

## **Bibliometric analysis on the incorporation of tire waste into gypsum composites**

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## **Análise bibliométrica sobre a incorporação de resíduos de pneus em compósitos de gesso**

### **RESUMO**

**Objetivo** – O objetivo do trabalho consistiu em realizar uma revisão bibliométrica acerca de pesquisas experimentais sobre a utilização de resíduos de borracha provenientes de pneus inservíveis em compósitos à base de gesso.

**Metodologia** – As etapas que orientaram o desenvolvimento da pesquisa consistiram na definição da *string* para busca nas plataformas Scopus e Web of Science, utilização do protocolo PRISMA para seleção e inclusão de artigos da amostra e utilização de ferramentas para organização dos dados extraídos.

**Originalidade/relevância** – O trabalho demonstrou escassez de estudos científicos sobre a temática, indicando que compósitos de gesso e borracha têm expectativas relevantes para o desenvolvimento de pesquisas futuras.

**Resultados** – A inclusão do tópico compósitos de gesso-borracha em pesquisas científicas é considerada recente, com a maioria dos artigos publicados a partir de 2020, sendo a Espanha o país predominante nas produções da temática.

**Contribuições teóricas/metodológicas** – Fornece, por meio de dados bibliométricos, uma visão da situação atual de pesquisas sobre materiais à base de gesso e borracha, produzidos visando à sustentabilidade e aos critérios de economia circular no setor da construção civil.

**Contribuições sociais e ambientais** – Demonstra um meio de investigação para mitigar impactos ambientais ocasionados pelo volume exacerbado acumulado e consequente do descarte inadequado de pneus usados.

**PALAVRAS-CHAVE:** Dados quantitativos. Pneus em fim de vida. Gesso.

## **Bibliometric analysis on the incorporation of tire waste into gypsum composites**

### **ABSTRACT**

**Objective** – This study aimed to conduct a bibliometric review of the experimental research on the use of rubber waste from end-of-life tires in gypsum-based composites.

**Methodology** – The steps that guided this research consisted of defining the search string on the Scopus and Web of Science platforms; using the PRISMA protocol to select and include the articles in the sample of this study and using tools to organize the extracted data.

**Originality/Relevance** – This study showed the scarcity of scientific studies on the subject, indicating that gypsum and rubber composites hold significant promise for future research.

**Results** – The inclusion of gypsum-rubber composites in scientific research is considered recent, with most articles published from 2020 onward and Spain publishing most studies on the subject.

**Theoretical/Methodological Contributions** – Its bibliometric data offers an overview of the current state of research on sustainable gypsum and rubber-based materials produced with circular economy criteria in civil construction.

**Social and Environmental Contributions** – It shows a means of investigation to mitigate environmental impacts caused by the excessive accumulated volume and improper disposal of used tires.

**KEYWORDS:** Quantitative data. End-of-life tires. Gypsum.

## **Análisis bibliométrico sobre la incorporación de residuos de neumáticos en compuestos de yeso**

### **RESUMEN**

**Objetivo** – El objetivo del trabajo consistió en realizar una revisión bibliométrica sobre investigaciones experimentales sobre el uso de residuos de caucho procedentes de neumáticos inservibles en compuestos a base de yeso.

**Metodología** – Las etapas que guiaron el desarrollo de la investigación consistieron en la definición de la cadena de búsqueda en las plataformas Scopus y Web of Science, el uso del protocolo PRISMA para la selección e inclusión de artículos de la muestra y el uso de herramientas para la organización de los datos extraídos.

**Originalidad/Relevancia** – El trabajo demostró la escasez de estudios científicos sobre el tema, indicando que los compuestos de yeso y caucho tienen expectativas relevantes para el desarrollo de investigaciones futuras.

**Resultados** – La inclusión del tema «compuestos de yeso y caucho» en las investigaciones científicas se considera reciente, ya que la mayoría de los artículos se han publicado a partir de 2020, siendo España el país predominante en las producciones sobre este tema.

**Contribuciones Teóricas/Metodológicas** – Proporciona, mediante datos bibliométricos, una visión de la situación actual de las investigaciones sobre materiales a base de yeso y caucho, producidos con criterios de sostenibilidad y economía circular en el sector de la construcción civil.

**Contribuciones Sociales y Ambientales** – Demuestra un medio de investigación para mitigar los impactos ambientales causados por el volumen acumulado excesivo y la consiguiente eliminación inadecuada de neumáticos usados.

**PALABRAS CLAVE:** Datos cuantitativos. Neumáticos al final de su vida útil. Yeso.

## 1 INTRODUCTION

The current population growth implies an increase in the need for vehicles and the production of tires. Estimates suggest that 1.5 billion tons of end-of-life tires (ELTs) are generated worldwide each year (Bianco; Panepinto; Zanetti, 2021). Brazil discards 100 million such units annually (Scanavacca Júnior, 2025) due to natural tread wear, accidents, punctures, among other reasons.

End-of-life tires have been traditionally disposed of in landfills. However, when disposed of in nature, they take around 600 years to decompose, causing environmental problems such as the contamination of water bodies by microplastics and the proliferation of disease-carrying mosquitoes due to water accumulation (Keber; Borges; Bortuluci, 2025). Moreover, tire rubber has inflammable components that can cause fires under improper storage conditions, negatively impacting human health and emitting gases into the atmosphere (Rigotti; Dorigato, 2022; Tran *et al.*, 2022). Therefore, the most sustainable option for managing this solid waste is to recycle and reuse it in the manufacture of new products.

According to Landi *et al.* (2018), the main materials generated during tire reprocessing are rubber (47%), steel (12%), and textile fibers (10%). Tire retreading also produces rubber waste in abundance (Pereira; Fazzan; Freitas, 2015). Thus, because it corresponds to a predominant residual fraction, the reintegration of this waste into the production chain often uses rubber.

The construction industry is moving toward the integration of circular economy models to reduce the amount of waste generated and mitigate incorrect final disposal (Zaragoza-Benzal *et al.*, 2024a). The sector has introduced various types of waste into alternative construction materials, including rubber, exploiting its good elastic properties, low density, and chemical stability. Most research focuses on the manufacture of cementitious composites, such as concrete, mortar, and paste, for structural, non-structural, and self-compacting applications (Herrero; Mayor; Hernández-Olivares, 2013).

Thomas, Gupta, and Panicker (2016) have analyzed the durability of concrete with waste from ELTs, replacing up to 20% of the fine aggregate with rubber. Their results showed that concrete containing waste has high resistance to aggressive environments, especially in areas subject to acid attacks. Similarly, the coating mortars in Kazmierczak *et al.* (2020), although their compressive strength and modulus of elasticity decreased with the increase in the replacement of sand by granulated rubber waste, showed a reduction in the emergence of cracks and maintained adhesion to the ceramic substrate and tensile strength when compared to the reference even after accelerated aging cycles.

Other eco-friendly materials made from tire polymers are also being studied, such as the manufacture of three-layer wood particle boards (Mancel *et al.*, 2025) and asphalt mixtures (Picado-Santos; Capitão; Neves, 2020). These studies have shown the viability of using rubber, offering possibilities for improving the characteristics of composites and decreasing the consumption of original raw materials. Especially for asphalt pavements, these novel composites may reduce preservation and maintenance costs throughout their life cycle.

In turn, humanity has widely used gypsum, a natural organic binder, since the dawn of time due to its excellent acoustic properties, hygrothermal regulation of walls, reaction to fire,

ease to mold, and quick to harden. However, it has some disadvantages depending on the type of application, such as its fragility, susceptibility to water, and rapid degradation (Río-Merino *et al.*, 2022; Serna *et al.*, 2012). Thus, some manufacturers use additives to overcome the adverse properties of gypsum, such as settings retarders and water repellents. Similarly, researchers have evaluated the use of waste materials to reinforce gypsum, such as gypsum waste itself, natural and synthetic fibers, expanded and extruded polystyrene, agricultural and industrial by-products, wood waste, and polymeric materials.

Regarding the use of tire rubber waste in gypsum matrices, Pinto *et al.* (2020) have investigated composites with particles in differing proportions (5%, 10%, and 15% by volume) and particle sizes (coarse: < 1.19 mm; fine < 0.6 mm). Their results showed a decrease in density as the rubber content increases, especially in panels with fine particles due to their greater porosity. Composites with 5% rubber showed mechanical strength similar to the control. However, those with 15% had a gradual decrease in flexural and compressive strength. According to the authors, this reduction is associated with lower adhesion between the gypsum paste and the rubber particles, according to morphological analysis using scanning electron microscopy (SEM).

Zaragoza-Benzal *et al.* (2023) combined shredded rubber with recycled mineral wool fibers to produce lighter composites. They observed a decrease in thermal conductivity of up to 30% in items with secondary raw materials when compared to the reference dosage, and better performance due to the action of water, with a decrease in capillarity height and water vapor permeability. They validated the use of the developed materials by the production of prefabricated blocks for covering walls and internal partitions. Furthermore, that study recommended its material as a possible application for humid environments and an alternative to improve the energy efficiency of the built space.

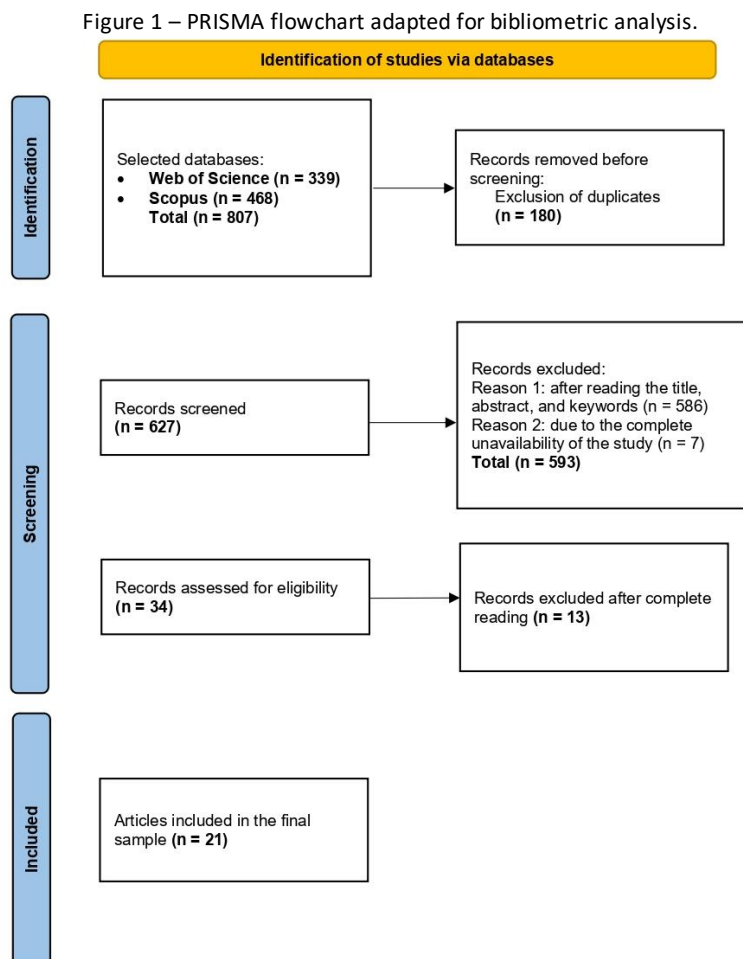
Ferrández *et al.* (2025) evaluated the recyclability of prefabricated gypsum with rubber aggregates. Although they observed a progressive decrease in mechanical resistance with an increase in the proportion of rubber, all obtained values exceeded the minimum requirements of the current European standard. Furthermore, their physicochemical characterization showed the recyclability of crushed dihydrate via heat treatment to obtain hemihydrate, retrieving the binder for new cycles of use.

In parallel, a bibliometric review consists of analyzing scientific publications in existing literature in a quantitative, statistical, and descriptive manner, identifying the most relevant and influential elements in a well-established field and enabling researchers to find gaps in knowledge, describe new research ideas, and position their contributions (Celestino *et al.*, 2024; Donthu *et al.*, 2021). Thus, it is essential to review previous studies that address the manufacture of different types of gypsum-based materials incorporating tire rubber to the evolution of studies and understand global research trends on the subject. At the time of this review, no previous studies related to the collection of quantitative data on the topic were found.

Thus, this study aimed to carry out a bibliometric review using multiple databases on experimental research that incorporated tire rubber waste into gypsum-based composites.

## 2 METHODOLOGY

According to Marlés-Sáenz *et al.* (2025), bibliometric analyses provide a detailed and up-to-date overview of a topic, identifying emerging areas and scientific advances and ensuring structured investigations of academic knowledge. Pimenta *et al.* (2017) have mentioned that these studies are based on quantitative and statistical methods. Thus, bibliometric reviews are essential for researchers to understand their research topics throughout their careers. They can also formulate qualitative discussions regarding bibliographic reviews and their results. To achieve its proposed objective, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol was applied in this study as it ensures analysis transparency and reliability. This methodology includes the identification, selection, and eligibility of the relevant literature according to predefined criteria to include articles in final sample. The flowchart below (Figure 1) represents the PRISMA steps.



Source: Prepared by the authors (2026).

In December 2025, searches were conducted on Scopus and Web of Science as these databases contain representative amounts of international scientific documents and references. Keywords and terms related to gypsum and tire rubber composites and Boolean operators were

used, forming the search string: (plaster\* OR gypsum\*) AND (rubber\* OR “tire rubber” OR “end-of-life tire” OR “rubber residu\*” OR “rubber waste”).

Document screening consisted of two stages: (1) reading of their titles, abstracts, and keywords and (2) the full reading of the articles. This process was adopted to obtain information on the relationship between the main objectives, materials, methods, and results in the chosen studies on the proposed theme.

The following were chosen as inclusion criteria: scientific articles that have been published in journals or conference proceedings, with no limit on the year of publication, in English, Portuguese, and Spanish describing experimental research on gypsum materials and tire rubber waste, i.e., laboratory research that considered the influence of rubber incorporation on the technical performance of composites, such as characteristics in the plastic state, physical-mechanical and thermo-acoustic properties, which may or may not have included analyses of the economic and environmental feasibility of the new materials manufactured. Duplicates, off-topic research, unavailable articles, and publications that failed to meet the aforementioned requirements were excluded from this review.

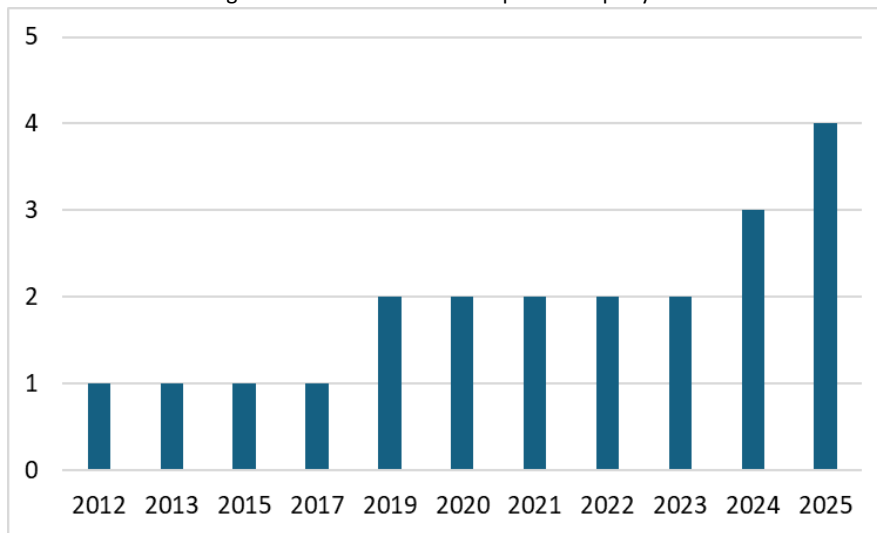
This study was developed with support from the literature in Ribeiro and Soares (2025), Sobral *et al.* (2025), and Fioriti, Bartholomei, and Tsutsumoto (2024). The data in the retrieved articles were extracted according to the following categories: (1) number of articles published per year; (2) journals of publication; (3) number of articles published by the main authors; (4) a map showing authors' countries of affiliation; (5) articles published in Qualis CAPES A1–A4 journals; and (6) correlations between terms and keywords. Moreover, Microsoft Excel was used to organize the extracted data into spreadsheets and construct graphs. VOSviewer, Quantum Geographic Information System (QGIS), and Mendeley software were used to create the keyword co-occurrence figure, the map of authors' countries of affiliation, and the configuration of bibliographic references, respectively.

### 3 RESULTS

A total of 21 articles were included in the final sample, 19 of which were published in English and 2 in Spanish. Note the small number of publications when compared to other reviews sample size. For example, the bibliometric survey by Braz and Braz (2020) on green roof applications in Brazil included 65 scientific studies. Fioriti, Bartholomei and Tsutsumoto (2024) analyzed quantitative data from 143 publications on the use of tire rubber in cementitious composites. The scientometric review by Arvizu-Montes and Martinez-Echevarria (2025) on vegetable fibers considered 240 publications, showing a small number of studies related to the production of gypsum-rubber composites.

The first analysis performed aimed to find the number of articles published per year (Figure 2).

Figure 2 – Number of articles published per year.

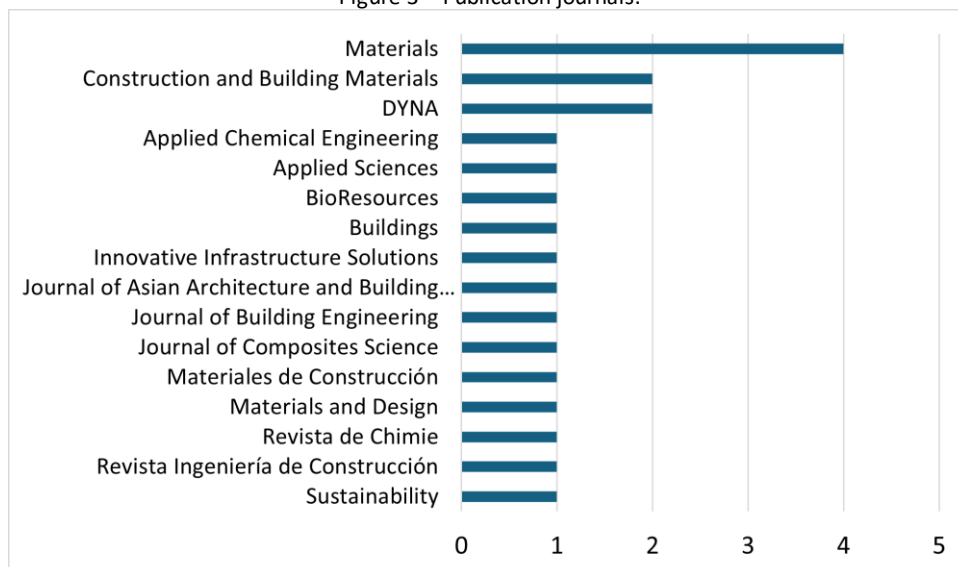


Source: Prepared by the authors (2026).

Figure 2 shows that the time frame for the chosen publications ranges from 2012 to 2025, with a progressive annual increase over the last three years. The peak in publications occurred in 2025, with about 19% of articles. Serna *et al.* (2012) were pioneers in researching gypsum and rubber composites. However, about 71% of the retrieved articles were published after 2020, indicating that the inclusion of this topic in academic studies constitutes a relatively recent phenomenon, which provides an opportunity for the consolidation of new research on the subject.

The graph in Figure 3 illustrates the number of publications per journal.

Figure 3 – Publication journals.



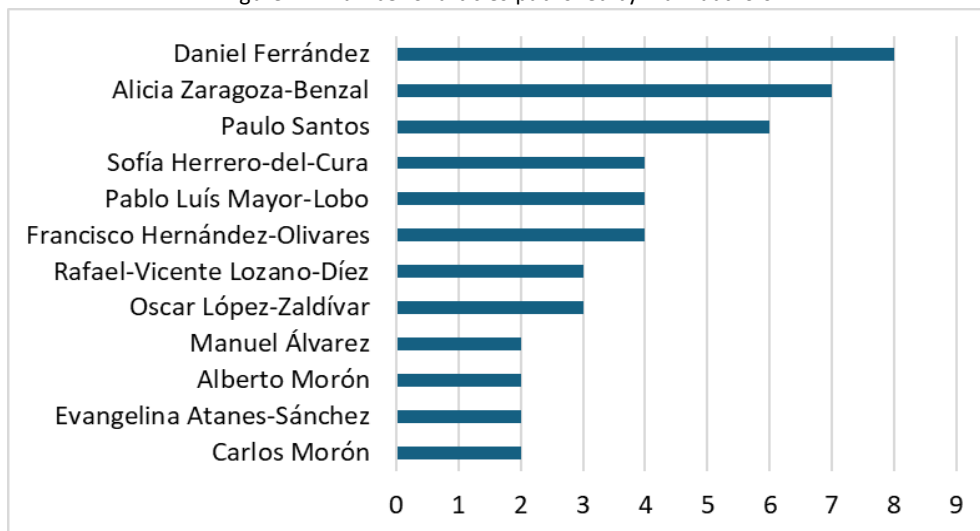
Source: Prepared by the authors (2026).

The journal Materials stands out for its four articles in the sample of this review, followed by Construction and Building Materials and DYNA (with three articles each). The

remaining journals had one publication each, showing diverse sources of publications on the topic. The journals encompass various fields of knowledge, such as Engineering, Materials Science, Applied Natural Sciences, Sustainable Development, Architecture, and Data Science. Thus, the interdisciplinary nature of the subject corroborates the importance of exploring gypsum and tire rubber composites.

Moreover, this investigation found 54 authors in the articles in the analyzed sample. Notably, Figure 4 only shows the main authors (those with two or more publications).

Figure 4 – Number of articles published by main authors.

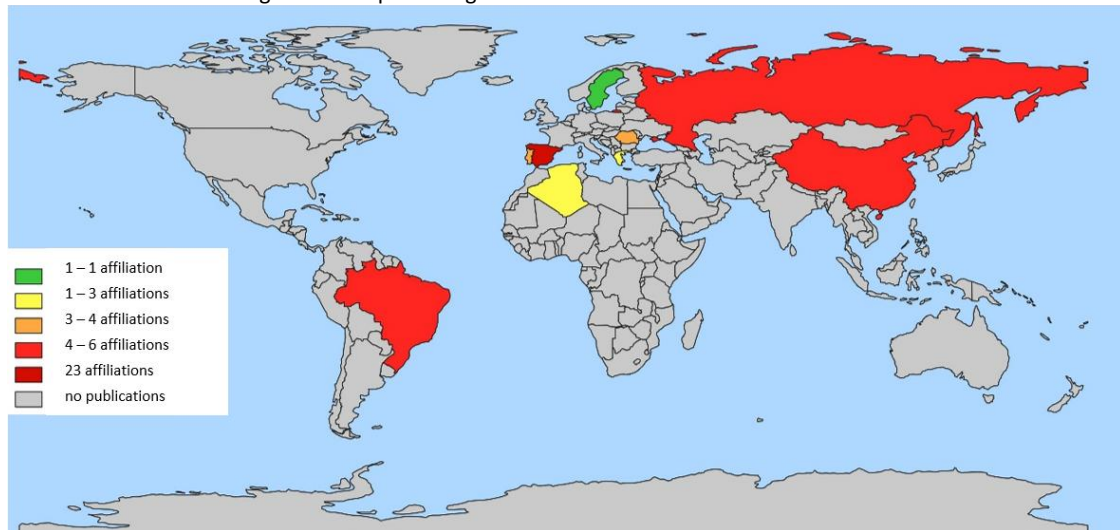


Source: Prepared by the authors (2026).

Figure 4 shows Daniel Ferrández as the most prolific author (eight studies), followed by Alicia Zaragoza-Benzal and Paulo Santos (with seven and six publications, respectively). Moreover, three authors had four publications; two, three publications; and four, two publications. Except for Paulo Santos, all authors in Figure 4 were affiliated with Spanish universities and institutions, most of whom collaborated with each other in their research.

Another factor in this analysis refers to authors' country of affiliation (Figure 5).

Figure 5 – Map showing the countries of affiliation of the authors.



Source: Prepared by the authors (2026).

The number of occurrences for each country corresponds to the affiliation of each of the 54 authors in the 21 studies in the sample of this review. This research found nine countries, with Spain leading the studies related to gypsum-rubber composites, with 23 affiliated authors. This may stem from the more widespread use of gypsum in Europe. According to Eurogypsum (2025), 1.5 billion square meters of interior surfaces in buildings in Europe are covered with mortar or plasterboard, as well as prefabricated panels and blocks. Furthermore, European countries are subject to various incentive policies and regulations on the management and reuse of municipal solid waste, which includes ELTs, as highlighted by Zaragoza-Benzal *et al.* (2025). Thus, research on gypsum and rubber composites tends to be more widely explored in this region. Nevertheless, China had six affiliations, followed by Brazil and Russia, with five affiliations each, Portugal and Romania, with four, and Algeria and Greece with three. Finally, Sweden only showed one affiliation.

Table 1 describes studies in the Brazilian Federal Agency for Support and Evaluation of Graduate Education A1-A4 Qualis Periódicos for 2021–2024. It also highlights the titles of the articles and the number of citations they had received up to the date of the search. According to Amorim (2023), Qualis Periódicos measures the quality of articles and other types of scientific dissemination by evaluating their vehicles of dissemination. Of the 21 articles in the sample, 14 had their journals ranked as tops performers (A1 to A4) in the indicated period, with A1 being the highest rating a journal can receive, observed in four studies. Herrero, Mayor, and Hernández-Olivares (2013) stand out as the most cited, accounting for about 37% of the citations in Table 1.

Table 1 - Articles published in journals with Qualis CAPES A1 to A4 (Part 1).

Authors (Year)	Article titles	Journal	Qualis CAPES (2021–2024)	Number of citations
Ferrández <i>et al.</i> (2025)	Study of Different Recycling Approaches for Gypsum-Based Composites with Recycled Rubber Aggregates	<i>Buildings</i>	A4	0
Zaragoza-Benzal <i>et al.</i> (2025)	Upcycling Automobile End-of-Life Tires for Development and Characterization of Circular Plasterboards	<i>Sustainability</i>	A3	0
Ferrández <i>et al.</i> (2024)	Eco-Design and Characterization of Sustainable Lightweight Gypsum Composites for Panel Manufacturing including End-of-Life Tyre Wastes	<i>Materials</i>	A3	10
Zaragoza-Benzal <i>et al.</i> (2024a)	Development and characterization of new lightweight waste-based plaster composites for building applications	<i>Journal of Building Engineering</i>	A1	8
Zaragoza-Benzal <i>et al.</i> (2024b)	Water Resistance Analysis of New Lightweight Gypsum-Based Composites Incorporating Municipal Solid Waste	<i>Journal of Composites Science</i>	A2	3
Zaragoza-Benzal <i>et al.</i> (2023)	Recovery of End-of-Life Tyres and Mineral Wool Waste: A Case Study with Gypsum Composite Materials Applying Circular Economy Criteria	<i>Materials</i>	A3	16
Álvarez <i>et al.</i> (2022)	Performance Characterisation of a New Plaster Composite Lightened with End-of-Life Tyres' Recycled Materials for False Ceiling Plates	<i>Materials</i>	A3	20

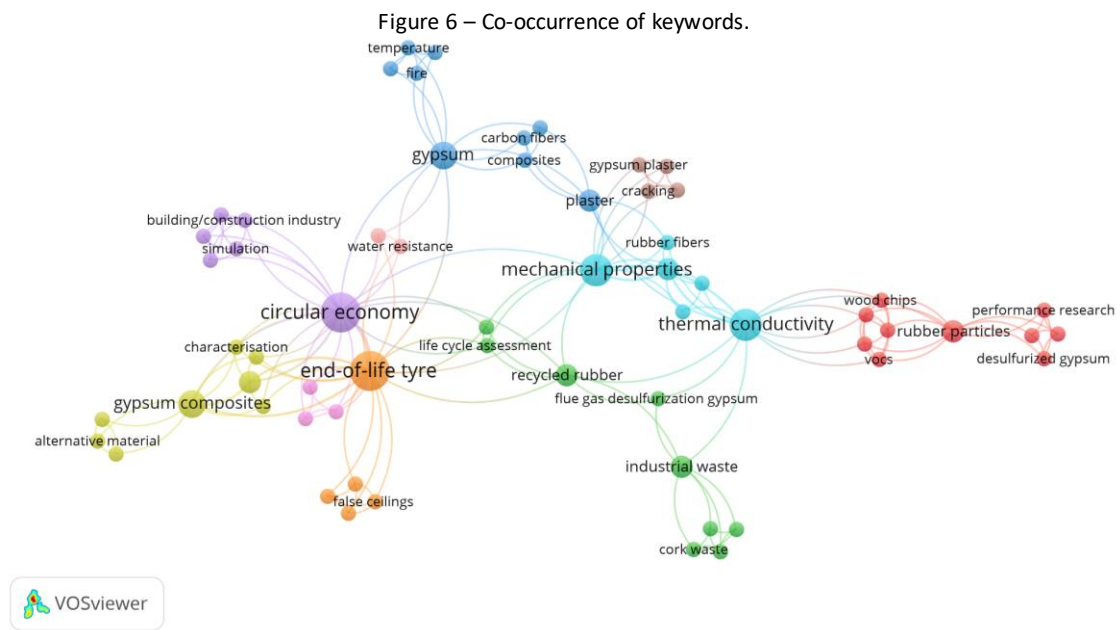
Source: Prepared by the authors (2026).

Table 1 - Articles published in journals with Qualis CAPES A1 to A4 (Part 2).

Authors (Year)	Article titles	Journal	Qualis CAPES (2021–2024)	Number of citations
Castellóna, Ayalaa, and Lanzón (2022)	Influence of tire rubber waste on the fire behavior of gypsum coatings of construction and structural elements	<i>MATERIALES DE CONSTRUCCIÓN</i>	A4	17
Lozano-Díez <i>et al.</i> (2021)	Mechanical Behavior of Plaster Composites Based on Rubber Particles from End-of-Life Tires Reinforced with Carbon Fibers	<i>Materials</i>	A3	17
Meddah, Laoubi, and Bederina (2020)	Effectiveness of using rubber waste as aggregates for improving thermal performance of plaster-based composites	<i>Innovative Infrastructure Solutions</i>	A3	21
López-Zaldívar <i>et al.</i> (2017)	Effects of water absorption on the microstructure of plaster with end-of-life tire rubber mortars	<i>Construction and Building Materials</i>	A1	42
Adamopoulos <i>et al.</i> (2015)	Manufacturing and Properties of Gypsum-Based Products with Recovered Wood and Rubber Materials	<i>BioResources</i>	A3	24
Herrero, Mayor, and Hernández-Olivares (2013)	Influence of proportion and particle size gradation of rubber from end-of-life tires on mechanical, thermal and acoustic properties of plaster-rubber mortars	<i>Materials and Design</i>	A1	144
Serna <i>et al.</i> (2012)	Improvement of gypsum plaster strain capacity by the addition of rubber particles from recycled tyres	<i>Construction and Building Materials</i>	A1	70

Source: Prepared by the authors (2026).

Keywords are essential components for describing the central idea and relevant insights of a study (Li *et al.*, 2016). Figure 6 shows the co-occurrence of keywords and terms in the articles in the sample of this review.



Source: Prepared by the authors (2026).

The term “circular economy” appeared six times in the sample. As evinced in the reviewed studies, such as Zaragoza-Benzal *et al.* (2023) and Dima *et al.* (2019), introducing circular economy criteria into conventional processes and products adds value to the construction industry. The term is strongly linked to “end-of-life tyre” (nine occurrences). Based on this, and in line with expectations, the purpose of applying ELT rubber is seen as a strategy to reintegrate waste into the production chain in order to reduce the consumption of original raw materials and revalue waste material.

Similarly, the prominence of the term “mechanical properties” in Figure 6 shows the interest in the mechanical performance of materials from secondary raw materials. Studies also investigated physical behavior, according to the keywords “fire,” “temperature,” and “water resistance.” The retrieved studies investigated their main properties of interest by tests of apparent density, surface hardness, mechanical strength (plate bending and compression), and water absorption (by total immersion and capillarity).

The frequency of “thermal conductivity” (four occurrences) also evinces the interest in studying the thermal comfort of these new composites. Gypsum plaster alone has a good capacity to regulate the temperature of buildings, mitigating thermal amplitudes and enabling energy savings. The possibility of enhancing thermal resistance by incorporating rubber would be advantageous, especially in regions with mild climates or high temperature variations, as in Meddah, Laoubi and Bederina (2020).

Furthermore, carbon fibers and wood chips may indicate that composites are investigated in combination with other types of waste material. Overall, in addition to showing

researchers' main focus, the results obtained by evaluating commonly used keywords and terms can guide new authors studying this topic.

#### 4 CONCLUSIONS

This bibliometric analysis retrieved 21 selected articles according to its inclusion and exclusion criteria that addressed gypsum and tire rubber composites as an alternative sustainable building material.

The scientific publications found span from 2012-2025 (the last year in this analysis). They also showed a recent progressive increase. The journal *Materials* and author Daniel Fernández produced the most in this field. Although few countries have produced studies on the topic of this review, Spain leads such field of research with 23 affiliated authors. About 67% of the studies in this sample were published in *Qualis Periódicos (2021-2024) A1–A4* vehicles. The most recurring terms in authors' keyword section referred to "circular economy," "end-of-life tires," "mechanical properties," and "thermal conductivity."

Overall, this bibliometric review addressed a well-defined thematic area. Note that other databases exist for searching scientific publications than those in this research. The literature has scarcely evaluated binding materials to manufacture coatings, cardboard sheets, and prefabricated elements as a composite made from rubber waste, representing an opportunity for future research to develop this underexplored area of study. Residual rubber from tires can cease to constitute a contamination problem and become a solution for improving some properties of gypsum, being reintegrated into the civil construction production chain.

#### REFERENCES

AMORIM, G. Três publicações do IFBA obtêm bom conceito na avaliação quadrienal do Qualis Periódicos da Capes. **Instituto Federal da Bahia**, Bahia, 20 jan. 2023. Available at: <https://portal.ifba.edu.br/noticias/2023/tres-publicacoes-do-ifba-obtem-bom-conceito-na-avaliacao-quadrienal-do-qualis-periodicos-da-capes>. Accessed on: Jan 5, 2026.

ADAMOPOULOS, S.; FOTI, D.; VOULGARIDIS, E.; PASSIALIS, C. Manufacturing and Properties of Gypsum-Based Products with Recovered Wood and Rubber Materials. **BioResources**, p. 5573-5585, 2015.

ÁLVAREZ, M.; SANTOS, P.; LOPES, P.; ABRANTES, D.; FERRÁNDEZ, D. Performance Characterization of a New Plaster Composite Lightened with End-of-Life Tyres' Recycled Materials for False Ceiling Plates. **Materials**, v. 15, n. 16, 2022.

ARVIZU-MONTES, A.; MARTINEZ-ECHEVARRIA, M. J. Vegetable Fibers in Cement Composites: A Bibliometric Analysis, Current Status, and Future Outlooks. **Materials**, v. 18, n. 2, 2025.

BIANCO, I.; PANEPINTO, D.; ZANETTI, M. End-of-life tyres: Comparative life cycle assessment of treatment scenarios. **Applied Sciences**, Switzerland, v. 11, n. 8, 2021.

BRAZ, S. N.; BRAZ, J. C. R. Telhado Verde: Uma nova tecnologia sustentável. **Revista Nacional de Gerenciamento de Cidades**, v. 8, p. 147-157, 2020.

CASTELLÓN, F. J.; AYALA, M.; LANZÓN, M. Influence of tire rubber waste on the fire behavior of gypsum coatings of construction and structural elements. **Materiales de Construcción**, v. 72, n. 345, 2022.

CELESTINO, M. S.; BELLUZZO, R. C. B.; ALBINO, J. P.; VALENTE, V. C. P. N. Análise bibliométrica: revisão de literatura e proposta de framework metodológico em 12 passos. **ARACÉ**, v. 6, n. 4, p. 13421-13446, 2024.

DIMA, C.; BADANOIU, A.; STOLERIU, S.; LUCA, D. Influence of Various Types of Waste on the Main Properties of Gypsum Based Composites for Thermal Insulations. **Revista de Chimie**, p. 1750-1753, 2019.

DONTHU, N.; KUMAR, S.; MUKHERJEE, D.; PANDEY, N.; LIM, W. M. How to conduct a bibliometric analysis: An overview and guidelines. **Journal of Business Research**, v. 133, p. 285-296, 2021.

EUROGYPSUM. Use in Buildings – Gypsum All Around. **Eurogypsum**, Bruxelas, 2025. Available at: <https://eurogypsum.org/the-gypsum-industry/use-of-gypsum-in-buildings/>. Accessed on: Jan 12, 2026.

FERRÁNDEZ, D.; ÁLVAREZ, M.; ZARAGOZA-BENZAL, A.; SANTOS, P. Eco-Design and Characterization of Sustainable Lightweight Gypsum Composites for Panel Manufacturing including End-of-Life Tyre Wastes. **Materials**, v. 17, n. 3, 2024.

FERRÁNDEZ, D.; ZARAGOZA-BENZAL, A.; ATANES-SÁNCHEZ, E.; MERILLAS, B.; MATEUS, R.; SANTOS, P. Study of Different Recycling Approaches for Gypsum-Based Composites with Recycled Rubber Aggregates. **Buildings**, v. 15, 2025.

FIORITI, C. F.; BARTHOLOMEI, C. L. B.; TSUTSUMOTO, N. Y. Análise bibliométrica sobre borracha de pneus incorporada em compósitos de cimento. **Periódico Eletrônico Fórum Ambiental da Alta Paulista**, v. 20, n. 1, p. 375-386, 2024.

HERRERO, S.; MAYOR, P.; HERNÁNDEZ-OLIVARES, F. Influence of proportion and particle size gradation of rubber from end-of-life tires on mechanical, thermal and acoustic properties of plaster-rubber mortars. **Materials and Design**, v. 47, p. 633-642, 2013.

KAZMIERCZAK, C. DE S.; DUTRA SCHNEIDER, S.; AGUILERA, O.; ALBERT, C. C.; MANCIO, M. Rendering mortars with crumb rubber: Mechanical strength, thermal and fire properties and durability behaviour. **Construction and Building Materials**, v. 253, 2020.

KEBER, Natasha Jose; BORGES, Patrícia; BORTULUCI, Cláudia Conte. Pneus. **Portal de Educação Ambiental**, São Paulo, 24 fev. 2025. Available at: <https://semil.sp.gov.br/educacaoambiental/2025/02/pneus/>. Accessed on: Dez 18, 2025.

LANDI, D.; GIGLI, S.; GERMANI, M.; MARCONI, M. Investigating the feasibility of a reuse scenario for textile fibres recovered from end-of-life tyres. **Waste Management**, v. 75, p. 187-204, 2018.

LI, H.; AN, H.; WANG, Y.; HUANG, J.; GAO, X. Evolutionary features of academic articles co-keyword network and keywords co-occurrence network: Based on two-mode affiliation network. **Physica A: Statistical Mechanics and its Applications**, v. 450, p. 657-669, 2016.

LÓPEZ-ZALDÍVAR, O.; LOZANO-DÍEZ, R.; HERRERO DEL CURA, S.; MAYOR-LOBO, P.; HERNÁNDEZ-OLIVARES, F. Effects of water absorption on the microstructure of plaster with end-of-life tire rubber mortars. **Construction and Building Materials**, v. 150, p. 558-567, 2017.

LOZANO-DÍEZ, R. V.; LÓPEZ-ZALDÍVAR, Ó.; HERRERO-DEL-CURA, S.; MAYOR-LOBO, P. L.; HERNÁNDEZ-OLIVARES, F. Mechanical behavior of plaster composites based on rubber particles from end-of-life tires reinforced with carbon fibers. **Materials**, v. 14, n. 14, 2021.

MARLÉS-SÁENZ, E.; GÓMEZ-LUNA, E.; GUERRERO, J. M.; VASQUEZ, J. C. Innovative Bibliometric Methodology: A New Big Data-Based Framework for Scientific Research. **Energies**, v. 18, n. 10, 2025.

MANCEL, V.; ČABALOVÁ, I.; KRILEK, J.; OLGUN, Ç.; ÖNCEL, M.; TOR, Ö.; SZUL, T.; WORONIAK, G.; PIOTROWSKA-WORONIAK, J. Utilization of Waste Rubber Materials After the End of Their Life Cycle in the Production of Three-Layer Particleboards—Physical and Mechanical Properties. **Polymers**, v. 17, 2025.

MEDDAH, A.; LAOUBI, H.; BEDERINA, M. Effectiveness of using rubber waste as aggregates for improving thermal performance of plaster-based composites. **Innovative Infrastructure Solutions**, v. 5, n. 2, 2020.

PEREIRA, A. M.; FAZZAN, J. V.; FREITAS, V. Análise da viabilidade do uso da fibra de borracha de pneu como reforço em tijolo de solo cimento. **Revista Nacional de Gerenciamento de Cidades**, v. 3, p. 53-65, 2015.

- PICADO-SANTOS, L. G.; CAPITÃO, S. D.; NEVES, J. M. C. Crumb rubber asphalt mixtures: A literature review. **Construction and Building Materials**, v. 247, 2020.
- PIMENTA, A. A.; PORTELA, A. R. M. R.; OLIVEIRA, C. DE B.; RIBEIRO, R. M. A BIBLIOMETRIA NAS PESQUISAS ACADÊMICAS. **SCIENTIA Revista de Ensino, Pesquisa e Extensão**, v. 4, 2017.
- PINTO, N.; FIORITI, C.; AKASAKI, J.; ACUNHA, T.; OKIMOTO, F. Performance of plaster composites incorporating rubber tire particles. **Revista Ingeniería de Construcción**, v. 35, p. 215-231, 2020.
- RIBEIRO, F. M.; SOARES, J. C. Pesquisa bibliométrica sobre o conforto térmico urbano relacionado às legislações urbanísticas e à simulação computacional: um recorte temporal de 2020 a 2025. **Periódico Técnico e Científico Cidades Verdes**, v. 13, p. 393-409, 2025.
- RIGOTTI, D.; DORIGATO, A. Novel uses of recycled rubber in civil applications. **Advanced Industrial and Engineering Polymer Research**, v. 5, n. 4, p. 214-233, 2022.
- RÍO-MERINO, M. DEL; VIDALES-BARRIGUETE, A.; PIÑA-RAMÍREZ, C.; VITIELLO, V.; SANTA CRUZ-ASTORQUI, J.; CASTELLUCCIO, R. A review of the research about gypsum mortars with waste aggregates. **Journal of Building Engineering**, v. 45, 2022.
- SCANAVACCA JÚNIOR, L. Reciclagem de pneus inservíveis: avanços, aplicações e perspectivas no Brasil. **Portal Embrapa Meio Ambiente**, Brasília, 3 out. 2025. Available at: <https://www.embrapa.br/en/busca-de-noticias/-/noticia/103505979/artigo---reciclagem-de-pneus-inserviveis-avancos-aplicacoes-e-perspectivas-no-brasil>. Accessed on: Dec 29, 2025.
- SERNA, Á.; RÍO, M. DEL; PALOMO, J. G.; GONZÁLEZ, M. Improvement of gypsum plaster strain capacity by the addition of rubber particles from recycled tyres. **Construction and Building Materials**, v. 35, p. 633-641, 2012.
- SOBRAL, J. I. A.; LAFAYETTE, K. P. V.; BEZERRA, J. S.; PAZ, D. H. F. Tendências na disposição dos resíduos da construção civil: caminhos atuais e estratégias emergentes. **Periódico Eletrônico Fórum Ambiental da Alta Paulista**, v. 21, n. 2, 2025.
- THOMAS, B. S.; GUPTA, R. C.; PANICKER, V. J. Recycling of waste tire rubber as aggregate in concrete: Durability-related performance. **Journal of Cleaner Production**, v. 112, p. 504-513, 2016.
- TRAN, T. Q.; SKARIAH THOMAS, B.; ZHANG, W.; JI, B.; LI, S.; BRAND, A. S. A comprehensive review on treatment methods for end-of-life tire rubber used for rubberized cementitious materials. **Construction and Building Materials**, v. 359, 2022.
- ZARAGOZA-BENZAL, A.; FERRÁNDEZ, D.; AGUILAR-SIMÓN, C.; MORÓN, A.; SANTOS, P. Upcycling Automobile End-of-Life Tires for Development and Characterization of Circular Plasterboards. **Sustainability**, v. 17, n. 2, p. 558, 2025.
- ZARAGOZA-BENZAL, A.; FERRÁNDEZ, D.; SANTOS, P.; ATANES-SÁNCHEZ, E. Development and characterization of new lightweight waste-based plaster composites for building applications. **Journal of Building Engineering**, v. 96, 2024a.
- ZARAGOZA-BENZAL, A.; FERRÁNDEZ, D.; BARRIOS, A. M.; MORÓN, C. Water Resistance Analysis of New Lightweight Gypsum-Based Composites Incorporating Municipal Solid Waste. **Journal of Composites Science**, v. 8, 2024b.
- ZARAGOZA-BENZAL, A.; FERRÁNDEZ, D.; SANTOS, P.; MORÓN, C. Recovery of End-of-Life Tyres and Mineral Wool Waste: A Case Study with Gypsum Composite Materials Applying Circular Economy Criteria. **Materials**, v. 16, 2023.

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## DECLARATIONS

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### AUTHOR CONTRIBUTIONS

When describing each author's contribution to the manuscript, use the following criteria:

- **Conception and study design:** Maria Eduarda Amorim Ferreira
- **Data Curation:** Maria Eduarda Amorim Ferreira
- **Formal Analysis:** Maria Eduarda Amorim Ferreira
- **Acquisition of Financing:** Maria Eduarda Amorim Ferreira (PIBPG 2025 - CHAMADA PÚBLICA CNPq Nº 50/2024 - PROGRAMA INSTITUCIONAL DE BOLSAS DE PÓS-GRADUAÇÃO (PIBPG) - CICLO 2025)
- **Investigation:** Maria Eduarda Amorim Ferreira
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- **Writing - Initial Draft:** Maria Eduarda Amorim Ferreira
- **Writing - Critical Review:** Cesar Fabiano Fioriti
- **Final Review and Editing:** Cesar Fabiano Fioriti and Maria Eduarda Amorim Ferreira
- **Supervision:** Cesar Fabiano Fioriti

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### DECLARATION OF CONFLICTS OF INTEREST

We, **Maria Eduarda Amorim Ferreira and Cesar Fabiano Fioriti**, declare the following regarding the manuscript entitled "**Bibliometric analysis on the incorporation of tire waste into gypsum composites**":

1. **Financial ties:** This study was funded by the Brazilian National Council for Scientific and Technological Development (CNPq).
  2. **Professional Relationships:** No professional relationships relevant to the content of this manuscript have been established.
  3. **Personal Conflicts:** No personal conflicts related to the content were identified.
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