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## **BIBLIOMETRIC STUDY ON ALKALI-ACTIVATED AND GEOPOLYMERIC MATERIALS AT THE STATE UNIVERSITY OF NORTHERN RIO DE JANEIRO DARCY RIBEIRO - UENF (2002 TO 2023)**

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**Abstract:** Alkali-activated materials is a term used to describe mortars, concretes and grouts obtained through the use of an alkali-activated cementitious matrix, produced through the reaction of a solid aluminosilicate under alkaline conditions. This article presents a comprehensive bibliometric review of studies related to alkali-activated materials in the Civil Engineering and Advanced Materials Engineering laboratories at the State University of Northern Rio de Janeiro Darcy Ribeiro, with the aim of analyzing academic production in order to identify and quantify the current scenario, so as to contribute to future studies on the subject. As a result, it was found that although LAMAV began its activities nine years after LECIV, its output has grown steadily and is currently superior to the aforementioned laboratory.

**Keywords:** Alkali-activation. Bibliometry. Geopolymers. VOSViewer.

## INTRODUCTION

The manufacture of conventional Portland cement has a significant impact in terms of greenhouse gas emissions, especially carbon dioxide (CO<sub>2</sub>), which accounts for almost all the gases emitted. According to the World Business Council for Sustainable Development (WBCSD, 2009), this industry is responsible for around 5% of total anthropogenic carbon emissions globally.

As a result, the cement industry has been faced with the challenge of seeking sustainable alternatives through the adoption of new technologies aimed at producing materials with a lower environmental impact than traditional building materials. The complete replacement of Portland cement in concrete production can be achieved through the development of a class of materials known as alkali-activated or geopolymer cements.

According to Davidovits (1994), geopolymer cements are resistant materials where geopolymerization involves the chemical reaction of an aluminosilicate with alkaline and calcium polysilicates, forming a binder with mechanical properties comparable to those of Portland cement. It is worth noting that geopolymers are obtained from agro-industrial waste, such as fly ash, sugar cane bagasse and rice husk ash, blast furnace slag, among others.

Furthermore, these binders are currently being used to produce concrete and show technical and ecological advantages over Portland cement, such as: high compressive strength; resistance to high temperatures; low permeability and low CO emissions .<sub>2</sub>

Thus, alkali-activated and geopolymer cements have numerous technical advantages, as well as promoting a more sustainable approach, since industrial waste is reused, reducing the need to extract natural resources and minimizing the amount of waste destined for landfills.

The purpose of this article was therefore to carry out a bibliometric analysis of research into alkali-activated and geopolymeric materials at the State University of Northern Rio de Janeiro Darcy Ribeiro (UENF), specifically in the Civil Engineering (LECIV) and Advanced Materials (LAMAV) laboratories. To achieve this goal, graphs were created to represent the academic output of the professors, including a count of patents, orientations, citations, dissertations, theses and scientific articles.

Bibliometric studies are a methodology frequently used in various areas of knowledge to evaluate scientific or technical production. In essence, bibliometrics consists of the quantitative and qualitative analysis of publications, with the aim of developing reliable indicators related to the production, dissemination and use of published information.

## METHODOLOGY

In order to observe the research scenario on alkali-activated and geopolymeric materials at UENF, the definition of the databases and the delimitation of the time frame were established. This definition is intended to link the types of information that can be found with the results sought. It was therefore decided to use the LATTES Platform as the database for the survey of programs, covering the period from 2002 to 2023.

It is worth noting that this study was initially intended to look at postgraduate courses (masters and doctorates). However, for a more in-depth and complete analysis, undergraduate data was added.

On the LATTES Platform, the research was conducted by searching the CVs of the professors who make up the Civil Engineering and Advanced Materials Laboratories. The aim was to identify patents, orientations, citations, dissertations, theses and scientific articles in which these professors had worked or participated. Given that this platform offers the option of searching by keywords, the following terms were selected: “geopolymer(s)”, “geopolymer”, “alkali-activation”, “alkali-activated material”, “alkaline activation” and “alkali-activated”.

It is important to note that there was an emphasis on analyzing articles published in journals, limiting the period to between 2019 and 2023, since funding institutions consider the last five years to be an important timeframe for releasing possible funding for projects and scholarships, among other things. This choice was made to determine which journals, both national and international, are the most sought-after for this area of study. A bibliographic map was then generated using VOSviewer *software* version 1.6.19.

In order to generate the bibliographic map in the VOSviewer *software*, it was necessary to access the *Web of Science* base list via CAFE

Access - Federated Academic Community of the CAPES Periodicals platform. CAFE Access allows remote access to the portal's restricted paid content for users linked to Higher Education Institutions (HEIs), by logging in with their institutional *e-mail address*.

The *Web of Science* search interface found documents using keywords and search filters. However, logical operators were used to group the keywords, dividing them into two sets separated by “OR” and connected by “AND”: “alkali-activated OR alkali-activation OR alkali-activated materials AND geopolymer OR geopolymeric OR geopolymerization”.

In this context, in order to create the bibliographic map in the VOSviewer *software*, it was necessary to export the file generated by the *Web of Science* search in .TXT format. In addition, the type of analysis was defined as co-authorship, and criteria were established for the analysis, such as the minimum number of documents per author and the minimum number of citations per author. Once these settings had been made, the *software* generated a map showing the names of the authors who had published articles and their connections with other authors, enabling the identification of collaboration networks between them.

As a result, each lecturer's work was accounted for, allowing for a comparison of the amount produced by each one. This procedure was repeated for the years of production, the laboratories and the programs at UENF. Later, using Excel, graphs and tables were drawn up based on the results obtained.

Finally, after completing this stage of quantitative analysis, detailed discussions were held to identify and qualify the current scenario of research related to the subject, adding more depth to the study.

## DATA ANALYSIS AND RESULTS

During the survey, 13 professors were identified who had produced studies on geopolymers/alkali activated materials in graduate and undergraduate programs at UENF. In order to facilitate the interpretation of the graphs, it is essential to know which professors are associated with the Civil Engineering Laboratory (LECIV) and the Advanced Materials Laboratory (LAMAV), as shown in Tables 1 and 2, respectively.

LECIV TEACHERS	ABBREVIATIONS
Afonso Rangel Garcez de Azevedo	Azevedo, A. R. G.
Dylmar Penteado Dias	Dias, D. P.
Guilherme Chagas Cordeiro	Cordeiro, G. C.
Jean Marie Désir	Désir, J. M.
Jonas Alexandre	Alexandre, J.
Ránces Castilho Lara	Lara, R. C.
Sergio Luis González Garcia	Garcia, S. L. G.

Table 1 - Teachers associated with the Civil Engineering Laboratory and their respective abbreviations.

Source: Developed by the authors (2024).

LAMAV TEACHERS	ABBREVIATIONS
Afonso Rangel Garcez de Azevedo	Azevedo, A. R. G.
Angelus Giuseppe Pereira da Silva	Silva, A. G. P.
Carlos Maurício Fontes Vieira	Vieira, C. M. F.
Eduardo Atem de Carvalho	Carvalho, E. A.
Elaine Cristina Pereira	Pereira, E. C.
Gustavo de Castro Xavier	Xavier, G. C.
Jonas Alexandre	Alexandre, J.
Ronaldo Pinheiro da Rocha Paranhos	Paranhos, R. P. R.

Chart 2 - Teachers associated with the Advanced Materials Laboratory and their respective abbreviations.

Source: Developed by the authors (2024).

It is important to note that there are professors who work in both laboratories, such as Professors Afonso Rangel Garcez de Azevedo and Jonas Alexandre. This information contributes to a more comprehensive understand-

ing of the distribution of productions between the two research environments.

It should also be noted that there are researchers who are not currently teaching at UENF, such as Jean Marie Désir. This professor had institutional ties until 2007 and currently works at the Federal University of Rio Grande do Sul (UFRGS). Thus, for the purposes of this survey, only productions up to the year his time at UENF ended were considered, in order to maintain the consistency and accuracy of the data analyzed.

In this context, Table 1 provides a detailed overview of the total number of productions produced by researchers at UENF, as well as how many works were identified in each laboratory. In addition, the data reveals the presence of professors working in multiple laboratories, which highlights the collaborative nature of research at the university. This interaction between laboratories, which can also be done through partnerships, is capable of resulting in an exchange of knowledge and experiences, further enriching the research environment.

TEACHER	LECIV	LAMAV
Azevedo, A. R. G.	27	52
Silva, A. G. P.	0	9
Vieira, C. M. F.	0	56
Dias, D. P.	72	0
Carvalho, E. A.	0	2
Pereira, E. C.	0	1
Cordeiro, G. C.	4	0
Xavier, G. C.	0	3
Désir, J. M.	2	0
Alexandre, J.	1	3
Lara, R. C.	2	0
Paranhos, R. P. R.	0	2
Garcia, S. L. G.	12	0
<b>TOTAL PRODUCTIONS</b>	<b>120</b>	<b>128</b>

Table 1 - Production of each teacher in their respective Laboratories.

Source: Developed by the authors (2024).

According to the data presented in the table above, Professor Afonso Rangel Garcez de Azevedo is the professor with the highest number of productions, totaling 79 works, distributed between 27 in the Civil Engineering Laboratory and 52 in the Advanced Materials Laboratory, showing his contribution to both research areas.

However, it is important to note that Professor Dylmar Penteadó Dias emerges as the professor with the highest number of productions at LECIV, with a total of 72 papers. On the other hand, Professor Carlos Maurício Fontes Vieira stands out as the teacher with the highest number of productions within LAMAV, totaling 56 works.

Interest in geopolymer research at UENF began in 2002 in the Civil Engineering Laboratory, while it was only in 2011 that the Advanced Materials Laboratory began to focus on this subject.

Graphs 1 and 2 illustrate the evolution of the production of alkali-activated/geopolymeric materials over the years, covering the period from 2002 to 2023, which includes the challenging period of the Covid-19 pandemic. This analysis seeks to examine the trajectory of scientific production in this area, taking into account the potential impacts of the pandemic on research.

Initially, when analyzing these graphs, there is an upward trend in the production of studies over the years, reflecting the growing interest in these materials. In addition, it is important to highlight possible fluctuations in production, which can be influenced by a variety of factors, such as technological advances, availability of funding and availability of students/researchers.

That said, it is clear that in 2015 there was little production on the subject of alkali-activated/geopolymeric materials in both laboratories, with the lowest production compared to the other years. This situation

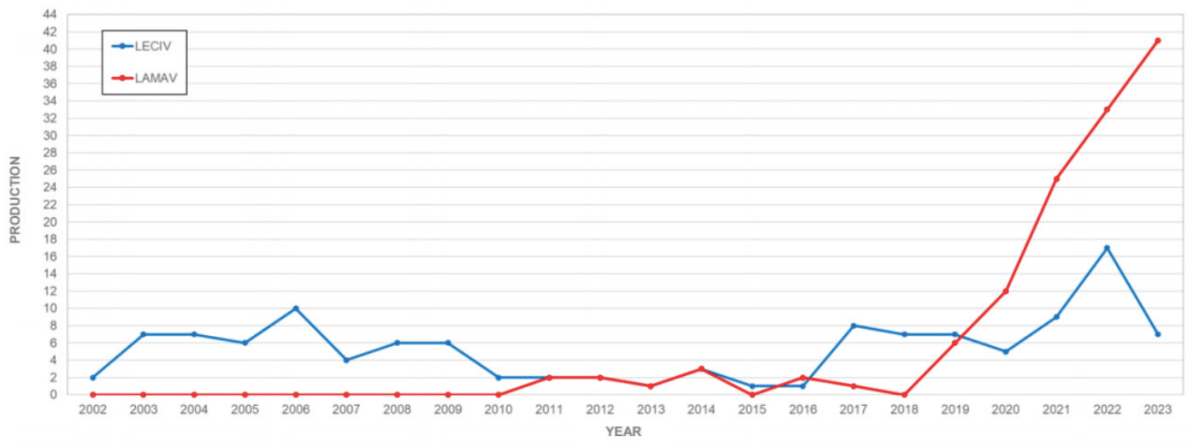
is reflected in the scarcity of dissertations on the subject and few students at the time. After this decline, there was exponential growth in research related to this topic.

According to Mourão (2022, p. 99), “the understanding that the pandemic (Covid-19) influenced scientific production, in the sense of boosting it, is an assertion that is widely accepted in the academic-scientific community.” This understanding is highlighted by the data in the graphs in this study, which show that, from a quantitative point of view, all the categories evaluated showed an increase in production during the pandemic biennium (2020-2021) compared to the previous year (2019).

Despite the later start of LAMAV’s research, it has grown steadily over time, surpassing LECIV’s scientific output since 2020. LAMAV’s productions have stood out for involving a greater number of professors and inter-institutional partnerships, which contributes to a greater diversity of research and number of publications.

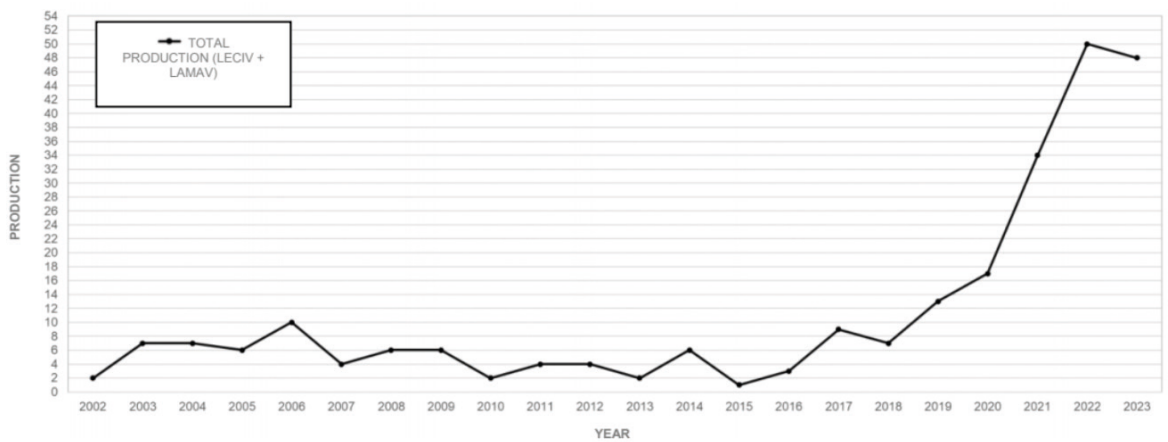
In addition, graphs (Graphs 3 and 4) have been drawn up representing the professors’ output over the years. These graphs provide a detailed analysis of the evolution of each professor’s contribution over different periods of time.

Graph 3 shows that the output of the Civil Engineering Laboratory, where Professor Dylmar Penteadó Dias was the pioneer in this area of research at UENF, began in 2002 and has maintained a constant output over the years. This consistency indicates a continuous commitment and evolution in his research, which can also be observed through the establishment of collaborative partnerships with other professors from the same Laboratory, further strengthening the development of the area of study.



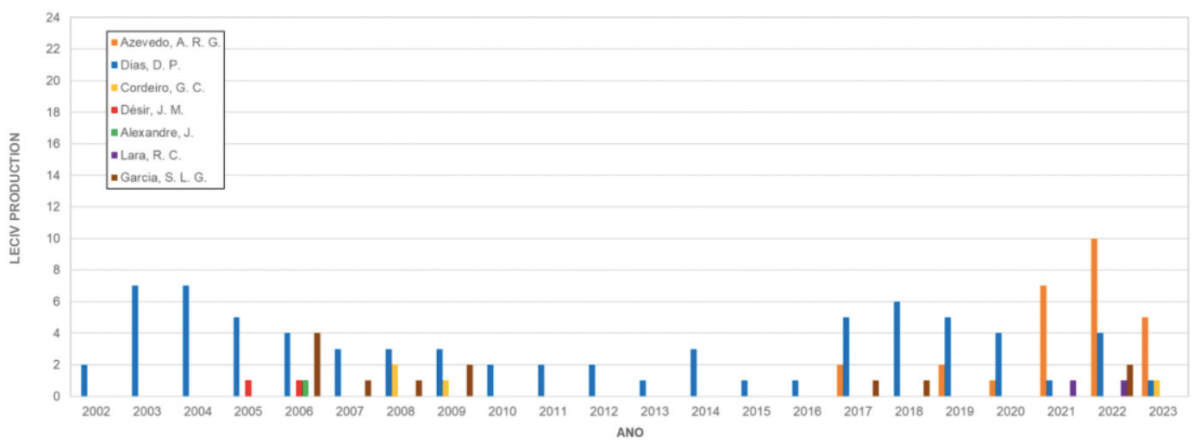
Graph 1 - Production of alkali-activated/geopolymeric materials by each laboratory.

Source: Developed by the authors (2024).



Graph 2 - Total production of alkali-activated/geopolymeric materials at UENF.

Source: Developed by the authors (2024).



Graph 3 - Production of LECIV teachers by year.

Source: Developed by the authors (2024).

Professor Afonso Rangel Garcez de Azevedo joined the Civil Engineering Laboratory in 2017. Since then, he has made a significant contribution to scientific production in this area, with a considerable amount of output. His recent involvement suggests a promising potential to positively impact research into alkali-activated/geopolymeric materials at UENF.

Graph 4 provides information on the geopolymer production of the professors at UENF's Advanced Materials Laboratory. It is noteworthy that Professor Ângelus Giuseppe Pereira da Silva was responsible for the start of production in this laboratory in 2011.

It is important to note that LAMAV's productions began through a collaboration with Professor Dylmar Penteadó Dias from LECIV, demonstrating the collaboration between professors and the transfer of knowledge at the University. This initial collaboration resulted in the paper entitled "Geopolymer Ca,Na,K-PSS as Ceramic Coating Anticorrosive", published at the 8<sup>th</sup> International Latin-American Conference on Powder Technology in 2011. In this sense, it was observed that, since 2016, there have been no productions by Professor Ângelus on the subject, since the research activities carried out in partnership with Professor Dylmar have ceased. This suggests a change in LAMAV's research dynamics over the years.

In this context, the significant performance of Professors Carlos Maurício Fontes Vieira and Afonso Rangel Garcez de Azevedo stands out. Both have made a significant contribution to the production of alkali-activated/geopolymeric materials, indicating a fundamental role in the continuity and advancement of research in this area.

The analysis of these graphs highlights not only the individual contribution of each professor to production on the subject, but also indicates an evolution over time in the involvement and engagement of researchers on the subject.

The State University of Northern Rio de Janeiro Darcy Ribeiro has a total of fifteen sectors focused on this specific area of research, which encompass a variety of productions, some already completed and others still in progress. For a better understanding, details of completed activities can be found in Table 2, while ongoing activities can be found in Table 3.

ACTIVITY COMPLETED		
SECTOR	LECIV	LAMAV
Research project	12	0
Technical production	0	1
Published book chapter	2	33
Full paper published in conference proceedings	30	27
Extension project	2	0
Patent	2	8
Full article published in a journal	27	36
Guidance and supervision: scientific initiation	12	2
Guidance and supervision: master's thesis	18	5
Guidance and supervision: doctoral thesis	3	6
Guidance and supervision: other	2	0
Guidance and supervision: undergraduate course completion work	0	1

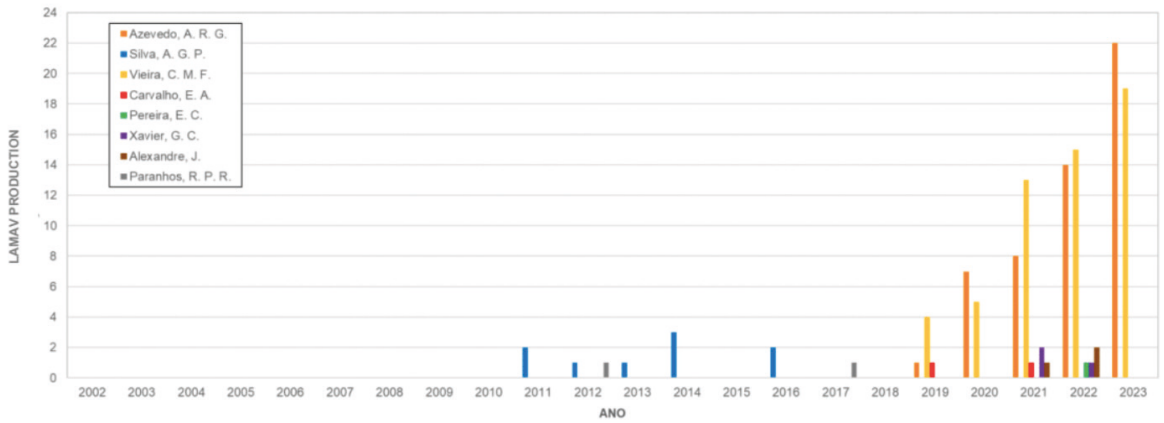
Table 2 - Productions completed by each Laboratory.

Source: Developed by the authors (2024).

ACTIVITY IN PROGRESS		
SECTOR	LECIV	LAMAV
Research project	7	0
Guidance and supervision: scientific initiation	2	2
Guidance and supervision: master's thesis	1	5
Guidance and supervision: doctoral thesis	0	2

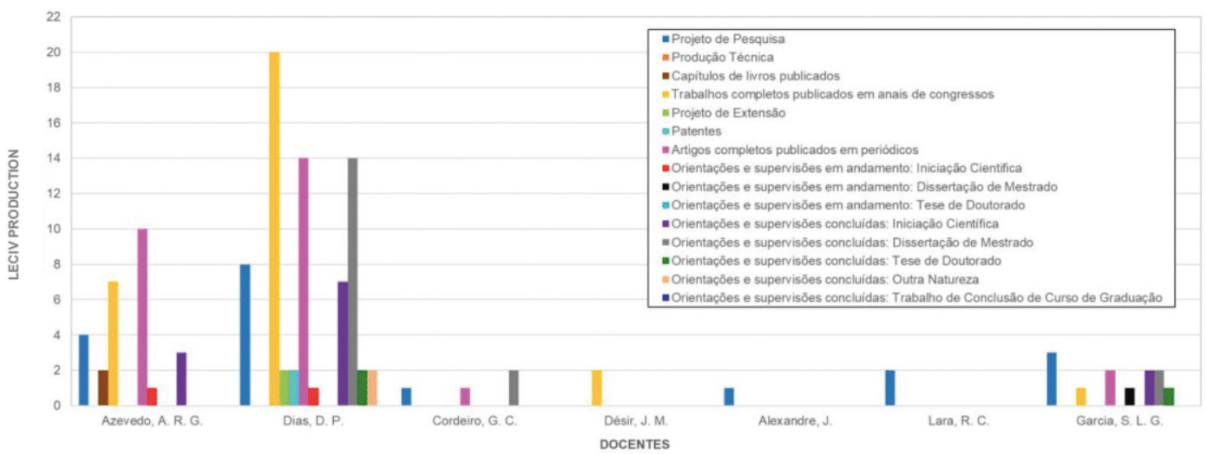
Table 3 - Ongoing productions by each Laboratory.

Source: Developed by the authors (2024).



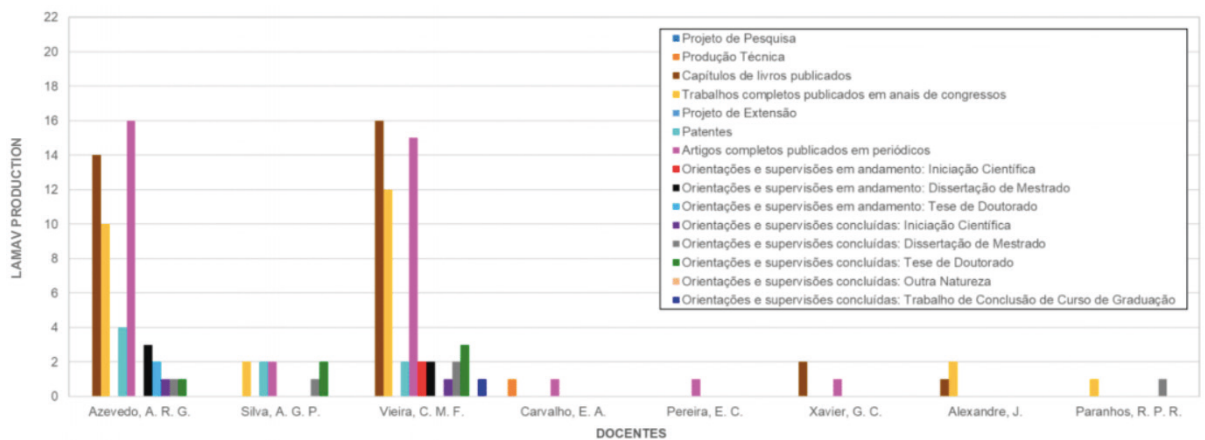
Graph 4 - Production of LAMAV teachers by year

Source: Developed by the authors (2024).



Graph 5 - Production of LECIV teachers in relation to sectors.

Source: Developed by the authors (2024).



Graph 6- Production of LAMAV teachers in relation to sectors.

Source: Developed by the authors (2024).



Table 2 details the activities completed in each laboratory, providing an overview of the history of research carried out to date. For example, LECIV records a total of 110 completed activities, and LAMAV has 119 completed activities. Both laboratories have a strong impact on this area of research.

Table 3 shows ongoing activities, indicating projects in progress and orientations that are still in progress. Thus, LECIV has 10 productions under development, while LAMAV has 9 productions, which shows a certain general balance between them, as well as in the activities completed.

Graphs were also drawn up (Graphs 5 and 6) which represent a fundamental step in understanding the dynamics of research at UENF, enabling a detailed analysis of the individual productions of each professor in relation to the established sectors. These graphs were designed to provide a clear perception of which sectors have aroused the greatest interest in each Laboratory and also among the professors.

Graph 5 shows the output of the Civil Engineering Laboratory (LECIV), highlighting the main lecturers and their areas of focus. It can be seen that professors Afonso Azevedo and Dylmar Dias have produced in various sectors at UENF.

Professor Dylmar Penteado Dias stands out for the number of full-length papers published in conference proceedings, followed by full-length articles published in journals and completed supervision and guidance, specifically master's dissertations. However, Professor Afonso Rangel Garcez de Azevedo has focused on producing full articles in journals, followed by full papers published in conference proceedings.

Graph 6 shows LAMAV's productions, in which Professors Afonso Rangel Garcez de Azevedo and Carlos Maurício Fontes Vieira stand out with a wider range of productions. Both have a common interest in full-length

articles published in journals, although Afonso has produced more in this sector. Next in line is the production of published book chapters, with this category of production being more significant for Professor Carlos Maurício.

A detailed analysis of these graphs reveals that most of LECIV's output is concentrated in full papers published in conference proceedings and guidelines. On the other hand, LAMAV's growth has been particularly notable in terms of the number of full articles published in journals. It is worth noting that mentoring students tends to be a longer process than publishing articles through partnerships, which contributes to the difference in the amount of production between the two laboratories.

Because of this observation, in order to analyze this growth, a survey of full articles published in journals in the last five years (2019 to 2023) was carried out, as shown in Table 4, which includes the challenging period of the Covid-19 pandemic.

Of the 13 professors involved in research into alkali-activated/geopolymeric materials over the last five years, only six have published articles in journals. Of these, one professor had a production linked to LECIV, while four are associated with LAMAV. Notably, Professor Afonso Rangel Garcez de Azevedo has published in both laboratories. It should also be noted that LECIV had 15 publications in journals and LAMAV had 34 publications, as shown in Table 4.

TEACHER	LECIV	LAMAV
Azevedo, A. R. G.	10	16
Vieira, C. M. F.	0	15
Dias, D. P.	5	0
Carvalho, E. A.	0	1
Pereira, E. C.	0	1
Xavier, G. C.	0	1

Table 4 - Production of articles published in journals by teachers.

Source: Developed by the authors (2024).

Despite Professor Afonso's significant output at LECIV, it is clear that the Advanced Materials Laboratory is currently the main player in this field, as highlighted above. This is evidenced by the significant contribution of Professors Afonso Azevedo and Carlos Maurício Vieira, who have considerably more articles published in journals than their peers. This disparity in production between the laboratories underscores the importance of LAMAV in the alkali-activated materials research scenario at UENF.

In order to examine the individual performance of the professors, Graph 7 was drawn up with the aim of understanding the evolution of each researcher over time. The graphic visualization of the data simplifies the identification of the variation in the production of each professor over the years, enabling a more detailed analysis and a broader understanding of the panorama of this area of research.

Graph 7 shows not only the total number of papers produced by researchers at UENF, but also the distribution of these papers by laboratory. It can be seen that, as with scientific production in general, the pandemic period (2020-2021) proved to be favorable for the publication of articles. This is partly due to the fact that many researchers had completed the laboratory stages of their experimental research, which favored high publication performance.

It is worth noting that in 2019 there was only one publication; however, in subsequent years there has been a notable increase. The year 2020 saw six publications, while 2021 saw a significant increase, with nineteen publications, and in 2022 this number remained high, with eighteen publications, almost the same rate as the previous year.

However, in 2023, despite previous data indicating notable growth in the study of alkali-activated/geopolymeric materials at

UENF, there was a drop in the number of articles published in journals. This is due to the fact that the main focus in 2023 was directed towards other research sectors. There were only 5 articles published, while there were 19 papers published in journals, 17 book chapters published, as well as 1 patent, 1 research project, 2 completed supervisions (master's dissertation), as well as 1 ongoing supervision of a master's dissertation, 1 scientific initiation and 1 doctoral thesis.

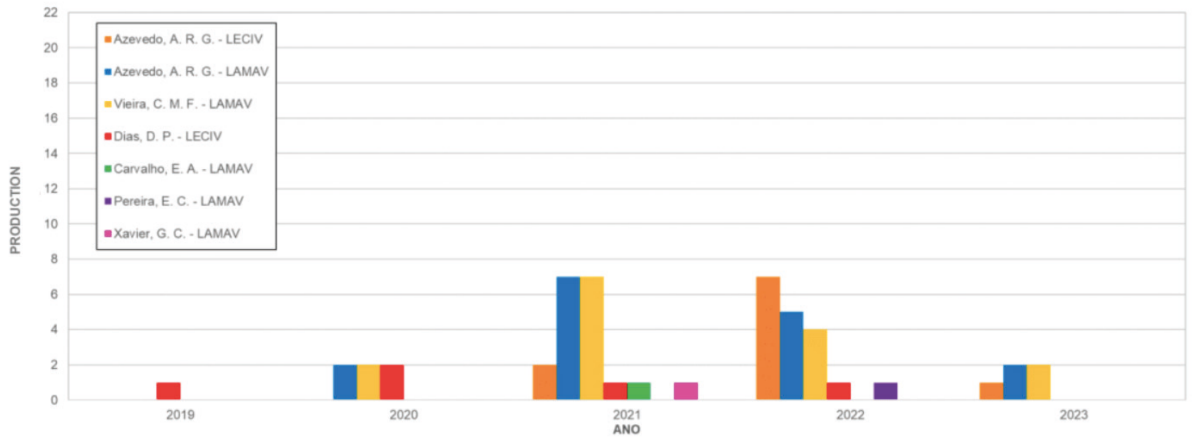
A survey was also carried out of the leading journals in which papers related to the topic were published. In this context, 15 journals were identified, both national and international, as shown in Table 5 and Graph 8.

The purpose of this survey was to analyze the main options available for disseminating research results, thus serving to guide authors in identifying the most suitable vehicles for disseminating their scientific work.

REVIEW	LECIV	LAMAV
Biomass Conversion and Biorefinery	1	0
Case Studies in Construction Materials	8	11
Ceramics International	0	2
Cleaner Materials	1	0
Construction and Building Materials	1	3
Engineering Research Express	1	0
International Journal of Applied Ceramic Technology	0	4
Journal of Building Engineering	0	4
Journal of Materials Research and Technology	0	4
Materials	1	2
Materials Research Express	1	0
Polymers	0	2
IBRACON Journal of Structures and Materials	0	2
Theoretical and Applied Fracture Mechanics	1	0

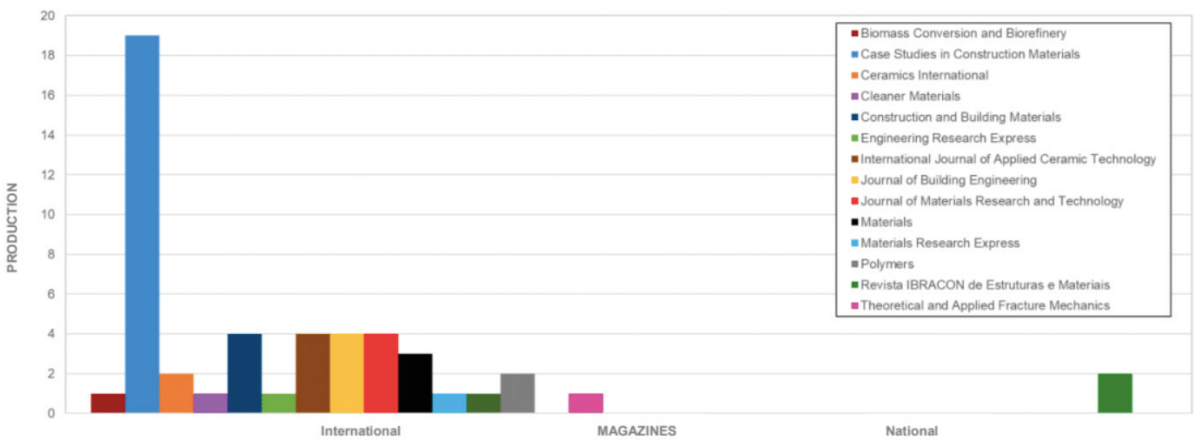
Table 5 - Journals chosen for publications in periodicals.

Source: Developed by the authors (2024).



Graph 7 - Production of each teacher per year in terms of publications in journals.

Source: Developed by the authors (2024).



Graph 8 - National and international journals with papers published on alkali-activated/geopolymeric materials.

Source: Developed by the authors (2024).

These journals play a crucial role in the academic landscape, serving as vehicles for the dissemination of scientific knowledge and the exchange of ideas between researchers and academics around the world.

The presence of national and international journals reflects the consideration of different contexts and audiences, offering a comprehensive view of the publication opportunities available to researchers involved in the subject. While national journals can offer and contribute to the advancement of knowledge for a local/regional audience, international journals provide greater visibility and opportunities for collaboration on a global scale.

As a result of this investigation, Case Studies in Construction Materials stands out as the journal with the largest number of articles, totaling 19 productions from both LECIV and LAMAV. It is worth noting that this is an international publication, thus expanding the reach and visibility of the research carried out at UENF. On the other hand, there was only one Brazilian journal, Revista IBRACON de Estruturas e Materiais, among the options available at LAMAV, suggesting a greater predominance of international publications in this research environment.

In order to investigate the connections established for the publications of articles in journals, a bibliographic map was drawn up using a co-authorship network analysis, as shown in Figure 1. This methodology makes it possible to identify the way in which authors are interconnected, according to the number of publications together.

To carry out this analysis, the results obtained from the Web of Science were used, applying specific filters, such as the period from 2019 to 2023 and specific keywords, as described in the methodology of this article. The data collected was processed using the VOSviewer *software*. During this process, it was necessary to standardize the names of authors due to the use of different nomenclatures to identify them in the academic-scientific environment.

The circles on the map represent the authors, and the size of each circle indicates the number of publications made by the respective author in the sample analyzed. The lines, in turn, represent the collaborations established between the authors, highlighting the interactions and partnerships in scientific production.

In the analysis of researchers involved in studies on alkali-activated/geopolymeric materials, Afonso Rangel Garcez de Azevedo and Carlos Maurício Fontes Vieira, professors at LAMAV/UENF, stand out, along with Markssuel Teixeira Marvila (UFV) and Sérgio Neves Monteiro (IME).

Markssuel Teixeira Marvila is currently at the Federal University of Viçosa (UFV), but works as a collaborating professor at UENF. He also did his undergraduate and master's degrees at LECIV/UENF and his doctorate at LAMAV/UENF. Sérgio Neves Monteiro, on the other hand, is currently working at the Military Engineering Institute (IME), but was a lecturer at LAMAV/UENF from 1994 to 2012.

It should be noted that LAMAV has established partnerships both nationally

and internationally, which is reflected in the significant number of scientific productions. In contrast, LECIV's partnerships are predominantly internal, limiting the scope and variety of collaborations and research projects within the institution itself. This difference in the scope of partnerships directly influences the quantity and quality of scientific output from each laboratory.

Collaborations with foreign authors on various research projects have had a considerable impact on the production of articles and the establishment of international partnerships. This engagement not only enriches UENF's academic-scientific panorama, but also promotes visibility and global recognition of the research carried out. Therefore, the involvement of these foreign researchers could lead to a significant increase in scientific production on the subject in the short term.

## FINAL CONSIDERATIONS

The bibliometric analysis carried out on alkali-activated/geopolymeric materials at the Universidade Estadual do Norte Fluminense Darcy Ribeiro (UENF), specifically at the Civil Engineering (LECIV) and Advanced Materials (LAMAV) Laboratories, revealed a series of relevant aspects that contribute to a more in-depth understanding of the research scenario in this area.

The research conducted in this study provided a comprehensive view of the academic output of professors at the State University of Northern Rio de Janeiro Darcy Ribeiro (UENF), highlighting not only the quantity, but also the quality and trajectory of research over time. Professors such as Dylmar Penteadó Dias, Afonso Rangel Garcez de Azevedo and Carlos Maurício Fontes Vieira emerge as leaders in this scenario, with their ongoing commitment and collaborative partnerships, making a significant contribution to progress in this area.

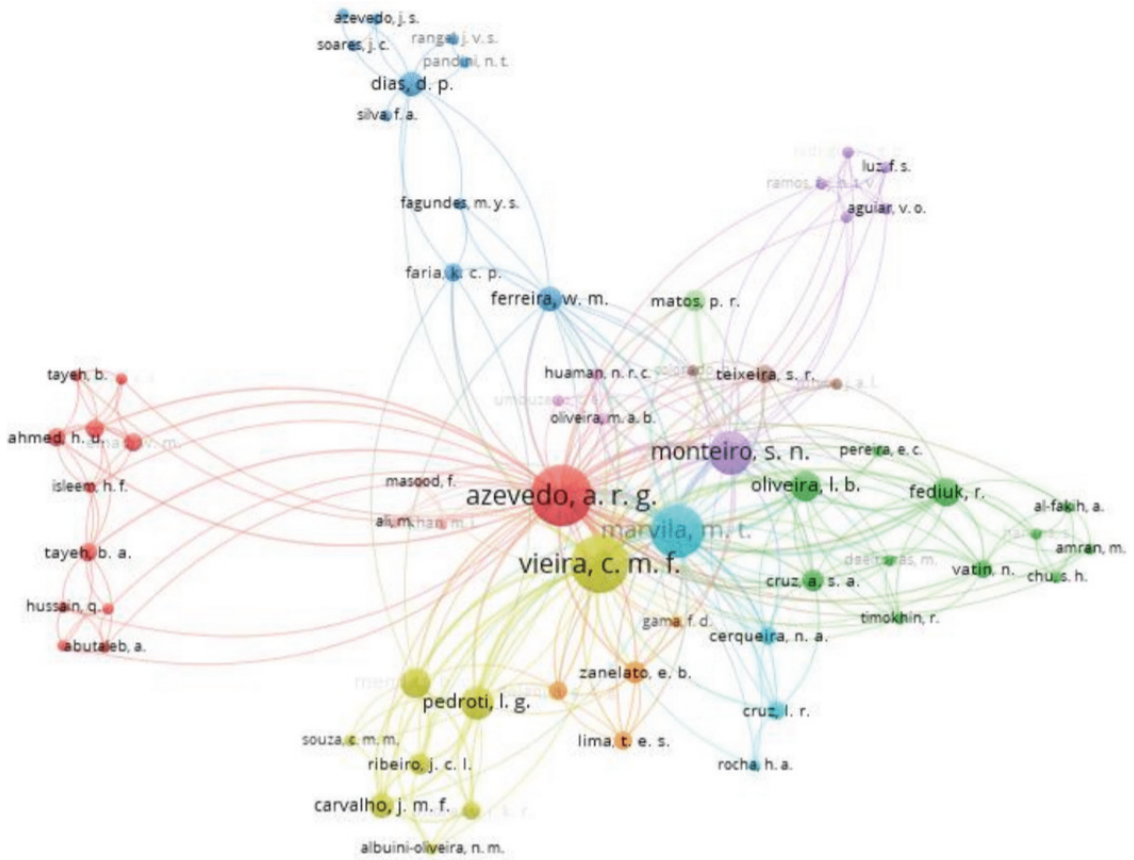


Figure 1 - Bibliographic map of publications in journals. Source: Developed by the authors (2024).

It is clear that the Civil Engineering Laboratory (LECIV) began its activities on the subject in 2002, while the Advanced Materials Laboratory (LAMAV) only began in 2011. Although LAMAV began its work later, it is noteworthy that this laboratory has more work than LECIV, especially in terms of the number of full articles published in journals.

In addition, it was found that most of the LECIV professors' work is done in collaboration with Professor Dylmar Penteado Dias. On the other hand, the activities at LAMAV also began with partnerships signed with this professor, demonstrating the relevance and impact of this collaboration on the academic scene at UENF.

It is worth noting that the Covid-19 pandemic has had a significant impact on scientific production, boosting publications, as evidenced by the data obtained.

Identifying the main journals of note for the publication of work related to the theme provides valuable guidance for researchers in choosing the most appropriate vehicle for disseminating their results. The presence of international journals, such as *Case Studies in Construction Materials*, reflects the recognition and relevance of the research carried out at UENF on a global scale.

The collaborations established between researchers, both at UENF and at foreign institutions, stand out as fundamental elements for the advancement of scientific knowledge. Through these collaborations, researchers have the opportunity to share knowledge, experiences and resources, thus enriching the development of studies and projects on the subject in question.

Finally, in this context of collaboration and scientific progress, it was possible, through this research, to come to the conclusion that interest in alkali-activated/geopolymeric materials has increased over time. This growth is significant, since these materials have important properties, such as mechanical strength, durability and the ability to withstand adverse conditions, making them suitable for application in various sectors of the construction industry. As a result, this phenomenon is driving the incessant search for unconventional materials and technologies

that are more sustainable and have a lower environmental impact, as well as contributing to innovation and development in different areas of industry and academia in Brazil.

## THANKS

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