

P-1.1

Research overview of hydrogen production from biomass: A bibliometric analysis of the research published during the 1979-2019 period

N.K. Gamboa-Rosales^{1*}, J.L. Ayastuy², J.R. Otegi-Olaso³, J.R. López-Robles³

¹ CONACYT – Autonomous University of Zacatecas – Av. Ramón López Velarde No. 801. Col. Centro, C.P. 98000, Zacatecas, Zacatecas, México.

² Department of Chemical Engineering, Faculty of Science and Technology, University of the Basque Country (UPV/EHU), 48940 Leioa, Spain

³ Department of Graphic Design and Engineering Projects, Faculty of Engineering, University of the Basque Country (UPV/EHU), Alameda Urquijo, S/N, 48013, Bilbao, Spain

(*) Corresponding author: ngamboa@conacyt.mx

Keywords: Hydrogen production, Biomass, Bibliometric analysis, Research overview, SciMAT

1. Abstract

The purpose of this paper is to develop a conceptual analysis of hydrogen production from biomass research in literature by quantifying the main bibliometric performance indicators, identifying the main authors, countries, journals and research areas and evaluating the intellectual structure and evolution of the field using SciMAT as a bibliometric analysis software. In this way, the methodology implemented in this research encompasses both the bibliometric performance analysis and science mapping approaches of biomass-based hydrogen production research themes. The bibliometric performance analysis is centered on the citation-based impact of the scientific output, while science mapping illustrates the evolution of the research themes that build the field through the use of bibliometric network analysis techniques. To this end, the publications related to biomass-based hydrogen production research available at Scopus have been compiled between 1979 and 2019 (876 publications). Finally, the paper provides objective evidence of the evolution of the hydrogen production from biomass field, which confirms the interest that researchers have in this theme to develop new capabilities. Finally, it offers a framework to support researchers evaluating the field and, finally, to assist them in the development and direction of their future analysis identifying trends in terms of research.

2. Introduction

The depletion of fossil-based fuels and, specially, the emission of greenhouse gases into the atmosphere in fossil fuels-based energy systems, have driven a search for alternatives to substitute for fossil fuels. Among them, biomass is knowledged as the most promising, as it can be converted into hydrogen, a clean energy carrier [1].

Keeping in mind it, the aim of the present research is to analyze and illustrate the evolution of the biomass-based hydrogen production field and its research themes using bibliometric techniques [2; 3]. To do that, the main indicators related to performance are quantified and the evolution of the biomass-based hydrogen production field is analyzed using a bibliometric analysis software based on a bibliographic network [4].

In order to identify the main research themes related to biomass-based hydrogen production and its evolution, a bibliometric approach is proposed based on the analysis of the main performance indicators and the scientific map between 1979 and 2019. To this purpose, the documents and their bibliographic information available in Scopus have been compiled, -considered as one of the main scientific and academic databases- and subsequently processed with SciMAT [5]. The information collected facilitates the analysis of the main performance indicators: productivity of authors in terms of publications and citations, countries and journals. This first part of the analysis has also been evaluated using h-index and H-Classics, thus homogenizing the indicators presented by each of the authors and the main publications [6].



P-1.1

3. Methodology and Dataset

3.1 Methodology

Bibliometric methods include one of the most common and accepted techniques for analyzing the output of basic research. Such methods are increasingly valued as a tool for measuring scientific quality, productivity, and evolution [2; 7; 8-9].

SciMAT provides four phases to analyze the biomass-based hydrogen production field within a specified period: (i) Research themes detection; (ii) Visualizing research themes and thematic network [10]; (iii) Discovery of thematic areas [11]; and (iv) Performance analysis [12]. Moreover, this analysis applied the H-Classics to determine the most cited publications. In addition, the scientific maps developed have made it possible to visualize the evolution of the field of hydrogen production from biomass in an agile and clear way, delimiting the areas of research and time, capturing its conceptual and cognitive structure.

Prior to the scientific map, each period is characterized as a thematic network and it is represented as a set of themes classified and positioned in a 4-quadrant plane divided into four categories, called a strategic diagram (see Figure 1(a)). These categories are: Motor themes (themes well developed and relevant for the structuring of a research field), Highly developed and isolated themes (themes well developed with internal ties but which are isolated from the rest of the themes, and which have a marginal role in the development of the field), Emerging or declining themes (themes weakly developed) and Basic or Transversal Themes (important themes for the development of the scientific field but which are not developed).

The scientific map collects each strategic diagram and relates its evolution over time. This map is classified by thematic areas to facilitate its analysis and the relationship that may exist between different research themes (see Figure 1(b)).

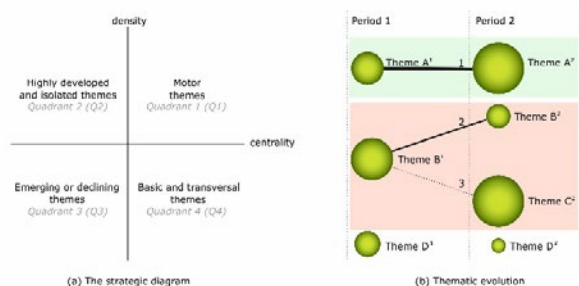


Fig. 1. Strategic diagram and thematic evolution map.

Finally, the bibliometric performance analysis and conceptual evolution analysis make it possible to understand the research field.

3.2 Dataset

In this way, the publications related to the hydrogen production from biomass have been collected in order to analyze the bibliometric performance and science mapping. Consequently, the research publications dedicated to biomass-based hydrogen production were downloaded from Scopus using the following advanced query: *TITLE ("hydrogen production" AND "biomass") OR TITLE-ABS-KEY ("hydrogen production from biomass" OR "hydrogen from biomass" OR "biomass for hydrogen production" OR "hydrogen production processes from biomass" OR "hydrogen production techniques from biomass" OR "hydrogen production methods from biomass" OR "hydrogen production technologies from biomass")*.

This query helped retrieve 876 publications from 1979 to 2019. The citations of these publications were also used in this work; these were collected up to March 13, 2019.

As a second step, and to avoid flatness of the data, the years as a whole were split into consecutive periods. While periods are frequently used to cover the same time span, given the low number of publications in the early years, the best option in the present analysis was to divide the time span into comparable periods. A de-duplicating process was also applied to improve data quality by grouping those meanings and concepts that represent the same notion (e.g., "biohydrogen", "bio hydrogen" and "bio-hydrogen" were merged as "bio-hydrogen").

P-1.1

4. Results and Discussions

An overview is provided of the science mapping and the hidden relationships between key themes in the main research fields related to biomass-based hydrogen production. This overview is structured into two complementary parts: analysis of the content of the articles published and a conceptual evolution map. The former helps in identifying the themes arising from the biomass-based hydrogen production corpus, its main concepts, and its role in the building of the hydrogen production from biomass field.

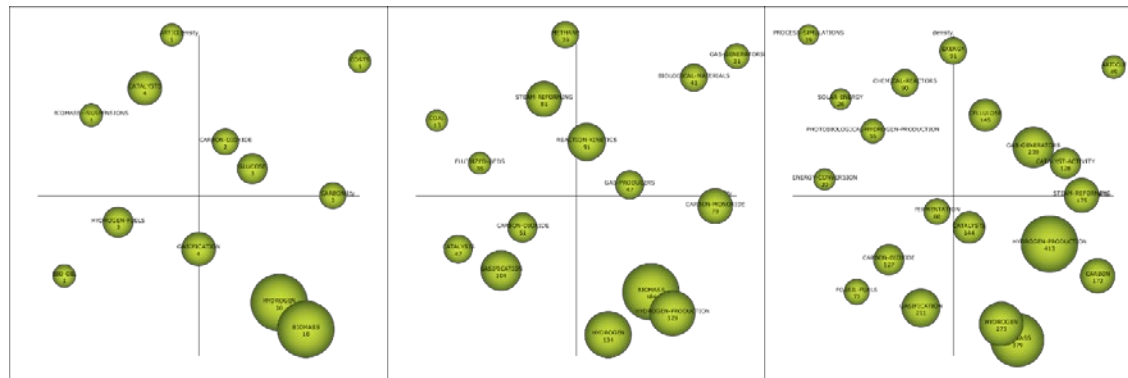


Fig. 2. Strategic diagrams. (a) Period 1: 1979-1999. (b) Period 2: 2000-2009. (c) Period 3: 2010-2019.

5. Conclusions

The present study presents the first bibliometric study on the hydrogen production from biomass, identifying the main themes and related research areas. More than 876 original research articles have been analyzed and processed using SciMAT.

In terms of bibliometric performance, the size of literature related to biomass-based hydrogen production research showed a noteworthy increase in the past 40 years (1979–2019). Given the large volume of publications and citations received in this field, it is expected that the interest will continue to grow and serve as a support to other knowledge areas such as energy, transport and sustainable technologies.

References

- [1] Y. Kalinci, A. Hepbasli, I. Dincer, Biomass-based hydrogen production: a review and analysis, *International journal of hydrogen energy* 34 (2009), 8799-8817.
- [2] H.F. Moed, New developments in the use of citation analysis in research evaluation, *Archivum immunologiae et therapiae experimentalis* 57 (2009), 13.
- [3] P. Glenisson, W. Glänzel, F. Janssens, B. De Moor, Combining full text and bibliometric information in mapping scientific disciplines, *Information Processing & Management* 41 (2005), 1548-1572.
- [4] M.J. Cobo, A.G. Lopez-Herrera, F. Herrera, E. Herrera-Viedma, A Note on the ITS Topic Evolution in the Period 2000-2009 at T-ITS, *IEEE Transactions on Intelligent Transportation Systems* 13 (2012), 413-420.
- [5] M.J. Cobo, A.G. López-Herrera, E. Herrera-Viedma, F. Herrera, SciMAT: A new science mapping analysis software tool, *Journal of the American Society for Information Science and Technology* 63 (2012), 1609-1630.
- [6] M.Á. Martínez, M. Herrera, J. López-Gijón, E. Herrera-Viedma, H-Classics: Characterizing the concept of citation classics through H-index, *Scientometrics* 98 (2014), 1971-1983.
- [7] H.F. Moed, R.E. De-Bruin, T.N. Van-Leeuwen, New bibliometric tools for the assessment of national research performance: Database description, overview of indicators and first applications, *Scientometrics* 33 (1995), 381-422.
- [8] M.A. Martinez, M.J. Cobo, M. Herrera, E. Herrera-Viedma, Analyzing the Scientific Evolution of Social Work Using Science Mapping, *Research on Social Work Practice* 25 (2015), 257-277.
- [9] J.R. López-Robles, I. Porto Gómez, J.R. Otegi-Olaso, M.J. Cobo, 30 years of intelligence models in management and business: A bibliometric review, *International Journal of Information Management* 48 (2019), 22-38.
- [10] Q. He, Knowledge discovery through co-word analysis, *Library Trends* 48 (1999), 26.
- [11] J.R. López-Robles, J.R. Otegi-Olaso, I. Porto Gomez, N.K. Gamboa-Rosales, H. Gamboa-Rosales, H. Robles-Berumen, Bibliometric network analysis to identify the intellectual structure and evolution of the big data research field, in: 19th International Conference on Intelligent Data Engineering and Automated Learning, IDEAL 2018, D. Camacho, P. Novais, A.J. Tallon-Ballesteros, and H. Yin, eds., Springer Verlag, 2018, pp. 113-120.
- [11] J.R. López-Robles, J.R. Otegi-Olaso, N.K. Gamboa-Rosales, H. Gamboa-Rosales, M.J. Cobo, 60 Years of Business Intelligence: A Bibliometric Review from 1958 to 2017, in: *New Trends in Intelligent Software Methodologies, Tools and Techniques: Proceedings of the 17th International Conference SoMet_18*, IOS Press, 2018, p. 395.

