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Expanding and Shifting Trends in Recent Alternative Fuels Literature

Hansel Bonifacio Trujillo[1], Guillermo Valencia Ochoa[2] and Yulineth Cardenas Escorcia[3]

[1] Mechanical Engineering, Grupo de Investigación en Gestión Eficiente de la Energía, Kaí, Faculty of Engineering, Universidad del Atlántico, Colombia

[2] Mechanical Engineering, Grupo de Investigación en Gestión Eficiente de la Energía, Kaí, Faculty of Engineering, Universidad del Atlántico, Colombia

[3] Industrial Eng., Grupo de Investigación en Gestión Eficiente de la Energía, Kaí, Faculty of Engineering, Universidad del Atlántico, Colombia

Abstract

This paper presents a bibliometric analysis oriented to an expanding and shifting trends study in the last 5 years of the available information related to alternative fuels, evaluating the number of articles available and their quality using histcites. The 10 countries with the most publications on the topic were analyzed concluding that the USA is the country with the most research on alternative fuels, with 129 articles of which 67 are considered of high quality.

Keywords: Scientometric, Average citations, High Quality Papers, Relative Growth Rate, Doubling Time, Web of Science

1 Introduction

In recent decades, scientific research and publications have been increasing thanks to advances in information technology, because this facilitates the dissemination and collection of information, which are then stored in databases [1]. The study of the information is bibliometric or scientometry, which analyzes the available informa-

tion on the topic of interest, in order to analyze and quantify the degree of research on this topic [2], [3].
Bibliometrics represents a statistical approach to mastering the increasing flow of scientific information, and to analyzing and understanding the cognitive characteristics of science, quantitatively measuring communication in science and providing results to scientists and users outside the scientific community [4]. There have been a number of techniques evaluated over time to assess information resources, being bibliometry one of the techniques adopted by library professionals to explore the impact of any field of knowledge [5], [6]. The bibliometric methods are the most used in the field of library science and documentation, it also has wide applications in other areas [7], [8]. Many fields of research use bibliometric methods to explore the impact of their field, the impact of a set of researchers, or the impact of a particular document, making quantitative and statistical analyses to describe publication patterns within a particular field or body of literature [9-11]. Researchers may use bibliometric evaluation methods to determine the influence of a single author, to describe the relationship between two or more authors or works, to identify the pattern of publication and authorship, citations used for a topic, articles of major impact, etc., over a period of time [12-15]. For researchers, this science is very useful, since it allows them to focus their research on the most studied topics of greatest impact by the scientific community [16]. The scientific community has grown substantially since the official establishment of the Operations Research Society of America (ORSA) in 1952, the Society for Operational Research (SRO) of the United Kingdom in 1953 and the Institute of Management Sciences (TIMS) in 1953, which has developed important research work and consolidated a research area that today encompasses thousands of researchers [17], [18]. These associations have promoted some classical journals in the field that have become the key instrument for disseminating new research contributions. The Quarterly Operational Research, founded in 1950, later became the Journal of the Operational Research Society (JORS), Operations Research (1952) and Management Science (1954) [19].
The main contribution of this work is to apply the techniques and computer resources of bibliometrics to evaluate research on alternative fuels, quantifying the countries with the greatest research and the quality of scientific articles in the last 5 years. Alternative fuels arose from the need for energy sources other than oil, due to the pollution produced by petroleum-derived fuels [20], [21]. This problem has led to growth in the research of new alternatives, being this the interest of this work.

2 Methodology

Scientometry is one of the most important tools for the evaluation of scientific production, which studies the disciplines of science quantitatively, based on publications and communication of information, as well as including the identification of emerging areas of scientific research, the development of research over time or the geographical and organizational distribution of research.

Scientometric analysis was performed using histcites, a software package used for bibliometric analysis and visualization of information. By means of the software we searched the publications registers of the ten most contributing countries to the research of alternative combustribles, from 2013 to 2017 in the database of webcites, in order to calculate the total number of publications (TNP) classifying it by country, to calculate the number of high quality articles (NHQ), to identify the impact of the citations of the ten main countries that contribute to the field, to know the relative growth rate (RGR).

The NHQ, which was based on the calculation of paper citation from different countries was calculated according to equation 1, considering that the citation pattern varies from country to country, and the articles that received more than double the average citations were considered high quality papers.

$$NHQ\% = \frac{number\ of\ high\ quality\ papers\ per\ country}{Total\ high\ quality\ paper\ number} x100. \quad (1)$$

The growth of publications was analyzed using relative growth rate and doubling time parameters. RGR is measured to study the increase in the number of items over time, which is measured using equation 2 as [22]

$$RGR = \left(\frac{\ln(N2)-\ln(N1)}{t2-t1}\right), \quad (2)$$

where N2 y N1 correspond to the number of publications in years t2 and t1.

Finally, the doubling time was estimated based on equation 3 as

$$Dt = \frac{\ln(2)}{RGR}. \quad (3)$$

3 Results and discussion

Figure 1 shows the number of article publications from the 10 countries with the largest number of publications in the last 5 years, which shows that the USA has the highest number of publications, in total 129, followed by India with 35, China with 35, Spain with 26, UK with 25, Canada with 23, Germany with 22, South Korea with 20, Turkey with 18 and France with 17, for a total of 350 articles. There is a large difference in the number of US publications compared to other countries, maintaining an average number of articles of 26 articles per year, publishing 26.85% of the total number of articles from the ten countries. Countries such as India, China and the UK are showing slow growth in the number of publications, while the other countries are showing irregular behaviour in their publications, which do not maintain a constant number of publications or show growth.

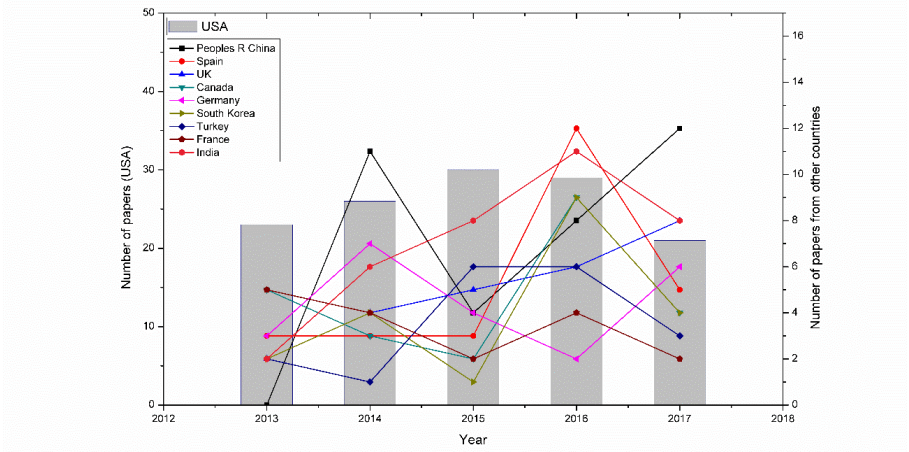

Figure 1. Ranking & yearly publication of countries

It is not enough just to measure the number of publications, it is also very important to measure their quality, which is measured by the number of times they are cited in other articles. Table 2 presents indicators to measure quality, such as the total number of citations, which is shown for each country, with USA being the country with the highest number of citations, presenting 718 citations, of which 20 are considered high quality, which corresponds to 15.5% of their total articles. Followed by the USA, India has a total of 343 citations, of which 4 are considered high quality, which corresponds to 11.42% of its total articles. The other countries have few published articles and low quality of their articles.

Country	TNP	TNC	AC	NHQ	NHQ%
USA	129	71	5,57	20	52,63
India	35	343	9,0	4	10,53
People R China	35	263	7,51	1	2,63
Spain	26	201	7,73	4	10,53
UK	25	150	6,00	3	7,89
Canada	23	122	5,30	1	2,63
Germany	22	165	7,50	2	5,26
South Korea	20	251	12,55	2	5,26
Turkey	18	92	5,11	1	2,63
France	17	131	7,71	0	0,00
Total	350	2436		3	

Table 2. Total publications, citations, average citation & high quality papers.

Table 3 shows the distribution of citations in total published articles, which are listed from 0 to 6. In all countries it is observed that the largest number of articles have not been cited, giving a total of 280, it is also shown that USA has articles that have been cited more than once, which is a high quality index of articles, while the other countries have few articles cited.

No. of citation	USA	India	China	Spain	UK	Canada	Germany	S. Korea	Turkey	France
0	97	29	29	20	21	19	18	18	15	14
1	12	2	2	2	1	3	2	0	2	3
2	13	2	2	3	1	1	1	1	1	0
3	4	0	0	1	2	0	0	0	0	0
4	0	1	1	0	0	0	0	1	0	0
5	2	1	1	0	0	0	0	0	0	0
6	1	0	0	0	0	0	1	0	0	0
>6	0	0	0	0	0	0	0	0	0	0

Table 3. Distribution of citations

Figure 2 represents the growth rate (RGR), which is measured to study the increase in the number of articles and to calculate Dt. It is evident that in all RGR countries it decreases over the years, however, as shown in the figure, the RGR values go up to 1.5, which indicates that the number of articles published in all countries is practically stable.

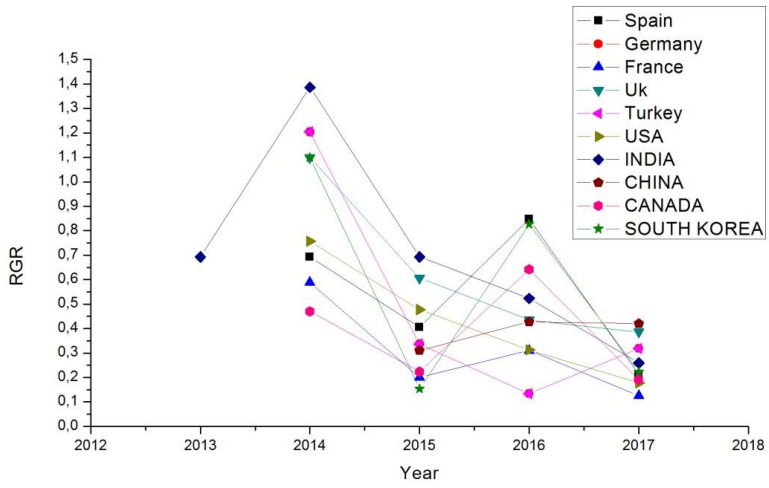

Figure 2. Top 10 countries research output, relative growth rate (RGR)

The doubling time analysis (Dt) is shown in Figure 3, where a larger doubling time increase is seen in India, indicating lower item productivity. Countries such as Germany and South Korea show irregular behaviour due to inconsistencies in the number of annual publications. Finally, China has the shortest publication time, which indicates that this country is growing.

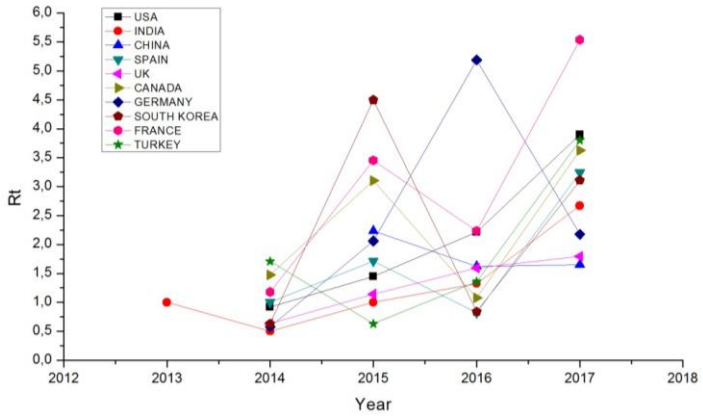

Figure 3. Top 10 countries research output, doubling time (Dt)

4 Conclusions

Considering the information available in the database, it is concluded that the country with the greatest contribution in alternative fuels research is USA, besides being of high quality and in continuous growth, presented a great advantage compared to countries such as China, India, Spain, Canada, UK, Germany, South Korea, Turkey and France. USA has a great advantage in the production of articles and is far from being surpassed, since the other countries do not have a high growth to be able to surpass the USA in the next years. In generating the countries present a low decrease in the production of articles related to alternative fuels and in the duplication of articles, nevertheless presents an increase in the doubling time.

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