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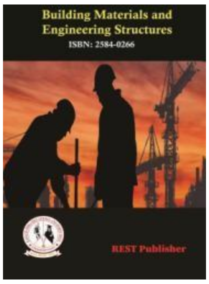

Analysis of Material selection for automotive fender using the weighted sum method

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Abstract. *Introduction: Material selection for automotive fenders involves the process of choosing the most suitable materials to be used in the construction of fenders based on various performance criteria, including mechanical properties, durability, weight, cost, safety, and environmental considerations. It involves assessing different materials and their characteristics to determine the optimal choice that meets the specific requirements of fenders. Research Significance: We will be able to choose a material with the right qualities thanks to research on the best materials for car fenders. Research on material choice for vehicle fenders was conducted for several reasons, including weight reduction and fuel efficiency, impact resistance including safety, resisting corrosion and durability, manufacturing procedure and cost optimisation, design flexibility and style, and environmental sustainability. It promotes innovation, aids in the creation of innovative materials, and aids automakers in meeting the changing demands of the market and customers. Method: This research employs the weighted sum approach to analyse the choice of material for an automobile fender. Alternate Parameters: High Strength Steels (Docol600DP and Docol1000DP), Aluminium alloys (AA2036T4 and AA6010T4), Thermoplastic polymers (PPE/PA/989Resin, PPO/PA66, NY66/40CF, PPS/40CF, AR/PC, PC/PBT resin) Evaluation Parameters: Ultimate Tensile Strength (UTS), Yield Strength (YS), Young's Modulus (YM), Linear Coefficient of Thermal Expansion (CTE), Material Cost (MC). Results: From the result it is seen that D1000DP is got the first rank where as is the PPE/PA/989 is having the lowest rank. Conclusion: the first ranking D1000DP is obtained with the lowest quality of PPE/PA/989.*

Keywords: *MCDM, D1000DP, PPE/PA/989, D600 DP*

1. INTRODUCTION

Cost, weight, and structural performance are only a few factors that affect the material choice for vehicle closures. The car's bonnet, amongst other things, must comply with the requirements for security for pedestrians set by the child and adult heads of the imp players. The brain Injury Criterion (HIC), which offers a measure of the likelihood of brain injuries as a consequence of a collision and takes into account the impacts of head acceleration with the duration of time of the acceleration, was developed since the causes of damage are complex. [1]. The overall thickness of the fender is the sole component of the layout that can be changed using additional components; The design of the fender installation mechanism is decided. The existing mild steel fender was utilised as a reference versus which every other probable materials were evaluated in order to do a quick calculation of the fender thicknesses because there aren't any formal standards or specifications that a car fender must conform to. An easy structural evaluation and frequency analysis has been carried out to make sure that all fenders of every possible content had a comparable number of skills and stresses if examined under the same loads and frequencies of nature that have been adequately eradicated from the most exciting ones [2]. A innovative experimental adjustable fender skirt constructed of prepared composite has had its shape transition displayed in a lab environment at half-scale. The material's composite framework has been shown to be sufficiently rigid to sustain the aerodynamic loads placed on a cruising vehicle. When choosing materials, it is expected that crosswinds and aerodynamic drag will affect the structure equally. Through the use of computational fluid dynamics research and vehicle road testing, the precise distribution of loads on a fender skirt may be identified. The findings of this research can serve as a guide for decisions regarding the precise position of radial SMA actuators, the best domed form for aerodynamics, and a method for selective SMA actuation [3]. A grasp of the comparison economy of competing material systems is essential for efficient material selection. The assessment of production costs is the first step in a thorough understanding of economics, which continues throughout the product's lifecycle to take into account consumption and disposal costs. The downstream lifespan costs are typically not included in the understanding of manufacturing piece costs1, despite efforts being made in this direction. The fender of a typical mid-size automobile serves as an example body panel application for this analytical comparison of lifecycle costs of different material systems. This strategy aims to provide a more thorough understanding of intermaterial rivalry in automotive applications. [4]. Over the last decade, more research has been done on how to incorporate environmental sustainability into material selection, but this method is not typically applied to material design. Environmental metrics developed through life cycle analysis were used to select materials for building automotive brakes that are environmentally friendly and meet performance targets. Den et al. The proposed improved technology states that materials should be selected first based on performance indicators, and then based on a combination of mechanical properties and environmental impact. Global weighing methods were used to compare required environmental performance, mechanical properties and monetary cost when selecting materials for fender construction. [5]. Other works that have been published on the same topic offer strategic and all-encompassing frameworks for integrating sustainability into product development. For instance, an LCA employing a mathematical technique was proposed by Ribeiro et al. (2008). While this method might work well for a small list of potential materials, applying it to a huge database can be difficult. The authors used chosen components as input for the LCA of an automobile fender. The authors relied on their intuition when choosing the material, but they were aware that more research was needed to create a material picker that would provide a more uniform set of material choices for an LEC analysis. In order to include sustainability while making decisions about product design, production, and distribution, Wage (2007) outlined a four-step methodology. Stuart and Sommerville (1998) noted that it is vital to quantitatively examine the available material possibilities in order to select a material that is ecologically feasible. Integrating quantitative issues into life-cycle evaluation and acquiring data on end-of-life expenses, nevertheless, have proven difficult (Giudice et al., 2005; EcoLife Thematic Network, 2002). [6]. The clinging substance was previously known as stamping scrap. The various material types include the finished product, blank holder scrap, draw bead scrap, and addendum scrap. The white region above the drawn bead doesn't need to be stamped because there is hidden nesting detritus there. It proves that printing scrap does not just only hold the component. Multiple components utilised to control material flow, enhance the part's formability, and improve quality make up stamping scrap [7]. Particle size analysis and mechanical testing performed on the composite specimen revealed that plantain fibre reinforced high density polyethylene composite can greatly improve auto body fender. Additionally, effective fibre modification is essential for enhancing the mechanical qualities of composite materials. When compared to uncompatibilized composites and different substances for auto body fenders, the proposed composites have demonstrated superior mechanical qualities and cost effectiveness [8]. For General Motors, MacLean Fine Composites supplied G83C prepreg material and processed the autoclave cure cycle used to manufacture the composite Corvette hood and front fender. Using polyethylene glycol (PEG) as HTF, a Quickstep drying cycle was performed using a QS5 unit (see also figure). He preheated the tanks to 55°C, 140°C and 190°C with HTF in less than an hour before starting to cure the cold, medium and hot tanks. In contrast to autoclave curing, the QuickStep curing cycle included a preliminary dwell time of 5 min at 100 °C to promote resin gelation and devolatilization by resin transport. The vacuum was abetted at 95 kPa and 80 kPa for the QuickStep curing cycle and the autoclave cycle, respectively [9]. High organic component ratios were used, and their structural performance was surprisingly excellent. A standard polyester-fibreglass strengthened part was successfully substituted by a homogeneous portion consisting of thermoset resin (PTP_ prepregs) and hemp fibres. The revolutionary bio-based resin contained 10% petrochemicals and 90% renewable components. For the purpose of to evaluate the green composite's weather durability, it was placed behind the headlights and fender of a MAN passenger bus. In the laminated body the panels, in double-curvature permanent roof, and and the roof spoiler of the ECO Elise prototype vehicle, which was revealed in July 2008, hemp fibres have taken the place of Lotus' conventional fibreglass reinforcement. The main component of a "A" class premium polyester base composite body was built using environmentally friendly hemp technology materials. The metallic finish of the tripe that was not painted contrasted dramatically with exposed hemp fibres, showcasing how unique this car is from bumper to spoiler [10]. Aluminium is the substance that consumes most energy. The electrolysis and alumina manufacturing processes utilise the bulk of this energy. The smallest quantity of power may be required to produce steel fenders. Although producing PP/EPDM fender requires a little bit more electricity than producing steel, producing more complicated polymers such PPO/PA or PC/PBT requires a lot more energy.. Each power bar's division shows the proportionate contributions of different energy sources. Here, it is evident that a significant amount of the total energy consumed by polymers is derived from crude oil. The primary cause of this is that oil is used as a material feedstock and an energy source in the process of making polymer materials [11]. The structural integrity of the thermoplastic composites material-made car fender is evaluated by comparing it to a steel fender. Two distinct kinds of composites, randomised fiber-reinforced PP (RFP) and TPC fabric created from commingled thread with 60% CF/PP, are used to cover the intermediary plastic material. Due to continuing reinforcements, the TPC layer offers significant structural advantages, but the RFP's high flow characteristic improves manufacturability. Here, we looked at how a stainless steel business automobile fender (the front fender for the KIA Picanto) performed depending on the number of plates, how they were stacked, and other mechanical factors [12]. It's interesting to point out that for the 1973 model year, fiber-filled plastic fender additions initially became accessible to the full-sized Dodge. Woodstock Die Casting, nevertheless, gave Chrysler a quote for a zinc die cast component with a 050-inch wall. This provider of specialised die casts also offered thin wall zinc. The item was less expensive to make than the fiber-filled plastic fender extension that was already being made. For the balance of the 1973 model year, Woodstock produced the component when Chrysler opted to use the thin wall zinc extension [13]. Engineered thermoplastics are increasingly taking the role of metal in the automotive industry because of their advantages in complicated styling, part integration, and weight reduction. Noryl® GTX, an assortment of creative thermoplastic mixes of PPO-PA6-PA66 from SabicI Innovative Plastics (SIP), has accurately substituted metals in applications like vehicle body-panel-like fenders by satisfying both practical and aesthetic requirements. [14]. As if this were not a big enough ask for a material, we also required assurance that the paint on the fender wouldn't adversely affect rheometric efficiency beyond what was permitted. Our results showed that the rheometries of raw panels were 6700 Newton, but following worst-case paint processing—which implies that repair processes were necessary—they were reduced to 3500 Newton. Although these results were unexpected, the decline remained well below the necessary performance parameters [15].

2. METHODOLOGY

The weighted sum method for multifaceted optimising (MOO), despite its limitations in terms of showing the Pareto ideal set, continues to be utilised for producing a large number of the solution points by evenly varying the amount of weights employed in additional to a single final point showing the options that were probably taken into account in picking of one set of the weights. The effectiveness of the strategy for this additional ability is still waiting for a thorough analysis. Despite the fact that there are numerous additional methods for calculating the proportions (Marler and Arora 2004, for instance), they are all ultimately just different ways of structuring one's options and priorities. We concentrate on the mathematical aspects of the reaction and the theoretical basis of weights rather than offering another mechanism for converting wishes into weights. Additionally, factors resulting from a specific set of values that affect the Pareto optimal solution point are found. By completing this research, we add to the reservoir of knowledge, offer fresh perspective on the methodology, and put up innovative ideas to improve the method's ability to expose alternatives. [16]. Adapting answers can be employed to solve problems with multiple goals and a Pareto front with (i) convex areas of constant curves, (ii) convex areas of non-dominated answers, and (iii) convex areas of dominant answers. a weighted sum strategy. First, the majority of the answers discovered using the conventional weighted-sum method lie in the area with relatively higher curve for multiobjective optimisation issues with irregularly curving Pareto fronts. This shows that the same value weighted-sum method produces extremely few solutions for the flat region. The adaptive weight-sum method presents a prospective zone for further section refining because the area connecting P1 and P2 is vast in comparison to other sections. [17]. The weighted sum method's contour curve, shaped like a straight line, is depicted .The goal space is split into two subspaces by the contour curve. When compared to solutions on the contour curve, one subspace's solution are superior, while the other subspace's solutions are inferior. Solutions that share a contour curve possess a scalar value that is the same. That is, no matter the quantity of targets, the area of the superior zone is around 1/2. The contour curves of each of the Lp scalarizing techniques, as seen in .reveal that they have smaller superior regions either 1/2 e.g., 1/2m, or the Chebyshev technique. Additionally, the worth of m, target reduces noticeably as the overall amount of targets grows. Accordingly, the likelihood of discovering the optimum solution identified by the selected scaling technique is less than i) the weighted sum method, i) additional Lp secularisation techniques, and ii) the likelihood stays constant for the weighted sum method, while it sharply decreases with additional LP scaling techniques as m increases. Comparing the Chebyshev approach to the weighted sum method, it is questionable if it is especially successful for multi-objective situations [18]. Additionally, the worth of m, target reduces noticeably as the overall amount of targets grows. Accordingly, the likelihood of discovering the optimum solution identified by the selected scaling technique is less than i) the weighted sum method, i) additional Lp secularisation techniques, and ii) the likelihood stays unchanged for the weighted sum method, while it sharply reduces with additional LP scaling techniques as m increases. Comparing the Chebyshev approach to the weighted sum method, it is questionable if it is especially successful for multi-objective situations. The adaptive weighted sum method effectively resolves multi-objective optimisation issues; it provides solutions with equal distribution, locates Pareto best practises in non-convex regions, and disregards non-Pareto optimal options. The AWS technique, nevertheless, has traditionally only been useful for bi-objective optimisation issues. In order to differentiate the older method from the generalised multifaceted adaptive weighted sum method presented there, we shall refer to the latter as the "bi-objective adaptive weighted sum method". [19]. With the aid of the AWS technique, an ISA for model-based MOO has been given. By successively updating the RBF models employed in MOO, this technique aims to slowly but surely continuously estimate the true POF. ISA is proposed to effectively update RBF model in each optimisation by considering the Ensamples and the MMD samples within the POF form the prior iteration, in addition to the boundary information needed for the design space. Because the total amount of freshly formed samples ranges from one and the amount of goals plus one, the total sample size is effectively managed as a result. The effectiveness of this suggested strategy for using the gradient-based SQP solver is most improved by AWS. [20]. This work concentrates on creating a powerful multi-objective MDO approach because the majority of MDO problems are multi-objective. For the creation of large-scale, intricate technological systems like aircraft, the AWSCSSO approach can provide a constantly spaced, widely scattered, and smooth Pareto front. The AWSCSSO approach is validated using a conceptual design issue involving two quantitative scenarios and an aeroplane. The information that follows can lead to a number of conclusions. First, problems with multiple goals can be successfully solved with AWSCSSO. It offers the whole Pareto front for experimental plane challenges and design concept issues. Second, establishing a consistently separated, widely distributed, and flat Pareto front is a potential strategy for defining real MDO issues utilising AWSCSSO [21]. The quantity of GSA particle available was calculated using a brand-new weighted sum (WS) approach. They evaluated the NSAM answers under chosen pairs of situations in an effort to match and subsequently understand the combined particle GSA concentration, which is the main instrument employed in the WS method. The systems were established using simulations and tests, followed by WS compositions established through reaction measurements and curve fitting under these circumstances, which validated the systems. Overall, using both sampling from the environment and laboratory testing, the WS technique and the SMPS were compared. The WS method stands out because it is the initial one to provide GSA concentrations in real-time throughout the ideal size spectrum; it also happens to be the initial to do this without causing any presumptions regarding how aerosols will be dispersed, such as a geometric average deviation or a moral lognormal distribution; and as it barely alters the commercially available NSAM method, researchers and manufacturers can easily alter the tool and carry out GSA additional research with at ease. [22]. According to convexity theories, the best solutions to scalarized issues that have positive (nonnegative) weights include all (weakly) efficient solutions. In addition, positive (nonnegative) weighted solution to the weighted sum problem remain (weakly) efficient. A variety of the second-order conditions are created by Wang (1991) that are simultaneously essential and sufficient to produce the MOP. Second order requirements are produced for MOPs with element wise ordering by Cambini (1998), whereas second order criteria are created for MOPs with generic convex conical by Cambini et al. (1997). Second-order required conditions were introduced by Aghezzaf (1999) and Aghezzaf and Hachimi (1999). Bolintineanu & El Maghri (1998), Bigi & Castellani (2000), & Jimenez and Novo (2002) are contemporary articles. [23]. For the oversight and growth of natural resources, a knowledge of the hydrologic behaviour of bodies of water is essential. Precipitation-runoff changes is a more complex process at the watershed level. However, a water body's structural characteristics can influence its hydrologic behaviour and ability to produce flow. By examining the kind and type of drainage patterns and carrying out a quantitative morphometric study, one can better comprehend the role performed by geological formations in the formation of stream networks. A watershed's morphometric features, which strongly point to its hydrological reaction, may be utilised to explain its hydrological functioning [24]. The implications of inaccurate weighted sum calculations at high frequencies may be assessed using an altered shot record. The shot record that was processed using the time gradient of ground force from the load cell as well as the shot record which is being deconvolved utilising the time gradients of the weighted total ground force are simultaneously exhibited. In the main shallow reflection seismology frequency band (between 30 and 500 Hz), there should not be any significant problems. The greatest variations can be seen in the coloured area. [25].

Evaluation parameters:

Ultimate Tensile Strength (UTS): Ultimate tensile refers to the greatest tensile stress which an object can withstand before failing. strength (UTS), and it is determined using a standardised tensile test. Engineers use it to assess a material's structural integrity and adaptability for different applications. It stands for how well it holds up to being pulled apart.

Yield Strength (YS): The yield strength of a material—also referred to as the yield point or yield stress—denotes the stress at which it experiences significant deformation or starts to behave plastically. It gauges how much deformation a material can withstand or resist before undergoing permanent or plastic deformation.

Young's Modulus (YM): Young's modulus, sometimes referred to as the modulus of elasticity or simply the modulus of elasticity, serves as a crucial mechanical characteristic that assesses the material's rigidity or its capacity to tolerate deformation due to elastic forces when subjected to force or stress. Under circumstances involving linear elastic behavior, it quantifies the proportion of internal stress to internal stress in an object.

Linear Coefficient of Thermal Expansion (CTE): The linear coefficient of thermal expansion (CTE) is a measurement of how much a thing expands or contracts in reaction to temperature changes. It quantifies the difference in length of the material when its temperature increases by a degree Celsius (or one degree Fahrenheit)..

Material Cost (MC): The cost of the raw materials or components needed in the creation or manufacture of a product is referred to as the material cost (MC). It is a large portion of the total cost of production and is extremely important in determining a product's profitability and price.

Alternate parameters:

High Strength Steels (Docol600DP and Docol1000DP): High-strength steels are modern grades of steel that are especially created to offer outstanding durability and efficiency characteristics. Examples are Docol600DP and Docol1000DP. When lightweight materials with high strength are sought, such as in the automotive industry, these steels are frequently utilised.

Aluminium alloys (AA2036T4 and AA6010T4): Aluminium is a specific component of alloys like AA2036T4 and AA6010T4 that has been blended with additional alloying elements to improve its mechanical capabilities, corrosion resistance, and various other qualities. Numerous industries, particularly aerospace, automotive, construction, and consumer electronics, employ these alloys extensively.

Thermoplastic polymers (PPO/PA66, NY66/40CF, PPS/40CF, AR/PC, PC/PBT,PPE/PA/989 resin): A type of polymer known as a thermoplastic polymer can soften and melt when heated and then solidify once more when cooled. They can be repeatedly moulded and reshaped thanks to this feature without going through substantial chemical changes. Due to their adaptability, simplicity of processing, and acceptable mechanical qualities, they are extensively used in many different sectors.

3. RESULT AND DISCUSSION

TABLE 1. Material selection for automotive fender

Candidate Materials					
Material Properties	UTS (MPa)	YS (MPa)	E (GPa)	CTE (µm/m-°C)	MC ($/kg)
D600 DP	650	400	207	10.8	0.8
D1000DP	1100	850	207	11.7	0.8
AA2036T4	338	193	71	23.4	11.8
AA6010T4	290	170	69	24.8	12.7
PPE/PA/989	55	60	2.3	85	5.2
PPO/PA66	53	54	4.5	64.8	4.7
NY66/40CF	267	120	24.6	14.8	6.05
PPS/40CF	175	143	32.8	17.3	20.4
AR/PC	49.8	56.3	2.2	93.6	3.8
PC/PBT	54	58	3.8	46	2.7

Table 1 shows the Material selection for automotive fender using the Analysis method in WSM Alternative: includes benefit criteria for UTS(MPa), YS(MPa), E(GPa) and loss criteria for CTE(µm/m-°C), MC ($/kg) .Evaluation preference: D600 DP, D1000DP, AA2036T4, AA6010T4, PPE/PA/989, PPO/PA66, NY66/40CF, PPS/40CF, AR/PC, PC/PBT.

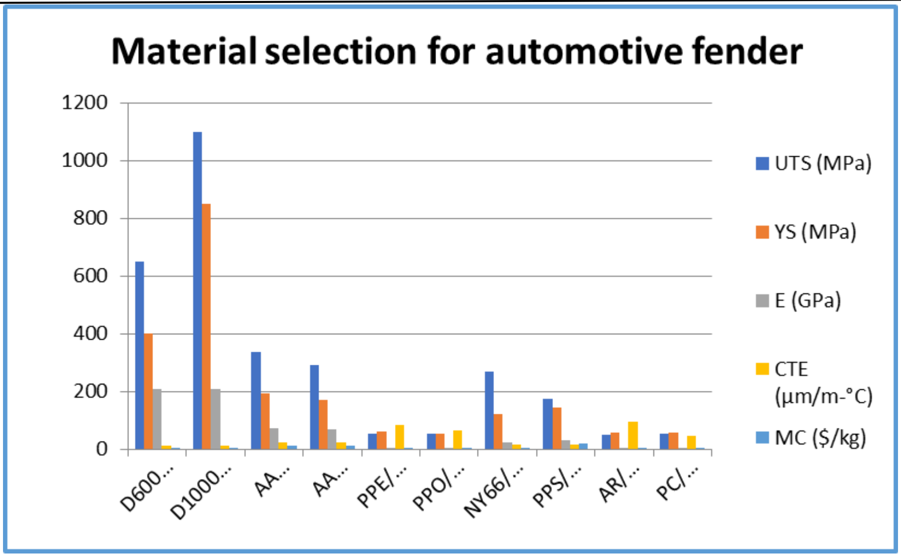

FIGURE 1. Material Selection for automotive fender

Figure 1 Shows the UTS (MPa) It is seen that the D1000DP has the highest value and AR/PC showing the least value , YS (MPa) It is seen that the D1000DP has the highest value and PPO/PA66 showing the least value, E (GPa) It is seen that the D1000DP and D600 DP has the highest value and AR/PC showing the least value, CTE (µm/m-°C) It is seen that the AR/PC has the highest value and D600 DP showing the least value, MC ($/kg) It is seen that the PPS/40CF has the highest value and D1000DP and D600 DP showing the least value.

TABLE 2. Normalized data

Normalized Data				
0.590909091	0.470588235	1	1	1
1	1	1	0.923076923	1
0.307272727	0.227058824	0.342995169	0.461538462	0.06779661
0.263636364	0.2	0.333333333	0.435483871	0.062992126
0.05	0.070588235	0.011111111	0.127058824	0.153846154
0.048181818	0.063529412	0.02173913	0.166666667	0.170212766
0.242727273	0.141176471	0.11884058	0.72972973	0.132231405
0.159090909	0.168235294	0.158454106	0.624277457	0.039215686
0.045272727	0.066235294	0.010628019	0.115384615	0.210526316
0.049090909	0.068235294	0.018357488	0.234782609	0.296296296

Table 2 shows the Normalized data for Alternative: UTS (MPa), YS (MPa), E (GPa), CTE (µm/m-°C), MC ($/kg). Evaluation preference: D600 DP, D1000DP, AA2036T4, AA6010T4, PPE/PA/989, PPO/PA66, NY66/40CF, PPS/40CF, AR/PC, PC/PBT.

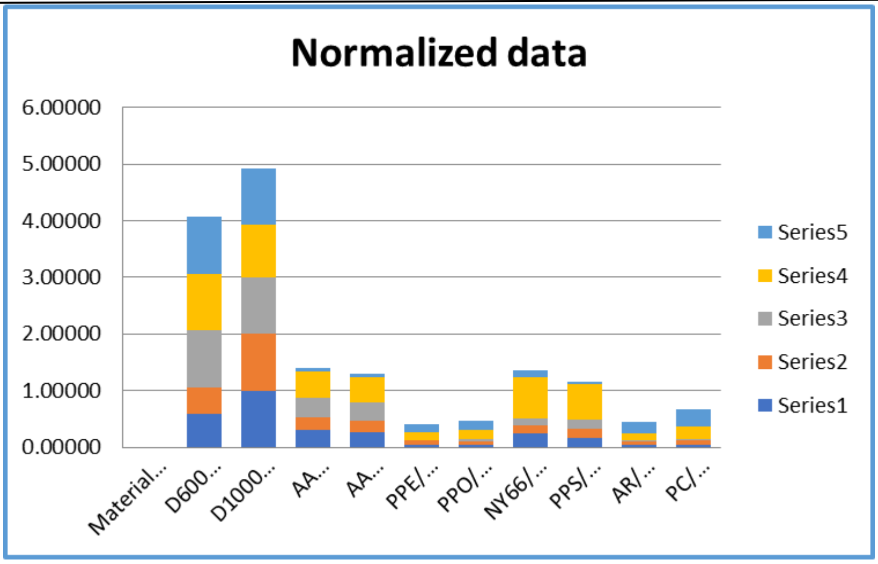

FIGURE 2. Normalized Data

Figure 2 shows the Normalized data for Material Selection for automotive fender: UTS (MPa), YS (MPa), E (GPa), CTE (µm/m-°C), MC ($/kg). Evaluation preference: D600 DP, D1000DP, AA2036T4, AA6010T4, PPE/PA/989, PPO/PA66, NY66/40CF, PPS/40CF, AR/PC, PC/PBT.

TABLE 3: Weightages

Weight				
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2
0.2	0.2	0.2	0.2	0.2

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				
0.118182	0.094118	0.2	0.2	0.2
0.2	0.2	0.2	0.184615	0.2
0.061455	0.045412	0.068599	0.092308	0.013559
0.052727	0.04	0.066667	0.087097	0.012598
0.01	0.014118	0.002222	0.025412	0.030769
0.009636	0.012706	0.004348	0.033333	0.034043
0.048545	0.028235	0.023768	0.145946	0.026446
0.031818	0.033647	0.031691	0.124855	0.007843
0.009055	0.013247	0.002126	0.023077	0.042105
0.009818	0.013647	0.003671	0.046957	0.059259

Table 4 shows the weighted normalized decision matrix for Alternative: UTS (MPa), YS (MPa), E (GPa), CTE (µm/m-°C), MC ($/kg). Evaluation preference: D600 DP, D1000DP, AA2036T4, AA6010T4, PPE/PA/989, PPO/PA66, NY66/40CF, PPS/40CF, AR/PC, PC/PBT.

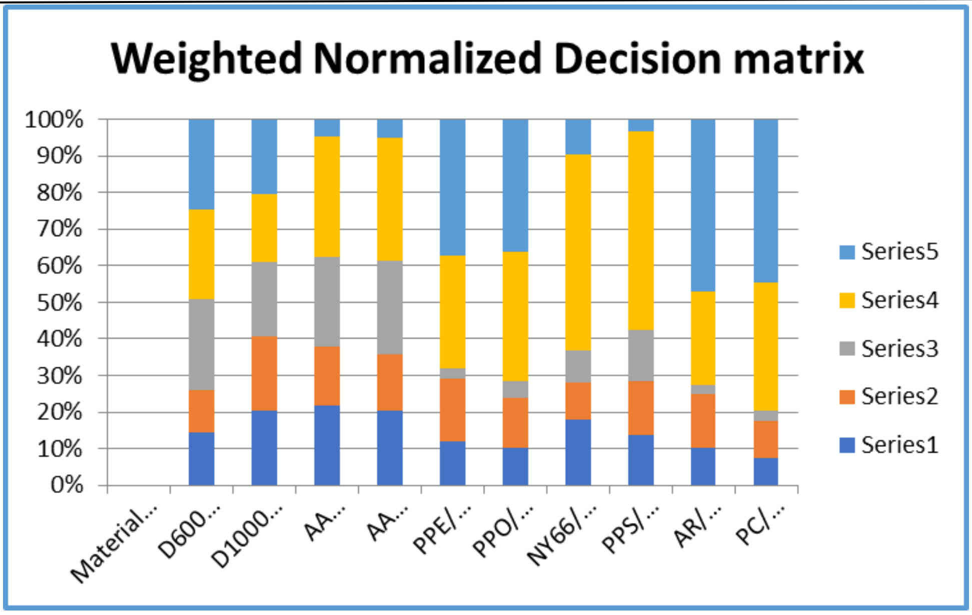

FIGURE 3. Weighted Normalized Decision matrix

Figure 3 shows the weighted normalized decision matrix for Alternative: UTS (MPa), YS (MPa), E (GPa), CTE (µm/m-°C), MC ($/kg). Evaluation preference: D600 DP, D1000DP, AA2036T4, AA6010T4, PPE/PA/989, PPO/PA66, NY66/40CF, PPS/40CF, AR/PC, PC/PBT.

TABLE 5. Preference Score & Rank

	Preference Score	**Rank**
D600DP	0.812299465	2
D1000DP	0.984615385	1
AA2036T4	0.281332358	3
AA6010T4	0.259089139	5
PPE/PA/989	0.082520865	10
PPO/PA66	0.094065959	8
NY66/40CF	0.272941092	4
PPS/40CF	0.22985469	6
AR/PC	0.089609394	9
PC/PBT	0.133352519	7

Table 5 shows the final rank of this paper the D1000DP is in 1st rank, D600DP is in 2nd rank, AA2036T4 is in 3rd rank, NY66/40CF is in 4th rank, the AA6010T4 is in 5th rank, the PPS/40CF is in 6th rank, the PC/PBT is in 7th rank, the PPO/PA66 is in 8th rank, the AR/PC is in 9th rank, and the PPE/PA/989 is in 10th rank. The final result is done by using the WSM method.

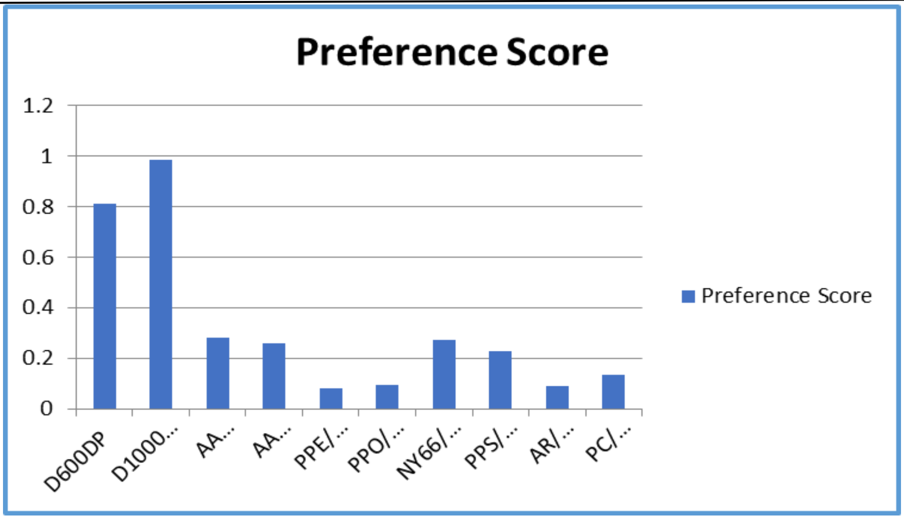

FIGURE 4. Preference Score

Figure 4 shows the preference Score for D600 DP 0.812299465, D1000DP 0.984615385, AA2036T4 0.281332358, AA6010T4 0.259089139, PPE/PA/989 0.082520865, PPO/PA66 0.094065959, NY66/40CF 0.272941092, PPS/40CF 0.22985469, AR/PC 0.089609394, PC/PBT 0.133352519.

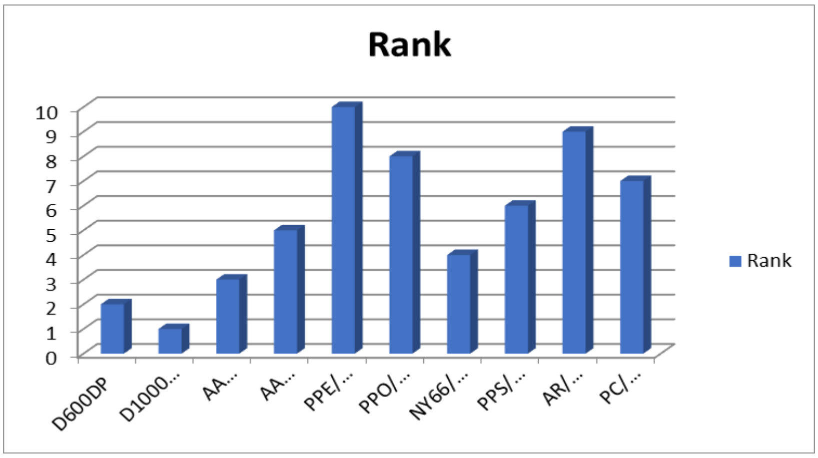

FIGURE 5. Rank

Figure 5 shows the final rank of this paper the D600 DP is in 2nd rank, D1000DP is in 1st rank, AA2036T4 is in 3rd rank, AA6010T4 is in 5th rank, PPE/PA/989 is in 10th rank, PPO/PA66 is in 8th rank, NY66/40CF is in 4th rank, PPS/40CF is in 6th rank, AR/PC is in 9th rank, PC/PBT is in 7th rank.

4. CONCLUSION

Material selection for automotive fenders involves the process of choosing the most suitable materials to be used in the construction of fenders based on various performance criteria, including mechanical properties, durability, weight, cost, safety, and environmental considerations. A innovative experimental adjustable fender skirt constructed of prepared composite has had its shape transition displayed in a lab environment at half-scale. The material's composite framework has been shown to be sufficiently rigid to sustain the aerodynamic loads placed on a cruising vehicle. When choosing materials, it is expected that crosswinds and aerodynamic drag will affect the structure equally. Through the use of computational fluid dynamics research and vehicle road testing, the precise distribution of loads on a fender skirt may be identified. The findings of this research can serve as a guide for decisions regarding the precise position of radial SMA actuators, the best domed form for aerodynamics, and a method for selective SMA actuation. A grasp of the comparison economy of competing material systems is essential for efficient material selection. The assessment of production costs is the first step in a thorough understanding of economics, which continues throughout the product's lifecycle to take into account consumption and disposal costs. The downstream lifespan costs are typically not included in the understanding of manufacturing piece costs1, despite efforts being made in this direction. The fender of a typical mid-size automobile serves as an example body panel application for this analytical comparison of lifecycle costs of different material systems. This strategy aims to provide a more thorough understanding of intermate rial rivalry in automotive applications. The effectiveness of the strategy for this additional ability is still waiting for a thorough analysis. Despite the fact that there are numerous additional methods for calculating the proportions (Marler and Arora 2004, for instance), they are all ultimately just different ways of structuring one's options and priorities. We concentrate on the mathematical aspects of the reaction and the theoretical basis of weights rather than offering another mechanism for converting wishes into weights. Additionally, factors resulting from a specific set of values that affect the Pareto optimal solution point are found. By completing this research, we add to the reservoir of knowledge, offer fresh perspective on the methodology, and put up innovative ideas to improve the method's ability to expose alternatives. Adapting answers can be employed to solve problems with multiple goals and a Pareto front with (i) convex areas of constant curves, (ii) convex areas of non-dominated answers, and (iii) convex areas of dominant answers. a weighted sum strategy. First, the majority of the answers discovered using the conventional weighted-sum method lie in the area with relatively higher curve for Mult objective optimisation issues with irregularly curving Pareto fronts. This shows that the same value weighted-sum method produces extremely few solutions for the flat region. The adaptive weight-sum method presents a prospective zone for further section refining because the area connecting P1 and P2 is vast in comparison to other sections.

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