Analysing the Performance of Polycrystalline Solar Panel due to the Effect of Color Filters at Different Temperatures & under Different Climatic Conditions

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Abstract— *An attempt is made to evaluate the effect of colors of light on the performance of polycrystalline photovoltaic module .A case study is conducted to experimentally verify the effect of various color filters on the performance of solar panel. Based on the surface temperature, solar irradiance the power output of photovoltaic system have been evaluated. The main factors affecting the solar energy system that came in our concern was temperature and illumination. Depending on these two factors we saw how it affects the cell performance and output. This work aims to study the effect of colors of light on the behavior of polycrystalline silicon solar panel to calculate the cell output under different environmental conditions. The model is used to calculate the cell output power for over a period of six months.*

Keywords— Solar Cell, Polycrystalline Photovoltaic Panel, Colored Filters, Multimeter, Power Output, Temperature, Irradiation

I. INTRODUCTION

Nowadays we get most of our energy from non-renewable energy sources eg. Fossil fuels but we cannot depend upon them forever as the resources are limited, our dependence on fossil is close to its end. And on the other hand the energy requirement of the world is ever increasing. The increasing energy demands put a lot of pressure on the conventional energy sources. Therefore, there is a need for alternative energy sources which can provide us energy in a sustainable manner. The obvious choice of a clean energy source, which is abundant and could provide security for the future development and growth, is the sun's energy [1]. Solar radiations can be converted to electric energy by using Photovoltaic process.

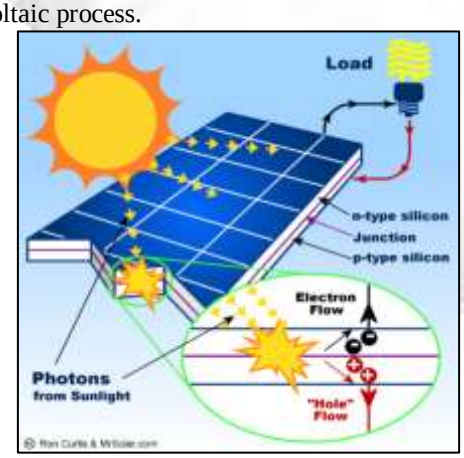

Fig. 1: [2] working of solar cell

The development of affordable, inexhaustible and clean solar energy technologies will have huge and longer-term benefits [3]. Photovoltaic systems have been installed to provide electricity to the billions of people that do not have access to mains electricity. Power supply to remoter houses or villages, irrigation and water supply are important application of photovoltaics for many years to come [4]. Since the photovoltaic cells uses a part of the solar energy spectrum which is determined by the band gap of a semiconductor. The photons which have a power greater or lower than the band gap generate heat that can be dissipated by the transmission loss. These heat generations called thermalization process where the photons are absorbed with less energy than the solar cells band gap energy. This thermalization process is the dominant loss that limits the conversion performance of solar cell [5]. As discussed above, the spectrum of the solar energy is not fully utilized in photovoltaic cells. Studies have been done towards the next advancement for increased output and efficiency. The color of light is determined by its wavelength and dictated in the color spectrum [6].

Colour	Approximate Wavelength (nm)
White	390-780
Violet	390-455
Blue	455-495
Green	495-575
Yellow	575-600
Orange	600-625
Red	625-780

Fig. 2: [7] sunlight color wavelength table

The aim of this study is to investigate the effect of different color filters on the power output of polycrystalline silicon panel at different temperature under different climatic conditions.

II. LITERATURE REVIEW

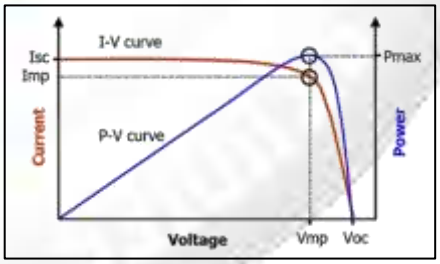

Fig. 3: [12] I-V curve of solar cell

Our work starts with analyzing the performance of polycrystalline solar panel by calculating the output power due to the effect of color filters. From several research papers, and works done up to date, we found that, temperature and illuminance are the key factors that heavily influence the output power of polycrystalline panel. So many researchers suggested that other applications can provide an effective way and an alternative to the use of solar radiations [8]. C.O. Osueke (2011) [9] aims to maximize the capacity of the panel by introducing a system of convex lens and color filter. Sudhakar K (2013) [10] this study is done to determine the wavelength and the effect of

color filters on the performance of monocrystalline solar panel. D.M. Tobnaghi (2013) [11] study proposed that the performance of solar cells is independent on environmental conditions and their output parameters

Like maximum output power, open circuit voltage, short circuit current, and fill factor vary by temperature.

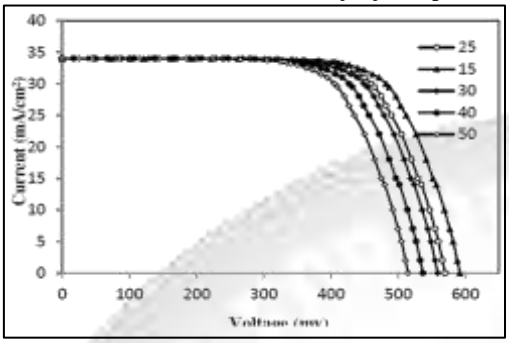

Fig. 4: [13] V-I curve of solar cell under different temperature

R. Siddiqui (2014) [14] summarizes the electrical characteristics of two polycrystalline silicon photovoltaic module under the influence of indoor and outdoor conditions. Tania Bhattacharya (2014) [15] the research work the effects of temperature on photovoltaic module output performance were investigated.

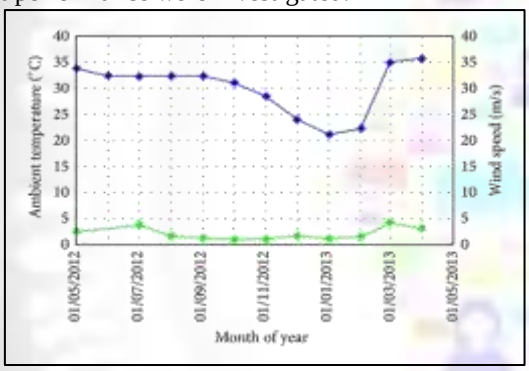

Fig. 5: [16] solar cell ambient temperature and wind speed graph

A statistical analysis has been done which shows that the correlation between the efficiency and ambient temperature is very good as compared to the correlation between efficiency and wind speed. A.M. Muzathik (2014) [17] proposed a simple formula to derive the photovoltaic cell temperature from the environmental variables such as ambient temperature, irradiance and wind speed also the total percentage error of the expected temperature would be less than 3% in this study. Sayran A. Abdulgafar (2014) [18] this study is to optimize the efficiency of solar panel by submerged it in distilled water at different depths. Dr. M. Narendra Kumar (2014) [19] **as** the solar power is based on the intensity and wavelength of sun rays, so this paper analysis the performance of panels due to the effect of temperature and the intensity of rays and proved that solar system maximum efficiency can be obtained if the sun rays wavelength is more and the temperature on panel surface is less. Indra Bahadur Karki (2015) [20] discuss about the effect of the light intensity and temperature on the output performance on the solar module. Study shows that short circuit current and maximum current are increase linearly with increasing light intensity and open circuit voltage and maximum voltage are decrease with increasing temperature module.

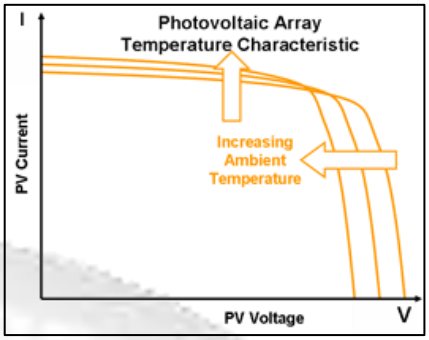

Fig. 6: [21] temperature characteristic of solar cell

B. V. Chikata (2015) [22] a multicrystalline solar panel is used, where its performance is improved with the use of mirrors and by the rate of thermal degradation. Hussein A. Kazem (2016) [23] monocrystalline solar panel has been taken and determines that different wavelength can influence the solar cell in a different how way. But the tests were conducted on days where the outside temperature did not exceed 25 degree Celsius. Adnan Ahmed Siddique (2016) [24] this research aims in calculating output power and to compare and understand the behavior of temperature and sunlight on 3 panels namely monocrystalline, polycrystalline and amorphous and result shows that photovoltaic cell performance is very much sensitive to cell surface temperature and this temperature is influenced by weather parameters like ambient temperature, wind velocity, humidity, solar irradiance, cell structure and material.

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