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جامعة الشارقة

THE EFFECT OF DUST ON SOLAR SYSTEMS AND DUST MITIGATION METHODS

Supervisor:
Dr. Ahmed Amine Hachicha

Students Names:
Israa Al Sawafta , U14123302
Deema Emadaldin, U14121856
Zainab Al Hashimi,U14122113

Project Summary

The efficiency of solar energy systems is limited due to many reasons, one of the most important factors that affect the performance of these systems and has paid no attention to is soiling which is the dust accumulation on the top of the surface of solar systems. The purpose of this project is to study the effect of dust on the output power of solar Photovoltaic (PV) panels and on the solar weighted specular reflectivity ρ (SW,θ,φ) of mirrors (reflectors) used in Concentrated Solar Power (CSP) systems then to solve this problem. The soiling loss was not constant and it was higher for CSP mirrors reflectivity compared to the PV power increased from 17.8% to 64% and from 0.29% to 17%, respectively, from 21-Jan.-18 to 15-Apr.-18. An Anti-Soiling Coating (ASC) was developed using Titanium dioxide and Dodecylamine (DDA) with a good transparency and hydrophobicity which will reduce the water consumption needed for cleaning. An Electrodynamic Screen (EDS) was designed and tested to study if it is efficient in charging and removing the dust particles .

Methodology

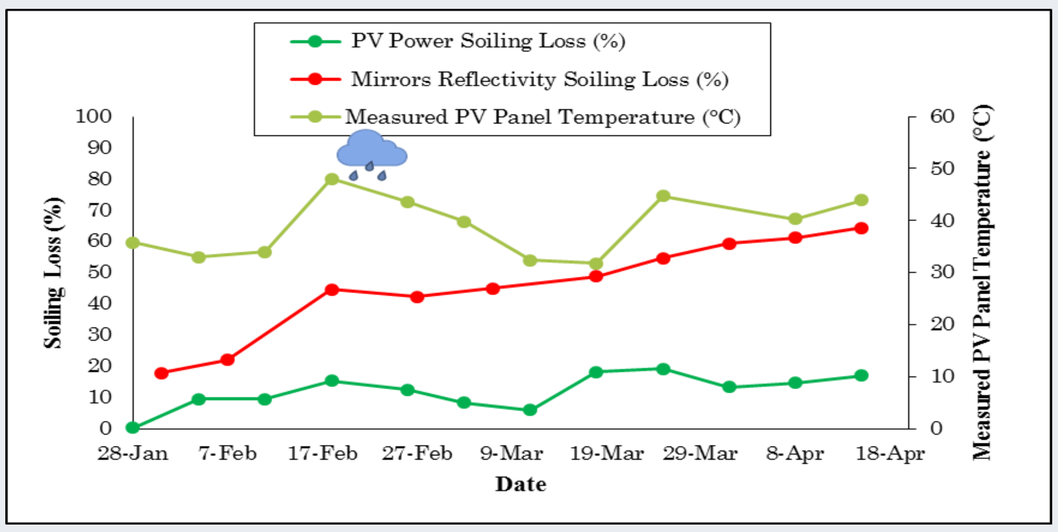
The methodology adopted in this work include:

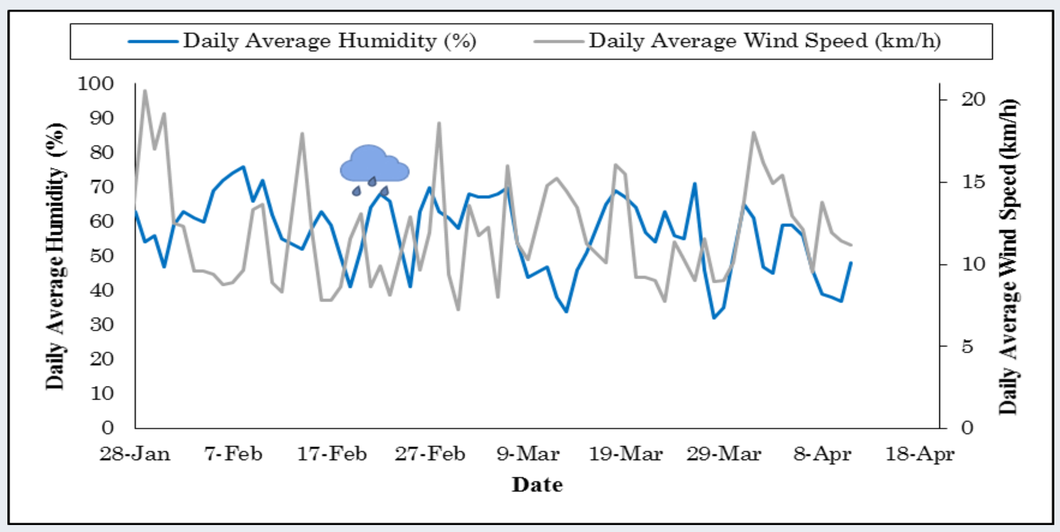
- Experimental work to study the effect of dust on solar systems , develop an ASC and test an EDS.
- Numerical simulation of EDS electric field.
- Computational work .

The Effect of Dust on Solar Systems

The results show how the soiling loss for both systems: solar PV and CSP systems increases during this exposure period.

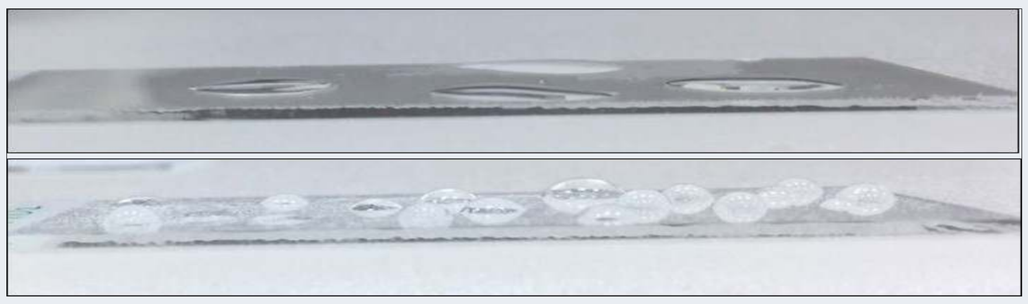
- CSP systems are affected by soiling more than PV systems.
- The soiling loss is not constant and it is affected by weather conditions.

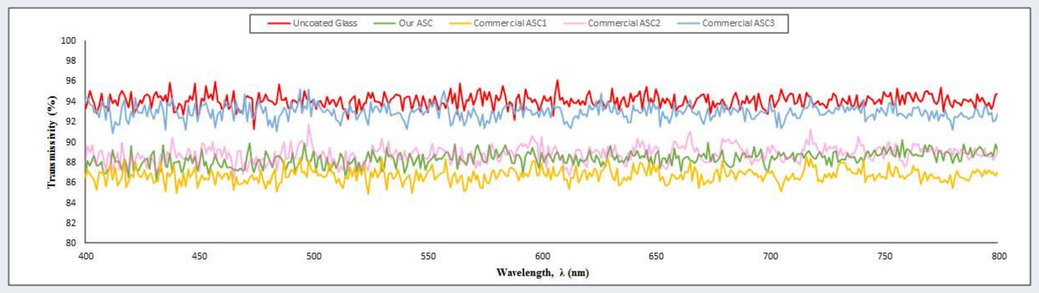




Anti Soiling Coating (ACS)

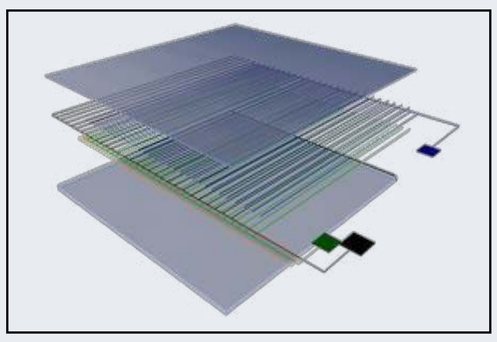
The developed coating is made of Titanium dioxide and DDA. The coating has good hydrophobicity and good transmissivity compared to other commercial coatings.

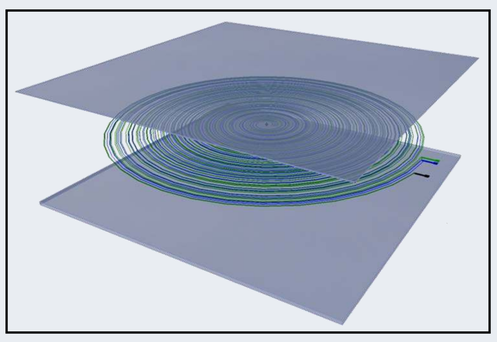




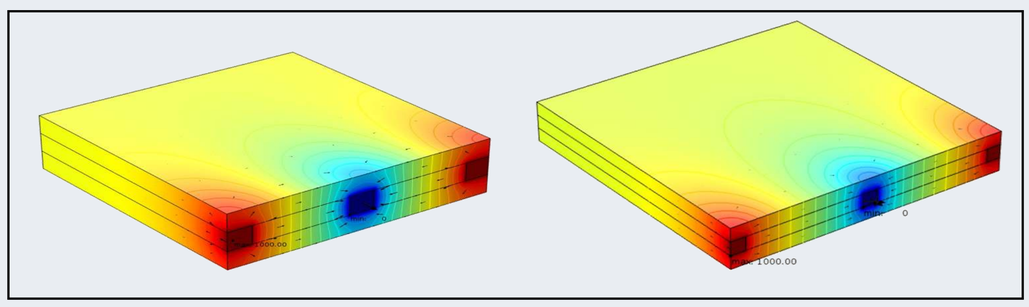
Electrodynamic Screen (EDS)

EDS is a technology used to charge the dust particles. Two different designs were proposed for EDS: with rectangular and spiral electrodes. These screens were tested by connecting them to a 3Phase AC source. The dust particles were charged and moved for the first few seconds. The screen will be improved to get better performance for charging the dust.





Comsol Multiphysics was used to simulate EDS electric field. The results show how the electric field increases with decreasing the space between EDS electrodes so the dust particles will acquire more charge and jump from phase to another until they fall down.



Conclusion

The objective of this work is to study the effect of dust on solar systems and to mitigate dust deposition on their surface.

- The obtained results showed a drop in the output power and in the solar weighted specular reflectivity for PV and mirrors, respectively with increasing the dust concentration, the drop was higher for CSP mirrors than PV modules.
- ASC was developed and tested, it has good hydrophobicity which will help in reducing the water consumption used for cleaning.
- EDS can be used as a method to reduce the dust accumulation on solar systems.