DOR: 20.1001.1.24234931.1400.8.2.16.2

Review Article

Received: 09/29/20

Accepted: 01/18/21

Volume 8, Issue 2, Autumn & Winter 2021, p. p. 30-31

Journal of Renewable and New Energy

jrenew.ir

A Review on Dust Activities in Iran and Parameters Affecting Dust Accumulation on Photovoltaic Panels

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Received: 29 September 2020 Accepted: 18 January 2021

Abstract

Most of the regions with high solar potential for the development of photovoltaic systems are arid and deserted regions such as the Middle East and North Africa. In such regions, dust activities affect the output of photovoltaic panels critically. With the goal to investigate dust activities in Iran and the parameters affecting dust accumulation on the surface of photovoltaic panels, the current article conducted a comprehensive review of the related documents. Studies carried out in this regard, showed that in the recent years, the frequency and severity of dust activities in Iran have been significantly increased. The reasons for such changes and the main origins of dust activities in Iran were described in detailed. Furthermore, the physical and chemical properties of dust particles collected from the surface of panels in different regions were determined. Moreover, by reviewing the literature, the parameters affecting dust accumulation on the photovoltaic panels were categorized and the impact of each of these parameters were described in detail. The results of the current study can serve as a thorough reference for researchers, designers, and engineers in regions struggling with dust events.

Keywords: Dust, Dust origin, Photovoltaic Panel, Wind, Humidity.

1. INTRODUCTION

Due to high environmental, technical and economic advantages, the development and utilization of photovoltaic systems in the world is growing at a dramatic speed [1-3]. The performance of these systems in converting solar energy to electricity is extensively a function of environmental conditions such as solar radiation, ambient temperature, wind, humidity, and other environmental parameters [4]. Therefore, any changes in these parameters have a great influence on the design and performance evaluation of photovoltaic systems. Most of the regions with high solar potential for the development of photovoltaic systems are arid and deserted regions with hot and dry climates such as the Middle East and North Africa [5]. In such regions, dust activities affect the output performance of photovoltaic panels critically. The negative effects of dust activities on the modules in these areas have slowed down and, in some cases even stopped, the development of photovoltaic systems. This problem is much more serious in the climate of Iran, where is repeatedly faced with dust activities as well as aerosol dispersion [7-9].

Climatic and climatic conditions in Iran indicate very favorable solar radiation for the development of solar systems in the country [10-11]. However, dust activities in the country are considered as one of the biggest environmental challenges for this development in the region [12]. Therefore, a significant increase in the number of published studies in this field, especially since 2009 can be seen [7-9].

Preliminary studies in this area indicate that limited research in this area does not provide sufficient data [7]. In addition, climate and environmental change greatly affect the effect of dust and the efficiency of photovoltaic panels [12-13]. Consequently, more information is needed to design and optimize photovoltaic solar systems as well as to generalize the reduction in their performance and efficiency due to the accumulation of dust. Therefore, the present study reviews the related works conducted regarding dust activities in Iran and parameters affecting dust accumulation on photovoltaic panels.

2. MATERIAL AND METHOD

The first step to overcoming dust problem is to exactly know where these dust activities are originated, how dust particles are accumulated on the surface of photovoltaic panels and what are the parameters influencing this process. Therefore, with the goal to investigate dust activities in Iran as well as the parameters affecting dust accumulation on the surface of photovoltaic panels, the present article conducted a comprehensive review study on the related documents. Moreover, by reviewing the literature, the effective parameters in the process of dust accumulation on the surface of photovoltaic panels were categorized and the impacts of each of these parameters were described in detail.

3. Results and Discussion

Studies carried out in this regard, showed that in recent years, the frequency and severity of dust activities in Iran have been significantly increased. The reasons for such changes and the main origins of dust activities in Iran were described in detailed. A review of related literature showed that dust activities in Iran are either originated from the internal sources such as the Dasht-e Kavir and the Dasht-e Lut or transferred to the country from the outside of the country border. The main foreign dust origins in the southern and western border of Iran are the deserts within Iraq, Saudi Arabia, United Arab Emirates, and Syria. While in the eastern border of Iran, the Sistan Basin, the Registan Desert, Makran Desert, and Hamoun Mashkil are considered as the main foreign sources of dust activities. Furthermore, in order to investigate the effect of dust on the performance of photovoltaic panels, the physical and chemical properties of dust particles collected from the surface of panels in different regions of the world were determined. The results of the current study revealed that the process of dust accumulation on the surface of photovoltaic panels affected by the size and properties of the dust particles within the site, the cover glass on the surface of photovoltaic panel and several environmental parameters such as wind, rain, humidity, and gravity.

4. Conclusions

The results of the current study can serve as a thorough reference for researchers, designers, and engineers who deal with photovoltaic systems in regions struggling with dust events such as the Middle East, and in particular, Iran.

5. Acknowledgement

The authors of the present study express their gratitude for the sincere cooperation and financial support of the Renewable Energy Department of Shahid Beheshti University (REDSBU), Iran National Science Foundation (INSF) and the Tehran Urban Research and Planning Center.

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