Verifying the science behind anti-soiling coatings

ChemiTek Solar, a Portuguese industrial manufacturer specialising in anti-soiling coatings for PV modules, in collaboration with The Green Energy Park in Benguerir, Morocco, has successfully concluded the outdoor testing and characterisation of its solutions. The results have been published by Heliyon, the all-science, open access journal. Here, PES takes a look at the findings.

The objective of the research paper titled 'Performance Analysis of Innovative Cleaning and Soiling Mitigation Solutions in the Semi-Arid Climate of Benguerir, Morocco' was to evaluate the performance of antistatic and hydrophobic coatings for photovoltaic solar panels in the challenging semi-arid weather conditions of Benguerir, Morocco.

The study involved a thorough examination of five photovoltaic (PV) systems with several coatings and cleaning strategies on them. It is important to note that the PV panels and electrical configurations were identical. The first PV system remained uncleaned and did not undergo any coating or cleaning solutions. The second PV system was periodically cleaned with water. The third PV system employed the Solar Wash Protect (SWP) cleaning and antistatic protection solution. The fourth and fifth PV systems, D-Solar Defender (DSD) and Industrial Glass Protect (IGP) respectively, employed unique combinations of two hydrophobic coatings.

After a rigorous nine-month testing period, the results showcased substantial efficiency gains in the PV panels treated with anti-soiling coatings, compared to the reference system. During the initial three-month cleaning period, the coated PV panels demonstrated an average efficiency gain of approximately 10%. Even during the subsequent non-cleaning period of six months, the efficiency gain remained consistently around 5% when compared to uncleaned modules.

Ultimately, the cumulative energy gain of the coated systems, when compared to the reference system cleaned solely with water, averaged an impressive 3% over the entire outdoor exposure period. For reference, during the dry period, the uncleaned modules had over 6% of soiling loss compared to the modules cleaned with just water.

An important advantage of the coatings was their ability to minimise water consumption during the cleaning process. For instance, the Solar Wash Protect (SWP) cleaning and antistatic protection solution required 50% less water compared to cleaning without a specialised solution. This water-saving feature not only contributes to environmental conservation, but also simplifies the cleaning process for PV panels.

'These research findings emphasise the significance of employing innovative cleaning and preventive maintenance strategies, such as anti-soiling coatings, in dry areas to enhance the performance of photovoltaic systems,' stated Dr. César Martins, CEO of ChemiTek. 'This has significant implications for investors, researchers, and engineers interested in grid-connected photovoltaic and soiling mitigation technology.'

By addressing the persistent challenge of PV panel soiling, ChemiTek's breakthrough solutions pave the way for enhanced energy generation, reduced maintenance costs, and increased production in PV systems, while also promoting environmental sustainability through water conservation.

The collaboration between Green Energy Park and ChemiTek Solar is a significant milestone in the advancement of sustainable energy technologies, as it not only highlights the performance gains achieved through anti-soiling coatings, but also provides valuable information on the factors that influence the efficiency of photovoltaic systems in semi-arid climates.

The semi-arid climate of Benguerir, Morocco poses specific challenges for PV panels, including high dust accumulation rates, limited water resources, and high ambient temperatures. The evaluation of antistatic and hydrophobic coatings in this context is crucial for identifying effective strategies to mitigate the impact of soiling and maximise energy production.

The results of the study clearly demonstrate the benefits of the innovative anti-soiling coatings. During the initial three-month cleaning period, the coated PV panels exhibited an average efficiency gain of approximately 10%, compared to the uncleaned system. This significant improvement can be attributed to the anti-adherent properties of the coatings, which reduce the adhesion of the dust particles to the surface of the PV modules. As a result, the panels maintain higher levels of solar absorption and conversion efficiency.

Even in the subsequent non-cleaning period of six months, the coated systems continued to outperform the uncleaned system. With an average efficiency gain of around 5%, the coatings proved their long-term durability and effectiveness in mitigating the impact of dust accumulation. This sustained improvement in energy production is a key advantage of the anti-soiling coatings, as it ensures consistent performance and reduces the need for frequent maintenance.

The cumulative energy gain of the coated systems, compared to the water-cleaned reference, reached an average of 3% after the nine-month outdoor exposure period. This result further emphasises the

significance of the coatings in enhancing the overall energy production of PV systems. Such an increase in cumulative energy gain can have substantial economic and environmental implications, especially for large-scale solar installations. It not only translates into higher electricity generation, but also contributes to reducing greenhouse gas emissions and dependence on traditional energy sources.

The anti-soiling technology that provided the best results, as expected, was the antistatic coating provided by the Solar Wash Protect. The coating dissipates the static electricity from the surface of the modules, reducing the attraction of the dust. This property, combined with the anti-adherent, results in less buildup of soiling and an increased easiness during the cleaning process.

The hydrophobic coatings showed optimum performance during the rainy season, with some days reaching up to 6% of increased production when compared to the modules cleaned with just water. The antistatic coating reached a maximum of 4.3% during the rainy days. Given the reduced number of rainy days in the semi-arid environment, these gains were not enough to overcome the performance of the antistatic coating during the nine months.

Furthermore, the presence of the coatings makes the cleaning process easier and more efficient. The anti-adherent properties of the coatings reduce the soiling's adhesion to the surface of the PV modules, facilitating the removal of dust and debris. This not only saves time and effort but also minimises the risk of surface damage that can occur during the cleaning procedures. The ease of cleaning contributes to the overall maintenance efficiency of PV systems and reduces operational costs.

The outcomes of the study have compelling implications for various stakeholders in the photovoltaic industry. Investors can benefit from the increased energy production and improved efficiency offered by the anti-soiling coatings, as it enhances the financial viability of solar projects. Researchers can leverage this knowledge to further optimise coating materials and develop tailored solutions for different climatic conditions. Solar engineers can incorporate the use of anti-soiling coatings in the design and maintenance of PV systems, ensuring long-term performance and increasing the ROI.

In conclusion, the scientific paper demonstrates the real-world benefits of innovative anti-soiling coatings for photovoltaic systems in semi-arid climates.

The findings highlight the considerable efficiency gains, cumulative energy production improvements, and water-saving advantages achieved through the application of these coatings.

By addressing the challenges of PV panel soiling, the coatings pave the way for enhanced energy generation, reduced maintenance requirements, and increased sustainability in the photovoltaic industry. The use of easy to apply coatings is also critical to their adoption since the cost of application can easily overcome the cost of the coating itself.

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ChemiTek Solar's interpretation of the results

ChemiTek's dedication to developing cutting-edge and eco-friendly agents for contaminant removal and advanced coatings to mitigate soiling on solar panels is rewarded when it can demonstrate the efficiency of its products.

While the company continues to conduct rigorous tests and certifications, field studies remain its greatest ally in showcasing solutions of excellence.

With an unwavering commitment to sustainability and technological progress, ChemiTek Solar strives to optimise solar energy production, while minimising the operation and maintenance expenses of solar installations.

Moreover, it actively advocates for water conservation, further cementing its position as a key player in the renewable energy sector.