Obtaining The Potential Difference From Prickly Pear Plant

Abstract
Researchers from various fields are trying their bests to introduce different methods of converting the chemical energy produced by plants through the process of photosynthesis into electricity, which could be a vast source of renewable energy in near future. Today’s demand of the world is to investigate various type of renewable, sustainable, pollution free and highly efficient energy sources. In this research paper, few fundamental investigations are found for generating an electrical energy (potential difference) from living plants like Prickly Pear. The energy is generated by embedding the cells at various points in the plant to allow flow of electrons using reduction and oxidation reactions. Multiple tests has been conducted using different type of electrodes and cells and attempted to determine the characteristics of the generating system. Though the research work in this field is in infancy, we were able to produce the potential difference of about 2.285 volts using a pair of electrodes and cells. Such hypothesis has been tested at different time of the day and different seasons of the year. Also, lots of new types of materials has been tested and used in combination to give better performance for the development of such a green energy. We expect, such a green and clean energy could be used for few low power electrical and electronic appliances for their operation in near future.
1. Introduction

By default, there is sustained electrical potential difference (voltage) between the xylem, phloem and their leaves of many plants. It had been routinely observed and reported for decades but the origin of this voltage remains controversial and a subject of considerable debate. A study led by the Massachusetts Institute of Technology (MIT) & University of Washington (UW), found that plants generate up to 250 millivolts when the proper electrodes and/or sensors are placed in a plant and the other in the surrounding soil. By using the voltage boost converter (a device that takes a low incoming voltage and stores it to produce a greater output), it produces an output voltage up to 1.15 volts. But by this method, we were able to produce the potential difference of about 2.285V using single pair of electrode and cell, without using any kind of boost converter or conditioning circuits.

Electricity generation from plants or trees would enable everyone to be planting the trees in ones surroundings. Governments of many countries also motivated 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 by the process of plantation. Plant & tree power is improbable to replace the power sources for the most of applications. But this kind of system could provide low power, low cost, continuous, pollution free & natural option of the electricity or power source.

2. Why Prickly Pear living plant ?

This research paper involves several steps for generation of optimum voltage (potential difference) from the plants and trees. For this stipulated purpose, it includes the classification of plants like Ficus, Cactus, Almus, Pinus, Acer, Yuca and so on. Out of all these, Prickly Pear plant, which belongs to cactus type is selected for the following reasons:

- Cheap and affordable plant.
- Easily available throughout the world.
- Can grow in farms, gardens, yards or even in pots.
- Not consume directly by animals, pets or human beings.
- More succulent plant with long life span.
- Can grow and live in extreme environmental conditions.
- Large surface area of leafs is available.
- Large amount of sap flow is available.
- Contents large amount of Minerals, Vitamins, Amino acids, Enzymes, Monosaccharide, Polysaccharides, Glucose, Plastoquinone, Ferredoxin, Carbohydrates, Water, sterols, lignin and many more.
- Less corrosive for electrodes and cells.
- Photosynthesis process taken place on large extent.

3. Actual Set Up And Methods Used

Generally, any plant material contents various types of organic and inorganic chemicals which are absorbed by their root systems. We have utilized these chemicals and minerals as an electrolyte material to occur the electrolysis process. For preparing the electrodes and cells, different types of materials like Copper, Aluminium, Zink, Lead, Iron, Carbon, Steel, Silver, Gold, Tungsten and Platinum were used. Also, the different type of shapes and sizes of the electrodes as well as cells were tested for the optimum output of potential difference. Within the cells, the dielectric materials
like paper insulator, nylon grill and mica strips were used and tested under different conditions. The electrodes and cells were inserted into Prickly Pear leaves wherein the sap flow works as an electrolyte. The actual photographs of different sized and shaped electrodes as well as cells are shown in the following figure (1).

Figure 1: Electrodes and cells of different size & shape

4. Electrical Response Of Prickly Pear Plant

After preparing proper electrodes and cells of particular materials, the response has been tested at different time of the day and also in different seasons of the year. The Platinum (Pt) – Zink (Zn) pair of electrodes as well as cell response was studied comparatively in Research/Instrumentation Laboratory of Sant Gadge Baba Amravati University Amravati. The maximum potential difference of about 1.510 Volts was recorded so far today as shown in the following Table 1. It is observed that the potential difference increases with the size of electrodes.

Table 1 : Observed potential difference with time

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Platinum positive and Zink negative electrodes</th>
<th>Time in Minutes (Minute)</th>
<th>Potential difference in Volts (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
<td>00</td>
<td>0.782</td>
</tr>
<tr>
<td>2</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
<td>04</td>
<td>0.843</td>
</tr>
<tr>
<td>3</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
<td>08</td>
<td>0.912</td>
</tr>
<tr>
<td>4</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
<td>12</td>
<td>0.985</td>
</tr>
<tr>
<td>5</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
<td>16</td>
<td>1.194</td>
</tr>
<tr>
<td>6</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
<td>20</td>
<td>1.235</td>
</tr>
<tr>
<td>7</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
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<td>1.288</td>
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<tr>
<td>8</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
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<td>1.332</td>
</tr>
<tr>
<td>9</td>
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<td>Pt(+ ve) ; Zn(- ve)</td>
<td>36</td>
<td>1.459</td>
</tr>
<tr>
<td>11</td>
<td>Pt(+ ve) ; Zn(- ve)</td>
<td>40</td>
<td>1.510</td>
</tr>
</tbody>
</table>

The available photocopy of the experimental set up and the moderate reading obtained using Platinum (Pt) – Zink (Zn) pair of electrode is shown in figure (2). In overall, the entire readings were taken within 40 minutes and thereafter the output voltage became almost stable in magnitude.
Using single pair of Platinum(Pt)-Zink(Zn) material, the maximum potential difference of about 1.510 Volts was recorded, which is somewhat greater than the related separate electrode pair in Aloe Vera. The photocopy of recorded voltage using Impedance Analyzer as well as Digital Multimeter (DMM) is shown in figure (4) below.
5. Concluding Remarks
The natural process of simultaneous reduction and oxidation takes place at both the electrodes, which results in the flow of ions through the electrolyte (i.e. sap flow) of Prickly Pear plant. When such type of multi-layered and big sized electrodes or cells are used, that gives us more voltage, current and power for operation and implications of miniature electronics circuits and gadgets. Such types of energy cells are of low cost, reusable, less corrosive, pollution free and eco-friendly. Ultimately, the energy source becomes renewable, non-conventional, cheap and also an emerging source of electricity. If more research open up new ways of using tree and plants power, our dependence on non-renewable energies can be reduced on some extent.

References

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