Comparative Performance of Platinum-Zinc and Gold-Zinc Cells for Greenelectricity

Mr. G. S. Wajire
Associate Professor,
Department of Electronics,
Shri Shivaji College, Akola (M.S.)
e-mail : gsw.741@gmail.com

Dr. Y. B. Gandole
Principal,
Adarsha Science, J. B. Arts & Birla Commerce
Mahavidyalaya, Dhamangaon Rly., Dist. Amravati
e-mail : ygandole@gmail.com

Abstract: Electric energy is playing a major and indispensable role in day-to-day life of human being. Most all the fields are encompassed with electricity and related appliances. To surmount the demand of electrical energy is ever growing problem and is creating several threats to the environment. To deal with the situation, various types of non-conventional and renewable energy sources are being invented and developed throughout the world.

In this research papers, an impact is given to generate DC voltage, from living plants like xerophytesas well asmesophytes types. Such kind of energy source is non-conventional as well as renewable type of energy source and is very useful. It is eco-friendly technique of low voltage generation. Though the current research work of electricity generation from living plants is in infancy, but has wide scope in future for the development and evolution of renewable and non-conventional energy resources. The undertaken research work describes the design aspect of low power energy source wherein various plants are used as natural electrolytes alongwith various electrodes and cells.

By studying various physical, chemical and electrical parameters of some conducting materials, typical electrodes and cells were designed and developed. Platinum-Zinc and Gold-Zinc cells are considered as good conducting materials for preparation of electrodes and cells. The comparative performance of Platinum-Zinc and Gold-Zinc cells has been studied throughout these research papers.

Keywords:*Renewable energy,xerophyte, green and eco-friendly source, Platinum-Zinc, Gold-Zinc cell*

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Introduction:

Electricity plays a major role in the field of electronics, physics and chemistry. Due to the insufficiency of electricity whole human being is facing the problem of load shading. There are number of ways by which electricity is being generated. The conventional as well as non-conventional methods are being research and developed used by different agencies, boards, institutes& companies. On some extend, every scientific team 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 living plants like xerophytic types. After generation of the electricity it will be utilized as a new kind of power source for small electronic circuits, devices & gadgets. This may stand as one of the renewable emerging source of energy. Such type of low voltage can be generated without creating waste materials, and also without polluting any environmental parameters.

If we become able to produce electricity from living plants or trees, everyone wants to be planting the trees in ones surroundings. Governments of many countries are also motivating such a process of plantation of trees and plants. As a result, the number of trees in the globe will also increase, which indirectly will save our planet from the serious issue of global warming. Though, the plant & tree power is improbable to replace the power sources for the most of applications. But this kind of system could provide low cost, continuous, pollution free &more natural option of the electricity or power source. On the primary level, the researcherstried tointroduced such kind of low power source from the living plants. In near future, it might be used for different applications. Platinum-Zinc and Gold-Zinc cellsare considered as good conducting materials for preparation of electrodes and cells [1]. The comparative performance of Platinum-Zinc and Gold-Zinc cells has been studied throughout these research papers.

Designing concept of electrodes and cells:

Withthe help of different xerophytic plants, various shape and size of the electrodesweretested practically for optimum values of output voltage, current and power [2]. Overall, twelve different materials like Copper, Aluminum, Zinc, Platinum, Iron, Silver, Gold, Carbon, Iron, Magnesium and Stainless Steel were used to design and developed the electrodes and cells. While designing the various kinds of electrodes and cells, following parameters has been taken into consideration.

- Shape of electrode should be suitable to accommodate it into the plant

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- Maximum electrode area should come in contact with the available sap flow
- Sap flow of the plant should reach to both the sides of electrodes
- Square, rectangular, elliptical and circular shaped electrode has less contact area of sap flow [3]
- Corrugated shaped electrodes has more contact area of sap flow comparativelyand are most suitable for optimum output values
- Small sized electrodes has less contact area of sap flow which results in less output values
- Big sized electrodes maydamage the leaf or plant which may reduce the remaining life span of the plant or tree
- Rod or wire type electrodes hasless contact area of the sap flow

Due to the unavailability of Platinum strip electrodes in local market, the researcher had to select the appropriate one from the instruments supplier. The selected electrode of glass body(EQUIPTRONICS make) was suitable to connect with the sap flow present in the plants.

Response of various xerophytic plants for different electrode pairs and cells:

Variousxerophytic plants such as Aloe vera, Opuntiadillennii, Euphorbia neriifolia, Cereushildmannianus, Euphorbia antiquorem, Agave vivipara, Opuntiastricta and Euphorbia lactea were studied practically for output voltage, current and power. But the only plants with good potential difference (or voltage) and output current are considered. Following five plants viz. Aloe vera, Opuntiadillennii, Euphorbia neriifolia, Cereus hildmannianus and Agave vivipara gave better response for various electrodes and cells [4].

i) Response for Platinum-Zinc(Pt-Zn) electrode pair:

The abovementioned fivexerophytic plants named as Aloe vera, Opuntiadillennii, Euphorbia neriifolia, Euphorbia hildmannianus and Agave vivipara werealso studied using Platinum-Zinc (Pt-Zn)electrode pair. The readings for output voltage and output currentare recorded in following table (1).Also, the measurements of Specific conductivity and pH value of plant extract are noted in the same table.

Table (1): Response of various Xerophytes for Platinum-Zinc electrode pair

S. N.	Name of the Xerophytes used	Specific conductivity in mʊ	pH value of plant extract	Output voltage in Volts	Output current in mA
1)	Aloe vera	3.92	6.4	1.255	0.075
2)	Opuntiadillennii	7.44	6.2	1.475	0.185
3)	Euphorbia neriifolia	5.32	5.7	1.021	0.082
4)	Cereus hildmannianus	5.40	5.3	0.961	0.025
5)	Agave vivipara	4.16	5.1	1.029	0.033

From the above table it is found thatOpuntiadillennii produces maximum voltage as well maximum current using Platinum-Zinc electrode pair. Figure(1) below shows the graphical representation and analysis of output voltage, output current, Specific conductivity and pH value obtained for these plants [5].

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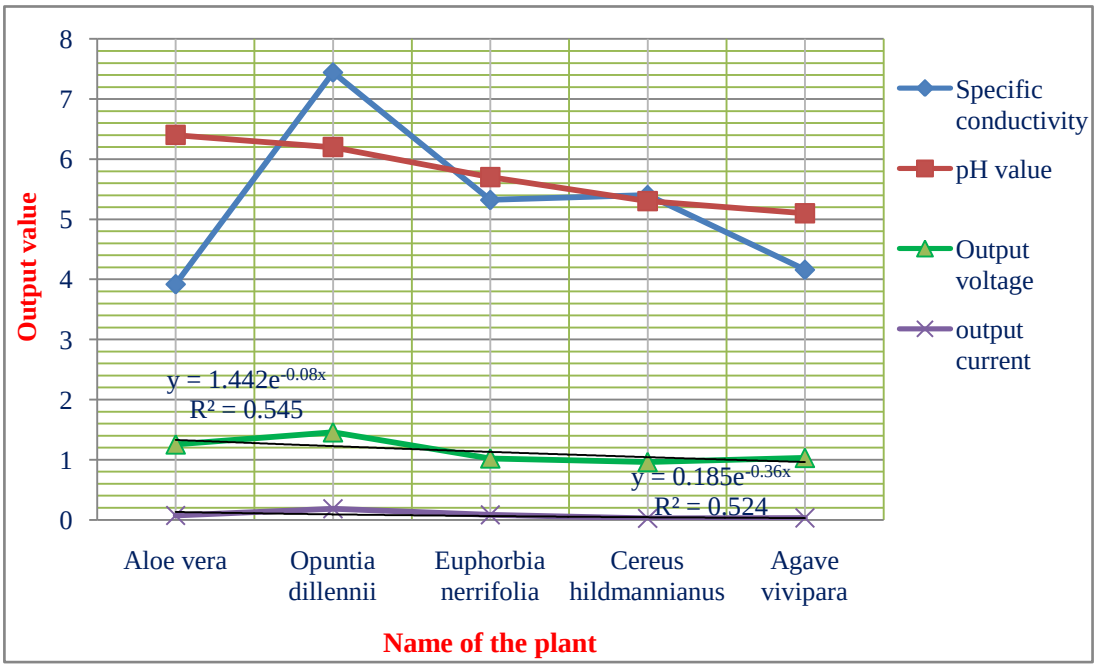

Figure (1): Correlation of output voltage, output current, specific conductivity and pH value for Pt-Zn electrode pair

As shown in graph of above figure (1), the trendlines along with the equations and R-squared values are drawn for output voltage and output current of different plants. It is observed that maximum output voltage as well as current is generated for Opuntiadillennii plant and there is decline in both sides of exponential curve for other plants. The equation of line $y = 1.442 * e^{-0.08x}$ with R-square value, $R^2 = 0.545$ of exponential curve for output voltage shows that the decline rate is low with respect to output current [6]. The overall range of output current is very small. The decline rate for document set of output current is slight higher with equation $y = 0.185 * e^{-0.36x}$ with R-square value, $R^2 = 0.524$, as compared to output voltage generated.

ii) Response for Gold-Zinc (Au-Zn) electrode pair:

The abovementioned same five plants named as Aloe vera, Opuntiadillennii, Euphorbia neriifolia, Euphorbia hildmannianus and Agave vivipara arealso studied using Gold-Zinc (Au-Zn)electrode pair and the readings for output voltage and output currentare tabulated in following table (2). Also, for the sake of comparison,the measurements of Specific conductivity and pH value of plant extract are noted in the same table along with the values of voltage and current [7].

Table (2): Response of various Xerophytes for Gold-Zinc electrode pair

S. N.	Name of the Xerophytes used	Specific conductivity in mʊ	pH value of plant extract	Output voltage in Volts	Output current in mA
1)	Aloe vera	3.92	6.4	1.231	1.78
2)	Opuntiadillennii	7.44	6.2	1.072	1.14
3)	Euphorbia neriifolia	5.32	5.7	0.967	0.96
4)	Cereus hildmannianus	5.40	5.3	1.037	0.24
5)	Agave vivipara	4.16	5.1	1.033	0.32

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From above table it is found thatAloe vera produces maximum voltage as well maximum current using Gold-Zinc electrode pair. Figure (2) below shows the graphical representation and analysis of output voltage and output current obtained for these plants.

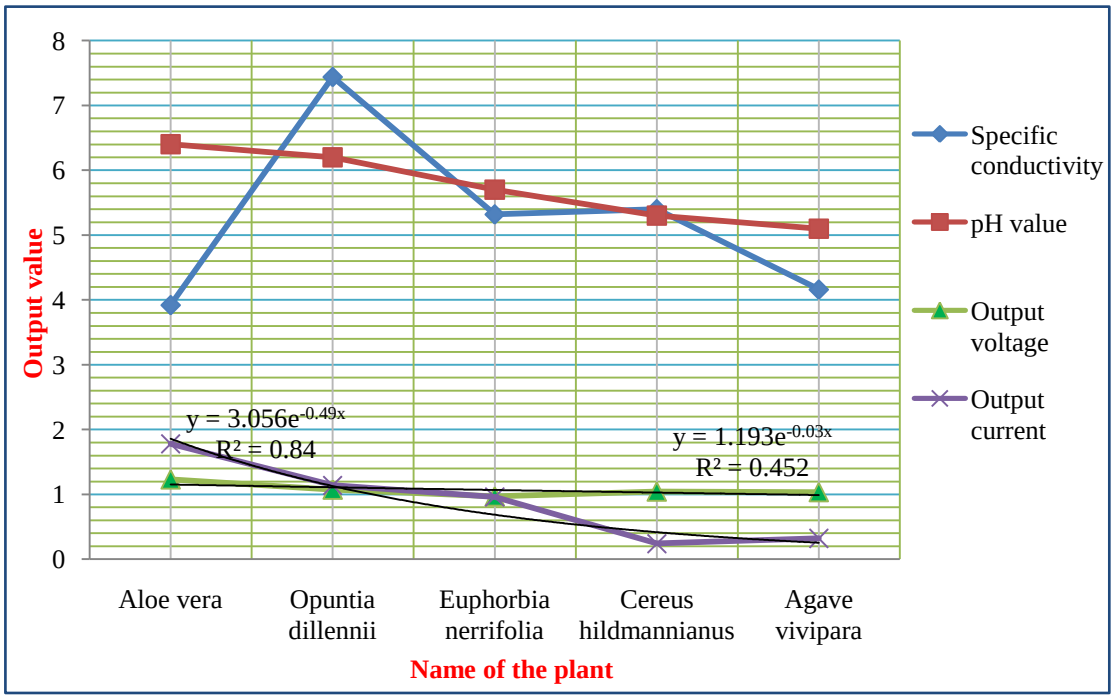

Figure (2): Correlation of output voltage, output current, specific conductivity and pH value for Au-Zn electrode pair

As shown in above figure (2), the trendlines along with the equations and R-squared values are drawn for output voltage and output current of different plants. It is observed that maximum output current is generated for Aloe vera plant and there is decline in exponential curve for other plants. The equation of line $y = 3.056 * e^{-0.49x}$ with R-square value, $R^2 = 0.84$ of exponential curve for output current shows that the decline rate is high with respect to document set of output voltage. The decline rate for document set of output voltage is very low with equation $y = 1.193 * e^{-0.03x}$ with R-square value, $R^2 = 0.452$, which is steady decline as compared to output current generated.

Conclusion:

After due analysis, it was found that the simultaneous reduction and oxidation (i.e. redox) reaction/process takes place at both the electrodes. When such type of Platinum-Zinc (Pt-Zn) and Gold-Zinc (Au-Zn)cells are used, that gives us typical voltage, current and power for operation of miniature electronics circuits and gadgets. It is found that Platinum-Zinc pair produces more voltage and less current values whereas Gold-Zinc pair produces less voltage and more current values. Such types of electrodes and cells are of low cost, reusable, less corrosive, pollution free and also eco-friendly for the environment [8]. As a result, the energy source becomes renewable, non-conventional, cheap and an emerging low power source of electricity.

The current undertaken research work is in infancy, but more research will open up new ways of using trees, plants and vegetative power [9]. So that dependency of human being on conventional and non-renewable energies may be reduced to some extent. Let's hope that our imagination may cross boundaries and we might be plugging into the surrounding trees and plants to charge our iPods, cell phones and other gadgets.

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Authors short profile:

1) Mr. Gajanan S. Wajire, is working as Associate Professor, in Department of Electronics, Shri Shivaji College of Arts, Commerce and Science, Akola, Maharashtra, (India) – 444 003. He received M.Sc. (Applied Electronics) & B.Ed. degrees from SantGadge Baba Amravati University, Amravati in 1994 & 1995 respectively. He has completed Advance Diploma in Software Applications & Programming (ADSAP), and also qualified "State Eligibility Test (SET)" in Electronics, from Pune University in 1999. He has undertaken and completed two UGC sponsored "Minor Research Projects (MRP)" in Applied Electronics. He is a registered student of Ph.D. of SantGadge Baba Amravati University, Amravati (M.S.). Recently he has submitted Ph. D. Thesis to SantGadge Baba Amravati University, Amravati.

2) Dr. Yogendra B. Gandole, is Principal at Adarsha Science, J.B. Arts and Birla Commerce College, Dhamangaon Rly.– 444709 (India). Hereceived M.Sc. Applied Electronics from Amravati University, Amravati in 1987, 'Advance Diploma in Computer Software, System Analysis and Application' from Bombay Technical Board in 1992, M.Sc. Communication Electronics from YashawantraoChavan Maharashtra Open University, Nashik in 2000. He completed**Ph.D.** in **Electronics** from SantGadge Baba Amravati University, Amravati in 2008 and also **Ph.D.** in **Communication Electronics** from YCMOU, Nashik.He has been actively engaged in the research work and guided many Ph. D. students. The current interests of research topics are Virtual Instrumentation and Computer Assisted Learning. Various fields of interest are Modeling and Simulation, DigitalSignal Processing, Artificial Intelligence, Neural Network, Ultrasonic Instrumentation &Electricity Generation. Till now more than50 research papers and 10 books are published.