

Analysis of Body Material for Electric Car

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Abstract

The FHSU electric vehicle design team is nearing the completion of a new car build to be raced in upcoming electro rally races. One of the final tasks associated with the new car build is determining the best material to use for the body of the car. The aim of this research was to determine the most suitable material for use in an electric race car among six commonly used materials: ABS, PVC, carbon fiber, fiberglass, 2024 aluminum, and 304 stainless steel. The team chose to perform an analysis of the characteristics of these materials to determine the best material based on strength, price, degradability, and density.

Introduction

This poster presents a study comparing six materials commonly used in racing vehicles: 2024 aluminum, 304 stainless steel, PVC, ABS, fiberglass, and carbon fiber. The aim is to determine which materials are most suitable based on their strength, degradability, price, and density. The results will be useful for enhancing the performance of the FHSU electric race car.

Methods

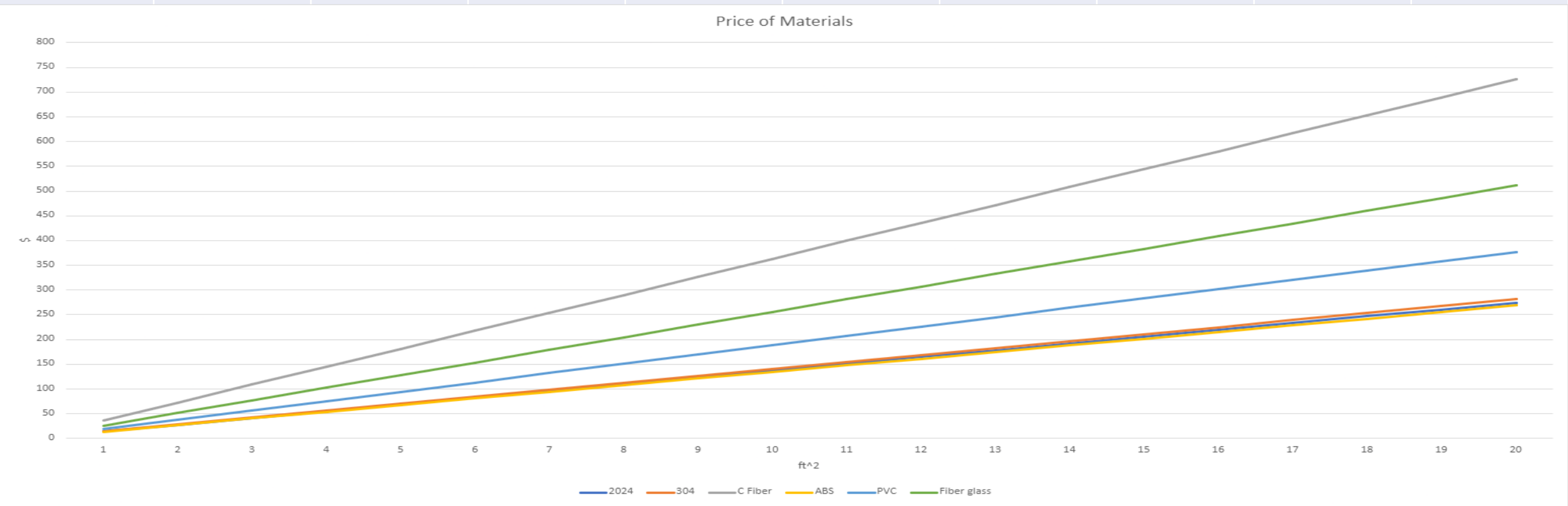
The density, price, and strength of all the materials were given by the parts supplier. The strength is then divided by the density to have a strength/weight ratio necessary to compare the materials properly. Also factored in was the price per square foot of material.



Analysis and Results

The metals and carbon fiber were the most robust materials. The plastics and fiberglass were significantly weaker. However, after comparing the strength-to-weight ratios of the materials, the gap closed between the plastics and 304 stainless steel, while carbon fiber and 2024 aluminum showed to be significantly stronger. Then, after considering any potential damage the sun could cause through heat and UV light, the plastics were ruled out as an option. Then, the materials were compared based on cost to strength and corrosion resistance. Fiberglass and 304 stainless steel were ruled out due to low performance for the price and 304's significant chance of corrosion due to being made of an iron alloy. This leaves 2024 aluminum and carbon fiber as good options for the body material on a racecar, with carbon fiber leading in strength and weight and 2024 aluminum leading in cost. Due to having a limited budget, 2024 aluminum was deemed the better material for most circumstances

Materials	\$/ft ²	Tensile Strength psi	Impact Strength Ft/lbs/in*3	Density lbs./cu.in.	Tensile/Density	Impact/Density	Chance to Melt	Corrosion	UV Safe
Carbon Fiber	13.72	50000	NA	0.1	500000	NA	No	No	Yes
2024 Aluminum	14.06	31200	NA	0.289	107958.4775	NA	No	Minimal	Yes
304 Stainless Steel	36.28	120000	NA	0.05-.067	1791044.776	NA	No	Yes	Yes
Fiberglass	13.44	4200	6.3	0.037	113513.5135	170.2702703	No	No	Yes
PVC	18.85	5600	10	0.05	112000	200	Yes	No	No
ABS	25.56	7000	4	0.061-.07	100000	57.14285714	Yes	No	No



References

- ASM. (n.d.). Asm.matweb.com. <https://asm.matweb.com/>
- bajaj, siddhanth. (2023, March 23). *ABS Vs PVC | A Comprehensive Comparision*. PlasticRanger. <https://plasticranger.com/abs-vs-pvc/>
- McMaster-Carr. (2015). *McMaster-Carr*. McMaster.com. <https://www.mcmaster.com/>

Conclusion

Carbon fiber was determined to have the best physical properties, however the cost of buying sheets was too expensive and is only marginally improved by making the parts by hand. This comes with a significant tradeoff of time and effort as a mold would need to be made to shape the carbon fiber to and any mistake will be expensive. This leaves 2024 aluminum as the best choice, due to the strong physical properties and low price.

