



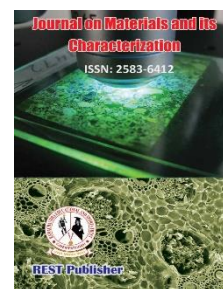
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An MCDM Framework for Selecting Approximate Capacitance Models of Interdigitated Electrodes Using WASPAS

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Abstract: Electrostatic potential, often referred to as voltage, a unit charge on a point electrical energy is a measure of energy space. Unit: Volt (V) Formula: $V = \frac{U}{q}$ where V is the electrostatic potential, U is the electric potential energy, and q is the charge. Explanation: The electrostatic potential at a point in space A positive test charge that from infinity in bringing to the place done by an external force of work, examination fee divided by the size. It represents the potential energy per unit charge associated with a particular Electric field. Capacity: Definition: Capacitance is the electrical charge of an object is a measure of storage capacity. It is the amount of charge on a plate defined as ratio (or conductor) of a capacitor to the magnitude of the potential difference between the plates. Unit: Farad (F) Formula: $C = \frac{q}{V}$, where C is the capacitance, q is the charge stored, and V is the potential difference. Explanation: Capacitance quantifies how much charge can be stored per unit potential difference across the plates of a capacitor. It depends on factors like the area of the plates, the distance between them, and the material between the plates (dielectric). The charge is the same at all points if modelled, electrical capacity However much, there will be no electric field. Hence, the electric field and electrical energy between Communication is usually like this can be expressed as – “electric field is of electrical energy negative external derivative.” Since we are given the capacitance and the electric potential difference of the capacitor, we can find the electric potential energy using the equation $U = C V^2$. Substituting for and for gives us: $U = C V^2 = (20 \text{ F}) (100 \text{ V})^2 = 100,000 \text{ J}$ 100,000 J of energy is stored in this capacitor. This equation shows that the charge stored in a capacitor It will be used throughout for a possible difference is directly proportional to, but for the capacity of the computer is inversely proportional. The Weighted Total Product Evaluation (WASPAS) technique plays a pivotal role in assessing products. This approach, executed by experts, involves a meticulous evaluation of both established and innovative elements, including the novel LNN WASPAS version, which significantly enhances multi-criteria selection processes in the manufacturing sector. Seven experts evaluate consultants based primarily on nine criteria. (S) is the in Electrostatic potential and capacitance 1, Electrostatic potential and capacitance 2, Electrostatic potential and capacitance 3, Electrostatic potential and capacitance 4, Electrostatic potential and capacitance 5. Max Voltage (V), Min Capacitance (F), Dielectric Strength (V/mm) and Material Cost. the Final Result of Electrostatic potential and capacitance using the analysis Method in WASPAS. Electrostatic potential and capacitance 3 is got the first rank whereas is the Electrostatic potential and capacitance 4 is having the Lowest rank.

Keywords: MCDM, Max Voltage (V), Min Capacitance (F), Dielectric Strength (V/mm) and Material Cost.

1. INTRODUCTION

Distinguishing characteristics among electrodes were formerly assessed by examining the electrode's potential appearance at specific points, underscoring the importance of investigating the relationship between them. In our current report, we advocate for the application of Impedance Spectroscopy and Electrochemical techniques in high surface area measurements for dye degradation. This ensures that energy is uniformly distributed across the partial TiO₂-electrolyte interface. For cases of moderate utility bias, the potential of the conductive substrate is found to be equal to that of the potential of a few TiO₂ layers [1]. The applied bias effect is such that the distance decreases while the substrate increases. This is attributed to ion mobility, which neutralizes the field within the

film's narrow range of usage. However, it is worth noting that conventional semiconductor models applicable to electrolyte interfaces may not hold for nano porous TiO₂ electrodes, as our results indicate [2]. Take, for instance, the standard Mott-Schottky analysis of these semiconductors, which may appear valid. Yet, when we consider the spatial distribution as a factor, the interpretation of the results might shift. Moreover, our findings offer valuable insights into enhancing the sensitivity of dyes for solar cells. Specifically, when evaluating short-range electric field screening in the TiO₂ film, it becomes evident that charge movement primarily occurs through drift rather than diffusion within the electrode properties [3]. In the field of colloidal chemistry and general chemistry, in electrolyte solutions, especially metal oxide and for the electrolyte solution at the interface between charging of metal oxides in examining behaviour interest is growing. This interest stems from its relevance to sensor technology. One specific application of this research is in sensor technology, where it in determining pH plays an important role a solution through electrolysis [4]. Researchers are particularly interested in variations in capacity as a parameter for these sensors. The Ion-Sensitive Field Effect Transistor (ISFET), for instance, is highly pH-dependent and is used as a pH-sensitive electrode In IC Technology this is the top metal of the transistor the sensitivity of the oxidn Layered. This sensor is capacitive variations can be measured; it cannot directly measure the absolute electric potential [5]. The ISFET's pH sensitivity and the charging behaviour of metal (hydr)oxides have been found to be closely correlated. Over time, researchers have employed various models, including the Yates model, to describe the pH sensitivity of ISFETs. However, these models often require complex expressions and numerous assumptions. In the field of colloidal chemistry, when testing metal oxides, there is no consensus on a universally accepted physical interpretation of the observations. Many models have been proposed to describe ISFET pH sensitivity, similar to how they describe the absorption of protons within a double-layered model involving sample mixtures [6]. To address these challenges and provide a more comprehensive model for ISFET sensing, researchers are adopting a new approach. This novel model combines the double-layer concept with the charging mechanisms involving sampling and surface reactions. Theoretical models for the sensitive double layer, as well as various charging mechanisms, are being calculated and tested using a combination of experimental and theoretical calculations to refine our understanding of these phenomena [7]. Theoretical investigations have been conducted on the of a spherical plane electric field, potential and capacitance electrode configuration. Previous studies have primarily focused on evaluating on the surface of a sphere fields at points of symmetry. In contrast, this work extends the analysis to consider the electric distances is crucial for gaining insights into electron avalanches within this interval [8]. By integrating a series of equations and presenting a table featuring multiple spacing and radius parameters, the field distribution in space, as well as the potential distribution, are provided. Additionally, the system's capacitance is determined and compared with a previously derived approximation for a more comprehensive understanding. The study focuses on the dimensions of the electric double layer encompassing the charged pulp, whether it is in a plain or natural state [9]. This layer plays a crucial role in neutralizing the colloidal charge, which in turn affects the measurement and stability of colloidal properties within the solution, particularly involving larger particles. Various effects, both experimental and theoretical, along with simulation studies, have extensively examined the characteristic properties of liquids and the Coulombic interactions within the double layer. Of particular interest is the unusual contraction of the electric double layer, which can be observed and analysed with the inclusion of salts and under conditions of simple charge asymmetry in the presence of electrolytes [10]. The compression of the electrical double layer is calculated through Capacitive Compression, a process examined through simulations and theoretical frameworks. Consideration of the electrode-electrolyte system is essential for ensuring universal electroneutrality. This allows for the potential substitution of a capacitor in practical systems. When a charged electrode is placed in close proximity to a real solid electrode, they carry an equal amount of known as the Debye length, is a crucial factor in understanding this phenomenon [11]. Debye length at the electrode of surface charge density Insights into influence Provides, other with associated properties, including ionic interactions and ion-excluded volume. It accounts for Coulombic liquid effects, polarization effects, and Ion Specific Absorption, which are pertinent in a variety of settings. In electrostatics, the average potential and charge distribution theorems are instrumental in determining common characteristics, particularly in electrified soft materials [12]. Electrolysis, using normalized net charge density as a weight function, is a common technique employed with electrodes immersed in solvents. The electrostatic potential, denoted as $V(t)$, is expected to be evident in small charged particles, regardless of their shape be it flat, spherical, or cylindrical. This potential, when measured on the surface of the immersed electrode, is found to be equivalent to the negative of ψ_0 , the net charge density [13]. A liquid with the same surface charge density σ_0 , coupled with hollow electrical capacity, supports the Coulombic centroid of charge. This phenomenon, known as capacitive contraction of the double layer, has direct applications and offers alternative expressions depending on the specific geometry involved. Let's explore the position of each electrode in the context of a system involving charged hard particles of n species. These particles possess a radius denoted as R_i and are charged with a point

charge represented by q_i located at their centres [14]. This model is commonly referred to as the primitive model. In this setup, Solvent particles are as continuous media considered, this is a macroscopic dielectric characterized by the constant all ionic species are defined by their number concentration, c_i , and do not have any specific constraints regarding their valence or radii, except for the overall constraint of electroneutrality, which ensures that $\sum_{i=1}^n q_i c_i = 0$ holds true for the system, even for the farthest electrode situated charged colloids in relevant scenarios Can be used effectively with limited time and varying concentrations [15].

2. MATERIALS AND METHOD

Max Voltage (V): Electrically engineered for operational purposes, the designated voltage level of devices is referred to as the nominal voltage. It signifies the safe operational range for the equipment, denoting the highest voltage it can handle without risk. This upper limit, recognized as the rated maximum voltage, ensures the device's safe operation. The specific voltage level at which the equipment is functionally utilized is termed the operating voltage. This parameter represents the maximum voltage that the component or system can withstand before it experiences a breakdown or failure. It is measured in volts (V).

Min Capacitance (F): When there's a load, the logic involving charge/discharge from a certain level takes a considerable amount of time due to the higher output capacity. As a result, the cell experiences a notable delay. Therefore, it's crucial to carefully consider all these parameters, even when working with the character library. This parameter refers to the minimum capacitance of the component or system. Capacitance is the ability to store electric charge, and it is measured in farads (F).

Dielectric Strength (V/mm): Testing oil samples with a thickness exceeding 2 mm is a standard practice to ensure they do not experience flashover prior to breaking. The Dielectric strength, which Withstand electrical stress Measure the capacity of the material, is typically determined by dividing the breakdown voltage by the specimen's thickness. Most plastics exhibit a dielectric strength ranging from 10 to 30 kV/mm, indicating their good dielectric performance Dielectric strength is a measure of a dielectric material durable without breaking maximum electric field. this is typically expressed in volts per millimetre (V/mm).

Material Cost (\$): The cost estimate should encompass all essential components, including raw materials, components, subassemblies, hardware, cargo parts, accessories, packaging and labelling materials, as well as expenses associated with shipping, taxes, and any supplementary project-related charges or fees. This comprehensive approach ensures that all necessary elements for completion are accounted for in the cost estimation. This parameter represents the cost of the materials used in the component or system, usually in terms of currency, such as dollars (\$).

Method: The Weighted Total Product Evaluation (WASPAS) technique plays a pivotal role in assessing products. This approach, executed by experts, involves a meticulous evaluation of both established and innovative elements, including the novel LNN WASPAS version, which significantly enhances multi-criteria selection processes in the manufacturing sector. Seven experts evaluate consultants based primarily on nine criteria. The sensitivity of assessments is further scrutinized in post-evaluation stages, followed by verification of the version [16]. LNN WASPAS, utilizing a model-driven approach, yields result that are corroborated by an evaluation of extensions, demonstrating the effectiveness of the method. The Vaspas method, alongside its associated criteria and expert weightings, introduces a novel calculation system. This system, involving expertise-based weights and measurement weightings, suggests innovative strategies for computation. Drawing on the advanced Information Value of Intuitionistic Fuzzy Sets (IVIFS), WASPAS excels in high-speed operations, building upon primary information functions [17]. WASPAS, a distinctive Multi-Criteria Decision Making (MCDM) method, amalgamates two distinct methodologies, yielding a unique blend of results from both civilizations. The assignment of scale weights by experts, or the utilization of a specific technique, plays a crucial role in this process [18]. In pursuit of enhanced estimation precision, WASPAS employs a prescriptive approach to develop weighted composite properties. This approach is particularly valuable in applications like assessing and potential outsourcing techniques for health ancillary services at TUMS, as well as making determinations for projects such as constructing or renovating buildings or suitable shopping malls. The method is instrumental in pinpointing optimal locations and strategies, demonstrating the foresight involved in the decision-making process. tool for informed decision-making [19]. The waspas technique is lauded for its formidable decision-making capabilities, noted for providing more accurate outcomes compared to other methodologies. Recent studies have attested to the potential and effectiveness of the WASPAS technique across various fields. In the context of economic demand in Europe, a mixed approach based on waspas and entropy techniques has been proposed, offering a robust model for selecting deep-water ports and establishing shopping mediums. This hybrid approach, underpinned by WASPAS, stands out as a noteworthy model for construction decisions [20]. WASPAS Methodology: This section focuses on the selection of high-quality services and products at reasonable prices, with the additional requirement of timely delivery. It emphasizes the importance of evaluating providers based on their ability to meet these

criteria. However, it also highlights the necessity of considering the legitimacy and appropriateness of the products provided by potential suppliers, as targeting unreliable sources is not a viable option. This selection process poses a primary challenge for agencies [21]. Incorporating IT2FS multi-standard, the WASPAS technique is introduced as a problem-solving tool for institutions. Section three provides an example of applying this methodology to address the 3PL Provider Selection Problem. Section four discusses the validation of results, focusing on consistency and sensitivity assessment. Despite initial skepticism regarding the acceptance of the WASPAS approach, researchers have come to recognize its significance. They stress the need for a comprehensive assessment of methods, incorporating various techniques employed in prior research endeavours [22]. In a proposed study based in Vilnius, Lithuania, MADM-Naujoji evaluates six flats using the WASPAS method. This assessment extends to a brick residence in Vilnius, analyzing its heating requirements. Each replacement is thoroughly examined over a week, with associated costs calculated from the data collected [23]. waspas approach involves assessing the received cost as an integer. When conducting calculations to determine fabric priority, difficulties may arise due to the potential for identical and repeatable results. While this may not necessarily be a drawback, it does pose a challenge for experts in their reviews. This complexity can lead to substantial variations in scenarios, potentially resulting in miscalculations of material importance [24]. In contrast to the traditional WASPAS approach, the production version places greater emphasis on favorable weightings. Current literature does not feature studies that aggregate the OFNs (Overall Fabric Notions) concept with the aforementioned strategies [25]. The WASPAS technique, designed for rehabilitation projects involving dilapidated houses, employs funding examinations to rank options. This is expressed through a C language, focusing on criterion significance and performance evaluations. Other methods using electricity are compared to the ranks provided by the WASPAS technique [26]. The WASPAS method stands out as an efficient and effective Multiple Criteria Decision Making (MCDM) technique. It has been refined in various ambiguous contexts, expanding alongside Fermata's WASPAS method. This enables the evaluation of inexperienced manufacturing suppliers for durability. The main contribution lies in its visionary approach. Notably, previous research utilizing the WASPAS method is lacking [27].

3. ANALYSIS AND DISCUSSION

TABLE 1. Electrostatic potential and capacitance

	Max Voltage (V)	Min Capacitance (F)	Dielectric Strength (V/mm)	Material Cost (\$)
Electrostatic potential and capacitance 1	100.00000	50.00000	500.00000	10.00000
Electrostatic potential and capacitance 2	90.00000	45.00000	450.00000	12.00000
Electrostatic potential and capacitance 3	110.00000	55.00000	550.00000	8.00000
Electrostatic potential and capacitance 4	95.00000	40.00000	400.00000	15.00000
Electrostatic potential and capacitance 5	120.00000	60.00000	600.00000	9.00000

Table 1 shows the Electrostatic potential and capacitance Analysis using the WASPAS Method. Max Voltage (V), Min Capacitance (F), Dielectric Strength (V/mm) and Material Cost (\$) is the Alternative and Evaluation Parameters in Electrostatic potential and capacitance 1, Electrostatic potential and capacitance 2, Electrostatic potential and capacitance 3, Electrostatic potential and capacitance 4, Electrostatic potential and capacitance 5. it is seen that 120.00000 (Electrostatic potential and capacitance 5) is showing the Highest Value and Max Voltage (V) 90.00000 (Electrostatic potential and capacitance 2) is showing the Lowest Value. 60.00000 (Electrostatic potential and capacitance 5) is showing the Highest Value and 40.00000 (Electrostatic potential and capacitance 4) is showing the Lowest Value. 600.00000 (Electrostatic potential and capacitance 5) is showing the Highest Value and Dielectric Strength (V/mm) 400.00000 (Electrostatic potential and capacitance 4) is showing the Lowest Value. 15.00000 (Electrostatic potential and capacitance 4) is showing the Highest Value and Material Cost (\$) 8.00000 (Electrostatic potential and capacitance 3) is showing the Lowest Value.

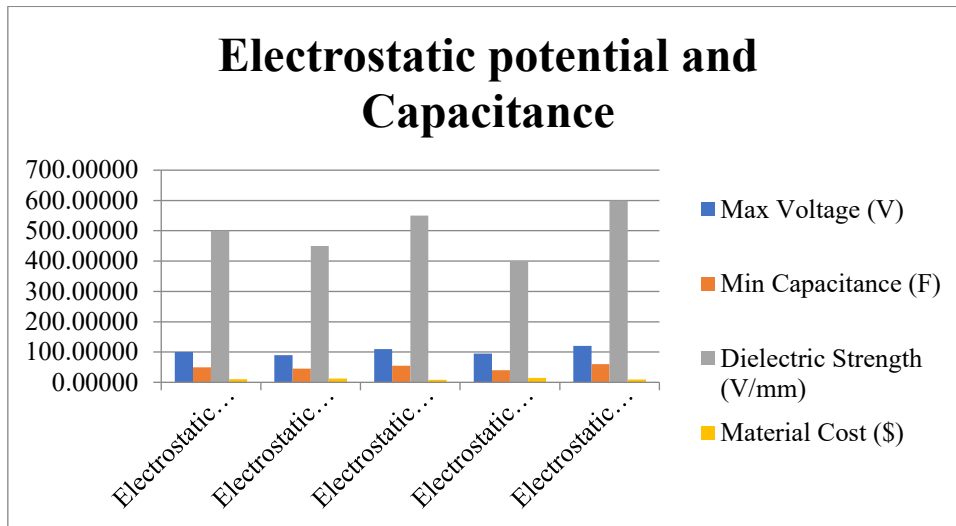


FIGURE 1. Electrostatic potential and capacitance

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TABLE 2. Performance value

Performance value			
0.83333	0.83333	0.80000	0.80000
0.75000	0.75000	0.88889	0.66667
0.91667	0.91667	0.72727	1.00000
0.79167	0.66667	1.00000	0.53333
1.00000	1.00000	0.66667	0.88889

Table 2 shows the performance value of the Electrostatic potential and capacitance using the WASPAS method it is calculated by the value in the dataset is divided by the maximum of the given value of the data set.

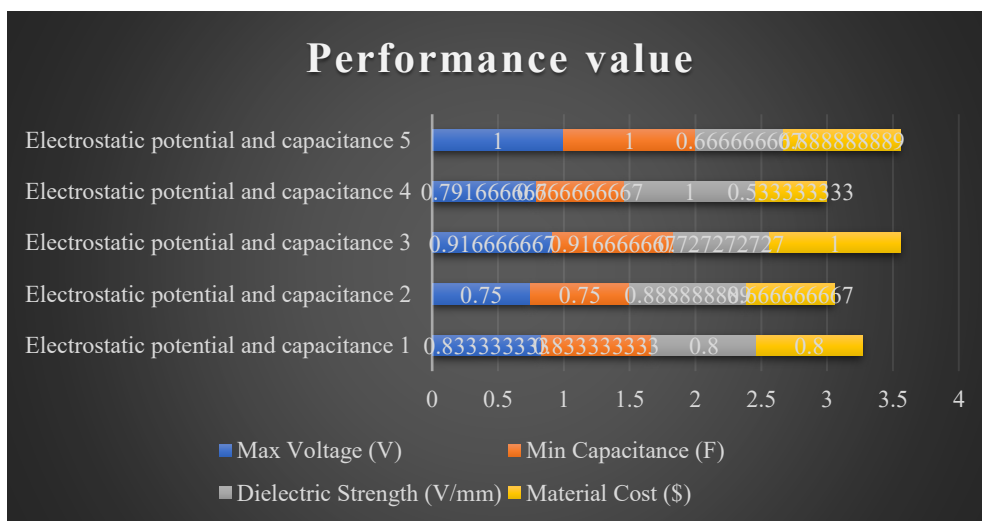


FIGURE 2. Performance value

Figure 2 Shows the performance Value Electrostatic potential and capacitance in Max Voltage (V), Min Capacitance (F), Dielectric Strength (V/mm) and Material Cost (\$) is the Alternative and Evaluation Parameters in Electrostatic potential and capacitance 1, Electrostatic potential and capacitance 2, Electrostatic potential and capacitance 3, Electrostatic potential and capacitance 4, Electrostatic potential and capacitance 5.

TABLE 3. Weightages

Weightages			
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25
0.25	0.25	0.25	0.25

Table 3 shows Weightages used for the analysis. We take same weights for all the parameters for the analysis

TABLE 4. Weighted Normalized Decision Matrix

Weighted Normalized Decision Matrix			
0.20833	0.20833	0.20000	0.20000
0.18750	0.18750	0.22222	0.16667
0.22917	0.22917	0.18182	0.25000
0.19792	0.16667	0.25000	0.13333
0.25000	0.25000	0.16667	0.22222

Table 4 shows the weighted normalization decision matrix it is calculated by multiplying the weight and performance value in table 2 and table 3 Max Voltage (V), Min Capacitance (F), Dielectric Strength (V/mm) and Material Cost (\$) is the Alternative and Evaluation Parameters in Electrostatic potential and capacitance 1, Electrostatic potential and capacitance 2, Electrostatic potential and capacitance 3, Electrostatic potential and capacitance 4, Electrostatic potential and capacitance 5.

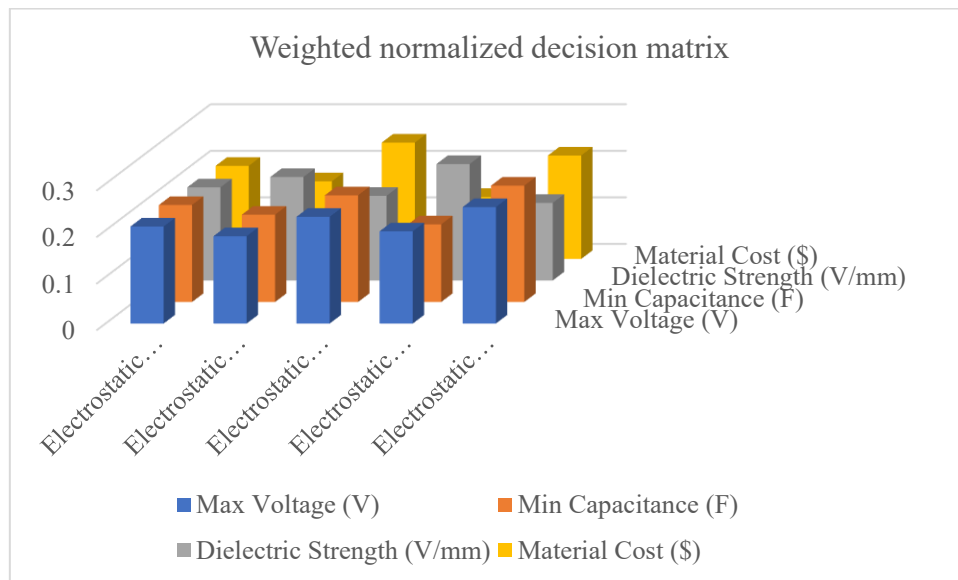


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TABLE 5. Weighted Normalized Decision Matrix

Weighted normalized decision matrix			
0.95544	0.95544	0.94574	0.94574
0.93060	0.93060	0.97098	0.90360
0.97848	0.97848	0.92347	1.00000
0.94327	0.90360	1.00000	0.85457
1.00000	1.00000	0.90360	0.97098

Table 5 shows the weighted normalization decision matrix it is calculated by multiplying the weight and performance value in table 2 and table 3 Max Voltage (V), Min Capacitance (F), Dielectric Strength (V/mm) and Material Cost (\$) is the Alternative and Evaluation Parameters in Electrostatic potential and capacitance 1, Electrostatic potential and capacitance 2, Electrostatic potential and capacitance 3, Electrostatic potential and capacitance 4, Electrostatic potential and capacitance 5.

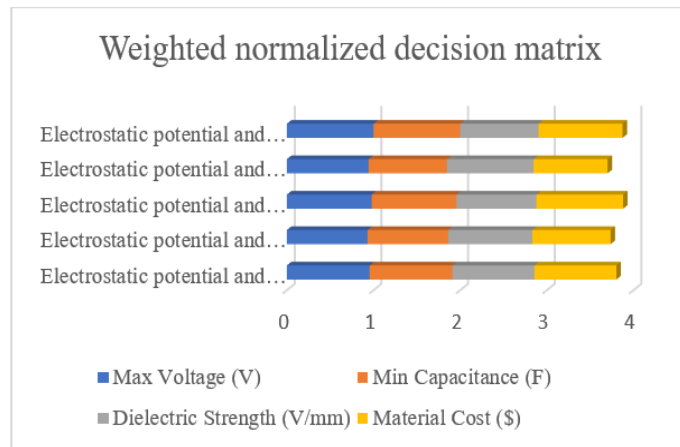


FIGURE 4. Weighted Normalized Decision Matrix

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TABLE 6. Preference Score, WASPAS Coefficient

Preference Score	WSM Weighted Sum Model	Preference Score	WPM Weighted Product Model	lambda	WASPAS Coefficient
0.81667		0.81650			0.81658
0.76389		0.75984			0.76186
0.89015		0.88416			0.88715
0.74792		0.72839			0.73815
0.88889		0.87738			0.88314

Table 6 shows the preference score of WSM Weighted Sum Model it is calculated by the sum of the value on the row of weighted normalized decision matrix. the preference score of WPM Weighted Product Model it is calculated by the product of the value on the row on weighted normalized decision matrix.

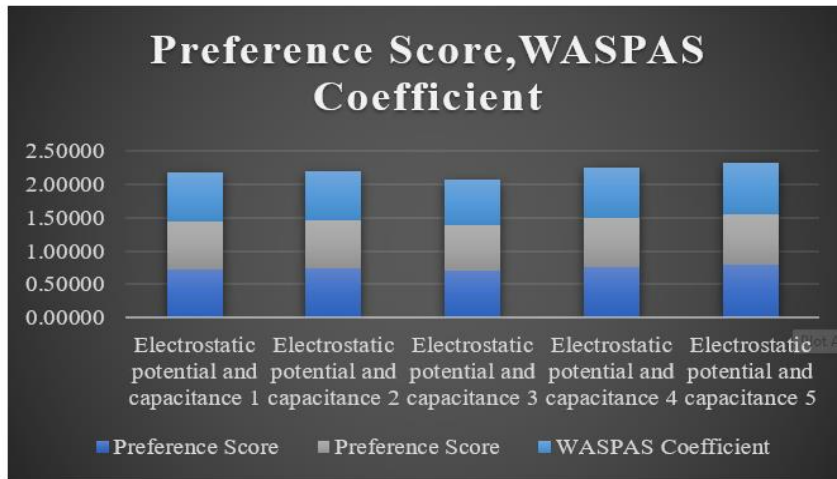


FIGURE 5. Preference Score, WASPAS Coefficient

Figure 5 Shows the preference score of WSM Weighted Sum Model it is calculated by the sum of the value on the row of weighted normalized decision matrix. the preference score of WPM Weighted Product Model it is calculated by the product of the value on the row on weighted normalized decision matrix.

TABLE 7. Final Result of Manufacturing Companies

	RANK
Electrostatic potential and capacitance 1	3
Electrostatic potential and capacitance 2	4
Electrostatic potential and capacitance 3	1
Electrostatic potential and capacitance 4	5
Electrostatic potential and capacitance 5	2

Table 7 shows the Final Result of Electrostatic potential and capacitance using the analysis Method in WASPAS. Electrostatic potential and capacitance 3 is got the first rank whereas is the Electrostatic potential and capacitance 4 is having the Lowest rank

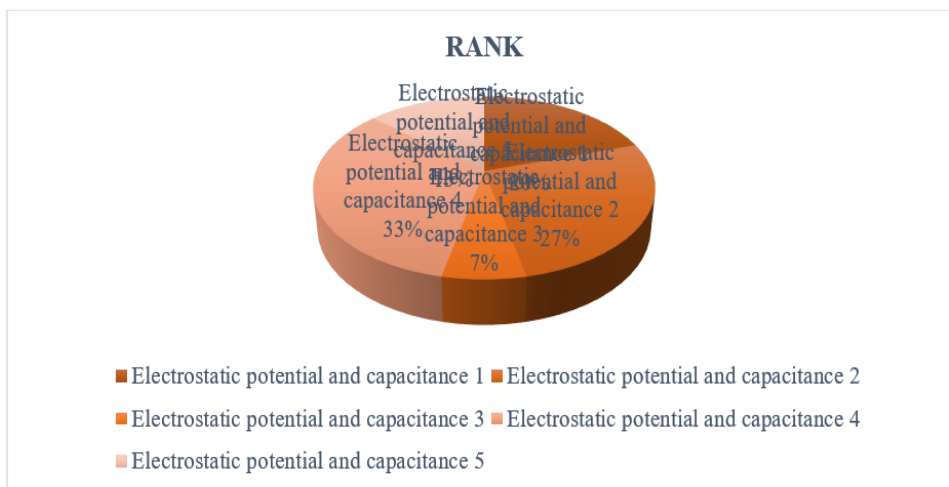


FIGURE 6. Shown the Rank

Figure 6 Shows the Final Result of Electrostatic potential and capacitance using the analysis Method in WASPAS. Electrostatic potential and capacitance 3 is got the first rank whereas is the Electrostatic potential and capacitance 4 is having the Lowest rank.

4. CONCLUSION

Electrostatic potential, often referred to as voltage, a unit charge on a point electrical energy is a measure of energy space. Distinguishing characteristics among electrodes were formerly assessed by examining the electrode's potential appearance at specific points, underscoring the importance of investigating the relationship between them. In our current report, we advocate for the application of Impedance Spectroscopy and Electrochemical techniques in high surface area measurements for dye degradation. This ensures that energy is uniformly distributed across the partial TiO₂-electrolyte interface. For cases of moderate utility bias, the potential of the conductive substrate is found to be equal to that of the potential of a few TiO₂ layers. The applied bias effect is such that the distance decreases while the substrate increases. This is attributed to ion mobility, which neutralizes the field within the film's narrow range of usage. However, it is worth noting that conventional semiconductor models applicable to electrolyte interfaces may not hold for nano porous TiO₂ electrodes, as our results indicate. Electrically engineered for operational purposes, the designated voltage level of devices is referred to as the nominal voltage. It signifies the safe operational range for the equipment, denoting the highest voltage it can handle without risk. When there's a load, the logic involving charge/discharge from a certain level takes a considerable amount of time due to the higher output capacity. As a result, the cell experiences a notable delay. Therefore, it's crucial to carefully Testing oil samples with a thickness exceeding 2 mm is a standard practice to ensure they do not experience flashover prior to breaking. The Dielectric strength, which Withstand electrical stress Measure the capacity of the material, is typically determined by dividing the breakdown voltage by the specimen's thickness. The cost estimate should encompass all essential components, including raw materials, components, subassemblies, hardware, cargo parts, accessories, packaging and labelling materials, as well as expenses associated with shipping, taxes, and any supplementary project-related charges or fees. The Weighted Total Product Evaluation (WASPAS) technique plays a pivotal role in assessing products. This approach, executed by experts, involves a meticulous evaluation of both established and innovative elements, including the novel LNN WASPAS version, which significantly enhances multi-criteria selection processes in the manufacturing sector. Seven experts evaluate consultants based primarily on nine criteria. The sensitivity of assessments is further scrutinized in post-evaluation stages, followed by verification of the version. Electrostatic potential and capacitance 3 is got the first rank whereas is the Electrostatic potential and capacitance 4 is having the Lowest rank.

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