ГАРАНЦИЈА КВАЛИТЕТА PV МОДУЛА

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Резиме: *Очекивано је да ће соларни панели имати гарантовано време сервисирања од 20 до 30 година, тако је ФН систем постао веома популаран за инвестирање. Међутим, скори неуспеси на отвореном су показали да теоријско и практично време сервисирања може битно да се разликује. У неким случајевима се кварови јављају и неколико недеља након уградње модула. У овом раду је објашњена потреба за додатном контролом и унапређеним методама тестирања.*

Кључне речи: *Соларни панел, додатна контрола, тестирање*

1. INTRODUCTION

It is expected for solar panels to have a guaranteed service time of 20 to 30 years and typical degradation rates of 0.3-0.5%/a of STC power output for crystalline modules. But in the open field, recent failures have indicated that theoretical and actual service lifetime can differ significantly. Failures can occur a few weeks after installation in some cases. In this paper it is presented an overview of the results of studies that focused on peel off, gel content and potential induced degradation tests, and results of quality assurance action.

If you compare the reasons for the aborts, the main reason for aborts for thin-film technologies have been the mechanical load test, insufficient STC power output and outdoor exposure test. For c-Si modules, failures are usually due to climate chamber test.

2. LAMINATION QUALITY

An encapsulant material made of ethylene vinyl acetate is used in PV modules. It is produced as a film and delivered and stored in rolls protected against humidity and light. Producers recommend storage at a temperature below 30°C and a relative humidity below 50%. The rolls should not recieve direct sunlight and should always be wrapped up in their original packaging.

This film is composed of the co-polimer EVA which is initially thermoplastic, but the manufacturer of the film adds a curing agent and other chemicals. The curing agent, peroxide, decomposes with increses in temperature and starts chemical reactions. That is

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the curing process in the laminator. The material is irreversibly cured when the original themoplastic has become an elastomer, which can no longer be melted.

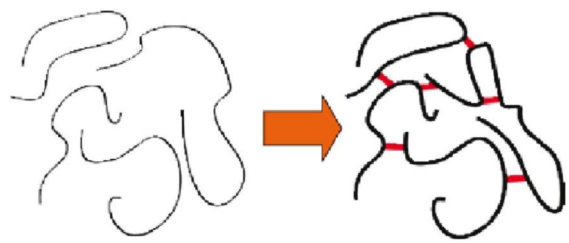

Figure 1. Schematic of the EVA curing process

The problems of EVA which can occure are:

- the curing agent may evaporate before curing due to incorrect storage, or mistakes made on the producer side;
- insufficient curing time, in order to achieve process optimization and increase the production, may results in inhomogenous curing across the modules, or homogenous but only partial curing;
- too high or too low temperature for curing, which may result in partial curing or the material could be irreversibly damaged;
- development of ultra-fast curing sheets, in combination with the increase in module sizes, which results in non-uniform curing (the problem is the time difference between the curing temperature reaching the center and the corner of a module);
-error made by supplier who does not put enough peroxide in the EVA, stores it for too long or just mixes different qualities, which may causes different properties within the module area.

Generally, the EVA manufacturers recommends a gel content >75%, but about 60% of tested modules do not reach this value. The quality of processing deviates not only among manufacturers but also within one producer.

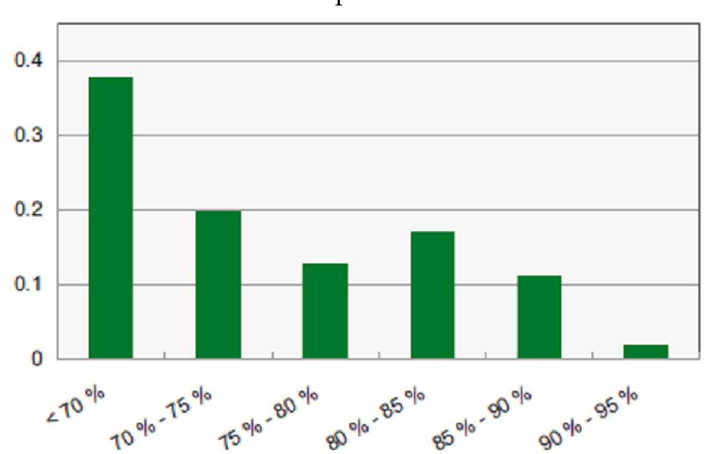

Figure 2. Frequency distribution of EVA gel content of 120 analyzed PV modules.

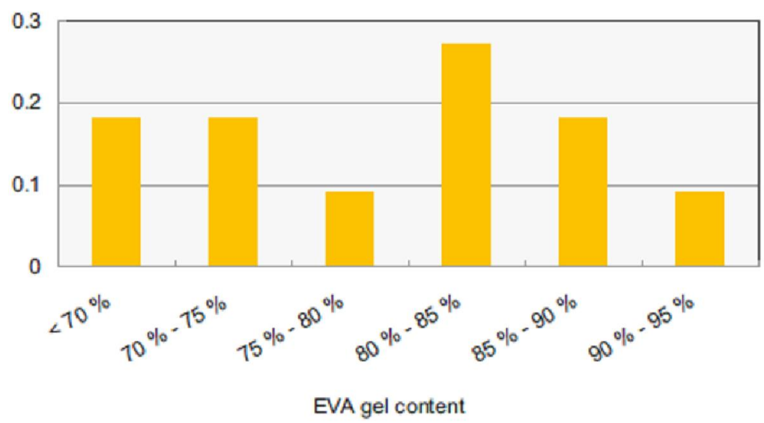

Figure 3. Frequency distribution of EVA gel content of analyzed solar modules from one manufacturer

It is also important to seal the module properly in order to ensure a long service time. Therefore, adhesion should be checked and the force required to separate the module layers should be measured.
It is possible to test the adhesion between encapsulant material and the back side of solar cells; encapsulant material and the bus bars; encapsulant material and the front glass; layers within back-sheet material.
The peeling test has to be initiated manually.
A free strip is then clamped in the wedge grip. An increasing force is applied to the wedge grip, and the specific force is recorded at the point when the strip starts to separate from the module. Some clustering of test results can be observed for forces above 95N/cm, but there is no standards defined for this test yet.

3. DEGRADATION OF THE STC POWER OUTPUT

The STC power output of PV module may degrade due to electrical potential between the frame and the cells. It can be detected via an electroluminescence analysis. The affected cells no longer contribute to power output and are recognized as 'black-cells' in electroluminescence images.
For installed modules, degradation first affects modules with the highest electrical potential and those located in humid environments (near to the ground, or frame parts with water inside).
The sensitivity of a module or of cells can be detected in accelerated damp-heat climate chamber tests. The modules were treated for 48 hours in a damp-heat chamber, with a potential of -100V at the terminals. The results are shown on figure 4.

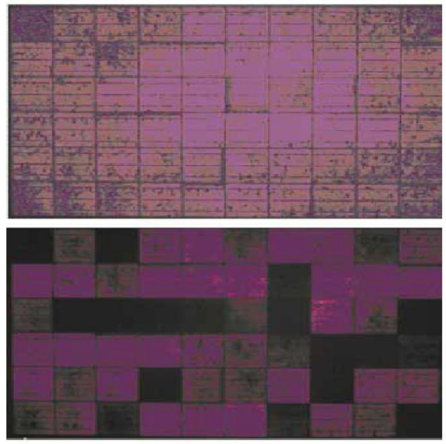

Figure 4. Top: module in initial state. Bottom: same module after treatment, with a loss of 40% of initial STC power output.

4. WEAK LIGHT BEHAVIOUR

The efficienci of modules at low irradiation levels is a crucial factor for the energy yeild of a PV system. Measured in a Pasan IIISb flash light sun simulator, the change in electrical efficiency relative to STC efficiency is evaluated. It has been measured for multicrystalline Si (m-c-Si) technology modules, with a wide variation of the results. A positive weak light behaviour at an irradiance level of 100W/m2 is a maximum efficiency loss of 10%. The worst performers have shown a decrease in relative efficiency of 30%, as it is illustrated at figure 5.

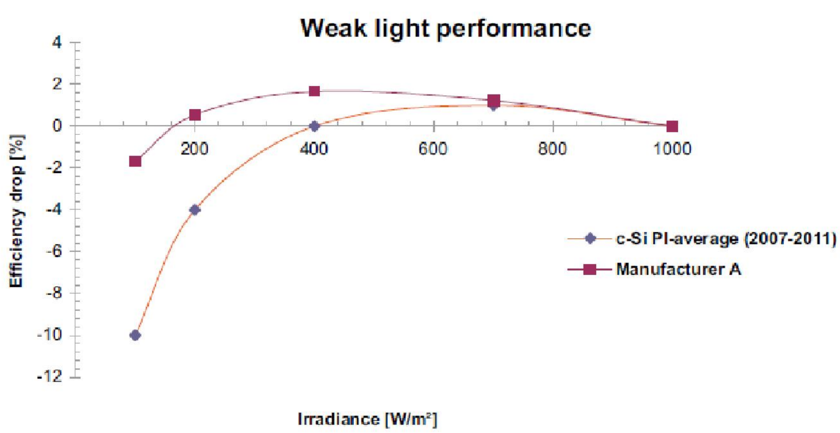

Figure 5. Weak light performance curve of amodule with a positive weak light behaviour. There is an efficiency drop of 30%, which is also possible.

5. FIELD DATA

The reason for testing already installed modules can be an unexpected low energy yeildof a PV system. This may occure to single modules. But equally for the entire strings of modules in a PV power plant. By adequate monitoring of photovoltaic system, the beginning of the degradation process can be detected. The need for further analysis is then required, which means removing the modules and transffering them to the laboratory environment. This can be quite time consuming and expensive, and can be prevented by performing a quality check before mounting.

6. CONCLUSION

If you take into consideration possibilities of module damage, low energy yeilds and quality assurance actions, it becomes clear that certification according to IEC are not sufficient for ensuring a service time of 20 or more years. There is many significant variations in quality between manufacturers and within the delivered charge from a specific manufacturer. If the module is already installed, it can be difficult to ascertain whether degradation is due to unsatisfactory design of the solar power system or to inherent problems of the modules themselves. With quality check-in tests, which include factory inspections, advanced visual inspections, electroluminescence analysis, EVA gel content tests and peel-off tests, it is posssible to prevent these problems and confirm the long-term stability of modules. This implemented quality asssurance actions also triggers an educative effect on the part of the manufacturers.

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QUALITY ASSURANCE OF PV MODULES

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