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Measurement of degradation of solar panels induced by damp heat

Medición de la degradación de paneles solares inducida por calor húmedo

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Abstract

Currently the generation of electricity is carried out, mainly, from the combustion of fossil fuels; which contributes to the emission of pollutants such as SOx, NOx, CO, PM10, PM2.5 and volatile organic compounds (VOC) that affect air quality. Solar energy is an alternative for the generation of clean energy through the use of solar panels, which convert the energy they receive from sunlight into electrical energy for human use. It is cheaper and more viable, since the sun is readily available. Solar panels are built from an element called silicon, which is involved in the process of creating electrical energy. The objective of this study was to characterize the resistance to degradation of solar panels exposed to the damp heat test using the IEC 61646 Standard. The results obtained contribute to the quality assurance of the solar panel manufacturing process, which is of vital importance. and knowledge of their useful life**.**

Solar Panel, Degradation, Assurance Manufacturing

Resumen

Actualmente la generación de electricidad se lleva a cabo, principalmente, a partir de la combustión de energéticos fósiles; lo cual contribuye a la emisión de contaminantes tales como SOx, NOx, CO, PM10, PM2.5 y compuestos orgánicos volátiles (COV) que afectan la calidad del aire. la energía solar es una alternativa para la generación de energía limpia por medio del uso de paneles solares, los cuales convierten la energía que reciben de la luz del sol en energía eléctrica para el uso humano. Es más barata y viable, ya que el sol es fácilmente disponible. Los paneles solares se construyen a partir de un elemento llamado silicio, el cual interviene en el proceso de creación de energía eléctrica. El objetivo de este estudio fue caracterizar la resistencia a la degradación de paneles solares expuestos a la prueba de calor húmedo mediante la Norma IEC 61646. Los resultados obtenidos contribuyen al aseguramiento de calidad del proceso de fabricación de paneles solares, lo cual es de vital importancia para un buen funcionamiento y conocimiento de la vida útil de los mismos.

Panel Solar, Degradación, Fabricación de garantía

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1. Introduction

The growing demand for electricity that occurs today leads to the development of new and better technologies that allow the proper management of work for energy conversion [I, II]. Alternative technologies give the opportunity to contribute to sustainability for technological development, knowledge and growth of impact on the treatment of different components that together with other technologies allow to have more of them and also substitutes that can be replaced and / or used. to have a higher energy charge [III, IV]. Energy is present in everything that surrounds us, all bodies have the ability to produce a unit of measurement such as work, the amount of energy is measured by the work that bodies are capable of doing, which can be in motion (kinetic energy) or static (potential energy), energy sources allow greater access and lower cost over the use of electricity that is currently consumed, the use of different types of energy allow access to great technologies and sources of information, such as solar energy which generates electricity from photovoltaic solar panels.

Solar energy is one of the main sources of energy, since it is found worldwide and is accessible to all people, most of the heat generated on earth corresponds to the sun, energy that can be used through a panel solar for the generation of electrical energy to a lesser or greater extent, through photovoltaic cells.

Photovoltaic solar energy consists of a solar panel that stores the greatest amount of energy produced by the sun and extracted from the environment during the day, to later convert it into photovoltaic energy that allows the distribution of electricity in the place that is required, thus obtaining a considerable differential savings from what tends to be paid in light/electricity as it is commercially distributed.

The need to reduce the defects that may occur in the production of photovoltaic modules leads to new studies to improve their quality and useful life, for some defects there are methods that allow detecting and correcting problems during the process, which can be poor welding, broken cells or defects in the raw material, but there are problems that can only be seen with the passage of time and the deterioration of the module [V, VI, VII, VIII].

The Degradation is a natural and inexorable phenomenon that becomes an adverse factor for any photovoltaic installation, since it causes changes and a reduction in the useful life of any material [IX, X, XI]. In the case of photovoltaic modules, it causes a decrease in their useful life and, therefore, decreases the economic benefits expected from the installation, increasing the expected return time of the investment and introducing a component of uncertainty in the establishment of the guarantee period, all of which are fundamental factors so that photovoltaic technology can compete on an equal footing with other types of alternative energy [XII].

The objective of this study was to determine the resistance to degradation of solar panels exposed to the damp heat test by means of the IEC 61646 Standard, since the panels are subject to different types of climate when operating in the external environment, for which have been designed.

The study of the degradation induced by damp heat inside the climatic chamber will be able to give an overview of the final power of a solar panel at the end of a period of 25 years. This study was organized into 6 sections. Section 1 deals with the introduction. In section 2 the Methodology, in section 3 the analysis of results, in section 4 the Acknowledgment. in section 5 the conclusions of this study, and in section 6 the references consulted.

2. Development of the Methodology

In this test, the module was subjected to 85ºC±2ºC and 85%±5% relative humidity for 1000 hours. It is the most aggressive test for the photovoltaic module.

The severity of this study, tests the lamination and sealing process carried out on the module manufacturing. With this test, defects such as delamination, as well as corrosion and loss of power due to moisture ingress, can be determined. Even if no delamination or corrosion defects were detected, the module may have been stressed, which is revealed by the adhesion test.

The study was carried out in the following manner in accordance with the IEC 61646 standard with the following provisions:

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The determination of the capacity of the module to withstand the effects of long-term moisture penetration was made as follows:

1. Solar Panels power was measured before damp heat test. Table 1.

2. Without previous conditioning, 5 Panels were placed inside the climatic chamber, with the following test conditions: 85ºC±2ºC and 85%±5% relative humidity for 1000 hours.

3. After the damp heat test, the power of the panels was measured to determine the percentage of degradation. Table 1

4. After Damp Heat Test, adhesion test was performed. Table 2.

3. Results

1. As can be seen in table 1. Adhesion values are within specification after the moist heat test, they ranged from 25 to 40N/cm, Graph 1.

2. Power tested before Damp Heat test was 252 to 259 Watt.

3. After the Damp Heat test, the Solar Panels presented a power between 249 to 255 Watt. Table 2, Graph 2.

4. As can be seen, the power loss of the Solar Panels after the Damp Heat test was less than 2%, ranging from 0.79 to 1.9, which indicates that its useful life will be at least 25 years.

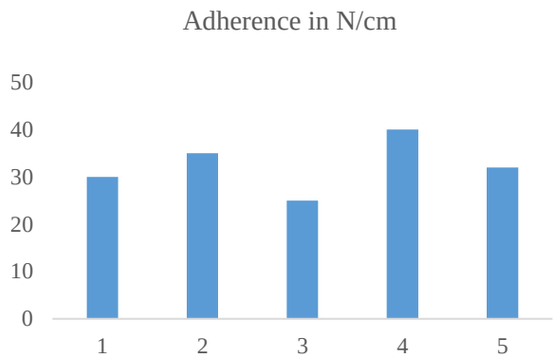
5. After the test no optical defects were found, only a yellowing of the contact plugs. Fig.1.

Module	Adherence in N/cm
1	30
2	35
3	25
4	40
5	32

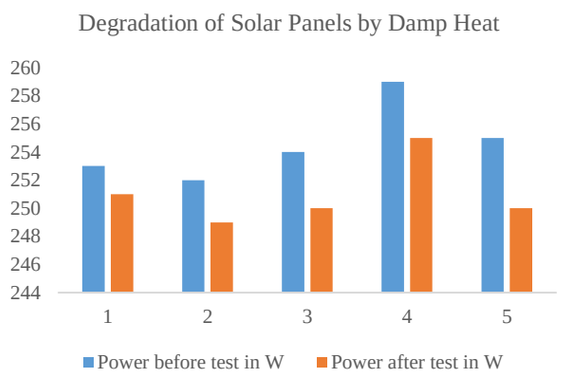
Table 1 Results of Adherence After the Damp Heat Test

Module	Power before Damp Heat Test in Watt	Power after Damp Heat Test in Watt	% Power loss
1	253	251	0.79
2	252	249	1.2
3	254	250	1.6
4	259	255	1.5
5	255	250	1.9

Table 2 Power Results before and after Damp Heat Test



Graph 1 Adherence after Damp Heat test



Graph 2 Power before and after Damp Heat test

Figure 1 Plugs after Damp Heat Test

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5. Conclusions

Degradation is a natural phenomenon that affects any material, in the case of photovoltaic modules the degradation phenomena can be: delamination, discoloration, oxidation, corrosion, rupture, etc. whose origin are various environmental factors such as: temperature, ultraviolet radiation, humidity, dust, pollution, depending on the geographical area where the photovoltaic solar panel is installed.

In this test, the change of the materials that make up the module in extreme conditions and the power of the modules were investigated, which directly impacts their performance and safety.

Apart from a yellowing in the sockets, no other optical defects were found. With this study it is concluded that the useful life of the module will be at least 25 years.

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