

Mapping Literature of Reclaimed Asphalt Pavement Using Bibliometric Analysis by VOSviewer



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Abstract The purpose of this research is to map the literature on reclaimed asphalt pavement (RAP) and to determine future related potential topics. Data were collected from the Scopus meta-data and analyzed using the bibliometric analysis technique with the VOSviewer tool. The result showed that there are several relationships between RAP and the topics related to aggregate, mixing, hot-mix asphalt, and compressive strength. However, some topics such as extraction, microstructural properties, furnaces, and interfacial transition zone in the RAP have not been widely researched. Numerous studies have been carried out on RAP by authors such as Xiao F, Amirkhani S N, Daniel J S, Canestrari F, Huang B, Zaumanis M, and Arulrajah. Some of the countries that have contributed significantly to RAP research are the United States of America, China, Italy, and India.

Keywords Reclaimed asphalt pavement · Bibliometric · VOSviewer

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1 Introduction

Reclaimed Asphalt Pavement (RAP) is a waste material obtained from dredging flexural pavement using a Cold Milling Machine [1]. Numerous studies have been conducted [2] to determine the more efficient and economical use of RAP [3]. Topic distribution is very broad in mapping the RAP because it has various purposes. During data collection, the word “Reclaimed Asphalt Pavement” was entered into a search engine, and the majority of the information that appeared was on materials, hot mix, and concrete. However, multidisciplinary RAP research was found from the Scopus database. The problem associated with RAP is the difficulty in mapping the scientific development cluster, based on the relationship between the authors and countries in this research’s citation and correspondence section. Generally, studies on the mapping of publications related to asphalt and bitumen [3] have been carried out, although it is not specific to RAP waste. Therefore, this research aims to explore the topic of RAP using the bibliometric VOSviewer method for authors to identify and acquire research gaps from its phenomena globally easily. This quantitative research comprises systematic articles, transparently and synthetically collected, to assess study findings on topics related to RAP [4, 5]. Bibliometric, which is a statistical analysis method that connects text or keywords between papers [6], including the citation relationship between authors [7], the co-occurrence of keywords with author institutions [8, 9], and analysis was used to carry out this research [10]. An author from Indonesia also wrote on RAP.

2 Methodology

This research analyzes the SCOPUS indexed literature on RAP using the bibliometric method with the help of VOSviewer. This software has the ability to map keyword, author, and citation relationships. Scopus has a large database and complete meta-data analysis, which was downloaded on February 7, 2021. This method is used to determine the information that contributes to answers to research questions on RAP. Systematic Review is carried out through various stages of data collection [11, 12], Filtering, Identifying and Interpreting on VOSviewer. The process flow is shown in Fig. 1. The data collection stage is carried out by entering the keyword “Reclaimed Asphalt Pavement” to obtain the associated articles. The data collection process using the keywords “Reclaimed Asphalt Pavement” is shown in Fig. 2.

The second process in filtering needs to focus on the subject area by increasing the relevance between the articles. This filtering is limited to journals published from



Fig. 1 Scopus bibliometric data interpretation flow

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1,994 document results

TITLE-ABS-KEY (reclaimed AND asphalt AND pavement) AND (LIMIT-TO (SUBJAREA, "SOCC") OR LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "COMP") OR LIMIT-TO (SUBJAREA, "PHYS") OR LIMIT-TO (SUBJAREA, "ENGG") OR LIMIT-TO (SUBJAREA, "MARE") OR LIMIT-TO (SUBJAREA, "ENVI") OR LIMIT-TO (SUBJAREA, "EART") OR LIMIT-TO (SUBJAREA, "ENER") OR LIMIT-TO (SUBJAREA, "CHEM") OR LIMIT-TO (SUBJAREA, "CHEM"))

Documents Secondary documents Patents

Analyze search results

| Document title | Authors | Year | Source | Cited by |
|--|---|------|---|----------|
| 1. Dynamic modulus characteristics of mixtures containing recycled asphalt pavements, warm mix additives, and antistrip agents | Wang, J., Su, N., Xiao, F., Amickhanian, S.N. | 2021 | Journal of Testing and Evaluation 49(5) | 0 |

Fig. 2 Scopus document results (scopus.com)

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Fig. 3 Export Scopus document to excel CSV (scopus.com)

1999 to 2021. Subject areas selected are Engineering, Material science, Environmental science, Earth and Planetary Sciences, Energy, Chemical Engineering, and Chemistry. Types of documents include articles, conference papers, book chapters, reviews, and conference reviews, while the choice of sources is taken from journals, conference proceedings, book series, trade journals, and books. The publication stage was selected for the final document and article in press with the filtering process shown in Fig. 3. A total of 1994 articles were obtained from the search results using the relevant keywords in accordance with the citation, bibliographical, and abstract. The selected results are saved in a CSV file format, which is then used to further analyze VOSviewer.

The identification process using Co-occurrence was summarized in CSV and created on VOSviewer with the following steps: Create a map based on bibliographic data → Read data from bibliographic database files → Choose the type of analysis

and counting method (Co-occurrence or Co-authorship) → choose threshold Co-occurrence with a minimum of 5 keywords → choose the number of keywords to be selected (500), then run analysis Visualization VOSviewer and interpretation.

3 Result and Discussion

3.1 RAP Publication Development

The Scopus data that is mined in relation to the publication on the topic of RAP increases every year, as shown in Fig. 4. However, from 1999 to 2003, there was no increase in publications on RAP by looking for asphalt content using the centrifugal method [13] and mixed research variants [14]. RAP was explored in concrete [15, 16] after 2011 and continued to increase irrespective of the slight decrease from 2015 to 2018.

The authors that conducted the reclaimed asphalt pavement were recorded in a total of 44 countries divided into 10 clusters, and 17 citations and corresponding links are shown in Fig. 5. Research on RAP has been carried out in various countries, which indicates that this topic is quite interesting and of a global nature. However, this study is dominated in America, China, Italy, and India.

The United States of America has the largest citation and contributors on RAP research. In addition, a total of 8 countries reinforce each other in citation between the authors, as shown in Table 1.

The citation analysis in Fig. 6 visualizes the network between one author and another through digitalization. The total number of authors on the topic of “reclaimed asphalt pavement” is 239, grouped into 19 clusters and interconnected with citation and relationship. They are further marked by differences in color and interconnected

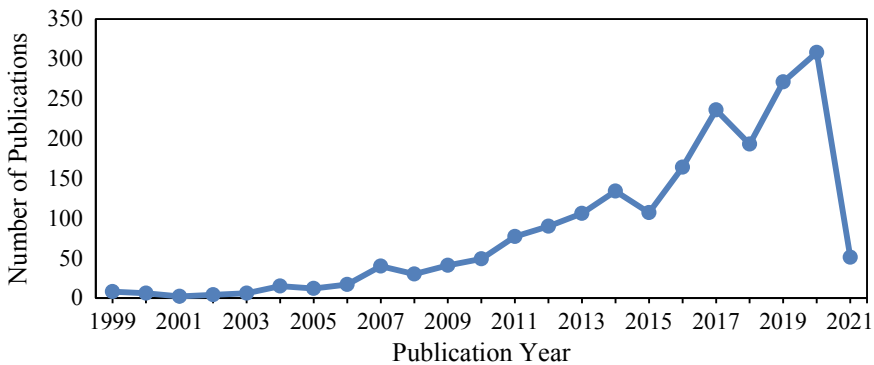


Fig. 4 Graph of the number of RAP publications each year

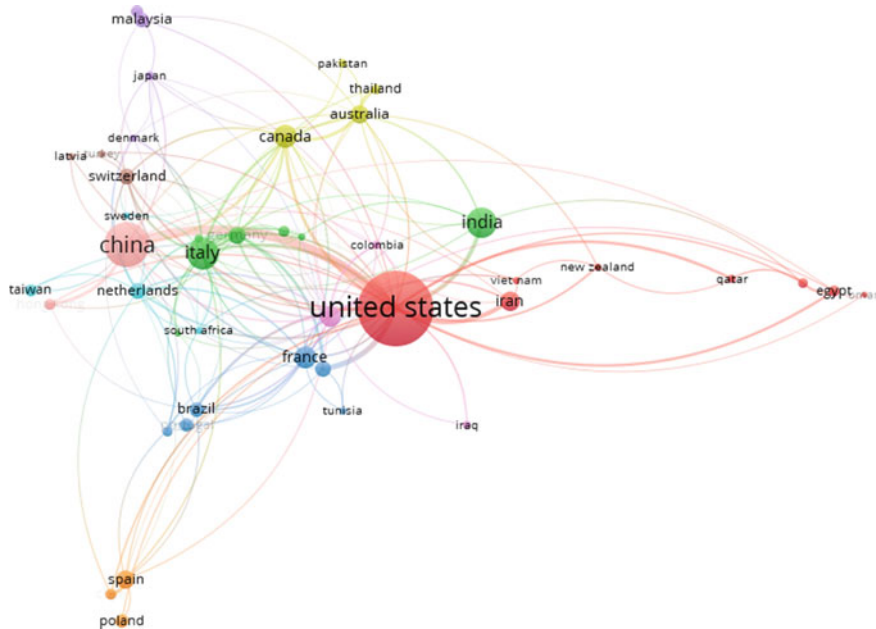


Fig. 5 Network visualization country

Table 1 Number of country clusters

| Cluster country | Number of countries | Country name |
|-----------------|---------------------|--|
| Cluster 1 | 8 | Egypt, Iran, New Zealand, Oman, Qatar, Saudi Arabia, United State, Vietnam |
| Cluster 2 | 7 | Czech Republic, Germany, Greece, India, Italy, San Marino, Serbia |
| Cluster 3 | 6 | Belgium, Brazil, France, Portugal, South Korea, Tunisia |
| Cluster 4 | 4 | Australia, Canada, Pakistan, Thailand |
| Cluster 5 | 4 | Denmark, Japan, Malaysia, Nigeria |
| Cluster 6 | 4 | Netherlands, South Africa, Sweden, Taiwan |
| Cluster 7 | 3 | Chile, Poland, Spain |
| Cluster 8 | 3 | Latvia, Switzerland, Turkey |
| Cluster 9 | 3 | Colombo, Iraq, United Kingdom |
| Cluster 10 | 2 | China, Hong Kong |

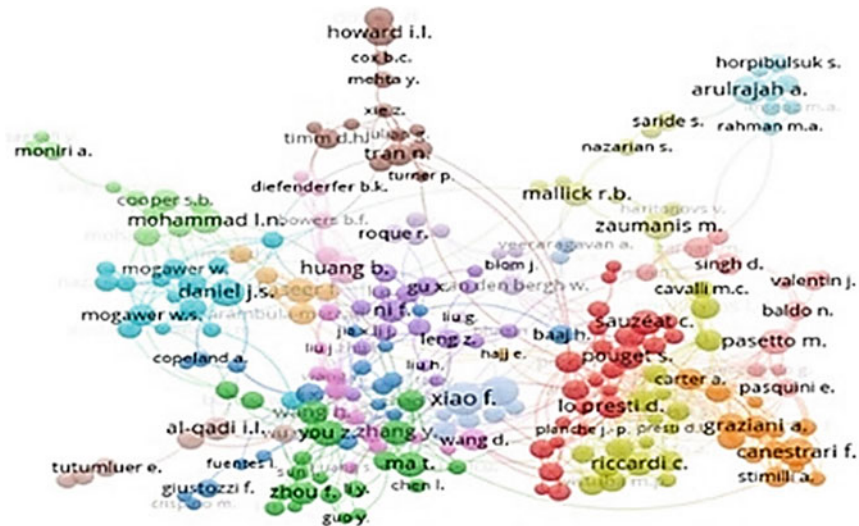


Fig. 6 Overlay visualization author

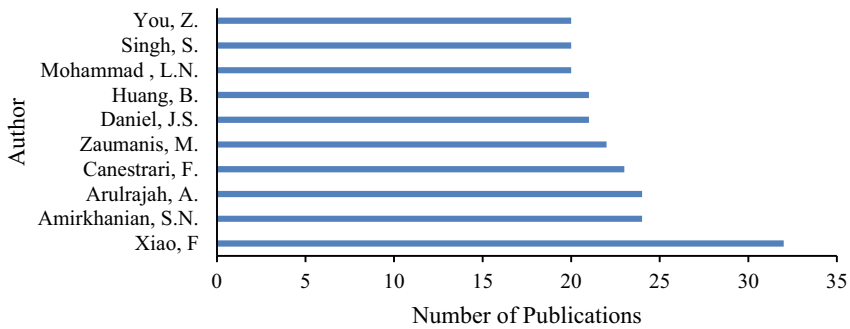


Fig. 7 Graph paper per Scopus data author

by 848 networks. Cluster 1 is light blue and consists of an author named Xiao F with a total of 32 papers.

Author contributions with research topics on RAP are identified in the network and overlay of Figs. 6 and 7. The author with the most citations is Huang B, with a total of 1325 citations from 21 articles. The year 2021 is expected to have a significant increase in the number of new authors interested in the topic of RAP around the world.

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