Cleaning system for pv panels problem statement

Technology

A lot happens inside the PV solar cells. The solar panels efficiency depends on a lot of factors such as; the ability of the panel to capture incoming sunlight, the ability of the panel to convey electrons that have the right energy amounts, and capacity to move the electrons freely around the circuit and to do work. The cells in a PV solar panel status such as lack of coating can impact the efficiency of the solar panels in production of energy (Green et. al, 2015). In response to this problem, the following study seeks to discuss the various methods of cleaning and maintaining solar PV systems.

In the market, the more the efficient the solar panel is the most expensive it becomes. On the other hand, if a person wants to install the solar panel and has limited space, they would be advised to choose the highly efficient panels as they ensure high production of energy. After installation, the main factors that affect the PV solar panel are mostly environmental, such as amount of sunlight available, air temperature and the wind in that particular area. The intensity of rainfall can also affect the performance of the panels (Schill et. al, 2015).

Maturing technology and commercial advances have made the photovoltaic PV systems tamper with silicon a major conducting element to be manufactured. The primary material property of this semiconductor limits rate PV efficiency within 15-20% (Bakhshi & Sadeh, 2016). If the solar panels are correctly installed properly then their orientation, exposure and sun-traces should be enough to maximize their insolation.

The maximization of solar insolation can be a breakthrough in the production of sustainable electricity energy. However challenges such as dust lifted by

the wind, pedestrian, and vehicle movement, volcanic eruptions, as well as pollution can negatively impact the PV solar panels performances (Singh, 2013). Therefore, the level of the maintenance of the solar panels depends on the surrounding environmental conditions. According to Green et. al, (2015). It should be noted that over time the performance of the panels will decline just like in any other machine, but most solar panels have been known to have a lifeline of about 25 years.

Humidity

100% of the energy coming from the sun, 30% of the energy is either reflected back to the clouds, oceans, and land masses (Khatib et. al, 2012). In places where the humidity is high ranging from 40- 78%, there is a minimal layer of water vapor at the front of the solar cell directly facing the sun. Therefore, the solar energy that strikes the solar panel is lost through reflection. The humidity creates hurdles for the energy received at the top of the atmosphere and also affects the devices consumption. Due to humidity, refraction appears which results in decreasing the intensity of light that in turn decreases the efficiency.

Temperature

Photovoltaic or the solar panels are used in the production of electricity. However, they are affected by their operating temperatures which are the product of the level of sunlight and then ambient air temperature (Han et. al, 2015). The length and strength of the sunlight received are essential factors in how a solar panel produces power efficiently. Nevertheless, temperature combined with other factors can reduce the efficiency and lower the PVs

energy output. Notably, the production efficiency of the solar panel reduces in cases of hot temperatures. Ironically, the PV solar panels work most efficiently in low and cold temperatures (Han et. al, 2015).

Cold and sunny environments offer optimal operating conditions for the solar panels. But, unfortunately in the coldest areas of the world have fragile sunshine making it impossible for the solar panels to receive adequate heat. The brightness of the sun in this areas also diminishes when the suns angle is low. Fortunately, there are solar tracker systems that adjust the angle of the PV panel to maximize the insolation and the brightness of the sun values which then improves the ability to take advantage of the positive effects of cold on the solar panel (Reichelstein & Yorston, 2013).

However, the positive implications of the cold temperatures on the PV panels can be counteracted by the clouds and snow that would consequently reduce the solar panels efficiency. Little can be done to reduce cloud cover and snow, but some steps can be taken to moderate the accumulation of snow on the solar panels. First, put the tilting of solar tracker units at a sharp angle will make the snow slide faster. The snow can also be removed manually using a push broom and also sweeping off the snow with a roof rake to prevent accumulation of the snow. The effect of temperature on the PV systems varies depending on the solar panel unit being used. Therefore, the use of high voltage PVs unit is encouraged as they are less negatively affected by the high temperatures than the lower voltage units.

Other methods such as dousing with water, can improve the power efficiency. However, economic efficiency would depend on whether the water

is expensive and plentiful. The development of more efficient designs that will be used for electrical generation from the solar panels may be made inefficient by the temperatures as the strength and duration of sunlight remain the most important factors in the production of energy in solar panels.

Dust

According to Adinoyi & Said, (2013), the influence of dust on the performance pf the PVs has not been done in detail. Dust are solid particles that vary in sizes, which are suspended temporarily in gas but settle down due to gravity. The effect of accumulated dust is that it reduces the solar radiation incident. The transmission of radiation through dust collected panels is from 2% to 40% which is determined by the amount and size of dust particles, season and also the location (Adinoyi& Said, 2013). Dust can be in different forms such as pollens from fungi, bacteria and vegetation. Moreover, dust can occur as microfibers from clothes carpet and linen among many others, all which are easily scattered in the air and eventually settle as dust. Dust settles in different ways, and the characteristic of how it settles on the PV solar systems is influenced by the property of the dust and the local environment, which includes site-specific factors that are influenced by nature especially human activities, built environment such as the surface, the height of the installation, and orientation among many others (Maghami et. al, 2016). Another factor is the environmental features such as the type of vegetation in the area as well as the weather conditions. Additionally, the type of dust chemical, biological and electrostatic as well as size, shape and

weight of the dust is important in determining the extent of the effect of the dust (Ghazi, et. al, 2014).

The surface finishing of the PV solar panels also, matters, as a sticky surface, that is, furry, electrostatic, rough, pasty-like may be more likely to accumulate dust that the less sticky and smoother surface finishing. Notably, dust attracts more dust, therefore, if the panel is sticky and dust settles, more dust will settle over time.

Horizontal surfaces tend to attract and accumulate dust more that the inclined surfaces. However, the wind is a contributing factor to the accumulation of dust. Contrary to popular belief, low-speed winds attract more dust settlement while the high-speed winds disperse the dust. Moreover, the installation of the PV systems in relation to the direction of the wind movements can either increase or decrease the probability of dust settlement on the PV solar panels. Therefore, dust settle during low pressure, high speed wind over an inclined or vertical surface. However, the property of dust can also determine the amount or the probability of settlement of dust on the solar panels.

In the recent years, the use of solar panels in the deserts has increased significantly due to their usage in water pumping, communication, light purposes and many more uses. However, even with the hope that the PV solar systems will be of great help to the people in the remote areas, there is a need to understand that accumulation of dust reduces their efficiency and performance. Apart from the effect of dust, high temperatures also contribute to the reduction in the solar panels efficiency.

According to (Maghami et. al, 2016), the performance of the solar thermal plate collectors is reduced by an estimated 1% due to the presence of dust accumulation, if the panel is inclined at an angle of 30 degrees from horizontal. The maximum degradation in the solar collectors was found to be at 4. 7, but only 1% of the loss of sunlight. The study also figured out that a horizontal glass receives more dust than the vertical one. Moreover, the transmittance value after the solar panels was exposed for a month for horizontal and the vertical glass plate 30% to 88% respectively.

Daily cleaning, however, did not work as a good corrector. The researchers recommended that the plastic firms correct the plates as plastic had a high electrostatic tendency in attracting more dust. A study done in Saudi Arabia indicates that in a period of 8 months there was a 32% reduction in the PV system mostly attributed to long term dust. In Kuwait, the solar PV systems performance declined by 17 % due to sand particles on the panels after six days (Maghami et. al, 2016). A conclusion was made that the influence of dust on the PV performance was high in spring and summer that in autumn and winter.

Research on the effect of dust on the solar panels in the desert areas found that there was a 7% degradation in efficiency of the photovoltaic panels while the thermal panels only degraded by 2. 8% to 7% (Maghami et. al, 2016). It was also found out that the accumulation of dust on the solar panels decreased when the panels were tilted from the horizontal.

The accumulation of dust on the surfaces of the PV systems reduces the amount of radiation getting into the solar cells and thus translated to losses

in the generation of power. Moreover, dust also changes the dependence on the angle of incidence of radiation. Dry areas especially are affected by dust and. Hence, the performance of the solar PV systems could be reduced by up to 15% (Maghami et. al, 2016). Therefore cleaning with water is the only solution, but for large scale PV use the task is usually expensive.

Snow Accumulation

Photovoltaic systems are mostly found in the remote areas because of their low maintenance costs and high-reliability attributes. However during winter, snow, and ice accumulate on the PV panels which in turn reduce the electrical output for a long time. Snow and ice accumulation on the arrays in some physical forms such as dry snow depositions, wet snow depositions, rime, glaze, and hoarfrost (Mejia &Kleissl, 2013).. Snow, glaze, rime, and hoarfrost are unpredictable from year to year and also differ from location to location. Notably, Rime causes serious problems in PV installations. Rime accumulates in the late autumn and does not melt off until the spring.

On the other hand, snow melts off, slides off and blows off PV panels fast, hence, a less threat to PV Installations tan rime. However, tilting the panels causes the snow to slide off quick preventing accumulation (Mazumder et. al, 2014). The glaze does not pose a serious problem in the operation on the PV solar panels since it appears just before the warm season. To mitigate the problem of snow, the capacity of the battery bank is increased. In Colombia for instance, they have developed a solar panel for flush mounting directly onto the comshells. The Wind that carries water droplets flows around instead of blowing into the comshell (GhaffarianHoseini et. al, 2013).

Natural Degradation

Research has shown that all the PV cells degrade naturally as time goes by regardless of the environment. Therefore, this is known as natural degradation and is reasonable for all the PV cells to degrade. High-quality solar panels tend to have less physical degradation as opposed to the low-quality ones. This issue cannot be prevented. Natural degradation affects the power output of the solar panels (Keating et. al, 2015). As time goes by the solar panels will be producing less energy meaning that a person will save a lot of money. A person should then adjust to return on investment with a precise rate of natural degradation which is necessary to getting the exact interpretation of the actual amount of the energy generated by the PV system.