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Assessment of Carbon Nanotube-Polymer Composite Materials using ARAS Method

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Abstract: *The assessment of carbon nanotube (CNT)-polymer composite materials entails examining several crucial parameters to comprehend their potential applications and performance. These composites present a promising avenue for fabricating materials with improved mechanical, electrical, and thermal characteristics. Fundamental evaluation criteria encompass dispersion quality, mechanical behaviour, electrical conductivity, thermal attributes, chemical resistance, and processing adaptability. The uniform dispersion of CNTs within the polymer matrix and the extent of CNT agglomeration profoundly influence the composite's properties. Mechanical evaluations concentrate on factors such as tensile strength, flexural modulus, and impact resistance, which dictate the material's structural robustness. Understanding electrical conductivity enhancement and percolation threshold aids in assessing the composite's applicability in electronic fields. Thermal properties, including conductivity, stability, and expansion coefficients, are pivotal for applications requiring effective thermal management. Chemical resistance assessments guarantee the composite's durability in diverse environmental conditions. Moreover, evaluating processing convenience, compatibility with manufacturing techniques, and cost-effectiveness is crucial for ensuring scalability and commercial feasibility. The ARAS (Analytical Hierarchy Process and Remote Sensing) methodology represents an innovative approach that merges the principles of with remote sensing techniques to streamline decision-making processes across diverse domains. This methodology capitalizes on the strengths of which furnishes a systematic framework for multi-criteria decision-making, and remote sensing, which furnishes valuable spatial insights from satellite or aerial imagery. In this exposition, we will explore the foundational aspects. Dispersion Quality, Mechanical Performance, Electrical Conductivity, Thermal Conductivity, Chemical Resistance and Processing Ease and Compatibility. Mechanical Properties, Electrical Conductivity, Thermal Properties, Dispersion and Interface Quality, Chemical Resistance and Environmental Impact. the Rank in Assessment of Carbon Nanotube-Polymer Composite Materials for Analysis using ARAS Method. Processing Ease and Compatibility is showing the highest value and Thermal Conductivity is showing the lowest value.*
Keywords: *Mechanical Properties, Electrical Conductivity, Thermal Properties, Dispersion and Interface Quality, Chemical Resistance and Environmental Impact.*

1. INTRODUCTION

Assessment of Carbon nanotube (CNT)–polymer composites represent a promising category of materials with diverse applications, owing to their distinct properties. These composites harness the exceptional mechanical, electrical, thermal, and structural characteristics of carbon nanotubes, when incorporated into a polymer matrix, to offer enhanced performance and functionality compared to conventional materials. This introduction provides a comprehensive overview of the key attributes of CNT-polymer composites and their significance across various fields, supported by recent research findings and insights from relevant articles [1]. Carbon nanotubes have garnered considerable attention due to their remarkable properties, including high aspect ratio, exceptional strength, and electrical conductivity. Integration of CNTs into polymer matrices presents an opportunity to enhance mechanical strength, thermal stability, electrical conductivity, and other desirable properties of polymers, thereby fostering innovation in diverse sectors such as aerospace, electronics, automotive, and biomedical applications [2]. Research has demonstrated that incorporating carbon nanotubes into polymer matrices results in improvements in mechanical properties such as tensile strength, Young's modulus, and hardness. The distinctive structure of CNTs, coupled with their exceptional mechanical properties, facilitates effective load transfer within the composite, leading to enhanced structural integrity and resistance to deformation [3]. CNT-polymer composites exhibit enhanced electrical conductivity compared to neat polymers, owing to the ability of CNTs to facilitate electron transport pathways within the composite. This property renders CNT-polymer composites suitable for applications in flexible electronics, conductive coatings, and electromagnetic interference shielding [4]. Moreover, CNT-polymer composites demonstrate superior thermal conductivity relative to neat polymers, attributed to the high thermal conductivity of carbon nanotubes. This results in improved thermal properties, including thermal stability and heat dissipation, making these composites suitable for thermal management applications such as heat sinks and thermal interface materials [5]. Various processing methods, such as solution compounding, melt compounding, and in situ polymerization, have been developed for producing CNT-polymer composites. The choice of fabrication technique influences the dispersion, alignment, and interfacial interactions between CNTs and the polymer matrix, thereby impacting the overall performance of the composite. Optimizing processing parameters is crucial for achieving uniform dispersion and desired property enhancements in CNT-polymer composites [6]. Despite significant progress, challenges persist, including achieving uniform dispersion of CNTs, controlling aggregation, and ensuring strong interfacial adhesion between CNTs and the polymer matrix. Addressing these challenges requires interdisciplinary approaches that integrate materials science, chemistry, and engineering. Additionally, scalable and cost-effective production of CNTs for large-scale applications is essential to fully realize the potential of CNT-polymer composites [7]. Understanding the environmental implications of CNT-polymer composites is critical for sustainable development. While CNTs offer unique properties and performance advantages, concerns regarding their production and disposal raise environmental and health risks. Research efforts focusing on environmentally friendly synthesis methods, recycling strategies, and life cycle assessments are imperative to mitigate these risks [8]. The field of CNT-polymer composites is rapidly advancing, driven by ongoing research and technological advancements. Future directions include the development of multifunctional composites with tailored properties, exploration of novel CNT structures such as graphene-linked nanotubes, and integration of CNTs with other nanomaterials for synergistic effects. Furthermore, emerging applications in areas such as wearable electronics, 3D printing, and energy storage hold promise for expanding the utility of CNT-polymer composites across various industries. [9]. Recent years have witnessed substantial efforts directed towards synthesizing, characterizing, and applying carbon nanotube-polymer composites. Researchers worldwide have been exploring innovative fabrication techniques, improving the dispersion of CNTs within polymer matrices, enhancing interfacial interactions between CNTs and polymers, and investigating the properties and performance of these advanced materials. [10]. Several techniques have been developed for fabricating carbon nanotube-polymer composites, spanning from solution-based methods to melt processing and in situ polymerization. Solution-based methods entail dispersing CNTs in a polymer solution followed by solvent removal or solidification to form the composite. Melt processing techniques, like extrusion and injection molding, involve blending CNTs with molten polymer matrices to create the composite materials. In situ polymerization methods involve polymerizing monomers in the presence of dispersed CNTs to directly form the composite structure. Each synthesis method offers distinct advantages and challenges, with the choice depending on factors such as desired properties, scalability, and processing requirements [11]. Carbon nanotube-polymer composites possess a broad range of characteristics that are modifiable through changes to the CNTs' kind, focused attention, variation, and alignments inside the polymer matrix. Among these characteristics are mechanical toughness, electrical conductivity, thermal stability, gas barrier properties, flame retardancy, and electromagnetic interference (EMI) shielding effectiveness. The outstanding mechanical properties of CNTs, combined with the flexibility and processability of polymers, enable the design and fabrication of composites with superior performance compared to traditional materials [12]. Carbon nanotube-polymer composites hold tremendous promise for various applications across multiple industries. In the aerospace industry, they can be utilized to manufacture lightweight and high-strength components for aircraft and spacecraft, offering substantial weight savings and improvements in fuel efficiency. In the automotive industry, these composites can find applications in structural components, body panels, and interior materials, contributing to enhanced safety, performance, and energy efficiency. In the electronics sector, they can facilitate the development of flexible and lightweight electronic devices, conductive coatings, and electromagnetic shielding materials [13]. Carbon nanotubes (CNTs) are hailed as the ultimate carbon fibres thermal conductivity, as well as stability at high temperatures and in various environments. These attributes make them highly desirable for enhancing the performance of multifunctional composites. However, the inherent softness of carbon nanotube surfaces, particularly their side walls, renders them largely incompatible with polymers and most solvents, leading to poor dispersion of nanotubes within a polymer matrix [14]. To address this challenge, non-covalently functionalized Collapsible nanotubes with single walls (SWNTs). Such composites show tiny thresholds for infiltration (usually 0.05–0.1 wt%). and demonstrate significant improvements in electrical conductivity upon SWNT loading. Through enhanced dispersion of SWNTs within commercial polymers, these composites offer a versatile solution for a range of electrical purposes without sacrificing the host polymer's the processing of physical characteristics. Applications for carbon dioxide nanotube/polymer composites include printable computer wiring, transparency conductors, and magnetic shielding coatings, showcasing their potential for advanced technologies [15].

2. MATERIALS AND METHOD

Dispersion Quality: pertains to how paragraphs are arranged and distributed in a written work. Ensuring high-quality dispersion involves organizing paragraphs logically and efficiently, where each contributes to the overall coherence and flow of the text. This includes using suitable transitions between paragraphs, crafting clear topic sentences, and ensuring a cohesive development of ideas. Well-dispersed paragraphs aid readers in navigating the content seamlessly, thereby improving comprehension and engagement.

Mechanical Performance: Mechanical performance relates to how a material responds when subjected to mechanical forces or stresses. This encompasses various characteristics like strength, hardness, and elasticity. A material exhibiting strong mechanical performance can endure different types of loads, impacts, or distortions without failing or suffering notable degradation. Understanding a material's mechanical behavior is crucial in determining its appropriateness for specific applications, ranging from structural elements in constructions and bridges to components in automobiles and everyday consumer goods.

Electrical Conductivity: Electrical conductivity indicates how readily a material permits the flow of electric current. It is gauged by the material's capacity to conduct electricity, typically assessed through its electrical resistance or conductivity. Materials with high electrical conductivity are vital in electrical and electronic uses such as wiring, circuit boards, and conductive coatings. They facilitate efficient transmission of electrical power and signals, making them indispensable in contemporary technology and infrastructure.

Thermal Conductivity: Thermal conductivity denotes a material's ability to conduct heat, measuring how efficiently heat transfers through it via conduction. Materials with high thermal conductivity are proficient heat conductors, finding applications in critical heat transfer scenarios like heat exchangers, cooling systems, and thermal insulation. Understanding a material's thermal conductivity is essential for devising effective thermal management solutions and enhancing energy efficiency across various industries.

Chemical Resistance: Chemical resistance signifies a material's capacity to endure exposure to corrosive substances, chemicals, or environmental conditions without significant degradation or harm. Materials with robust chemical resistance are utilized in environments where they may encounter acids, bases, solvents, or other corrosive agents. This property is crucial for ensuring the durability and reliability of materials in applications like chemical processing, manufacturing, and infrastructure development.

Processing Ease and Compatibility: Ease of processing and compatibility pertain to a material's convenience in being processed or shaped into its desired form, as well as its compatibility with different processing methods and techniques. This encompasses attributes like melt flow, moldability, extrudability, and compatibility with additives or other materials used in processing. Materials that are straightforward to process and harmonious with various manufacturing techniques offer increased flexibility and efficiency in production, resulting in cost savings and heightened product quality.

Mechanical Properties: Mechanical properties encompass the characteristics of a material dictating its response to applied mechanical forces or stresses, including aspects like strength, hardness, toughness, ductility, and elasticity. Understanding these properties is pivotal for anticipating a material's performance across a spectrum of applications, spanning load-bearing structures, mechanical parts, and consumer goods.

Electrical Conductivity: Electrical conductivity signifies a material's capacity to conduct electricity, gauged by its ability to permit the flow of electrons. Materials with heightened electrical conductivity, such as metals and conductive polymers, find utility in electrical wiring, electronic components, and power transmission systems.

Thermal Properties: Thermal properties delineate a material's reaction to heat, comprising its ability to conduct, transfer, and store thermal energy. These attributes are crucial in applications necessitating meticulous thermal management, like thermal insulation, heat sinks, and electronic devices. Thermal conductivity, specific heat capacity, and coefficient of thermal expansion stand as fundamental thermal properties.

Dispersion and Interface Quality: Dispersion and interfacial quality pertain to the uniformity of component distribution within a material and the excellence of interfaces amid disparate phases or components. Particularly significant in composite materials, where efficacy hinges upon interphase interactions, superior dispersion and interfaces yield enhanced mechanical, thermal, and electrical properties in composites.

Chemical Resistance: Chemical resistance denotes a material's ability to endure exposure to diverse chemicals, solvents, and environmental conditions sans degradation or impairment. Materials evincing robust chemical resistance are deployed in scenarios where they may encounter corrosive agents, such as within chemical processing, automotive, and construction domains.

Environmental Impact: Environmental impact encapsulates the ramifications that a product's lifecycle—spanning production, utilization, and disposal experts on the environment. This encompasses facets like resource depletion, energy consumption, emission of pollutants, and generation of waste. Products exhibiting minimal environmental impact are sourced sustainably, manufactured via eco-friendly processes, and can be recycled or disposed of responsibly at the culmination of their lifespan.

Method: The ARAS (Analytical Hierarchy Process (AHP) and Remote Sensing) methodology represents an innovative approach that merges the principles of AHP with remote sensing techniques to streamline decision-making processes across diverse domains. This methodology capitalizes on the strengths of both AHP, which furnishes a systematic framework for multi-criteria decision-making, and remote sensing, which furnishes valuable spatial insights from satellite or aerial imagery. In this exposition, we will explore the foundational aspects [16]. The ARAS methodology, its diverse applications spanning various sectors, and its significance in contemporary research endeavours. Moreover, we will delve into case studies and empirical evidence to underscore the efficacy of the ARAS methodology. Additionally, we will examine the challenges encountered and future avenues for development and implementation of this approach. At its core [17]. ARAS methodology is grounded in the integration of remote sensing data with the principles of to tackle intricate decision-making challenges. Remote sensing involves gathering information about the Earth's surface through sensors deployed on satellites or aircraft, encompassing imagery, spectral measurements, and other spatial data. Conversely, serves as a decision-making tool aiding in the decomposition of complex problems into hierarchical structures while evaluating the relative significance of criteria and alternatives [18]. The initial phase of the ARAS methodology entails clearly defining the decision-making conundrum and delineating the criteria and alternatives necessitating evaluation. This step often entails collaboration among domain experts and stakeholders to ensure comprehensive consideration of all pertinent factors. Subsequently, remote sensing data is amassed leveraging an array of sensors like optical, radar, or LiDAR, tailored to the specific requisites of the problem. This data encompassing imagery, spectral signatures, and spatial information relating to land cover, land use, and vegetation indices undergoes pre-processing to rectify sensor errors, atmospheric distortions, and geometric aberrations, ensuring its accuracy and suitability for subsequent analysis [19]. The processed remote sensing data is then seamlessly integrated into the framework to ascertain the relative importance of criteria and alternatives. empowers decision-makers to methodically compare and prioritize diverse options predicated on their performance against myriad criteria. Following the determination of criteria weights via AHP, the remote sensing data undergoes analysis to assess the performance of each alternative [20].

This analysis may entail classification, change detection, or other spatial analysis methodologies contingent on the nature of the problem at hand. The resultant findings are interpreted and visualized to effectively communicate insights to stakeholders, often through the creation of maps, charts, and other visual aids, facilitating the comprehension of intricate spatial information. The applications of the ARAS methodology span a spectrum of domains, including environmental management, urban planning, agriculture, and disaster management. In environmental management [21]. ARAS has been instrumental in evaluating land cover alterations, deforestation monitoring, and conservation prioritization, enabling more targeted resource allocation and improved ecological outcomes. Urban planning endeavours leverage ARAS to dissect urban sprawl dynamics, assess infrastructure development, and optimize land utilization, thus fostering sustainable urban growth patterns. Similarly, in agriculture, ARAS aids in monitoring crop health, optimizing irrigation strategies, and evaluating soil fertility, thereby facilitating informed decision-making to bolster agricultural productivity while minimizing environmental impacts. In disaster management scenarios [22]. ARAS facilitates the assessment of natural hazard impacts, prioritizes response efforts, and enhances disaster resilience planning, underpinned by rapid damage assessment and strategic resource allocation. A plethora of case studies and empirical research endeavours underscore the efficacy of the ARAS methodology in real-world decision-making contexts. For instance, a study conducted employed [23].

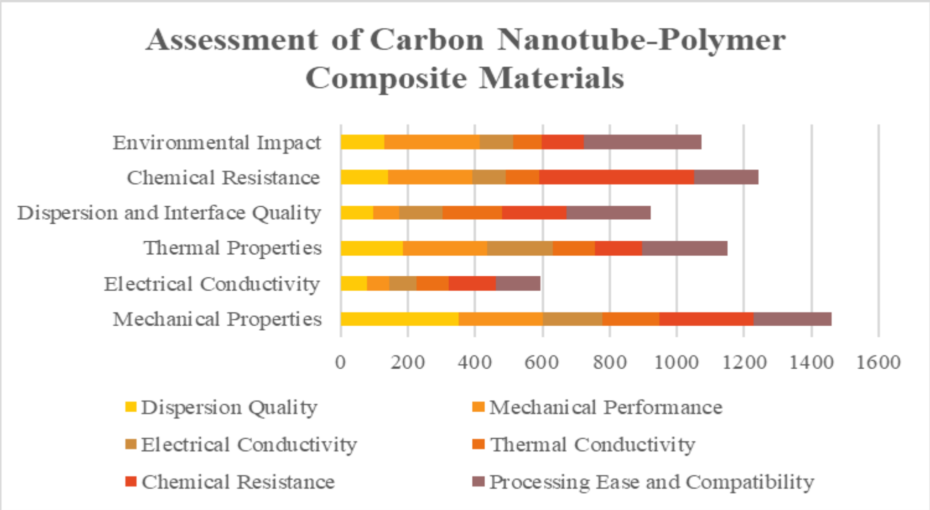
ARAS to prioritize conservation initiatives in a biodiversity hotspot, culminating in more efficacious interventions and enhanced conservation outcomes. Likewise, research conducted utilized ARAS to gauge the ramifications of urbanization on water quality, leading to the formulation of sustainable urban planning strategies. Despite its potential advantages [24], The ARAS methodology encounters several challenges, encompassing data availability constraints, algorithmic complexities, and stakeholder engagement issues. Addressing these hurdles necessitates sustained research and innovation in remote sensing techniques, decision-making frameworks, and interdisciplinary collaboration. Moreover, future research trajectories may encompass the development of machine learning algorithms for automated feature extraction from remote sensing data, the amalgamation of multi-source data for enriched decision-making outcomes, and the extension of ARAS applications to nascent domains like climate change adaptation and smart cities [25].

3. RESULT AND DISCUSSION

TABLE 1. Assessment of Carbon Nanotube-Polymer Composite Materials

	Mechanical Properties	Electrical Conductivity	Thermal Properties	Dispersion and Interface Quality	Chemical Resistance	Environmental Impact
Dispersion Quality	350	78	185	98	140	130
Mechanical Performance	250	68	250	76	250	285
Electrical Conductivity	180	80	197	128	100	98
Thermal Conductivity	170	95	125	180	99	85
Chemical Resistance	280	142	140	190	463	125
Processing Ease and Compatibility	230	130	255	250	190	350

Table 1 shows the Assessment of Carbon Nanotube-Polymer Composite Materials for Analysis using ARAS Method. Dispersion Quality, Mechanical Performance, Electrical Conductivity, Thermal Conductivity, Chemical Resistance and Processing Ease and Compatibility. Mechanical Properties, Electrical Conductivity, Thermal Properties, Dispersion and Interface Quality, Chemical Resistance and Environmental Impact. It is that seen Cultural Responsiveness in Data Collection is showing the Highest Value for Mechanical Properties and Thermal Conductivity is showing the lowest value. Chemical Resistance is showing the Highest Value for Electrical Conductivity and Mechanical Performance is showing the lowest value. Processing Ease and Compatibility is showing the Highest Value for Thermal Properties and Thermal Conductivity is showing the lowest value. Processing Ease and Compatibility is showing the Highest Value for Dispersion and Interface Quality and Mechanical Performance is showing the lowest value. Chemical Resistance is showing the Highest Value for Chemical Resistance and Thermal Conductivity is showing the lowest value. Processing Ease and Compatibility is showing the Highest Value Environmental Impact and Thermal Conductivity is showing the lowest value.



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$$X_{max} = Max\ (X_1 \ldots\ldots X_n) \quad (1)$$

TABLE 2. Calculation of maximum value

	Mechanical Properties	Electrical Conductivity	Thermal Properties	Dispersion and Interface Quality	Chemical Resistance	Environmental Impact
Max	**350**	**142**	**255**	**250**	**463**	**350**
Dispersion Quality	350	78	185	98	140	130
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Chemical Resistance	280	142	140	190	463	125
Processing Ease and Compatibility	230	130	255	250	190	350

Table 2 to calculate the maximum value for each aspect, we simply need to find the highest value among all the provided data points for that aspect.

$$X_{1nor} = \frac{X_1}{\sum(X_1 + X_2 \ldots\ldots X_n)} \quad (2)$$

TABLE 3. Normalised Matrix

	Mechanical Properties	Electrical Conductivity	Thermal Properties	Dispersion and Interface Quality	Chemical Resistance	Environmental Impact
Max	0.19337	0.193197	0.181237	0.213311	0.271554	0.245959
Dispersion Quality	0.19337	0.106122	0.131485	0.083618	0.082111	0.091356
Mechanical Performance	0.138122	0.092517	0.177683	0.064846	0.146628	0.200281
Electrical Conductivity	0.099448	0.108844	0.140014	0.109215	0.058651	0.068869
Thermal Conductivity	0.093923	0.129252	0.088842	0.153584	0.058065	0.059733
Chemical Resistance	0.154696	0.193197	0.099502	0.162116	0.271554	0.087843
Processing Ease and Compatibility	0.127072	0.176871	0.181237	0.213311	0.111437	0.245959

Table 3 To calculate the maximum value for each aspect from the given normalized matrix, we simply need to find the highest value among all the provided data points for each aspect.

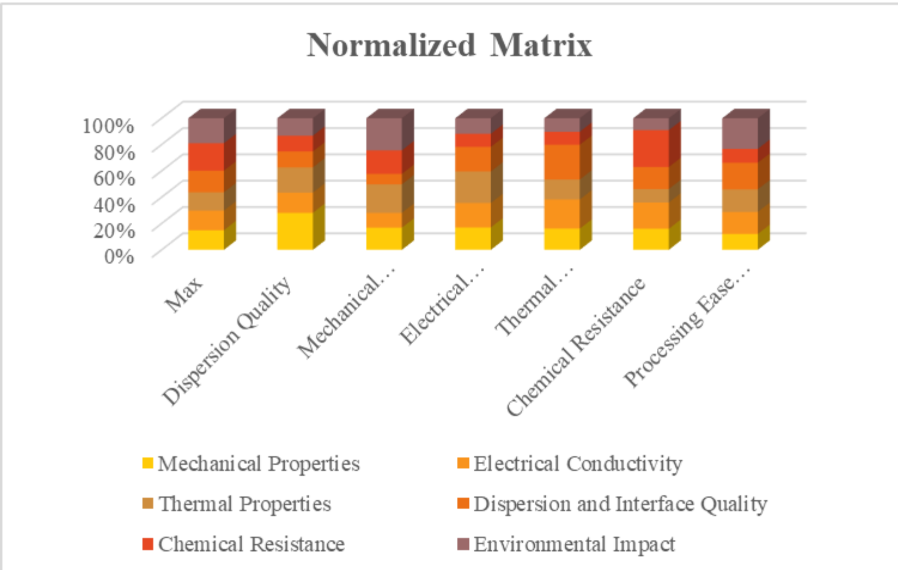

FIGURE 2. Normalised matrix

Figure 2 To calculate the maximum value for each aspect from the given normalized matrix, we simply need to find the highest value among all the provided data points for each aspect.

$$X_{wnormal1} = X_{n1} \times w_1 \qquad (3)$$

TABLE 4. Weighted Normalized Matrix

	0.25	0.25	0.25	0.25	0.25	0.25
	Weighted Normalized Matrix					
	Mechanical Properties	**Electrical Conductivity**	**Thermal Properties**	**Dispersion and Interface Quality**	**Chemical Resistance**	**Environmental Impact**
Max	0.048343	0.048299	0.045309	0.053328	0.067889	0.06149
Dispersion Quality	0.048343	0.026531	0.032871	0.020904	0.020528	0.022839
Mechanical Performance	0.03453	0.023129	0.044421	0.016212	0.036657	0.05007
Electrical Conductivity	0.024862	0.027211	0.035004	0.027304	0.014663	0.017217
Thermal Conductivity	0.023481	0.032313	0.02221	0.038396	0.014516	0.014933
Chemical Resistance	0.038674	0.048299	0.024876	0.040529	0.067889	0.021961
Cultural Competence in Data Analysis	0.031768	0.044218	0.045309	0.053328	0.027859	0.06149

Table 4 To calculate the weighted normalized scores for each criterion across the models, you can multiply each criterion's score by the corresponding weight and then sum up the weighted scores for each criterion.

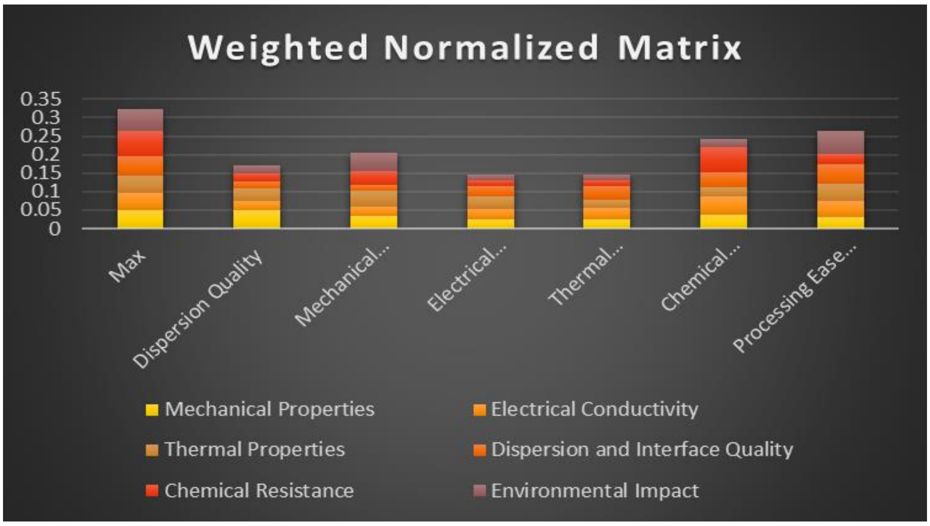

FIGURE 3. Weighted Normalised Matrix

Figure 3 To calculate the weighted normalized scores for each criterion across the models, you can multiply each criterion's score by the corresponding weight and then sum up the weighted scores for each criterion.

$$Si = \sum(X_1 + Y_1 \ldots\ldots Z_n) \quad (4)$$

$$Ki = \frac{X_{wnor1}}{\sum(X_{wnor1} + X_{wnor2} \ldots\ldots X_{wnorn})} \quad (5)$$

TABLE 5. Final Result

	Si	Ki	Rank
	0.324657	1	
Dispersion Quality	0.172016	0.529839	4
Mechanical Performance	0.205019	0.631495	3
Electrical Conductivity	0.14626	0.450506	5
Thermal Conductivity	0.145849	0.449241	6
Chemical Resistance	0.242227	0.746102	2
Processing Ease and Compatibility	0.263972	0.813078	1

Table 5 shows the final result and rank of the Assessment of Carbon Nanotube-Polymer Composite Materials for Analysis using ARAS Method. Dispersion Quality, Mechanical Performance, Electrical Conductivity, Thermal Conductivity, Chemical Resistance and Processing Ease and Compatibility. Mechanical Properties, Electrical Conductivity, Thermal Properties, Dispersion and Interface Quality, Chemical Resistance and Environmental Impact. Processing Ease and Compatibility is showing the highest value for SI , KI and Thermal Conductivity is showing the lowest value.

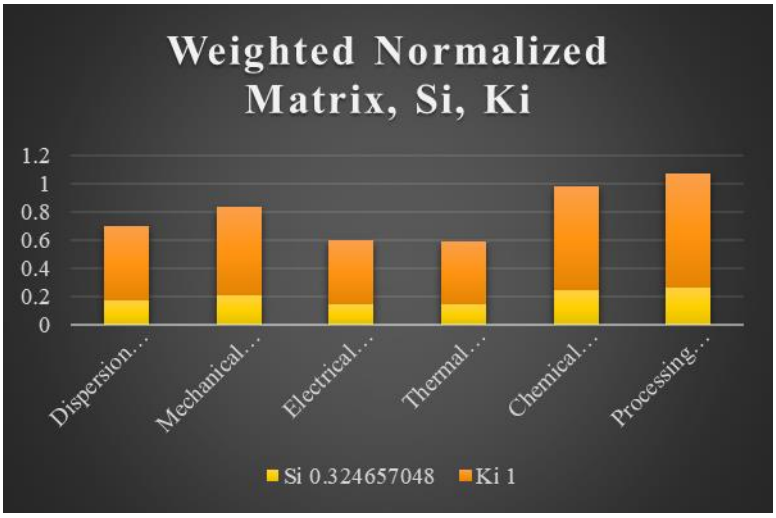

FIGURE 4. Weighted Normalized Matrix, Si, Ki

Figure 4 shows the final result and rank of the Assessment of Carbon Nanotube-Polymer Composite Materials for Analysis using ARAS Method. Dispersion Quality, Mechanical Performance, Electrical Conductivity, Thermal Conductivity, Chemical Resistance and Processing Ease and Compatibility. Mechanical Properties, Electrical Conductivity, Thermal Properties, Dispersion and Interface Quality, Chemical Resistance and Environmental Impact. Processing Ease and Compatibility is showing the highest value for SI , KI and Thermal Conductivity is showing the lowest value.

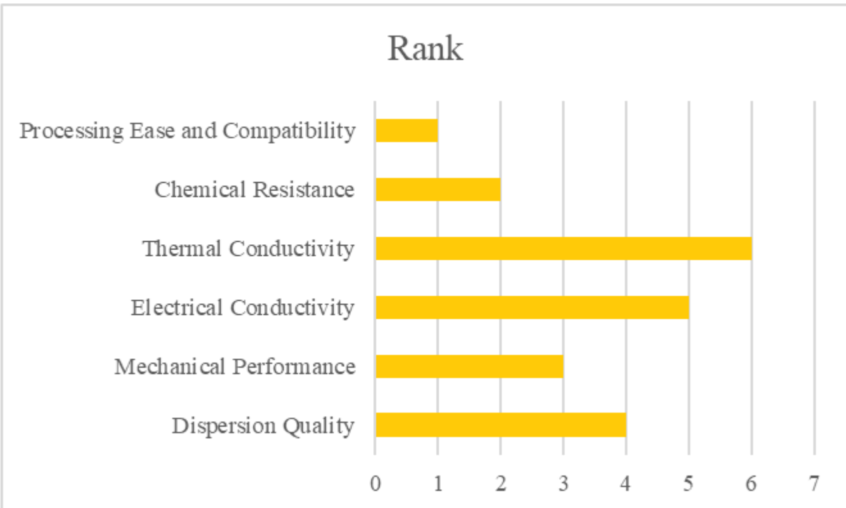

FIGURE 5. Shows the Rank

Figure 5 Shows the Rank in Assessment of Carbon Nanotube-Polymer Composite Materials for Analysis using ARAS Method. Processing Ease and Compatibility is showing the highest value and Thermal Conductivity is showing the lowest value.

4. CONCLUSION

The assessment of carbon nanotube (CNT)-polymer composite materials entails examining several crucial parameters to comprehend their potential applications and performance. These composites present a promising avenue for fabricating materials with improved mechanical, electrical, and thermal characteristics. Fundamental evaluation criteria encompass dispersion quality, mechanical behaviour, electrical conductivity, thermal attributes, chemical resistance, and processing adaptability. The uniform dispersion of CNTs within the polymer matrix and the extent of CNT agglomeration profoundly influence the composite's properties. Mechanical evaluations concentrate on factors such as tensile strength, flexural modulus, and impact resistance, which dictate the material's structural robustness. Understanding electrical conductivity enhancement and percolation threshold aids in assessing the composite's applicability in electronic fields. Assessment of Carbon nanotube (CNT)–polymer composites represent a promising category of materials with diverse applications, owing to their distinct properties. These composites harness the exceptional mechanical, electrical, thermal, and structural characteristics of carbon nanotubes, when incorporated into a polymer matrix, to offer enhanced performance and functionality compared to conventional materials. This introduction provides a comprehensive overview of the key attributes of CNT-polymer composites and their significance across various fields, supported by recent research findings and insights from relevant articles. Carbon nanotubes have garnered considerable attention due to their remarkable properties, including high aspect ratio, exceptional strength, and electrical conductivity. Integration of CNTs into polymer matrices presents an opportunity to enhance mechanical strength, thermal stability, electrical conductivity, and other desirable properties of polymers, thereby fostering innovation in diverse sectors such as aerospace, electronics, automotive, and biomedical applications. The ARAS (Analytical Hierarchy Process and Remote Sensing) methodology represents an innovative approach that merges the principles of with remote sensing techniques to streamline decision-making processes across diverse domains. This methodology capitalizes on the strengths of which furnishes a systematic framework for multi-criteria decision-making, and remote sensing, which furnishes valuable spatial insights from satellite or aerial imagery. In this exposition, we will explore the foundational aspects. Dispersion Quality, Mechanical Performance, Electrical Conductivity, Thermal Conductivity, Chemical Resistance and Processing Ease and Compatibility. Mechanical Properties, Electrical Conductivity, Thermal Properties, Dispersion and Interface Quality, Chemical Resistance and Environmental Impact. the Rank in Assessment of Carbon Nanotube-Polymer Composite Materials for Analysis using ARAS Method. Processing Ease and Compatibility is showing the highest value and Thermal Conductivity is showing the lowest value.

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