The Effect of Filtering Light on Photovoltaic Production

Problem: Does filtering of light affect the production of photovoltaic panels?

Hypothesis: The filtering of electromagnetic radiation will have no effect on the solar energy produced by the panel.

Independent Variable: Filtering of Light

Dependent Variable: Voltage and Current Output

Control Variables: Light Emission from Source, Angle of Panel to the Light Source, Panel Used, Resistance of Circuit

Materials:

- Photovoltaic Panel
- Multi-meter
- Meterstick
- "Filters"
    - Colored Plastics
    - Translucent Films
    - Transparent Films
    - Etc.
- Artificial Light Source that Closely Mimics the Sun
- SpectroVis Plus Spectrophotometer
- Optical Fiber

Procedure:

1. Complete a circuit with the solar panel and Multimeter, then record the voltage and current produced from ambient (background) light. This measurement will later be subtracted from the data collected to eliminate the impact of background light.
2. Set up solar panel parallel to the ground, directly facing the Artificial Light Source.
3. Turn on the light source.
4. Complete the circuit and record short circuit current and voltage.
5. Disconnect circuit.
6. Hold a filter 10cm (measured with the Meterstick) away from the light source such that all light hitting all portions of the solar panel is visibly filtered and repeat steps three and four.
7. Repeat step six with different filters.

Supplementary Procedure:

1. Follow the above procedure. However, use the Spectrophotometer and Optical Fiber to record the emission spectrums of light traveling from the lamp and through the filters.
2. These spectrums can be used to compare the light transmitted through each type of filter, and potentially to hypothesize on the different ranges of wavelengths that solar panels absorb most effectively.

Results:

Raw Data

	Current (mA)			Voltage (V)		
Background	0.25	--	--	0.36	--	--
No Filter (Lamp)	101.6	--	--	1.42	--	--
Clear Plastic	82.3	82.5	82.0	1.42	1.48	1.42
Green Film	61.3	62.3	62.1	1.37	1.37	1.38
Red Film	78.3	78.2	77.9	1.41	1.40	1.41
Yellow Film	74.9	75.2	75.2	1.22	1.22	1.22

Calculated Values

	Average Current w/out Background Contribution (mA)	Average Voltage w/out Background Contribution (V)
No Filter (Lamp)	101.4	1.06
Clear Plastic	81.9	1.08
Green Film	61.7	1.01
Red Film	78.1	1.04
Yellow Film	75.1	0.86

Calculations Explained:

The Average Current without Background Contribution figures were calculated by averaging the three readings for current for a given filter and then subtracting the measured background contribution. The same process was executed to achieve the Average Voltage without Background Contribution figures.

Discussion:

Based on universal decreases in short circuit current generated, it can be inferred that any medium will have some effect on electromagnetic radiation, thus having an effect on photovoltaic module production. However, while dramatic decreases in current production were observed, the voltage outputs were generally barely affected by filtering. The green film had the largest decrease in current generation, while the yellow filtering had the largest decrease in voltage output. The large decrease in current generation while using the green film can likely be explained by looking at plants and seeing that they emit mostly green visible electromagnetic radiation because they reflect or scatter light instead of transmitting or absorbing the green light. While plants do absorb other visible wave lengths such as red or yellow to create sugar for themselves in the process of photosynthesis, they do not use the green light. Interestingly, despite causing a dramatic decrease in current, the green filtering had little effect voltage. However, in the case of the yellow filtering, the opposite occurred. A dramatic decrease in voltage output was observed but current decreases were typical, or near average, when compared to other filters. We are unsure as to the cause of these results. All of the current readings disprove the null hypothesis, as current decreases are seen with all forms

of filtering. However, the voltage exploration of the experiment yields less conclusive results. There was a general but small decrease in voltage from most forms of filtering, the exceptions being the “clear” filter and yellow filter, the latter of which was already mentioned as an unexplained result. This again disputes the null hypothesis.

Another experiment could be conducted to have a better explanation for the sharp decrease in voltage of the PV module, while the light source was forced to pass through yellow film, as well as testing other materials such glass, water, or even just different colored plastic films like blue or orange.