode produces lowest output of all three types. Similarly, the grooved cell produces moderate output voltage whereas the corrugated cell produces highest values of output voltage, current and power. Abovementioned discussed electrodes and cells are of moderate cost, reusable, less corrosive, pollution free and eco-friendly too. Thus, such type of voltage source may referred to as renewable, cheap, an emerging and non-conventional low power source of electricity.

The undertaken research work is in embryonic stage, but more research can open new means of using trees and plants for generating electric power. So, let's expect our imagination may cross limitations and human being might be plugging into surrounding plants and trees to meet basic and low power energy needs using such type of green electricity.

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