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A Bibliometric (1993-2025) and Systematic Review (2015–2025) on the Reuse of Drilling Waste

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ABSTRACT

Drilling fluids are essential for water, gas, and oil exploration; however, they generate large volumes of waste that have significant environmental impacts. Therefore, strategies and technologies have been developed to enable their reuse and recovery, promoting sustainable management in accordance with the circular economy. This study aims to analyse the literature in the Scopus database through a bibliometric analysis covering the full available period (1993–2025) and a systematic review focused on recent studies published from 2015 to 2025 to identify advances in this area. The methodological design comprised three phases: i) search strategy, ii) cleaning, filtering, and bibliometric analysis, and iii) systematic review of case studies. The bibliometric analysis (1993–2025) covered 49 publications, revealing a primary focus on the reuse of drilling waste to produce construction materials, with countries such as China, the United States, and Brazil leading the field. The systematic review (2015–2025) highlights the use of drilling waste to produce bricks (sintered and non-sintered) and cement, primarily derived from drilling waste processed with Water-Based Mud (WBM) and Oil-Based Mud (OBM). The main technologies used to condition the materials include stabilisation/solidification and thermoprocessing. The study demonstrates the need for real-scale studies, economic valuations, and the development of regulatory frameworks to drive these findings toward widespread applications. This study provides environmental managers with a tool to support decision-making that promotes a circular economy and environmental protection.

1. INTRODUCTION

Drilling fluids, also known as drilling muds, are compositions and mixtures of materials that simplify the drilling of oil, gas, mining, and groundwater wells [1, 2]. These fluids enable functions such as bottom-hole washing, transport and suspension of solid materials, formation pressure balancing, bit cooling and lubrication, wellbore stabilisation, and obtaining stratigraphic information [3, 4]. Depending on the drilling site conditions, the commonly used muds include Water-Based Mud (WBM), Oil-Based Mud (OBM), Synthetic-Based Mud (SBM), and gas-based mud [5].

Drilling fluid waste, consisting of liquid and solid components (cuttings), represents the second largest volume of waste generated by the oil and gas exploration and production industry [6, 7]. The amount of waste generated depends largely on the diameter, depth, and drilling process used [8]. In 1991 alone, the US drilled approximately 30,000 wells, generating 157 million barrels of drilling fluid waste [9], and in 2016, the volume was estimated to exceed 125 million barrels [10]. A 2016 study in Norway reported the underproduction of 260,000 tons of drilling waste, mostly cuttings contaminated with Oil Base Fluid (OBF) [11].

Given this situation, researchers have long explored the negative impacts of drilling waste, including surface and groundwater contamination, reduced soil fertility, and biodiversity loss [12-14]. Therefore, current drilling waste management requires measures to reduce the associated environmental impacts [15].

Within the framework of sustainability, the management of drilling fluids and cuttings offers various opportunities to minimise drilling waste, such as the exploration and development of biodegradable additives [16], the implementation of emerging technologies such as recycling

[17], and the planning of narrow-boreholes to reduce volume [18]. From a circular economy perspective, the reuse of drilling fluids in other drilling operations has been promoted, and the materials can be repurposed for other applications [19]. The reuse of drilling cuttings and fluids supports industrial sustainability, which is aligned with Sustainable Development Goals (SDGs) 9, 12, and 13 [20].

Multiple technologies exist for treating drilling waste, including cuttings reinjection [21], sealed secure landfills, mud-to-cement technology (MTC) [22], solidification treatment [23], solid-liquid separation [24], electrochemical adsorption [25], chemical oxidation, and microbial treatment [26]. Another widely used method is thermal desorption because of its short treatment time, high contaminant removal efficiency, and ability to recover oil from waste [27].

Alternatives for managing oil drilling waste propose its use in sectors outside the drilling process, for example, as a substrate to produce native forest seedlings, thereby promoting greater growth, biomass production, and photosynthetic efficiency [28]. The potential use of residual drilling fluids, slag, and red mud (a bauxite byproduct) for preparing cementitious materials has also been explored [29]. Similarly, cuttings are reused in the market as concrete aggregates or construction fill materials [13].

Bibliometric analyses provide a consistent method for identifying research trends and knowledge gaps, allowing for the quantitative evaluation of research topics and progress in areas of interest [30]. In contrast, systematic reviews allow for the qualitative selection and evaluation of the existing literature [31]. Both analyses provide a key framework for understanding the available information concisely, thereby generating guiding principles for the sustainability and circular economy of drilling fluids and cuttings.

The existing literature provides an overview of drilling waste management [4], explores the environmental impacts of drilling fluid waste and treatment methods [13], analyses implementation techniques in specific areas [32], investigates the effectiveness of food waste in drilling fluids [33], and establishes options for the safe disposal of drilling waste [34]. However, the literature lacks a synthesis that demonstrates the progress made in utilising drilling waste external to the drilling process.

Therefore, this study investigates the current state of production and contributions to the reuse of drilling waste, as well as the practices and advances in the utilisation of drilling fluids and cuttings, based on recent research. This study aimed to analyse the Scopus database literature on drilling waste reuse over the full available period (1993–2025) using bibliometric techniques. In addition, a systematic review of scientific contributions from approximately the last decade (2015–2025) was conducted to identify ways to utilise this waste outside the drilling process.

2. MATERIALS AND METHODS

This study integrated a bibliometric analysis covering the entire period available in the Scopus database (1993–2025) and a systematic review of recent studies published between 2015 and 2025. For the former, bibliometric tools such as Bibliometrix 5.0 [35] and VOSviewer 1.6.20 [36] were used to analyse the compiled database. For the systematic review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method [37] was used to identify, screen, select, and include a specific group of studies according to the criteria defined by the authors. Figure 1 shows the methodological scheme, which is composed of three phases: i) search strategy; ii) cleaning, filtering, and bibliometric analysis; and iii) systematic review of drilling fluid reuse strategies aligned with the construction area.

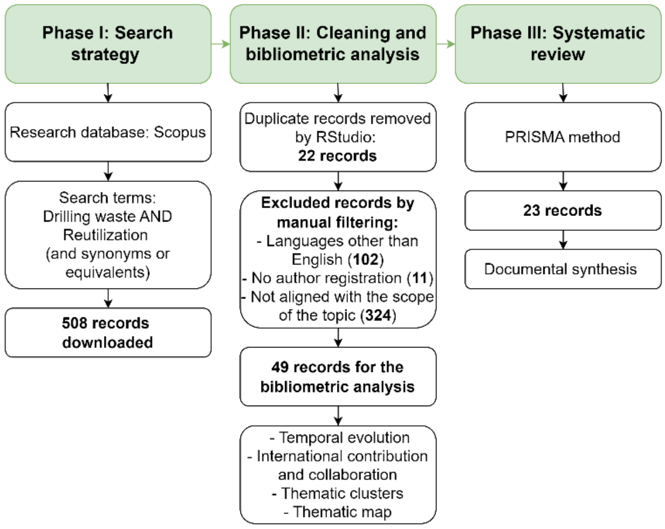

Figure 1. Methodological scheme for bibliometric and review development

2.1 Phase I: Search strategy

The search was conducted using the Scopus database. This database is characterised by a large number of indexed journals (more than 29,000 journals and 25 million open-access articles until July 2025 [38, 39]), rigorous annual quality control [40], and the inclusion of peer-reviewed literature from accredited sources [41].

The establishment of key terms related to the reuse or repurposing of drilling waste involved a search equation that included two main groups of terms: “drilling waste” and “reuse”, combined with the Boolean operators AND and OR (Table 1). The search period included the first record found up to 2025, with a download date of 18 November 2025. A total of 508 records were downloaded in .CSV format, which served as the basis for subsequent cleaning.

Table 1. Bibliographic search design

Term Group	Query String
Drilling waste (1)	"drilling fluid*" OR "drilling waste" OR "drilling cutting*"
Reutilization (2)	"recycling" OR "reus*" OR "reutilizat*"
Combine query string	
(TITLE-ABS-KEY ("drilling fluid*" OR "drilling waste" OR "drilling cutting*") AND TITLE-ABS-KEY ("recycling" OR "reus*" OR "reutilizat*))	

Additionally, to assess the robustness of the search strategy, a sensitivity search was conducted by incorporating additional terms such as “valorization/valorisation”, “beneficial use”, “repurposing”, “upcycling”, and “recovery”. Due to the large number of retrieved records (> 2000), a representative sample of the 100 most relevant records was screened based on titles and abstracts, revealing that most were not aligned with the study scope, focusing instead on treatment and disposal processes, fluid chemistry, or modelling, with less than 10%

addressing reuse studies.

2.2 Phase II: Cleaning, filtering and bibliometric analysis

The records obtained in Phase I were exported as. xlsx format using R Studio [42], automatically removing 22 duplicate records. The database cleanup also included selecting records with identifiable authors and published in English, considering English the primary language of communication in international scientific literature. Consequently, records in languages other than English (n = 102) and those without record authors (n = 11) were excluded.

Subsequently, the documents were evaluated based on their titles and abstracts to verify their thematic relevance. At this stage, 324 records were excluded because, although they contained the search terms, they did not directly address drilling waste reuse. Most exclusions corresponded to studies focused on fluid reconditioning or recirculation during the drilling cycle, which did not align with the approach defined for this study. Consequently, only studies focusing on waste valorisation through applications external to the drilling process were prioritised. As a result of this process, 49 records were selected (Figure 1).

Based on the 49 records, a bibliometric analysis was conducted using the tools Bibliometrix 5.0 [35] and VOSviewer 1.6.20 [36], which generated graphs of the temporal evolution of publications, contributions, and international collaboration, as well as the co-occurrence of keywords and thematic areas of research [43, 44].

2.3 Phase III: Systematic review of construction materials derived from the reuse of drilling waste

Phase III involved a systematic review according to the PRISMA protocol guidelines [37]. This method is characterised by its reproducible and adaptable approach to reviews, contributing to the definition of inclusion and exclusion criteria that allow for the concentration of studies with specific characteristics for subsequent analyses [45].

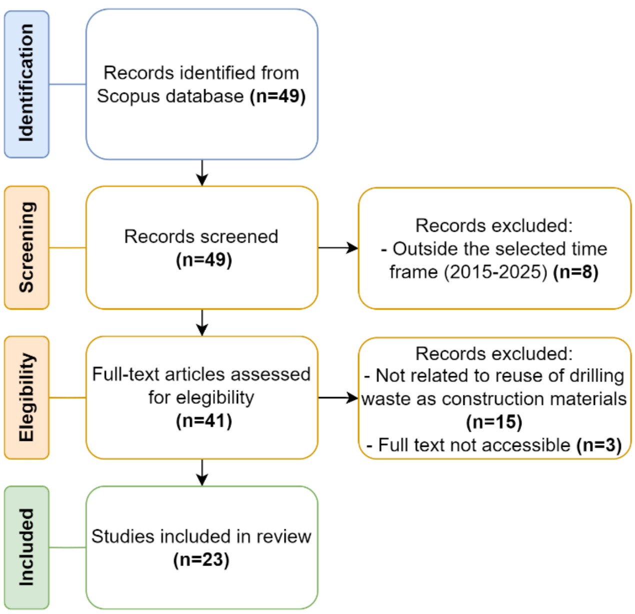

Figure 2. Flowchart of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method applied to the study for the delimitation of the documents to be included in the systematic review

The protocol allowed the selection of studies based on the inclusion/exclusion criteria, as shown in Figure 2. From the 49 records identified in the previous phase, the screening process excluded those outside the 2015–2025 period (n = 8). This period was chosen to analyse the recent evolution of the topic over a sufficiently long and representative period of current contributions, approximately the last decade, to capture the field's contemporary development and avoid biases associated with older or potentially outdated studies. However, it should be noted that the 2025 records correspond to a partial year, as the database was downloaded in November 2025. Also, a small number of studies (n = 3) could not be retrieved in full text due to access restrictions, and were therefore not considered in the eligibility assessment step.

In the eligibility process, studies unrelated to the reuse of drilling waste in construction materials were excluded. Based on this, 23 articles were included in the research, which were analysed in detail to create a thematic synthesis identifying the main construction materials obtained from drilling waste, the types of fluids used, the types of waste reused, and the main treatment methods.

3. RESULTS

3.1 Bibliometric analysis

3.1.1 Temporal evolution of publication trends and citation dynamics

The analysis of 49 documents related to the reuse of drilling waste revealed an intermittent evolution of the topic from 1993 to 2025. Based on the number of publications per year, two periods are distinguished: Period I (1993–2015) and Period II (2017–2025).

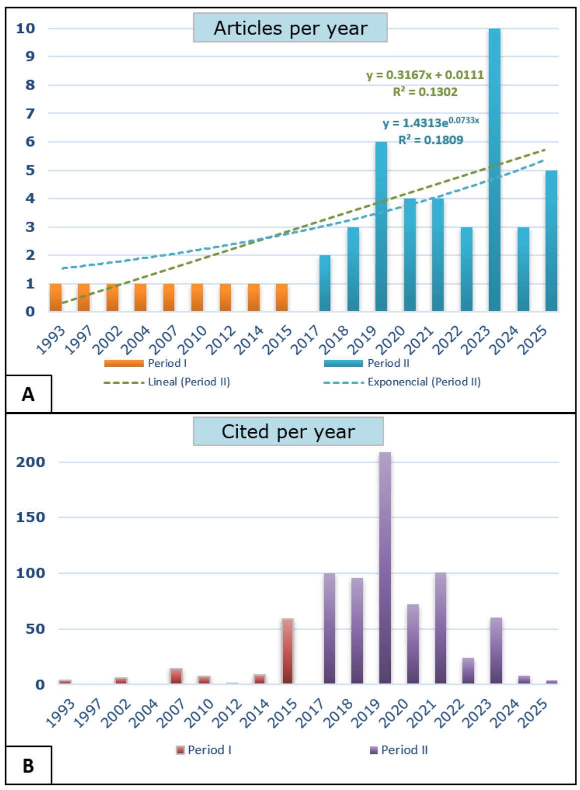

Figure 3. (A) Annual scientific publications by year (divided into two periods), (B) annual citation trends

Period I had a low scientific output, limited to one article per year, without a clear trend of growth or decline (Figure 3(A)). Research during this period began with the evaluation of the applicability of drilling waste for waste reduction and conducting pilot tests on the performance of mixtures of treated drilling waste and native soils as cover materials for municipal landfills [46]. They also initiated studies related to the implementation of drilling soils for the construction of embankments and as a substitute for aggregates [47, 48], brick making [49, 50], and analysis of the viability of vermicomposting for the remediation of cuttings, converting them into compost-type materials [51].

Some of the most cited research from this period were “An innovative utilization of drilling wastes as building materials” (with 14 citations) and “Feasibility study of the potential use of drill cuttings in concrete” (with 59 citations) (Figure 3(B)), which focused on the manufacture of building bricks, permeable bricks, and partial substitutes for concrete from drilling waste and on the evaluation of the potential of using drilling cuttings in concrete as a partial substitute for cement, showing that replacing 5% of cement with dry drilling cuttings reduces the compressive strength of the concrete by 10% [52].

In contrast, period II shows an increase in publications. However, this was not sustained, since the linear and exponential curves maintained R^2 values of 0.1302 and 0.1809, respectively, without exceeding the R^2 coefficient of 0.5 (Figure 3(A)). During this period, publications took on more technical and specific orientations, such as the environmental and mechanical performance of concrete and bricks made with cuttings [53, 54], exploring the use of petroleum-based drilling cuttings pyrolysis residues (ODPR) for the creation of non-autoclaved concrete materials, high-performance ceramics, and cement products [55-57], and in the evaluation of soil and water quality and eucalyptus growth [58]. The year 2019 had the highest number of citations (Figure 3(B)), with the most cited document being “Utilisation of red mud, slag and waste drilling fluid for the synthesis of slag-red mud cementitious material”, which addressed the reuse of drilling waste along with red mud for the preparation of cementitious materials [59]. Another notable article from this period was “Wastes from the petroleum industries as sustainable resource materials in construction sectors: opportunities, limitations, and directions,” which aimed to provide an overview of the use of petroleum waste materials in the construction sector [32].

3.1.2 Geographical distribution of research based on author-country occurrences

The scientific output on this topic includes contributions from authors in 16 countries (Figure 4). China had the highest number of author-country occurrences/affiliation occurrences (n = 84), followed by the United States (6), Brazil (5), Iran (5), and Canada (4). Table 2 shows a general analysis of the scientific contributions at the regional level.

Table 2. Representative literature of each region

Region	Most Relevant Topics
East and Southeast Asia	The viability of water-based drill cuttings in the manufacture of sintered bricks [60, 61] and lightweight aggregates [62] has been investigated. Drill cuttings contaminated with synthetic mud were used to produce aggregates for the manufacture of hot asphalt concrete [63].
West Asia	An overview of the use of various petroleum waste materials in the construction sector [32] and the use of cuttings as an additive in asphalt mixtures [64] is presented.
South America	Drilling cuttings have been evaluated in the development of eucalyptus plants, the impacts on soil and water quality, based on drilling cuttings and sewage sludge [58], use in the construction of paving stones [65], and viability of drilling waste and kaolin for obtaining glass ceramic material [66].
North America	The transformation of petroleum-based drilling muds and cuttings into biochar compounds [67], the feasibility of using alkali-activated fly ash (AAF) as a cementing material [68], and the use of drilling cuttings in concrete as a partial substitute for cement [52] have been studied.
Europe	The recycling of coal combustion ash from landfills and residual drilling fluid as a substitute for clay in construction materials [69]. Waste was used to produce soil-like materials and evaluate their performance on substrates with varying metal concentrations [70].

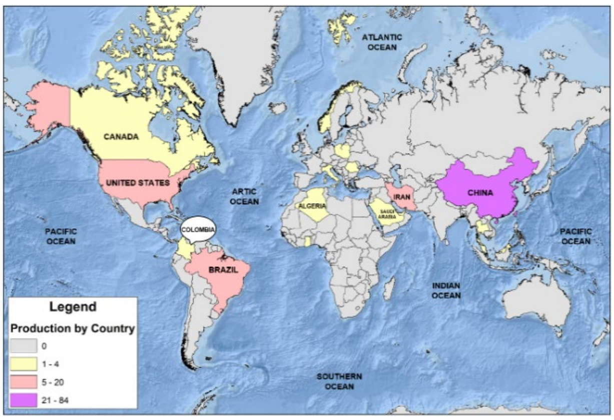

Figure 4. Map of country-level occurrences based on author affiliations in publications related to the reuse of drilling fluids

3.1.3 International collaboration networks

Figure 5(A) illustrates the collaboration networks between countries, and Figure 5(B) shows the intensity and concentration of these relationships. The bibliometrix graphical representations used the Kamada-Kawai parameters for the network layout and the Leiden clustering algorithm. Kamada and Kawai are among the most popular force-directed methods for drawing graphs with reflected symmetry [71], and Leiden ensures good connectivity between graphs and the localisation of higher-quality graphs, improving the visual interpretation of the information [72]. China was the main collaborator, establishing strong relationships with Norway, the United States, Canada, and Ghana. The isolated nodes include Middle Eastern countries (Saudi Arabia, the United Arab Emirates, and Iran), which maintain links with Malaysia. Finally, Italy and Algeria appear as bilateral nodes with limited relationships.

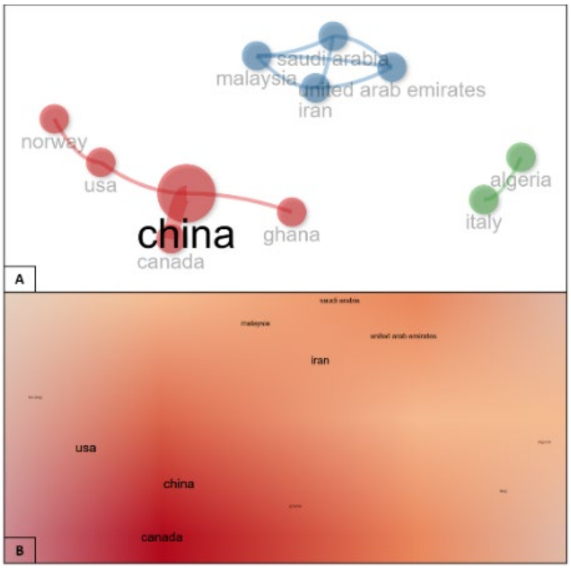

Figure 5. Network representation (A) and density map (B) of global collaboration

3.1.4 Thematic areas in the reuse of drilling waste and mud

The co-occurrence network of author keywords (Figure 6) allowed the identification of three clusters focused on the utilisation of drilling waste (Table 3). The graphical representation included a threshold of 13 items and a minimum occurrence of two author keywords.

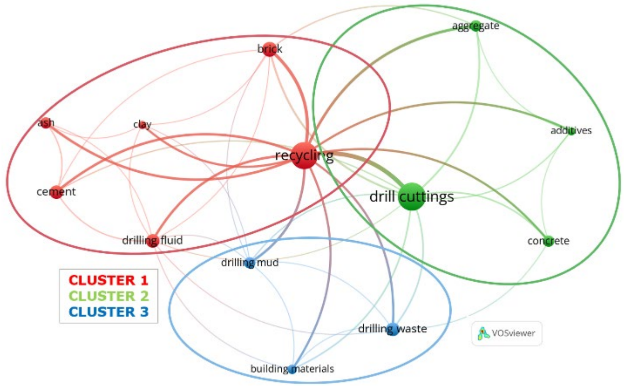

Figure 6. Keyword co-occurrence network

Table 3. Thematic clusters identified in the study

Cluster	Description
Cluster 1: Recycling and valorisation of drilling fluids	This cluster had the highest number of keywords (six items), grouping the terms ash, brick, cement, and clay, which can be created from the reuse of drilling fluids. For example, in western Russia, oilfield drilling mud is used to make ceramic construction bricks [73]. One study demonstrated that residual mud can be reused as a raw material for the real-time capsule injection (RCG) technique, serving as a substitute for cement injection, thereby increasing the demand for RCG [74]. Others are seeking to develop the production of cement, sintered, and non-sintered bricks from drilling cuttings using the Life Cycle Assessment (LCA) method [60].
Cluster 2: Drill cuttings as aggregates and additives in concrete systems	This thematic group addresses the reuse of drilling cuttings as concrete additives and aggregate. For example, drilling cuttings contaminated with oil have been valorised as a cement-based additive, reducing energy consumption at the source of contamination [75]. The literature also evaluates the use of water-based drilling cuttings from offshore oil fields as raw materials for manufacturing lightweight aggregates [62]. Furthermore, water-based drilling cuttings have been studied for their potential to improve concrete properties, and analyses using Energy-dispersive X-ray spectroscopy (EDX) have revealed their ability to bind metallic elements [76].
Cluster 3: Construction-based applications of drilling waste	The third cluster focuses on transforming drilling waste into inputs for the construction sector. In the oil sector, pyrolysis residues from drilling cuttings have been used as a base material for producing lightweight, high-strength construction ceramsites [77]. In the mining drilling sector, proposals include producing cementitious materials from residual drilling fluids, blast furnace slag, and red mud [59], and exploring the use of drilling waste for the manufacture of construction bricks and permeable bricks [50].

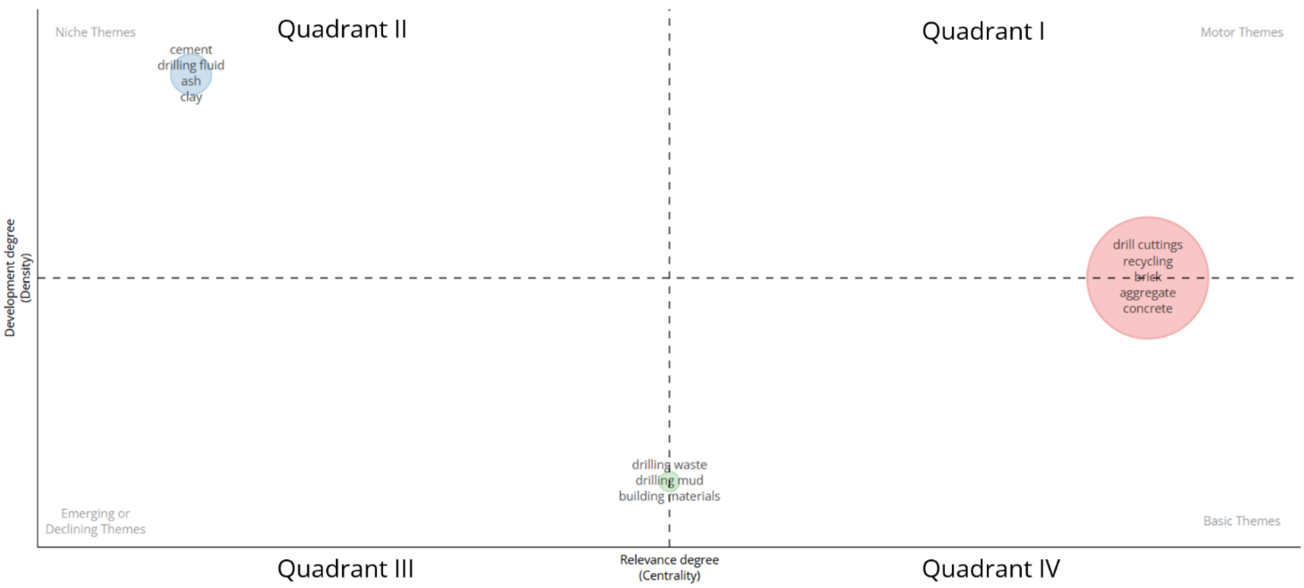

Figure 7. Quadrant diagram of centrality and density in the reuse of drilling waste

3.1.5 Thematic map in the reuse of drilling waste

The thematic map displays the field's keywords, grouped into four quadrants (Motor Themes (Quadrant I–high centrality and density), Niche Themes (Quadrant II–high density and low centrality), Emerging or Declining Themes (Quadrant III–low density and centrality), and Base Themes (Quadrant IV–high centrality and low density)) (Figure 7). The generation algorithm used was Walktrap, which frequently visited keywords, demonstrating a strong thematic relationship based on association trends [78]. Furthermore, a minimum frequency of five words per cluster was selected. Quadrants I and IV share the terms "drill cuttings," "recycling," "brick," "aggregate," and "concrete," indicating that these themes form a conceptual basis for the subject area and are under development, leading scientific research. Quadrant II groups the terms "cement," "drilling fluid," "ash," and "clay," indicating well-developed topics in specific areas, thus revealing isolated themes. Quadrants III and IV share the terms "drilling waste", "drilling mud", and "building materials", reflecting a possible transition from emerging to fundamental topics. Furthermore, a low density (cluster size) may indicate an under-researched topic with limited documentation.

3.2 Integrated review matrix of drilling waste reuse products and applications

The systematic review of the 23 articles selected using the PRISMA method allowed for the development of a matrix focusing on the reuse of drilling waste in construction materials. Table 4 summarises the main construction materials obtained from the reuse of drilling waste. The production of cement, concrete, and sintered and nonsintered bricks is prominent. To a lesser extent, reuse is evident in proppants/glass ceramics, hot-mix asphalt, road subbase, and lightweight aggregates. Regarding the type of fluid used in the drilling process from which the waste originates (Figure 8(A)), 48% of the studies reported WBM use, followed by OBM at 39% and SBM at 4%. On the other hand, Figure 8(B) details the type of material reused, with drilling cuttings accounting for the largest share at 83%, followed by drilling mud and a mixed category that reuses mud and cuttings, both at 9%.

Table 4. Main construction materials obtained from drilling waste

Application	References	Amount (%)	Countries
Sintered and non-sintered bricks/pavers	[54, 60, 61, 65, 79-81]	30	China, Colombia
Concrete/cement	[52, 53, 55, 57, 59, 76, 82, 83]	35	China, U.S.A
Lightweight aggregates	[62, 77]	9	China
Hot mix asphalt	[63, 64]	9	Thailand, Iran
Road subbase	[84]	4	China
Proppants/glass-ceramics	[56, 66, 69]	13	China, Brazil, Romania
Total	-	100	-

The manufacturing process for construction materials involves several steps, including thermoprocessing, sieving, chemical separation, solidification/stabilisation, pressure filtration, particle size control, and mineralogical characterisation. In terms of treatment, the majority of studies (87%) employed solidification/stabilisation, supported by an initial pyrolysis step to obtain fine particles (Figure 8(C)).

The reviewed studies show that the obtained materials have suitable properties for use, such as mechanical stability, environmental safety, adequate physical properties, and compliance with local regulations (Figure 8(D)). The limitations commonly reported for the production of construction materials from drilling waste correspond to the compositional variability (cement, sand, fly ash, and water combined with cuttings or drilling mud) of the material, lack of validation at an industrial scale, the need for special technological equipment, and high energy consumption (especially in pyrolysis) (Figure 8(E)).

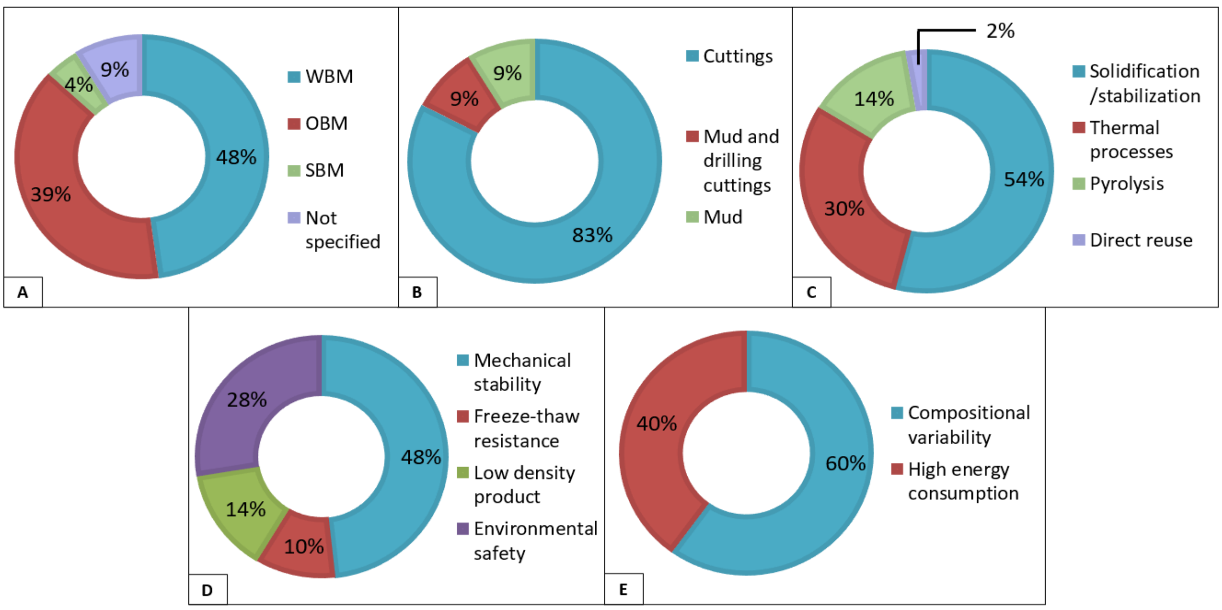

Figure 8. Main characteristics of the review: (A) type of drilling fluid used, (B) type of drilling waste, (C) main treatment methods, (D) mechanical and environmental performance, (E) identified limitations

4. INTERPRETATION OF RESULTS AND DISCUSSION

4.1 Results of the bibliometric analysis and systematic review

The bibliometric analysis of 49 documents related to the reuse of drilling waste revealed a consistent trend in the first period (1993–2015) and a gradual increase in research output in the second period (2017–2025). The increase in scientific production for the second period may reflect, among other factors, the growing international focus on sustainability following the adoption of the 2030 Agenda for SDGs in 2015, along with objectives such as SDG 9, focused on investments in durable infrastructure and sustainable industrial advancements [85], and SDG 12, which promotes the creation of sustainable infrastructure through waste management [86]. The 2030 Agenda can be considered part of a global framework that coincides with the increased interest in research on the use of drilling waste as a resource in various applications, particularly in agriculture [58, 87, 88], construction (Table 4), and the oil and gas industries [89, 90].

The analysis of the geographical distribution of research based on authors' affiliations shows that China has the largest representation in the analysed scientific production (approximately 84 occurrences at the country level) and stands out for its high oil production. In contrast, other regions with high oil production, according to oil barrel production data in 2024 [91], such as the United States, Saudi Arabia, Canada, and Iran, show a relatively smaller representation in terms of occurrences by affiliation. This highlights a gap between oil production and scientific output in these nations, suggesting that research on the reuse of drilling waste is not always concentrated in regions that generate the largest volumes.

China's prominent representation may be associated with, among other factors, increased support for research, evidenced by incentives and funding programs focused on the reuse and repurposing of drilling waste, such as the Science and Technology Cooperation Project of the CNPCSWPU Innovation Alliance [60, 61] and National Key Scientific Projects for Decommissioning of Nuclear Facilities and Radioactive Waste Management [53, 55, 81, 83], as well as the promotion of policies and regulations on environmental-economic management [92, 93]. In this context, planning instruments such as the 14th Five-Year Plan for the Development of the Raw Materials Industry may also be considered part of the institutional environment that fosters this type of research, by promoting the optimisation of energy and resource use and the incorporation of industrial solid waste in sectors such as the cement industry [60].

The thematic analysis identified three main interconnected lines of research: drilling fluid recycling, the use of drilling cuttings as aggregates, additives, and concrete, and drilling waste in construction. These lines are not independent areas but rather complementary approaches within the same field of research, which may lead to an overall theme.

A systematic review covering the period 2015–2025 shows that the reuse of drilling waste is primarily focused on its valorisation in the construction industry, yielding materials such as bricks and concrete (Table 4), although only laboratory-scale results have been reported to date. The reviewed studies highlight that the mechanical and environmental properties of the products depend on both the type of waste and the treatment applied (Figure 8).

In particular, limitations associated with the production of non-sintered bricks were identified, including the potential for exposure to acidic environments to affect the material's stability, thereby favouring the leaching of heavy metals. Likewise, high levels of water-based waste can alter the microstructure of the material, making the incorporation of minerals essential for the solidification and stabilisation of heavy metals in drill cuttings [79].

Additionally, the type of drilling fluid influences its reusability. Waste derived from OBM requires additional treatments, such as pyrolysis, to remove residual oil and stabilise the material before its incorporation with other mixing elements for manufacturing [57, 77]. In contrast, WBM requires fewer pretreatment stages, resulting in lower environmental risk and simpler composition, allowing for easy incorporation into construction materials [65, 76].

It is important to note that studies on the reuse of drilling waste from offshore oil fields are limited and pose a challenge, as proper waste management has become a critical environmental and engineering problem [62].

Currently, global brick production exceeds 1 trillion units annually, leading to excessive clay soil extraction and high energy consumption in industrial kilns. Consequently, brick manufacturing causes environmental problems, including the depletion of fertile soil [94], soil erosion, and greenhouse gas emissions [95]. Incorporating drilling waste as a replacement for natural clay reduces the environmental impact of the conventional method and promotes global sustainability [61].

4.2 Research gaps and future directions

One of the main limitations of this study is its exclusive reliance on the Scopus database. Although it contains a considerable number of publications, this approach may limit access to relevant information from other sources, such as specialised databases, institutional repositories, and other multidisciplinary databases [96, 97]. Another limitation was the lack of access to some publications (n = 3, approximately 6% of the initially identified records) because they were not available for full reading. While this could introduce a minor access bias, its impact on the results is expected to be limited given the relatively small proportion of missing literature compared to the remaining one.

The sensitivity search showed that incorporating broader terms increases the number of retrieved records but does not yield a proportional increase in studies aligned with the scope of this research. However, it is acknowledged that the search equation may not have captured all relevant studies due to the terminological variability used in indexing publications.

Unlike studies that analyse the viability of drilling waste in isolation to produce composite materials such as asphalt [64] or concrete [76], this study groups together a variety of construction materials after the valorisation of drilling cuttings and mud, maintaining an up-to-date approach covering approximately the last decade (2015–2025). This contributes to the development of a circular economy in the oil and gas industry and the sustainability of the construction sector. This study systematises the nature of the waste, the treatment employed, the mechanical and environmental characteristics of the resulting products, and the main limitations of the material manufacturing process (Figure 8).

In terms of content, there is a need to analyse further the durability of the developed materials, their long-term performance under different environmental conditions, and their economic value to determine the viability of these solutions at an industrial level (e.g., energy consumption). Furthermore, it is important to explore treatment and processing options that optimise energy consumption and reduce potential environmental impacts. Finally, it is crucial to promote the development of regulatory frameworks that encourage the reuse of drilling waste, fostering a circular economy and utilising industrial waste.

5. CONCLUSIONS

This study examined 49 documents from the Scopus database published between 1993 and 2025 on the reuse of drilling waste using bibliometric analysis. In addition, a systematic review following the PRISMA guidelines included 23 articles to identify current research advances in the reuse of waste in the construction sector, covering the period of 2015–2025.

The field is still developing and lacks a clear production trend, although it has seen significant growth since 2017. Research has focused on reusing waste materials to develop ceramic and cementitious products, with China emerging as the most represented country based on author affiliations. A systematic review of the last 10 years identified bricks and concrete as the main materials produced by industry. Waste derived from water-based materials (WBM) is the most widely used waste owing to its superior compatibility and ease of incorporation into other base materials.

The main contribution of this study is the development of a valorisation matrix for drilling fluids and cuttings in the construction sector, along with a synthesis of the mechanical properties of the products, the main treatments employed, and their limitations. This study provides a technical decision-making tool for the circular economy in the construction sector.

This study also highlights potential considerations for future research, such as advancing the scientific development of the topic at a real-world scale, not just in the laboratory, improving energy efficiency, integrating cost analyses, and strengthening regulatory frameworks, all of which are important for transforming this waste into large-scale infrastructure applications.

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