

Review

A Decade of Research on Medium-Density Fiberboard: A Bibliometric Analysis of Physical and Mechanical Properties

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Abstract

This bibliometric study examined 179 Scopus-indexed publications on the physical and mechanical properties of medium-density fiberboard (MDF) published between 2016 and 2025. BiblioMagika[®] was used for performance analysis, and Biblioshiny was used for key-word co-occurrence, thematic mapping, and thematic evolution. The papers identified as the cohort for analysis had received 2830 citations in total, with an average of 15.81 citations per paper, and an average h-index of 30. *The European Journal of Wood and Wood Products* and *BioResources* were the most productive sources. Three distinct categories were identified through keyword mapping among the studies reviewed: (1) advanced composites and reinforcement, (2) adhesive and emission-related studies, and (3) circular-material strategies. Thematic evolution showed a trend away from traditional resin-performance topics toward broader sustainability-related themes, particularly bio-based adhesives and recycling-related topics. Overall, this review provides a quantitative overview of publication patterns, influential sources, and thematic development in MDF research. It also provides direction for future MDF research, focusing on durability, large-scale feasibility, life-cycle assessments, and practical implementation.

Keywords: science mapping; co-word analysis; thematic evolution; Biblioshiny; wood-based panels



Academic Editor: André Luis Christoforo

Received: 10 March 2026

Revised: 22 April 2026

Accepted: 27 April 2026

Published: 30 April 2026

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1. Introduction

Medium-density fiberboard (MDF) is an engineered wood product widely used in interior design, furniture, and cabinetry. It is typically produced by separating softwood or hardwood residues into wood fibers, commonly through steam-assisted pressurized refining, before blending them with resin binders and compressing them at high temperature to form flat panels. MDF performance is commonly evaluated through physical and mechanical properties, including bending properties, modulus of rupture (MOR) and modulus of elasticity (MOE), as well as internal bond strength, density, weight, thickness swelling, and water absorption. These properties are influenced by both raw materials and processing conditions.

A substantial body of research has therefore focused on improving MDF durability and dimensional stability through adhesive modification, fiber reinforcement, and panel formulation. Recent studies have examined surface lamination process parameters [1], nanoclays and multiwalled carbon nanotubes in urea–formaldehyde systems [2,3], modified graphene and nanoclay additives for reducing emissions while retaining board strength [4,5], resin- and paraffin-content effects on fluid flow and physico-mechanical performance [6] and recycled wood-fiber processing routes that influence the physical and mechanical characteristics of MDF [7]. Other studies have explored a dialdehyde starch-based binder [8], post-heat treatment to improve dimensional stability [9], and phase change materials with hybrid reinforcements to enhance thermal behavior and toughness [10].

Meanwhile, environmental sustainability has become an important factor in MDF research. Alongside property optimization, recent studies increasingly consider lower-emission adhesives, recycled inputs, and alternative material strategies. As a result, the technical literature on MDF is already broad and mature.

However, what remains limited is not technical knowledge of MDF itself, but quantitative bibliometric mapping of how this literature is distributed, which themes are most visible, and how the field has developed over time. Bibliometric methods such as co-occurrence analysis and thematic mapping are useful for identifying the structure of research and the development of themes across a body of literature. Accordingly, the current study applies bibliometric methods to a set of 179 publications (2016–2025) on the physical and mechanical properties of MDF in order to clarify publication patterns, thematic groupings, and research development over time.

Accordingly, this study aims to answer the following research questions:

1. What are the publication and citation trends in research on the physical and mechanical properties of MDF over the study period?
2. Which documents and journals are the most influential in this research area?
3. What major thematic groupings emerge from keyword co-occurrence analysis and thematic mapping?
4. How have these themes evolved over time?
5. What research gaps and future directions can be identified from the integrated bibliometric findings?

2. Literature Review

This section briefly reviews recent MDF research directions and prior review papers relevant to this study.

2.1. Recent Development

Recent MDF studies mainly address four technical directions: alternative ligno-cellulosic fibers, resin modification, recycling of recovered fibers, and improvement of moisture-related performance [11–20]. Across these directions, researchers generally ex-

amine whether modified raw materials or binders can maintain acceptable bending, internal bond, and dimensional stability while also reducing emissions or virgin wood demand. This body of work also includes studies on converting agricultural residues into bio-based binders and on modifying conventional resin systems to improve board performance [19,20]. Overall, the experimental literature is already broad and technically mature. In this study, its relevance lies in showing why a bibliometric overview is useful for clarifying how these themes are distributed and connected across the wider research landscape.

2.2. Previous Review Papers on MDF

Several review papers have already synthesized selected subtopics in MDF research, including amino resins [21], recycled fibers [22], industrial adhesive synthesis [23], and oil palm fiber as an alternative raw material [24]. Table 1 summarizes the scope and contribution of these reviews.

Table 1. Summary of previous review papers on medium-density fiberboard (MDF).

Authors	Objective of the Study	Attributes Examined	Main Findings/Contributions
[23]	To review synthesis methods for industrial hot-melt nanostructured polyurethane adhesives (HMPUAs) to enhance bonding between MDF and PVC veneers.	– Synthesis methods (prepolymer method emphasized). – NCO/OH ratio, polyol selection. – Effects of nanoparticles (nanosilica, nanolignin, etc.). – Mechanical & thermal properties of adhesives.	The prepolymer method is most efficient. Nanoparticle additives significantly improve adhesive properties. Achieving consistent performance and durability under varied conditions remained a key challenge.
[24]	To review the potential of oil palm fiber as an alternative raw material for MDF production, addressing the supply limitations of rubberwood.	– MDF manufacturing process. – Mechanical (MOR, MOE, and IB) & physical properties. – Impact of fiber dimensions and chemical composition. – Chemical treatments (alkaline, acetylation).	The chemical structure and size of oil palm fiber had a strong influence on the properties of boards. Fiber compatibility can be enhanced by chemical modification, and the mechanical properties of the resultant MDF are increased.
[22]	To review and analyze research on recycling lignocellulosic fibers (from post-consumer MDF and paper waste) for the production of eco-friendly MDF.	– Recycling methods (with/without chemical reagents). – Quantitative yield & panel quality. – Production costs. – Concept of cascading wood use.	Post-consumer MDF fiber can be recycled, and this lowers the use of virgin wood. Diverse recycling techniques differ in productivity and price, and offer prospects of more sustainable panel manufacturing.
[21]	To review the utilization and characterization of amino resins (UF, MUF) for producing PB and MDF, with emphasis on optimization and low formaldehyde emission.	– UF/MUF resin synthesis processes. – Key performance parameters of adhesives. – Panel characterization methods. – Strategies for optimizing resins and pressing conditions.	Described the importance of the critical association between resin formulation, pressing conditions and ultimate panel performance. Highlighted ways of fulfilling good mechanical properties and reducing formaldehyde emissions.

Although these earlier reviews are detailed qualitative syntheses of technical sub-fields, they all produce a large methodological and holistic gap. These reviews are conventional narrative reviews that provide insightful yet limited professional insights on a single topic, i.e., the chemistry of resins, recycled fibers, alternative feedstocks, or the future of ad-

hesives. Most importantly, none of them offers a quantitative, macro-level analysis of the whole research environment. Likewise, they do not trace the field's developmental curve, identify the most productive journals, map collaboration networks, or systematically examine how research themes evolve over time. This creates a gap because individual topics have been reviewed in detail, yet there is no overall picture showing how they are connected, which are most prominent, and how the research field has developed over time.

Together, these review papers clarify important technical subtopics but do not provide a quantitative overview of publication trends, influential sources, or the thematic evolution across MDF research. This limitation motivates the present bibliometric analysis.

3. Data and Methodology

This work is quantitative in nature and uses a bibliometric methodology to find a systematic mapping of the intellectual framework and thematic development of research on the physical and mechanical properties of MDF. The general research design involved three key steps, which included database retrieval, screening and eligibility evaluation, and bibliometric performance and science mapping analysis. This bibliometric review was conducted in accordance with the PRISMA 2020 [25] reporting framework for study identification, screening, and inclusion. The study-selection process is illustrated in Figure 1.

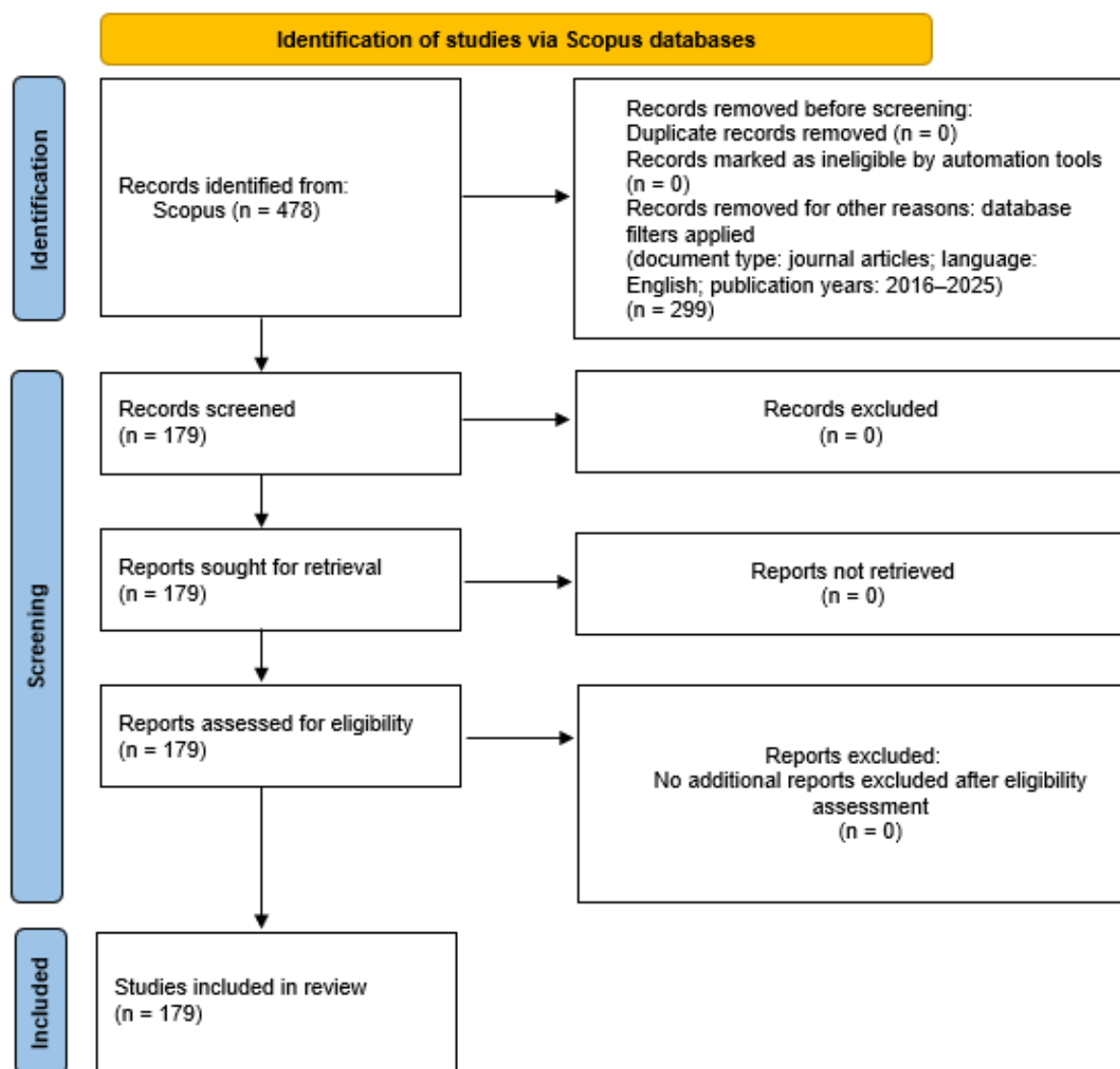


Figure 1. PRISMA flow diagram: Detailing steps in the identification and screening of sources.

3.1. Search Strategy and Data Collection

The bibliographic dataset was selected only from the Scopus database, as it has a wide range of peer-reviewed journals in the field of materials science, wood engineering, and composite research. A Boolean combination of keywords related to MDF and its physical-mechanical properties, as listed in Table 2, was constructed to ensure the search string was both relevant and focused.

Table 2. The search string.

Scopus	TITLE-ABS-KEY (("medium density fibreboard" OR "medium-density fibreboard" OR MDF) AND (wood OR timber OR lignocellulosic OR "wood-based" OR panel OR composite) AND ("physical properties" OR "mechanical properties")) AND NOT (forging OR metallurgy OR "metal forming" OR "model description file" OR electronics OR "median frequency")) Search and export date: 14 February 2026
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The search was narrowed down to articles published between 2016 and 2025 to represent ten years of research progress. Journal articles that were in English were included only to achieve consistency and quality control. After retrieval, duplicate records, conference papers, irrelevant subject areas, and publications that did not directly address physical or mechanical properties were filtered. Because the search query explicitly targeted studies on the physical and/or mechanical properties of MDF, the prominence of performance-related terms in the bibliometric maps partly reflects the study’s scope and partly reflects the influence of the search design.

A Scopus search identified 478 records. Application of predefined database filters, including document type (journal article), language (English), and publication years (2016–2025), resulted in the exclusion of 299 records. After applying these filter parameters, a total of 179 articles were screened at the title and abstract levels. As no records were excluded during this stage, all 179 studies were included in the bibliometric analysis. The full list of Scopus-indexed studies included in the bibliometric dataset is provided in Appendix A (Table A1).

3.2. Bibliometric Tools and Analytical Procedure

Data preprocessing was initially performed in Microsoft Excel, with manual cleaning to address inconsistencies in authors’ names, variations in keywords, and duplications. Subsequently, standardization was performed to ensure that homonyms (e.g., mechanical property vs. mechanical properties, Medium Density Fiberboard vs. MDF) were pulled together before analysis.

Performance analysis and overall publication patterns, such as yearly production, citation rates, nations of contribution, and journal distribution, were then undertaken with the aid of BiblioMagika® (version 2.10.5) [26]. This step offered descriptive measures including Total Publications (TPs), Citations Per Paper (C/P), the *h*-index, and patterns of collaboration.

Bibliometric approaches such as co-word analysis, thematic mapping, and thematic evolution provide complementary perspectives on how topics are structured and change over time. For this reason, the Biblioshiny web interface of the Bibliometrix R-package version R 4.5.2 was used to conduct science-mapping analyses [27]. The analysis of co-occurrence of author keywords was conducted to determine conceptual clusters of research on MDF. Accordingly, the thematic map was constructed using centrality and density measures in Callon, with the research themes categorized as motor, basic, niche, and emerging. In addition, a thematic evolution analysis was performed to observe shifts in the research focus between the early (2016–2020) and recent (2021–2025) timeframes.

This methodological framework allows for the analysis of the intellectual architecture and developmental path of MDF research over the last 10 years by combining performance measures with the methodology of science mapping.

4. Results

4.1. Citation Metrics and Publication Trends

In accordance with the bibliometric information given on the period between 2016 and 2025, the scholarly environment on the physical and mechanical properties of MDF is summarized in the following table and analysis. The academic publications on the physical and mechanical properties of MDF from 2016 to 2025 are representative of a coherent literature base, which is supported by the indicators provided in Table 3. There were 179 research papers published over the course of this 10-year span involving a large community of 789 contributing individuals. Notably, the standard number of 4.41 authors per paper indicates that there was a great level of teamwork in the discipline, probably owing to the multi-disciplinary nature of wood science, which is prone to incorporating chemistry, materials engineering, and structural analysis. At the same time, this trend of collaboration highlights the role of complex relations in the optimization of fiberboard properties and the joint academic quest of improving industrial standards of composite materials.

Table 3. Citation metrics.

Main Information	Data
Publication Years	2016–2025
Total Publications	179
Number of Contributing Authors	789
Number of Cited Papers	170
Total Citations	2830
Citation per Paper	15.81
Citation per Cited Paper	16.65
Citation per Year	314.44
Citation per Author	3.59
Author per Paper	4.41
Citation sum within <i>h</i> -Core	2530
<i>h</i> -index	30
<i>g</i> -index	43
<i>m</i> -index	2.727

Source: Generated by the author(s) using Bibliomagika® [26].

Concerning the reach and visibility of the studies, the information in Table 3 presents quite a strong degree of knowledge sharing and peer acceptance. The collection has already received a 2830 TC, yielding an average C/P of 15.81. These statistics, along with an *h*-index of 30 and a *g*-index of 43, indicate that a significant part of the published work has gained a lot of influence within the global scientific community. Furthermore, these bibliometric measures indicate that the literature created in this period can be used as a source of reference for further research on sustainable binders, waterproofing, and the mechanical properties of fiber-based panels. These can serve as a solid scientific foundation for research on the development of MDF.

The temporal pattern of scientific output in relation to the properties of MDF, outlined in Table 4, reveals a vibrant research environment with periodic bursts of academic output. The number of publications rose dramatically, reaching a peak of 31 in 2020, after starting with 12 TP in 2016. Although production of the annual volume went up and down in the following years, the field remained vibrant with 22 and 19 issues in 2024 and 2025, respectively. This long-term productivity implies that there is still significant focus on optimizing fiberboard performance within the materials science community, probably as a reaction to changing environmental policies and industry requirements for high-performance bio-composites.

Table 4. Publication by year.

Year	TP	NCA	NCP	TC	C/P	C/CP	<i>h</i>	<i>g</i>	<i>m</i>
2016	12	54	12	246	20.50	20.50	8	12	0.727
2017	14	55	12	254	18.14	21.17	9	14	0.900
2018	20	85	20	566	28.30	28.30	12	20	1.333
2019	14	58	10	325	23.21	32.50	9	14	1.125
2020	31	130	29	619	19.97	21.34	16	24	2.286
2021	17	90	17	452	26.59	26.59	10	17	1.667
2022	12	44	11	98	8.17	8.91	6	9	1.200
2023	18	80	18	147	8.17	8.17	7	11	1.750
2024	22	108	22	107	4.86	4.86	8	9	2.667
2025	19	85	19	16	0.84	0.84	3	3	1.500
Total	179	789	170	2830	15.81	16.65	30	43	2.727

Note: TP = total number of publications; NCA = number of contributing authors; NCP = number of cited publications; TC = total citations; C/P = average citations per publication; C/CP = average citations per cited publication; *h* = *h*-index; *g* = *g*-index; *m* = *m*-index. Source: Generated by the author(s) using Bibliomagika® [26].

The citation influence of these publications, which is also represented in Table 4, presents insight into the “vintage” of influential studies in the field. The high academic resonance of 2018 is highlighted by the volume of 566 TC and 28.3 C/P, closely followed by the 2020 cohort, which yielded an *h*-index of 16. The comparatively smaller number of citation years (2023–2025) is characteristic of bibliometric works, as recently published papers have yet to be incorporated into the citation network to the same extent. Nevertheless, the *h*-index values have remained constant throughout the decade, which proves that each year has provided underpinnings that have sustained the characterization and evolution of MDF.

4.2. Source and Journal Analysis

The analysis below examines the spread of research across diverse academic outlets and identifies the key journals that shape the conversation regarding the physical and mechanical characteristics of MDF. As shown in Table 5, the most prolific publication sources were specialized journals in wood science and materials engineering. *The European Journal of Wood and Wood Products* and *BioResources* are the top sources in this field of research, with 13 and 11 TPs, respectively. This focus indicates that scholars put more emphasis on journals with a long history of publication in the field of forestry products and bio-based materials. Moreover, noting multi-disciplinary journals such as *Materials* and *Polymers* among the top five indicates that the study of MDF is gradually shifting into the field of polymer science and the advanced characterization of materials, demonstrating the shift toward high-technology products from traditional wood composites.

Table 5. Top 20 most prolific journals with regard to research on physical and mechanical properties of MDF (2016–2025).

Source Title	TP	NCA	NCP	TC	C/P	C/CP	<i>h</i>	<i>g</i>	<i>m</i>
<i>European Journal of Wood and Wood Products</i>	13	58	13	162	12.46	12.46	7	12	0.636
<i>BioResources</i>	11	28	11	88	8.00	8.00	6	9	0.600
<i>Wood Material Science and Engineering</i>	10	43	10	122	12.20	12.20	5	10	0.500
<i>Materials</i>	8	39	8	95	11.88	11.88	4	8	0.571
<i>Polymers</i>	8	39	8	275	34.38	34.38	7	8	1.000
<i>Wood Research</i>	7	25	4	80	11.43	20.00	4	7	0.400
<i>Forests</i>	6	23	6	64	10.67	10.67	3	6	0.429
<i>International Journal of Adhesion and Adhesives</i>	5	21	5	242	48.40	48.40	5	5	0.556
<i>Drvena Industrija</i>	5	15	5	54	10.80	10.80	3	5	0.333
<i>Maderas: Ciencia y Tecnologia</i>	4	13	4	124	31.00	31.00	4	4	0.364
<i>International Wood Products Journal</i>	4	24	4	36	9.00	9.00	3	4	0.273
<i>Journal of Wood Science</i>	4	16	4	51	12.75	12.75	3	4	0.273
<i>Journal of Applied Polymer Science</i>	3	13	3	48	16.00	16.00	3	3	0.333
<i>Industrial Crops and Products</i>	3	17	3	78	26.00	26.00	3	3	0.333
<i>Journal of Building Engineering</i>	3	12	3	71	23.67	23.67	3	3	0.333
<i>Polymer Composites</i>	3	17	3	6	2.00	2.00	1	2	0.333
<i>Applied Sciences (Switzerland)</i>	3	14	3	46	15.33	15.33	3	3	0.429
<i>Journal of Tropical Forest Science</i>	2	9	2	4	2.00	2.00	2	2	0.222
<i>Journal of Advanced Research in Fluid Mechanics and Thermal Sciences</i>	2	15	2	15	7.50	7.50	2	2	0.286
<i>European Polymer Journal</i>	2	14	2	53	26.50	26.50	2	2	0.250

Regarding the impact on academic circles and the number of citations, Table 5 reveals a substantial gap in the number of publications and citation rates. Although the *European Journal of Wood and Wood Products* continues to have a high *h*-index of 7, the highest average impact is displayed by the *International Journal of Adhesion and Adhesives*, with 48.40 C/P. Likewise, *Polymers* records a significant TC of 275, which demonstrates its status as a high-impact journal in conducting research on the improvement of fiberboards in terms of chemical and mechanical properties. These indications imply that although specialized wood journals offer the largest volume, interdisciplinary journals appealing to adhesives and polymers are sometimes the sources of the most referenced and influential publications. This is mainly attributed to the fact that they reach a larger audience within the materials engineering community.

4.3. Highly Cited Articles

The list of highly cited articles provides the necessary information on the main research directions and the most powerful paradigms for investigating MDF properties. As Table 6 demonstrates, the most frequently cited articles published in 2016–2025 highlight three major areas of research: waste from agriculture and industry, the development of bio-based adhesive systems, and the application of nanotechnology. To illustrate, the most cited research [28] provided insights into the description of composites based on date palm leaflets and polystyrene waste, indicating a significant tendency to discuss a circular economy in the field of wood science. Similarly, much focus has been placed on substituting synthetic resins with sustainable alternatives, including chitosan–lignin resins and lignosulfonate-based systems. These are expected to reduce the environmental footprint and enhance the interior bonding strength of fiberboard panels.

Table 6. Top 10 highly cited articles.

No.	Author(s)	Title	Source Title	TC	C/Y
1	[28]	Characterization of a new composite material based on date palm leaflets and expanded polystyrene wastes	<i>Construction and Building Materials</i>	115	12.78
2	[29]	Preparation and properties of a chitosan-lignin wood adhesive	<i>International Journal of Adhesion and Adhesives</i>	97	10.78
3	[30]	Application of surface chemical functionalized cellulose nanocrystals to improve the performance of UF adhesives used in wood-based composites—MDF type	<i>Carbohydrate Polymers</i>	90	11.25
4	[31]	Effect of sodium lignosulfonate on bonding strength and chemical structure of a lignosulfonate/chitosan-glutaraldehyde medium-density fiberboard adhesive	<i>Advanced Composites and Hybrid Materials</i>	83	13.83
5	[32]	Binderless all-cellulose fiberboard from microfibrillated lignocellulosic natural fibers	<i>Composites Part A: Applied Science and Manufacturing</i>	75	6.82
6	[33]	Addition of cellulose nanofibers extracted from rice straw to urea formaldehyde resin; effect on the adhesive characteristics and medium-density fiberboard properties	<i>International Journal of Adhesion and Adhesives</i>	71	10.14
7	[34]	Effect of graphene oxide nanoparticles on the physical and mechanical properties of medium-density fiberboard	<i>Polymers</i>	63	10.50
8	[35]	Eco-friendly fiberboard panels from recycled fibers bonded with calcium lignosulfonate	<i>Polymers</i>	60	10.00
9	[36]	Recycling wood waste from construction and demolition to produce particleboards	<i>Maderas: Ciencia y Tecnologia</i>	59	6.56
10	[37]	Effects of recycled fiber content on the properties of medium-density fiberboard	<i>European Journal of Wood and Wood Products</i>	52	5.78

Note: TC = Total citations; C/Y = citations per year. Source: Generated by the author(s) using Bibliomagika® [26].

Moreover, the bibliometric data presented in Table 6 highlight the importance of adding compressed materials and other alternative sources of fiber when conducting a literature review on the physical and mechanical characteristics of MDF. In particular, the study of cellulose nanocrystals and nanofibers stands as a major technological change to nano reinforcement in terms of maximizing moisture resistance and MOE [30,33]. The recycled fiber and binderless panel studies also demonstrate the interest of the field in sustainability without affecting structural integrity. Correspondingly, the top articles with TCs of between 52 and 115 serve as the base literature for current experimental procedures and industrial quality standards for high-performance, environmentally friendly fiberboards.

4.4. Keyword Co-Occurrence Network Analysis

The keyword co-occurrence network shown in Figure 2 maps how terms in the selected studies are associated with one another. Because the search strategy explicitly targeted studies addressing physical and mechanical properties, performance-related terms appear prominently in the network. The more informative result is the way these terms connect with other topics. Three thematic groupings emerge from the analysis.

Cluster 1 (red) groups studies on advanced composites and reinforcement strategies. Keywords such as “mechanical properties”, “strength”, “MOE”, “nanocellulose”, and “graphene oxide” indicate frequent attention to additive-based modification. Representative studies reported improvements in bending strength, stiffness, internal bond strength, and moisture-related performance using cellulose nanocrystals, cellulose nanofibers,

graphene-based fillers, and related treatments [30,33,38,39]. Together, these studies show that reinforcement-based performance improvement is a recurring theme across the selected studies.

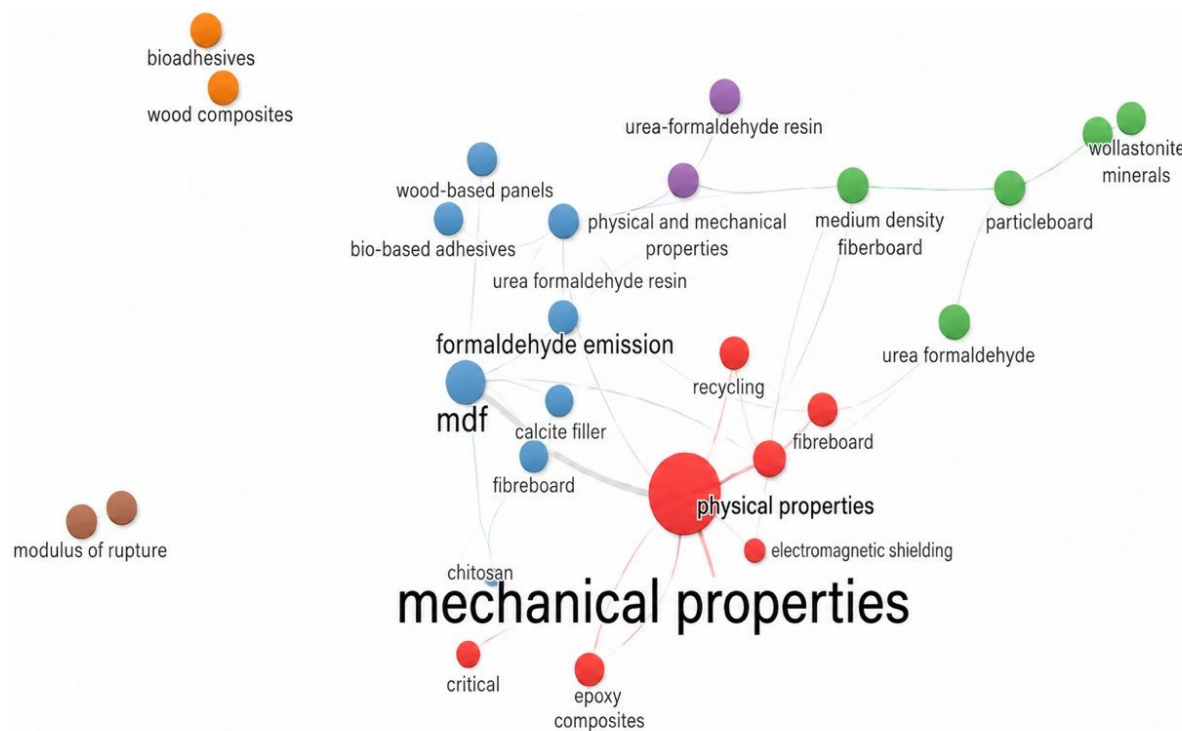


Figure 2. Keyword co-occurrence network showing thematic clusters in medium-density fiberboard (MDF) research (2016–2025).

Cluster 2 (blue) groups adhesive and emission-related studies. Keywords such as “urea-formaldehyde”, “formaldehyde emission”, “bio-adhesives”, “chitosan”, and “ligno-sulfonate” indicate strong links between adhesive chemistry, emission control, and board-property evaluation. Representative studies in this cluster include chitosan–lignin adhesives [29], lignosulfonate–chitosan systems [31,40], lignosulfonate-bonded fiberboards [35,41], natural tannin modification of urea–formaldehyde resins [42], lignin-based emission reduction in recycled-fiber boards [43], lignin nanoparticles for reducing formaldehyde emissions in medium-density fiber boards [44], and activated soybean protein isolate-modified urea–formaldehyde resin for producing eco-friendly fiberboards with lower formaldehyde content and improved mechanical properties [45]. In bibliometric terms, this cluster indicates sustained interest in greener adhesive systems and lower-emission resin technologies within MDF-related property research.

Cluster 3 (green) groups circular-material strategies and comparative panel studies. Keywords such as “particleboard”, “density”, “binderless”, “wood waste”, and “circular economy” indicate recurring interest in recycling, alternative feedstocks, and panel benchmarking. Representative studies include recycled-fiber MDF [37], construction and demolition wood waste used for panel production [36], recovered mine timber as a secondary feedstock [46], lightweight panel production from olive pits and waste melamine residues [47], and binderless boards [32,48,49]. This cluster highlights the connection between circular-material strategies and comparative property reporting in the selected studies.

Taken together, the co-occurrence network indicates three broad thematic groupings within the selected studies: advanced composites and reinforcement [30,33,34,38,39], adhesive and emission-related studies [29,31,42,45], and circular-material strategies [36,46,47].

Because the selected studies were deliberately focused on physical and mechanical properties, the prominence of performance-related terms is expected. More informative is the way these terms connect with sustainability-oriented topics, particularly bio-based adhesives, emission reduction, recycling and alternative feedstocks [29,47].

4.5. Thematic Map

The thematic map as shown in Figure 3 positions research themes according to Callon's centrality (relevance to the field) and density (development within the theme). The four quadrants correspond to motor themes (high centrality, high density), basic themes (high centrality, low density), niche themes (low centrality, high density), and emerging or declining themes (low centrality, low density). In this study, the map is useful for showing how adhesive, reinforcement, and circular-material topics are distributed across the selected studies.

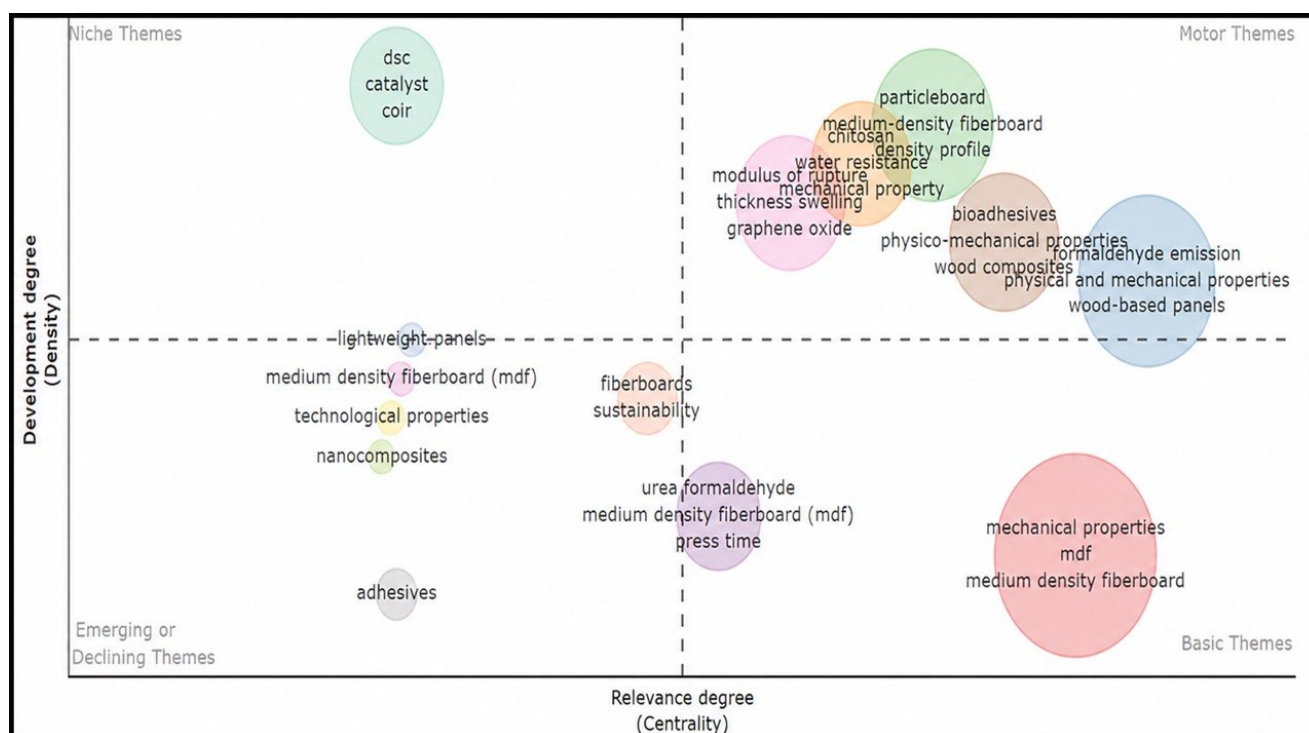


Figure 3. Thematic map of research themes based on centrality and density (2016–2025).

Motor Themes (high centrality, high density). The upper-right quadrant is dominated by adhesive- and emission-related topics, especially formaldehyde emissions and bio-adhesives. Representative studies include chitosan–lignin adhesives [29], lignosulfonate-based adhesive systems [31], calcium-lignosulfonate-bonded fiberboards [35], tannin-modified urea–formaldehyde resins [42], and low-formaldehyde soy-based binders [45]. Together, these studies indicate a mature, well-connected research line linking greener adhesive systems to board-property evaluation.

Basic Themes (high centrality, low density). The lower-right quadrant contains performance-oriented descriptors, including “mechanical properties” and related MDF terms. This is consistent with the study’s scope and indicates that many studies report comparable board property measures. Representative studies in this area connect reinforcement and resin-modification work with moisture- and strength-related testing, including cellulose nanocrystals [30], cellulose nanofibers [33], graphene oxide [34], and chemical treatment strategies [39]. In this sense, the Basic Theme quadrant serves as a shared reporting space across the selected studies rather than a separate, specialized theme.

Niche Themes (high density, low centrality). The upper-left quadrant contains technically developed but less connected topics. Examples include binderless all-cellulose fiberboards [32], specialized adhesive systems such as chitosan–lignin and soy-protein-based binders [29,50], and comparative panel applications such as particleboard studies using waste-derived feedstocks [47]. These themes show technical depth, but they remain more peripheral in the present map.

Emerging or Declining Themes (low centrality, low density). The lower-left quadrant contains topics with weaker connectivity or lower thematic development in the selected studies. These include selected work on conventional resin optimization [42,51] and less-connected alternative binder systems [50]. In the context of this map, such themes appear less consolidated than the adhesive/emission or reinforcement-related groups.

In general, the thematic map suggests that the selected studies combine well-developed adhesive- and emission-related themes [29,31,35,45] with a broad base of reinforcement and property-testing studies [30,33,39], alongside several more specialized topics such as binderless boards, alternative feedstocks, and comparative panel applications [32,47,50]. Overall, the map shows that MDF research is thematically diversified, with strong links between property reporting, adhesive innovation, and sustainability-related topics.

4.6. Thematic Evolution

The thematic evolution as shown in Figure 4 is an analysis examined how research topics changed between 2016–2020 and 2021–2025. Overall, the mapped literature indicates a gradual shift from conventional resin-performance studies toward broader sustainability-oriented themes. Earlier studies more often emphasized resin optimization, bending-related performance, and emissions control, whereas the later-period map shows stronger links between property-reporting terms and recycling-related themes.

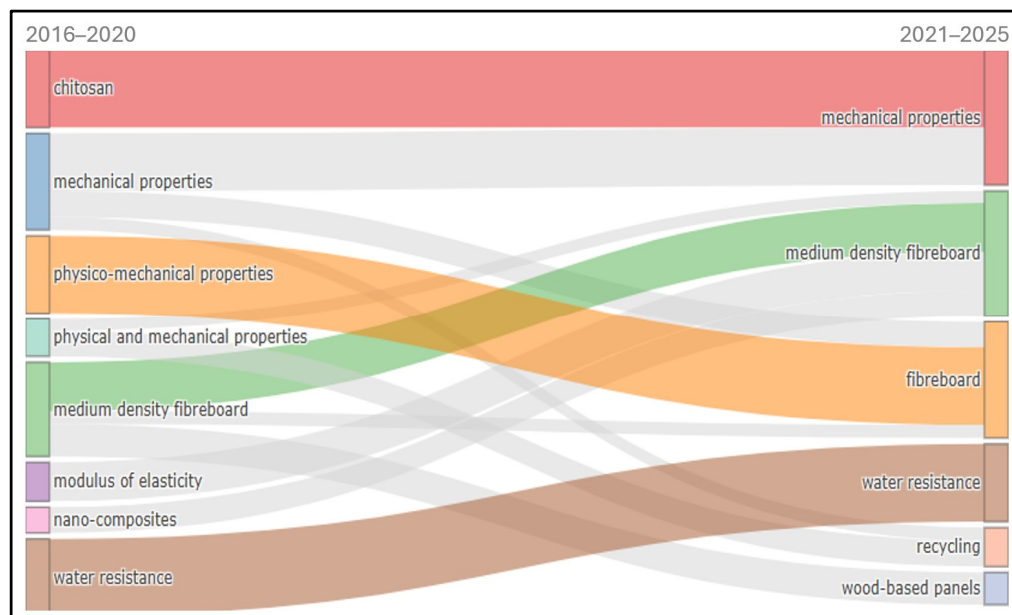


Figure 4. Thematic evolution of research themes across the study period.

Early period (2016–2020). During the first period, the mapped literature was more strongly associated with conventional resin systems and studies on bending strength, stiffness, and emissions reduction [30,33,42]. Recycling and alternative feedstocks were already present, but they appeared as smaller associated strands rather than dominant topics [37]. Early sustainability-oriented work was also visible in studies on bio-based adhesives and modified binder systems [29,50]. Overall, the early-period map suggests a re-

search profile still centered on conventional resin-performance studies, with sustainability-related themes beginning to emerge.

Recent period (2021–2025). During the second period, the thematic evolution map retained strong property-reporting terms while showing clearer links with recycling and related board-material themes [31,35,43,45,46]. This shift suggests a stronger linkage between sustainability-related topics and the reporting of board properties, rather than a complete departure from earlier performance-oriented research. Overall, the later-period map indicates thematic diversification within MDF research.

Conclusion. Overall, the thematic evolution results suggest a shift from conventional resin-performance studies toward a broader research profile integrating sustainability-oriented innovations. Earlier studies were more strongly associated with resin optimization, bending-related performance, and emissions control [30,33,42,50], whereas the later-period map shows clearer links between property-reporting terms and recycling-related themes [43,45,46]. This pattern indicates thematic diversification over time rather than a complete departure from earlier research directions.

5. Discussion

Although the bibliometric dataset included 179 publications, only studies that met the predetermined inclusion criteria were referenced in the narrative discussion, specifically those representing the main thematic clusters. All quantitative indicators, thematic maps, and evolution analyses were derived from the complete dataset.

Regarding RQ1, publication and source patterns show that research on MDF properties remained active throughout 2016–2025 and was published mainly in specialized wood-science journals, with additional visibility in materials and polymer journals. This suggests that MDF property research remains rooted in wood science while increasingly engaging adjacent materials-related fields.

Regarding RQ2 and RQ3, the highly cited articles and thematic analyses indicate three recurring directions in the literature: advanced composites and nano-reinforcement [30,33,34,38,39], adhesive and emission-related studies [29,31,35,40,42,45], and circular-material strategies [32,37,46,47]. Together, these patterns indicate growing interest in linking board property evaluation with adhesive innovation, emission reduction, recycling, and alternative feedstocks.

Regarding RQ4, thematic evolution suggests a gradual shift from conventional resin-performance studies toward broader sustainability-oriented topics. Earlier studies more often emphasized resin optimization, bending-related performance, and emissions control [30,42,50], whereas more recent studies more frequently connect property reporting with bio-based adhesives, recycled inputs, and alternative raw materials [35,43,45,46]. This indicates thematic diversification rather than a complete break from earlier research directions.

Regarding RQ5, several gaps remain visible. Many studies report similar strength-, stiffness-, and moisture-related measures [33,34,39], which support comparisons across studies, but longer-term durability, cyclic humidity performance, aging, scalability, and life-cycle assessment remain less visible. Stronger links are also needed between laboratory-scale findings and industrial processing, certification, and implementation.

These interpretations should be read together with the study limitations. The analysis was based on a single database, English-language journal articles, and a search strategy focused on the physical and mechanical properties of MDF. These choices improve consistency and replicability, but they may exclude relevant regional or non-English publications. Future bibliometric work could broaden database coverage and link mapping results with technical validation, industrial practice, and environmental assessment.

6. Conclusions

This bibliometric review analyzed 179 Scopus-indexed journal articles on the physical and mechanical properties of medium-density fiberboard (MDF) published between 2016 and 2025. By combining performance analysis with keyword co-occurrence, thematic mapping, and thematic evolution, the study provides a structured overview of publication trends, influential sources, and the main thematic patterns in this research area.

The results indicate that MDF research has expanded beyond conventional resin-performance studies toward a broader set of sustainability-related topics. More recent studies increasingly link property reporting to bio-based adhesives, reduced formaldehyde emissions, recycling, and the use of alternative raw materials. This pattern suggests that current MDF research increasingly connects material performance with environmental considerations.

This study is limited by its use of a single database, English-language journal articles, and a search strategy focused on physical and mechanical properties. Future studies could expand database coverage, compare a broader range of MDF publications, and connect bibliometric mapping with longer-term durability, scalability, life-cycle assessment, and industrial implementation.

Author Contributions: Conceptualization, N.A.J., G.I. and A.F.J.; methodology, N.A.J., Z.I. and N.S.Y.; validation, G.I., I.O., A.F.J. and J.M.; formal analysis, N.A.J., Z.I., F.A.R. and N.S.Y.; investigation, N.A.J., G.I. and I.O.; resources, G.I., I.O. and N.A.J.; data curation, G.I., N.A.J., I.O., M.E.W., M.K. and J.M.; writing—original draft preparation, N.A.J.; writing—review and editing, G.I., M.E.W. and M.K.; visualization, M.Z.H., A.N.R., F.A.R. and M.A.M.; supervision, G.I. and I.O.; project administration, M.Z.H., A.N.R. and M.A.M.; funding acquisition, G.I. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Perusahaan Intan Jepara Sdn Bhd, Geran Industri IRG/F02/JEPARA/85856/2023.

Data Availability Statement: Not applicable.

Acknowledgments: The authors would like to gratefully acknowledge everyone involved in this project, especially Perusahaan Intan Jepara Sdn Bhd for the research funding (IRG/F02/JEPARA/85856/2023) and also to the Sarawak Forest Department, Sarawak Forestry Corporation, and Samling Plywood Bintulu Sdn. Bhd., Daikin Plantation Sdn. Bhd. and Universiti Malaysia Sarawak. During the preparation of this manuscript, the authors used ChatGPT (OpenAI; GPT-5.4 Pro) and Grammarly for language revision and structural editing. The authors reviewed and edited the output and take full responsibility for the content of this publication.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Full list of Scopus-indexed studies included in the bibliometric dataset (n = 179).

No.	Authors	Title	Authors’ Keywords
1	[1]	Effects of Surface Lamination Process Parameters on Medium Density Fiberboard (MDF) Properties	Bending; Fiberboard; Gloss; Impregnated; Lamination; MOE; Press time; Scratch; Urea formaldehyde
2	[2]	Urea impregnated multiwalled carbon nanotubes; a formaldehyde scavenger for urea formaldehyde adhesives and medium density fiberboards bonded with them	graphene and fullerenes; mechanical properties; microscopy; nanotubes; swelling; viscosity and viscoelasticity

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
3	[3]	Effects of nano-clay on physical and mechanical properties of medium—Density fiberboards made from wood and chicken—Feather fibers and two types of resins; [Utjecaj nanogline na fizička i mehanička svojstva ploča vlaknatica srednje gustoće izrađenih od drva, vlakana pilećeg perja i dviju vrsta smola]	Clay nanofibers; Feather fibers; Mineral materials; Nano-composites; Wood fiber
4	[4]	Modified graphene as potential additive for urea formaldehyde (UF) resin in medium density fiberboard (MDF) manufacturing	Ethylenediamine; Formaldehyde emission; Graphene oxide; Medium density fiberboard(MDF); Urea formaldehyde resin
5	[5]	Effects of Nanoclay Modification with Aminopropyltriethoxysilane (APTES) on the Performance of Urea–formaldehyde Resin Adhesives	3-Aminopropyltriethoxysilane; Formaldehyde emission; MDF; Nanoclay; Urea formaldehyde resin
6	[6]	The effects of urea-formaldehyde resin and paraffin contents on fluid flow (air and water) and physico-mechanical properties of medium-density fibreboards	medium-density fibreboard (MDF); permeability; urea-formaldehyde resin (UF-resin); wood fibre; Wood-based panels
7	[7]	The Impact of Hydrolysis Regime on the Physical and Mechanical Characteristics of Medium-Density Fiberboards Manufactured from Recycled Wood Fibers	formaldehyde content; medium-density fibreboards; physical and mechanical properties; recycling; thermal hydrolysis
8	[8]	A dialdehyde starch-based adhesive for medium-density fiberboards	Bio-based adhesives; MDF; Microfibrillated cellulose; Starch oxidation; Wood-based panels
9	[9]	The effect of post-heat treatment in MDF panels	Dimensional stability; MDF panels; Physical and mechanical properties; Post-heat treatment; Temperature and time of heat treatment
10	[10]	Impact of bio-based phase change materials on the thermal inertia of panels made from medium-density fiberboard (MDF) residues	Fiberboard; Medium density fiberboard residues; Phase change material; Thermal inertia; Thermal storage
11	[15]	Reducing free formaldehyde emission, improvement of thickness swelling and increasing storage stability of novel medium density fiberboard by urea-formaldehyde adhesive modified by phenol derivatives	Formaldehyde scavenger; Medium density fiberboard (MDF); Phenolic compounds; Thickness swelling; Urea formaldehyde adhesive
12	[18]	Revealing the impacts of recycled urea–formaldehyde wastes on the physical–mechanical properties of MDF	-
13	[28]	Characterization of new composite material based on date palm leaflets and expanded polystyrene wastes	Date palm waste; Expanded polystyrene waste; Leaflets-Polystyrene Composite; Mechanical properties; Recycling; Thermal conductivity
14	[29]	Preparation and properties of a chitosan-lignin wood adhesive	A. Adhesives for wood; Ammonium lignosulfonate; C. Infrared spectroscopy; C. Thermal analysis; Chitosan; D. Mechanical properties of adhesives
15	[30]	Application of surface chemical functionalized cellulose nanocrystals to improve the performance of UF adhesives used in wood based composites—MDF type	APTES; CNC; Formaldehyde emission; Mechanical properties; Urea formaldehyde
16	[31]	Effect of sodium lignosulfonate on bonding strength and chemical structure of a lignosulfonate/chitosan-glutaraldehyde medium-density fiberboard adhesive	Chitosan; Lignosulfonate; MDF; Mechanical property; Sodium lignosulfonate; Water resistance
17	[32]	Binderless all-cellulose fibreboard from microfibrillated lignocellulosic natural fibres	A. Cellulose; B. Mechanical properties; E. Compression moulding; Microfibrillation

Table A1. *Cont.*

No.	Authors	Title	Authors' Keywords
18	[33]	Addition of cellulose nanofibers extracted from rice straw to urea formaldehyde resin; effect on the adhesive characteristics and medium density fiberboard properties	Cellulose nanofibers; Particleboard; Rice straw; Urea formaldehyde
19	[34]	Effect of graphene oxide nanoparticles on the physical and mechanical properties of medium density fiberboard	Graphene oxide; Internal bond; MDF; Modulus of elasticity; Modulus of rupture; Thickness swelling; Urea–formaldehyde resin; Water absorption
20	[35]	Eco-friendly fiberboard panels from recycled fibers bonded with calcium lignosulfonate	Bioadhesives; Calcium lignosulfonate; Fiberboards; Recycled fibers; Wood-based panels; Zero-formaldehyde emission
21	[36]	Utilization of construction and demolition waste for particleboard production	Board pressing; Urea formaldehyde resin; Wood particles
22	[37]	Effects of recycled fiber content on the properties of medium density fiberboard	-
23	[38]	Synthesis of graphene oxide (GO) and reduced graphene oxide (rGO) and their application as nano-fillers to improve the physical and mechanical properties of medium density fiberboard	graphene oxide (GO); medium density fiberboard; nanocomposites; nanofabrication; reduced graphene oxide (rGO)
24	[39]	The Combined Effects of Alkali Treatment and Ammonium Bicarbonate Addition on Selected Properties of MDF Panels	Alkali treatment; Ammonium bicarbonate; Fire resistance; Mechanical properties; Medium density fiberboard; Physical properties
25	[40]	Influence of glutaraldehyde on the performance of a lignosulfonate/chitosan-based medium density fiberboard adhesive	adhesives; biopolymers and renewable polymers; cellulose and other wood products; spectroscopy; thermogravimetric analysis (TGA)
26	[41]	Engineering the properties of eco-friendly medium density fibreboards bonded with lignosulfonate adhesive; [Dizajniranje svojstava ekološki prihvatljivih ploča vlaknatica srednje gustoće proizvedenih uporabom lignosulfonatnog ljepila]	Bio-based adhesives; Eco-friendly MDF; Lignosulfonate; Physical and mechanical properties; Wood-based panels
27	[42]	Supplementation of natural tannins as an alternative to formaldehyde in urea and melamine formaldehyde resins used in mdf production	Formaldehyde emission; Mdf; Mf; Tannin; Uf
28	[43]	Effect of Lignin Modification of Recycled and Fresh Wood Fibers on Physical, Mechanical, and Thermal Properties of Fiberboard	fiberboard; formaldehyde emission; kraft lignin; mechanical properties; thickness swelling; urea-formaldehyde resin
29	[44]	Advancing Sustainable Building Materials: Reducing Formaldehyde Emissions in Medium Density Fiber Boards with Lignin Nanoparticles	formaldehyde emission; formaldehyde scavenger; lignin nanoparticles; medium density fiberboard; urea formaldehyde resin
30	[45]	Eco-friendly fiberboards with low formaldehyde content and enhanced mechanical properties produced with activated soybean protein isolate modified urea-formaldehyde resin	Medium-density fiberboard; Soybean protein isolate; Urea; Urea-formaldehyde resin
31	[46]	Valorization of Recovered Mine Timber as a Secondary Feedstock for Medium-Density Fiberboard Manufacturing	cascade utilization; circular bioeconomy; medium-density fiberboard; mining timber; recovered wood; waste valorization
32	[47]	Effects of utilizing olive pits and waste melamine-impregnated paper in particleboard manufacturing on board properties; [Yongalevha üretiminde zeytin çekirdeği ve atık melamin emdirilmiş kağıt kullanımının levha özellikleri üzerine etkilerinin belirlenmesi]	MIP waste; Olive pit; Particleboard; Physical properties
33	[48]	Wood-like boards obtained from the recycling of rigid and flexible multilayer food packaging	boards manufacturing; mechanical properties; multilayer packaging; physical properties; recycling

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
34	[49]	Manufacturing and utilization of novel sustainable composites using pulled wool fibers waste from leather tanneries: Mechanical, physical, and dynamic characterization	damping capacity; flexural strength; pulled wool fibers; recycling; thermal conductivity
35	[50]	Mechanical and water-resistant properties of rice straw fiberboard bonded with chemically-modified soy protein adhesive	-
36	[51]	The impact of altering the molar ratio on formaldehyde content and the physical and mechanical properties of MDF panels	quality standards; technological properties; urea-formaldehyde ratio; Wood-based panels
37	[52]	Effect of medium-density fiberboard sawdust content on the dynamic and mechanical properties of epoxy-based composite	epoxy; mechanical properties; medium-density fiberboard; vibration
38	[53]	Properties of Un-Torrefied and Torrefied Poplar Plywood (PW) and Medium-Density Fiberboard (MDF)	medium-density fiberboard; modulus of rupture; roughness; water absorption
39	[54]	How nano-wollastonite can change the fundamental properties of a wood fibre and rice straw composites?	-
40	[55]	Reinforcement of fiberboard containing lingo-cellulose nanofiber made from wood fibers	Cellulose nanofiber; Fiberboard; Ligno-cellulose nanofiber; Wet pulverize; Wood-based materials
41	[56]	Statistical Methods in the Analysis of the Effect of Carbonisate on the Hardness of Epoxy-Resin-Based Composites	carbonisate; hardness; pyrolysis; recycling; statistical analysis
42	[57]	Application of mineral filler in medium density fiberboard (MDF) and its effect on material properties as a function of particle size	Dimensional stability; Liquid permeability; Mechanical properties; Medium density fiberboard (MDF); Mineral filler; Particle size; Urea formaldehyde
43	[58]	Mechanical and energy absorption properties of the composite XX-type lattice sandwich structure	Energy absorption property; Mechanical property; Sandwich structure; XX-type
44	[59]	Effects of factors on direct screw withdrawal resistance in medium density fiberboard and particleboard	Adhesives; Density; Medium density fiberboard; Particleboard; Screw; Water treatment
45	[60]	Investigation of the fire, thermal, and mechanical properties of zinc borate and synergic fire retardants on composites produced with PP-MDF wastes	Fiber wastes; Fire retardant; Thermal properties; Zinc borate
46	[61]	Properties of MDF manufactured with mixtures of wood from paricá plantations and wood waste from native Amazonian species; [Propriedades de painéis MDF fabricados com misturas de madeira de plantações de paricá e resíduos de madeira de espécies nativas da Amazônia]	Industrial wood processing; Schizolobium amazonicum; tropical wood species; wood-based panels
47	[62]	Effect of accelerated aging treatment on a surface property and dynamic mechanical properties of commercial wood-based panels	Accelerated aging treatment; Dynamic modulus of elasticity; Medium density fiberboard; Particleboard; Surface roughness
48	[63]	Influence of Mercerization on the Physical and Mechanical Properties of Polymeric Composites Reinforced with Amazonian Fiber	Castor oil; Leopoldinia piassaba fibers; Mercerization; Polymeric composites; Screw withdraw strength
49	[64]	Properties of medium-density fibreboards bonded with dextrin-based wood adhesive	Crosslinker; Dextrin adhesive; Glyoxal; Mechanical properties; Pmdi; Thickness swelling
50	[65]	Text Mining of Wood Science Research Published in Korean and Japanese Journals	co-occurrence network analysis; Journal of the Korean Wood Science and Technology; Journal of Wood Science; research information; term frequency-inverse document frequency (TF-IDF); text mining; word frequency analysis

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
51	[66]	Mechanical and physical screw withdrawal properties behavior of agglomerated panels reinforced with coir and pejibaye fibers	Coir; Mechanical properties; natural fibers; pejibaye; screw withdrawal
52	[67]	Formaldehyde emission from PVC–wood composites containing MDF sanding dust	-
53	[68]	Bending properties of wood I-joist made with <i>Pinus (pinus sp.)</i> and <i>curupixá (Micropholis venulosa)</i> flanges	Bending beam properties; Modulus of elasticity; Modulus of rupture; Structural adhesive; Wood engineered products
54	[69]	Development of wood composites from recycled fibres bonded with magnesium lignosulfonate	Bioadhesives; Magnesium lignosulfonate; Waste fibres; Wood composites
55	[70]	Thermal Analysis and Cone Calorimeter Study of Engineered Wood with an Emphasis on Fire Modelling	Cone calorimetry; Density profile; Engineered wood; Kinetic parameters; Thermogravimetric analysis
56	[71]	New insight into the use of latent catalysts for the synthesis of urea formaldehyde adhesives and the mechanical properties of medium density fiberboards bonded with them	¹³ C NMR; Ammonium salt; Catalyst; DSC; Mechanical properties; Synthesis and processing; Urea-formaldehyde
57	[72]	Effect of Pumice Powder on Mechanical, Thermal, and Water Absorption Properties of Fiberboard Composites	Composites; Epoxy; MDF; Mechanical properties; Pumice powder
58	[73]	Computational Design of Laser-Cut Bending-Active Structures	Active bending; Computational fabrication; Inverse design; Laser-cutting; Metamaterial
59	[74]	Degradation of medium density fibreboard and particleboard mechanical performance after exposed to different environmental condition	Medium density fibreboard; Melamine urea formaldehyde; Particleboard; Urea formaldehyde
60	[75]	Thermal behavior of insulation fiberboards made from MDF and paper wastes; [Toplinska svojstva izolacijskih vlaknatica izrađenih od otpadnog MDF-a i papira]	Insulation fiberboards; MDF wastes; Recycling; Thermal stability; Waste paper
61	[76]	Sustainable WPC Production: A Novel Method Using Recycled High-Density Polyethylene and Wood Veneer	compression molding; lightweight panels; manufacture; recycled plastic; wood plastic composite; wood veneer
62	[77]	The Study of Mechanical Properties of Sandwich Composites with a Hybrid Resin Matrix Based on Dammar, a Core of Chopped Corn Cobs and Natural Fabric Faces. Applications in the Furniture Industry	chopped corn cobs; Hybrid resin; mechanical properties; natural fabrics; sandwich composite materials
63	[78]	Mechanical and thermal behavior of hybrid composite medium density fiberboard reinforced with phenol formaldehyde	Basalt; Coir; DSC; Flammability; Medium density fiberboard; TGA
64	[79]	The Effect of Foamed Urea-Formaldehyde Adhesive on Physical and Mechanical Properties of Medium Density Fiberboards (MDF); [Učejak upjenjenog urea-formaldehidnog ljepila na fizička i mehanička svojstva srednje guste ploče vlaknatice (MDF)]	foamed urea-formaldehyde adhesive; foaming agent; medium-density fiberboard; physical and mechanical properties
65	[80]	Automated Shape Correction for Wood Composites in Continuous Pressing	continuous hot pressing; cyber granular; event-triggered control; forests resources; plate shape deviation correction; wood-based fiber composites
66	[81]	Manufacturing and characterization of innovative lightweight wooden furniture from polystyrene core wood sandwich panels	Engineered wood panels; Lightweight; Polystyrene core; Smart furniture; Wood-based sandwich structures
67	[82]	Effect of Calcite Addition on Technical Properties and Reduction of Formaldehyde Emissions of Medium Density Fiberboard	Calcite filler; Fibreboard; Formaldehyde emission; MDF; Technical properties

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
68	[83]	Investigating water transport in MDF and OSB using a gantry-based X-ray CT scanning system	-
69	[84]	Experimental Analysis of Connections Made with Wood-Based Panels and Brackets Under Cyclic Loading	bracket; Cyclic loading; ductility; impairment of strength; MDF; particleboard; viscous damping
70	[85]	Structural application of eco-friendly composites from recycled wood fibres bonded with magnesium lignosulfonate	Bending strength capacity; Bioadhesives; Corner joints; Magnesium lignosulfonate; Recycled fibres; Wood composites
71	[86]	Finite Element Analysis of Structural Strength in Flattened Bamboo Sheet Furniture	bamboo furniture; finite element analysis; flattened bamboo sheet; structural strength
72	[87]	Simulation analysis of the circular sawing process of medium density fiberboard (MDF) based on the Johnson–Cook model	-
73	[88]	Influence of Pressing Pressure on the Mechanical Properties of Durio zibethinus (Durian) Fiberboard	Automotive industry; Durian; Fiberboard; Husk; Urea formaldehyde
74	[89]	Enhancement of strength and water resistance of macro-defect free (MDF) gypsum modified by pregelatinized starch and hydrogen silicone oil	Compressive strength; Hydrogen silicone oil; Macro-defect-free; Pregelatinized starch; Water resistance
75	[90]	Eco-Design of Thermopressing through Induction of 100% Coriander-Based Fiberboards: Optimization of Molding Conditions	climate change; fiberboards; induction; mechanical properties; plant-based fibers; thermopressing
76	[91]	Bio-inspired layered nanolignocellulose/graphene-oxide composite with high mechanical strength due to borate cross-linking	Borate cross-linking; Graphene oxide; Lignocellulose; Physico-mechanical properties
77	[92]	Utilizing de-inked paper sludge for sustainable production of medium-density fiberboard: A comprehensive study	de-inked paper sludge; fiber-matrix interactions; recycling paper waste; sustainable materials; waste-to-resource conversion
78	[93]	Dependence of Polyurethane Content on Physical and Mechanical Properties of Wood Fiber/Palm Kernel Shell Composites	MDF; mechanical properties; palm kernel shell; polyurethane adhesive; wood fiber
79	[94]	Virtual characterization of MDF fiber network	-
80	[95]	Medium Density Fiberboard (MDF) with Efficient Electromagnetic Shielding: Preparation and Evaluation	Carbon fiber; Electromagnetic shielding; Fiberboard; Mechanical properties; Physical properties
81	[96]	Effects of adding nano-wollastonite, date palm prunings and two types of resins on the physical and mechanical properties of medium-density fibreboard (MDF) made from wood fibres	Minerals; Nanomaterials; Natural fibres; Palm leaves; Particleboard; Thermal conductivity coefficient ollastonite; Wood-composite
82	[97]	Enhancing water resistance of medium density fibreboards via periodate oxidation of thermomechanical fibres	-
83	[98]	Evaluation of UF resin content in MDF boards after hot-pressing by Kjeldahl method	-
84	[99]	Effect of alumina nano-particles on physical and mechanical properties of medium density fiberboard	Composites; Mechanical properties; Nano-composites; Process optimization; Tensile and compressive loads
85	[100]	Combining the pineapple leaf fibre (PALF) and industrial ramie fibre to the epoxy matrix for high-strength light weight medium-density fibreboards	Absorption studies; Mechanical properties; Pineapple leaf fibres; Ramie fibres; Taguchi optimization
86	[101]	Sorbitol glycidyl ether Epoxy/Brewer's spent grain biocomposite for fiberboard applications	Agro-waste; Bio-based material; Brewer's spent grain; Fiberboards; Sustainability

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
87	[102]	Developing polylactic acid (PLA)-based medium-density fiberboard: investigating three key manufacturing factors and their impact on physical and mechanical properties	-
88	[103]	Fabrication of structurally graded material (pure PLA/WFPC): Mechanical and microscopic aspects	FFF; mechanical integrity; microscopic morphologies; PLA; SGM wall; WFPC
89	[104]	Properties of particleboards made from mixture of oversized fibers from MDF waste process and wood particles of Norway spruce (<i>Picea abies</i>)	density profile; Oversized fibers; particleboard; physical and mechanical properties; wood particles
90	[105]	Failure analysis of a continuous press component in MDF production plant	Brittle fracture; Failure analysis; Heat treatment; Intergranular fracture
91	[106]	Use of secondary fibres from recycling processes of fibreboard manufacturing and post-consumer waste in medium density fibreboard	-
92	[107]	Evaluation of whey protein for modifying urea-formaldehyde in medium-density fiberboard (MDF) production	EWP; panel products; physical and mechanical properties; Whey protein
93	[108]	Reaction of door constructions made of cellular wood material to fire	Cellular wood material; Door elements; Fire resistance; Reaction to fire
94	[109]	Physical and Mechanical Properties of Fiberboard Made of MDF Residues and Phase Change Materials	fiberboard; MDF residues; phase change materials; physical-mechanical properties; thermal energy storage
95	[110]	Mechanical and Formaldehyde-related Properties of Medium Density Fiberboard with Zeolite Additive	Formaldehyde emission; MDF; Mechanical properties; Physical properties; Zeolite
96	[111]	Effects of heat treatment on some properties of MDF (medium-density fiberboard)	Fiberboard; formaldehyde emission; heat treatment; physical and mechanical properties
97	[112]	Canola Meal as Raw Material for the Development of Bio-Adhesive for Medium Density Fiberboards (MDFs) and Particleboards Production	bio-adhesive; canola meal; MDF; particleboard; protein; renewable resources; wood-based panels
98	[113]	Synthesis mechanism of an environment-friendly sodium lignosulfonate/chitosan medium-density fiberboard adhesive and response of bonding performance to synthesis mechanism	Bonding performance; Chemical structure; Chitosan; Crystalline structure; MDF adhesive; Sodium lignosulfonate; Synthesis mechanism; Thermal stability
99	[114]	Application of multi-directional forged titanium for prosthetic crown fabrication by cad/cam	CAD/CAM; Digital data; Fitness test; Glossiness; MDF titanium
100	[115]	Production of high-performance low density fibreboard from co-refined rubberwood-kenaf core fibres	Kenaf core; Light density fibreboard; Mechanical; Physical; Rubberwood
101	[116]	Hybrid coir medium density fibreboard made of coir and basalt fiber using urea-formaldehyde resin	Basalt fiber; Coir fiber; Modulus of elasticity; Modulus of rupture
102	[117]	Formaldehyde-free environmentally friendly lignocellulosic composites made from poplar and lignin obtained from paper mills	Black liquor; Composite; High performance; Lignin
103	[118]	Influence of needle-punching treatment and pressure on selected properties of medium density fiberboard made of bamboo (<i>Dendrocalamus strictus</i> Roxb. Nees)	Bamboo fibers; hot-pressing pressure; medium density fiberboard; needle-punching treatment; panel properties
104	[119]	Influence of press factor and additional thermal treatment on technology for production of eco-friendly MDF based on lignosulfonate adhesives	Additional thermal treatment; Eco-friendly MDF; Lignosulfonate adhesives; Press factor
105	[120]	Mechanical and Physical Properties of Green Biocomposite Based on Medium Density Fiberboard Sanding Powder/Polyethylene/Nanoclay	Biocomposite; Extrusion; Green; MDF sanding-powder; Mechanical properties; Nanomaterials

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
106	[121]	Relating MOE decrease and mass loss due to fungal decay in plywood and MDF using resonalyser and X-ray CT scanning	Fungal decay; MDF; Plywood; Resonalyser; X-ray CT scanning
107	[122]	Deformation Characteristics of Fiberboard Due to the Localized Heating	casting mold; Fiberboard; surface property; thermal deformation
108	[123]	Effects of Refining Parameters on the Properties of Oil Palm Frond (OPF) Fiber for Medium Density Fibreboard (MDF)	acidic fibre; Buffering capacity; fibrillation; medium density fibreboard (MDF)
109	[124]	Manufacturing of Composite Panels from Date Palm Leaflet and Expanded Polystyrene Wastes Using Hot Compression Moulding Process	Biocomposite panels; biowaste; date palm leaflets; expanded polystyrene; hot compression moulding process; mechanical properties; waste utilization
110	[125]	Potential of the crude glycerol and citric acid mixture as a binder in medium-density fiberboard manufacturing	-
111	[126]	Recovering fibres from fibreboards for wood polymer composites production	Cascade use; fibreboard; MDF; mechanical properties; physical properties; recycling; thermo-hydrolytic disintegration; wood polymer composite
112	[127]	Utilization of recycled material sources for wood-polypropylene composites: Effect on internal composite structure, particle characteristics and physico-mechanical properties	Cascade utilization; Fibre/particle characterisation; Physico-mechanical properties; Raw materials; Recycling and reuse; Wood polymer composites; X-ray micro-computed tomography imaging
113	[128]	Structural Optimization of Sustainable Lightweight Hemp Shive-Fiber Panels	carbon-negative materials; eco-friendly composites; hemp fibers; hemp shives; lightweight panels; moisture resistance; structural optimization; sustainable furniture materials; wood substitute
114	[129]	Adsorption of nanowollastonite on cellulose surface: Effects on physical and mechanical properties of medium-density fiberboard (MDF); [Adsorção de nano wollastonita na superfície de celulose: Efeitos nas propriedades físicas e mecânicas de placas de fibra de madeira de média densidade (MDF)]	Adsorption; Binding energy; Cellulose fiber; Nanocomposites; Nanowollastonite
115	[130]	Sound insulation and mechanical properties of wood damping composites	Composite panels; Dynamic mechanical properties; Rubber; Sound insulation performance; Wood materials
116	[131]	Recycling wood waste from construction and demolition to produce particleboards	Mechanical properties; Physical properties; Urea-formaldehyde; Wood panels; Wood residue
117	[132]	Preparation and characterization of high-strength and water resistant lignocelluloses based composites bonded by branched polyethylenimine (PEI)	Cross-linking; High strength; Lignocelluloses based composites; Polyethylenimine; Schiff's base addition reaction; Water resistance
118	[133]	The effect on panel properties of incorporation of reject paper fibre into MDF panels	MDF; Mechanical properties; Recycled paper waste; Trace metals
119	[134]	Sustainable panels design based on modified cassava starch bioadhesives and wood processing byproducts	Bioadhesives; Mechanical properties and water affinity; Polycarboxylic acids; Rheological behaviour; Structural and morphological analysis; Sustainable panels
120	[135]	Bio-Based Tannin Foams: Comparing Their Physical and Thermal Response to Polyurethane Foams in Lightweight Sandwich Panels	biomass; fire resistance; MDF panel; natural polymer; tannic extract
121	[136]	A novel approach in wood waste utilization for manufacturing of catalyst-free polyurethane-wood composites (PU-WC)	Polyurethane; Waste management; Wood; Wood-plastic composite

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
122	[137]	Circular Economy of Medium Density Fiberboard (MDF) and Medium Density Particleboard (MDP): Challenges and Advances in Sustainability and Production Processes; [Economia Circular de Painéis de Fibra de Densidade Média (MDF) e Painéis de Partículas de Média Densidade (MDP): Desafios e Avanços em Sustentabilidade e Processos Produtivos]	life cycle; medium density fiberboard; medium density particleboard; reuse
123	[138]	Engineering composites made from wood and chicken feather bonded with UF resin fortified with wollastonite: A novel approach	Cell-wall polymers; Chicken feather; Composite panels; Engineering materials; Natural materials; Thermal conductivity coefficient; Wollastonite; Wood
124	[139]	Formaldehyde adsorption capacity of chitosan derivatives as bio-adsorbents for wood-based panels	Chitosan nanoparticles; Formaldehyde emission; Formaldehyde scavengers; Grafted chitosan; Medium density fiberboard; Wood-based panels
125	[140]	Waste rose flower and lavender straw biomass—an innovative lignocellulose feedstock for mycelium bio-materials development using newly isolated <i>Ganoderma resinaceum</i> gal1m	Apparent density; Compressive resistance; <i>Ganoderma resinaceum</i> ; Hexane extracted rose flowers; Mycelium bio-composites; Steam distilled lavender straw; Water absorbance
126	[141]	Technological properties and fire performance of medium density fibreboard (MDF) treated with selected polyphosphate-based fire retardants	fire performance; Medium density fibreboard (MDF); polyphosphate-based retardants; smoke suppressants
127	[142]	Medium-density fibreboards bonded with phenol-formaldehyde resin and calcium lignosulfonate as an eco-friendly additive	bio-adhesives; calcium lignosulfonate; formaldehyde emission; lignosulfonate-PF resin; Medium-density fibreboard (MDF); phenol-formaldehyde resin (PF resin)
128	[143]	Sustainable composite panels from non-metallic waste printed circuit boards and automotive plastics	Automotive plastics; Non-metallic; Sustainable composite panel; Waste printed circuit boards
129	[144]	Fiber level catalyst-free oxidative carboxylation enhances physical properties of wood polymer composites	adhesive; carboxylation; lignocellulose; wood composites; wood modification
130	[145]	Mechanical and physical properties of medium density fibreboard with calcite additive	Calcite filler; Fiberboard; MDF; Mechanical properties; Physical properties
131	[146]	Characterization of blockboard and battenboard sandwich panels from date palm waste trunks	Battenboard; Blockboard; Date palm waste; Insulating material; Lightweight sandwich panel
132	[147]	Photoactive glazed polymer-cement composite	Glazing; Photocatalysis; Polymer-cement composite; TiO ₂ ; Waste water
133	[148]	Effect of chitosan-epoxy ratio in bio-based adhesive on physical and mechanical properties of medium density fiberboards from mixed hardwood fibers	Chitosan; Dimensional stability; Epoxy; Gel time; Mechanical properties
134	[149]	Effect of panel moisture content on internal bond strength and thickness swelling of medium density fiberboard	Commercial MDF; Physico-mechanical properties; Storage conditions; Wood-based panels
135	[150]	Effect of different acids during the synthesis of urea-formaldehyde adhesives and the mechanical properties of medium-density fiberboards bonded with them	addition polymerization; adhesives; applications; catalysts; synthesis and processing techniques
136	[151]	Mechanical Properties of Mycelium Based MDF	MDF; mechanical properties; Mycelium composites; physical properties; white-rot fungi
137	[152]	Improved durability of lignocellulose-polypropylene composites manufactured using twin-screw extrusion	A. Biocomposite; A. Thermoplastic resin; B. Environmental degradation; E. Extrusion
138	[153]	Plastic deformation assessment of sawdust-rPET composites under bending load	Bending properties; Mechanical properties; Polymer composite; Sawdust; Waste PET

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
139	[154]	VOC and carbonyl compound emissions of a fiberboard resulting from a coriander biorefinery: comparison with two commercial wood-based building materials	Chipboard; Coriander; Formaldehyde; MDF; Self-bonded fiberboards; VOC emissions
140	[155]	Preparation and characterisation of electromagnetic shielding medium-density fiberboard using Iron oxide nanoparticles	electromagnetic shielding; Fe ₃ O ₄ nanoparticles; Fiberboard; mechanical properties; physical properties
141	[156]	Properties of commercial fiberboard from <i>Sesbania aculeate</i> and <i>Tamarix aphylla</i>	fiberboard; moisture content; <i>Sesbania aculeate</i> ; <i>Tamarix aphylla</i>
142	[157]	Influence of fiber ratios and resin contents on the properties of medium density fiberboard made from rubberwood and Leucaena	Fiber ratio; Leucaena; Medium density fiberboard; Resin content; Rubberwood
143	[158]	Manufacture of medium density fiberboard (MDF) panels from agribased lignocellulosic biomass	Lignocellulosic biomass; MDF; Physical and mechanical properties
144	[159]	Approaching Self-Bonded Medium Density Fiberboards Made by Mixing Steam Exploded <i>Arundo donax</i> L. and Wood Fibers: A Comparison with pMDI-Bonded Fiberboards on the Primary Properties of the Boards	<i>Arundo donax</i> L.; medium density fiberboards; pMDI; self-bonding; steam explosion; wood fibers
145	[160]	Mechanical and thermal properties of polystyrene and medium density fiberboard composites	Pollution; Sustainability; Waste valuation
146	[161]	Investigation of mechanical properties and elucidation of factors affecting wood-based structural panels under embedment stress with a circular dowel i: analysis of the influence of various conditions on the embedment properties	Bearing; Edge distance; Embedment; End distance; Hardboard (HB); Medium density fiberboard (MDF); Oriented strand board (OSB); Particleboard (PB); Pilot hole; Plywood (PW); Standardized multiple regression analysis (SMRA); Wood-based structural panel
147	[162]	Bonding of recycled fibres with ureaformaldehyde resins	Formaldehyde release; Medium-density fibreboards; Physical and mechanical properties; Polymeric diphenylmethane diisocyanates; Recycled fibres; Urea-formaldehyde resin
148	[163]	Effect of iron oxide nanoparticles on the physical properties of medium density fiberboard	Curing temperature; DSC; EDS; Natural fiber composite; Physical properties; SEM; TGA; XRD
149	[164]	Physical properties of wastes from furniture industry for energy purposes	Chipboards; Fibreboards; Furniture industry; Wastes
150	[165]	“Investigating the synergistic effects of pulverized fly ash, calcium stearate and hydroxyl propyl methyl cellulose on macro-defect-free (MDF) cement performance”	Calcium stearate; Macro-defect-free (MDF) cement; Mechanical strength; Pulverized fly ash; Water resistance
151	[166]	Characterization of MDF produced with bolaina (<i>Guazuma crinita</i> Mart.) wood residues from plantation; [Caracterización de MDF producidos con residuos de madera de bolaina (<i>Guazuma crinita</i> Mart.) proveniente de una plantación]	chemi-mechanical pulp; chemical characterization; emulsion polymer isocyanate; fiber morphology; refiner mechanical pulp; technological properties
152	[167]	Preparation and Properties of Medium-Density Fiberboards Bonded with Vanillin Crosslinked Chitosan	adhesive; chitosan; MDF; mechanical strength; vanillin
153	[168]	Effect of zeolite as filler in medium density fiberboards bonded with urea formaldehyde and melamine formaldehyde resins	Amino resins; Mechanical properties; Medium density fiberboard; Thermal analysis; Water resistance; Zeolite
154	[169]	Static and dynamic thermal characterization of timber frame/wheat (<i>Triticum aestivum</i>) chaff thermal insulation panel for sustainable building construction	Agricultural waste; Dynamic; Hot box; Steady-state; Sustainable; Thermal insulation; Thermal transmittance; Wheat chaff

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
155	[170]	Effects of nano-wollastonite on physical and mechanical properties of medium-density fiberboard	Composite board; Fiber/matrix bond; Medium-density fiberboard; Minerals; Nanoscience; Thermal properties; Wollastonite
156	[171]	Oil Palm Empty Fruit Bunches (EFB): Influence of Alkali and Acid Treatment on the Mechanical Properties of Medium Density Fibreboard (MDF)	Acetic Acid; Bending Strength; Empty Fruit Bunches (EFB); Internal Bonding; Sodium Hydroxide (NaOH)
157	[172]	Effect of mineral materials content as filler in medium density fiberboard	Dolomite; LOI; Perlite; Sepiolite
158	[173]	Fabrication of functional hybrid carbon fiber-reinforced plastics with imparted surface concentrated electrical conductivity via multi-drop filling	Carbon fiber-reinforced plastics; Electrical conductivity; Liquid composite molding; Multi-drop filling
159	[174]	Medium density fibreboard production by hot pressing without adhesive using <i>Triarrhena sacchariflora</i> residue bio-pretreated by white-rot fungus <i>Coriolus versicolor</i>	fermentation; fibreboard; fungi; optimization; waste
160	[175]	Prediction of mechanical performance of acetylated mdf at different humid conditions	Acetylation; Finite element analysis; Internal bonding strength; Regression; Stiffness; Strength; Thickness swelling; Wood fiber
161	[176]	Surface characterization, mechanical and abrasion resistance of nanocellulose-reinforced wood panels	abrasion; cellulose nanocrystals; MDF; mechanical properties; roughness; wood composites
162	[177]	Effect of blending L-lysine-modified montmorillonite into urea-formaldehyde resin on formaldehyde emission and physicomechanical properties of medium density fiberboard	-
163	[178]	Characterization of MDF reinforced with Al ₂ O ₃ Nano particles considering physical, mechanical and quasi-static properties	finite element modeling; mechanical properties; Medium density Fiberboard; Nano-Al ₂ O ₃ powder; physical properties; quasi-static properties
164	[179]	The influence of mechanical pulping treatment on the physical properties of wood fibre plastic composites	Composite properties; Fibre modification; Mechanical pulp refining; Pilot-scale; SEM; Wood fibre plastic composites
165	[180]	Reduced use of urea-formaldehyde resin and press time due to the use of melamine resin-impregnated paper waste in MDF	Medium density fiberboard (MDF); Melamine resin-impregnated paper waste; Physical and mechanical properties; Press time; Urea-formaldehyde resin
166	[181]	Influence of Pressing Schedule and Adhesive Content on the Rheological Behavior of Wood Fiber-Furnish Mats	Adhesive content; Density profile; Mat-furnish; Medium-density fiberboard; Modelling; Pressing schedule; Rheology
167	[182]	Physical and mechanical properties of composites made from bamboo and woody wastes in Taiwan	Bamboo residues; Dimensional stability; Mechanical properties; Non-destructive testing; Physical properties; Wood wastes
168	[183]	Light medium-density fibreboards (MDFs): does acetylation improve the physico-mechanical properties?	-
169	[184]	Investigation of the interrelations between defibration conditions, fiber size and medium-density fiberboard (MDF) properties	-
170	[185]	Direct reuse at industrial level of ion-exchange resin regeneration wastewater in MDF manufacturing	-
171	[186]	Use of hornbeam, pine and MDF waste in wood-polymer composites as construction elements	Hornbeam; Medium density fiberboard; Pine; Recycling; Wood waste; Wood-polymer composites

Table A1. Cont.

No.	Authors	Title	Authors' Keywords
172	[187]	Synthesis of lignin-based polyacid catalyst and its utilization to improve water resistance of urea-formaldehyde resins	Adhesive; Catalyst; Lignin; Urea-formaldehyde resin
173	[188]	Use of multi-hollow polyester particles as optical brighteners to dry-process fibreboard (MDF)	colorimetric analysis; Fibreboard; multi-hollow polyester particles; optical brighteners; physico-mechanical properties
174	[189]	Mechanical properties of the wood-based x-type lattice sandwich structure	Failure modes; Lattice sandwich structure; Mechanical properties; Wood composite; X-type
175	[190]	Sound Insulation Performance of Wooden Damping Composites; [木质阻尼复合材料的隔声性能]	Damping performance; Multi-layer composite; Rubber materials; Sound insulation performance; Wooden materials
176	[191]	Effects of wollastonite on the properties of medium-density fiberboard (mdf) made from wood fibers and camel-thorn	Camel-thorn weed; Minerals; Nano-materials; Particleboard; Thermal conductivity coefficient; Wollastonite; Wood-composite
177	[192]	Influence of polyurethane resin on the mechanical properties of wood fibre and wood Fibre/Palm kernel shell composite boards	Composite; Mechanical properties; Palm kernel shell; Polyurethane adhesive; Wood fibre
178	[193]	Preparation and characterisation of waste poultry feathers composite fibreboards	Composites; Construction material; Fibreboard; Poultry feathers; Wood residues
179	[194]	Effect of panel density and resin content on properties of medium density fiberboard	Medium density fiberboard; Panel density; Properties; Resin content

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