TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics and Mechanics
Vol. 57, Issue I, March, 2014

REFERENCE SELECTION PROCEDURE FOR STUDYING THE SOILING EFFECT ON PV PERFORMANCE

Andrei BUTUZA

Abstract: *Most successful research projects begin with a good knowledge of the studied field. The knowledge foundation is usually built on a thorough literature review. This paper presents an objective and rigorous reference selection procedure that can stand as a good starting point of a literature review. The procedure is exemplified by a literature search regarding the effects of soiling, dust and other surface deposits, on the performance of solar photovoltaic collectors. The procedure allowed the identification of representative scientific contributions in the field of study and made possible the identification of the most representative papers, the journals and research centres that publish in the studied field.*

Key words: *reference selection procedure; thorough literature review; soiling;*

1. INTRODUCTION

A successful research requires a solid knowledge base in the studied field. The knowledge foundation is usually built on a thorough literature review.

This paper presents an objective and rigorous reference selection procedure. The procedure is exemplified with a literature search concerning the effects of soiling, dust and other surface deposits, on the performance of solar photovoltaic (PV) collectors.

2. REFERENCE SELECTION PROCEDURE

In order to select representative materials for the studied subject, a series of scientific databases were interrogated using a series of key words and expressions, thought by the authors to be characteristic for the subject in question.

For the literature review reference selection example, the search words are: photovoltaic, solar collector, dust, dirt, soiling, and dust deposition. The expression "solar collector" was used instead of "photovoltaic collector" because the problem of soiling of PV collectors is similar with the one of flat thermal solar collectors and thus available information was searched for both types of collectors.

The search words were used in syntaxes using logical operators AND / OR. Main key words were considered photovoltaic OR „solar collector” and secondary key words were considered dust OR dirt OR soiling OR „dust deposition”. An interrogation syntax example is presented below:

(*photovoltaic* OR *„solar collector”*) AND (*dust* OR *dirt* OR *soiling* OR *„dust deposition”*)

The following databases were used (in alphabetic order): IEEE Explore (IEEE), Science Direct, Scopus, Springer Link (Springer), Web of Knowledge - Thomson Reuters (ISI), Wiley - Online Library (Wiley).

The search fields used were title, abstract and key words, with the exception of ISI where only the title field was available.

The "Subject Area" (Scopus), "Collection" (IEEE) and "Thematic" (All others), were individually selected for each database.

The first step of the references selection procedure was the interrogation of the databases using a set of including and excluding criteria. The following document types were included: Article, Review, and Article in Press. Other types of documents, such as: Conference Papers, Letter to Editor etc. were excluded from the selection. Only Journals were selected as the "Source Type" and English was the preferred "Language".

An example of interrogation syntax, used in Scopus, containing the inclusion and exclusion criteria is as follows:

TITLE-ABS-KEY(*photovoltaic* OR *"solar collector"* AND *dust* OR *soiling* OR *dirt* OR *"dust deposition"*) AND DOCTYPE(*ar* OR *re*) AND SUBJAREA(*mult* OR *ceng* OR *chem* OR *comp* OR *eart* OR *ener* OR *engi* OR *envi* OR *mate* OR *math* OR *phys*)

The second step of the references selection procedure consisted in the study of the titles and abstracts of the articles resulted after the first step. A manual selection process was applied and references that dealt with subject such as interplanetary, Moon or Mars environment were excluded.

The third step of the selection procedure consisted in the study of the articles resulted after the previous two steps. The reference list was extended by adding articles cited in the studied papers that eluded the automatic selection process. A relevant reference added in this step [1], represents the oldest study containing elements related with the effects of soiling on the performance of solar collectors.

The fourth and fifth step of the references selection procedure consisted in the extension of the reference list, by including Romanian affiliated papers and by including fundamental manuals and Conference Papers. A noteworthy Romanian conference paper was also found in this step [2].

3. REFERENCE CONSIDERATIONS

After the selection procedure was finished, the journal papers were organised in a logical way following different criteria such as: the first, the newest and the most cited references. The first five references of these categories are presented in tables 1-3.

Table 1.

First references in the studied field

Reference	Author, year
[1]	(Hottel and Woertz, 1942)
[3]	(Garg, 1974)
[4]	(El-Shobokshy et al., 1985)
[5]	(Berganov, 1986)
[6]	(Bajpai and Gupta, 1988)

Table 2.

Newest references in the studied field

Reference	Author, year
[7]	(Adinoyi and Said, 2013)
[8]	(Touati et al., 2013)
[9]	(Massi Pavan et al., 2013)
[10]	(Charabi and Gastli, 2013)
[11]	(Moharram et al., 2013)

Table 3.

Most cited references in the studied field*

Reference	Author, year
[12]	(Martin and Ruiz, 2001)
[13]	(El-Shobokshy and Hussein, 1993)
[14]	(Elminir et al., 2006)
[15]	(Mani and Pillai, 2010)
[16]	(Kymakis et al., 2009)

*According to Scopus at 29.08.2013

In order to know the direction in which the research in a certain field in heading, it is important to know where the research started and which are the newest and the most cited publications. In this way the direction can be anticipated or new research niches can be addressed.

The publication trend concerning the effects of soiling on the performance of solar collectors is presented in figure 1.

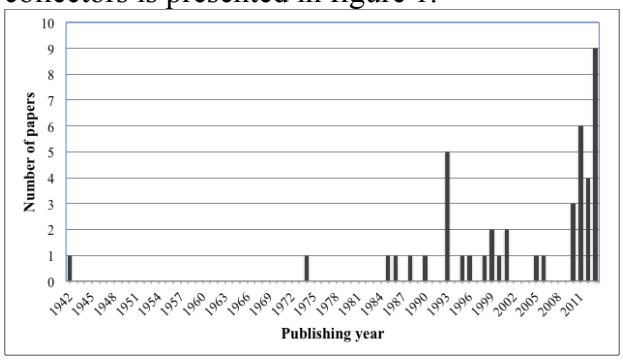

Fig. 1. Publication trend concerning the effects of soiling on solar collectors performance

Lists of the journals and research centres that publish the studied topic and one that contains the addresses of the research centres that presently work in the interest field were also drafted. These lists are presented in table 4 and table 5.

Table 4.

Most cited journals in the studied field

Journal	Influence factor*	Impact factor*	Number of references*
Solar Energy	1.5034	0.7801	14
Renewable Energy	1.4616	0.9267	9
Renewable and Sustainable Energy Reviews	2.6221	1.6505	2
Atmospheric Environment	1.6839	1.4032	2
Solar Energy Materials and Solar Cells	2.5870	1.7047	2

*Situation on 28.02.2013

Table 5.

Research groups working in the studied field

Name	Affiliation
Electrical Engineering Faculty	Politehnica University of Bucharest, Bucharest, Romania
Centre for Renewable Energy Systems Technology (CREST)	Loughborough University, Leicestershire, U.K.
Department of Industrial Engineering and Information Technology	University of Trieste, Trieste, Italy
Lab of Soft Energy Applications and Environmental Protection	TEI of Piraeus, Athens, Greece
Instituto de Energía Solar	Ciudad Universitaria, Madrid, Spain

This information is relevant in terms of publication availability and in terms of establishing collaborations with another research centre that studies the same matter.

4. CONCLUSION

The paper presents an objective and rigorous reference selection procedure, applicable to most scientific fields that require an up to date knowledge of the studied matter.

The procedure is exemplified with a reference selection concerning the effects of soiling, dust and other surface deposits, on the performance of solar PV collectors topic.

The procedure made possible the identification of the most representative papers for the studied field, the journals that publish this topic most and the research centres that presently study the field of interest.

5. REFERENCES

[1] Hottel, H.C., Woertz, B.B., *The Performance of Flat-Plate Solar-Heat Collectors*, Transactions of the A.S.M.E., 1942, p. 91-104;

[2] Dorobanțu, L., Popescu, M.O., Popescu, Cl., Crăciunescu, A., *The effect of surface impurities on photovoltaic panels*, International Conference on Renewable Energies and Power Quality (ICREPQ'11), Las Palmas de Gran Canaria (Spain), 13-15 April, 2011;

[3] Garg, H.P., *Effect of dirt on transparent covers in flat-plate solar energy collectors*, Solar Energy, 15, 1974, p. 299-302;

[4] El-Shobokshy, M.S., Mujahid, A., Zakzouk, A.K.M., *Effects of dust on the performance of concentrator photovoltaic cells*, IEE Proceedings I: Solid State and Electron Devices, 132(1 pt 1), 1985, p. 5-8;

[5] Berganov, I.R., Isaev, R.I., Makhkamdzhanov, B.M., *Effect of soiling of the surface of photovoltaic cells on the efficiency of operation of solar sources of electricity*, Applied Solar Energy (English translation of Geliotekhnika), 22 (4), 1986, p. 18-22;

[6] Bajpai, S.C., Gupta, R.C., *Performance of silicon solar cells under hot & dusty environmental conditions*, Indian Journal of

Pure and Applied Physics, 26(5), 1988, p. 364-369;
[7] Adinoyi, M.J., Said, S.M., *Effect of dust accumulation on the power outputs of solar photovoltaic modules*, Renewable Energy, 60, 2013, p. 633-636;
[8] Touati, F.A., Al-Hitmi, M.A., Bouchech, H.J., *Study of the Effects of Dust, Relative Humidity, and Temperature on Solar PV Performance in Doha: Comparison Between Monocrystalline and Amorphous PVS*, International Journal of Green Energy, 10(7), 2013, p. 680-689;
[9] Massi Pavan, A., Mellit, A., De Pieri, D., Kalogirou, S.A., *A comparison between BNN and regression polynomial methods for the evaluation of the effect of soiling in large scale photovoltaic plants*, Applied Energy, 108, 2013, p. 392-401;
[10] Charabi, Y., Gastli, A., *Integration of temperature and dust effects in siting large PV power plant in hot arid area*, Renewable Energy, 57, 2013, p. 635-644;
[11] Moharram, K.A., Abd-Elhady, M.S., Kandil, H.A., El-Sherif, H., *Influence of cleaning using water and surfactants on the performance of photovoltaic panels*, Energy Conversion and Management, 68, 2013, p. 266-272;
[12] Martin, N., Ruiz, J.M., *Calculation of the PV modules angular losses under field conditions by means of an analytical model*, Solar Energy Materials and Solar Cells, 70, 2001, p. 25-38;
[13] El-Shobokshy, M.S., Hussein, F.M., *Effect of dust with different physical properties on the performance of photovoltaic cells*, Solar Energy, 5I(6), 1993, p. 505-511;
[14] Elminir, K.H., Ghitas, E.A., Hamid, R.H., El-Hussainy, F., Beheary, M.M., Abdel-Moneim, M.K., *Effect of dust on the transparent cover of solar collectors*, Energy Conversion and Management, 47, 2006, p. 3192-3203;
[15] Mani, M., Pillai, R., *Impact of dust on solar photovoltaic (PV) performance: Research status, challenges and recommendations*, Renewable and Sustainable Energy Reviews, 14, 2010, p. 3124-3131;
[16] Kymakis, E., Kalykakis, S., Papazoglou, T.M., *Performance analysis of a grid connected photovoltaic park on the island of Crete*, Energy Conversion and Management, 50, 2009, p. 433-438.

PROCEDURĂ DE SELECȚIE A REFERINȚELOR BIBLIOGRAFICE
PENTRU STUDIUL IMPACTULUI DEPUNERILOR ASUPRA PERFORMANȚEI COLECTOARELOR PV

Rezumat: Proiectele de cercetare de succes încep cu o bună cunoaştere a domeniului studiat. Fundaţia de cunoştinţe este de obicei construită pe un studiu aprofundat al literaturii de specialitate. Această lucrare prezintă o procedură obiectivă şi riguroasă de selecţie a referinţelor bibliografice, şi poate fi un bun punct de plecare pentru un studiu bibliografic. Procedura este exemplificată printr-o căutare în literatura de specialitate privitor la efectele depunerilor de praf şi a altor depuneri de suprafaţă, asupra performanţelor colectoarelor solare fotovoltaice. Procedura a permis identificarea contribuţiilor ştiinţifice reprezentative în domeniul de studiu, a făcut posibilă identificarea documentelor reprezentative, a revistelor şi centrelor de cercetare, care publică în domeniul studiat.

Andrei BUTUZA, PhD Stud. Eng., Technical University of Cluj-Napoca, Faculty of Mechanical Engineering, Department of Mechanical Engineering, E-mail: Andrei.Butuza@termo.utcluj.ro, Office Phone: (+) 40 264 401605; Mobil: 0742.613.153.