COMPOSITE ENVISIONS KNOWLEDGE HUB
PRACTICAL AND INSIGHTFUL COMPOSITES INFORMATION

REDUCING WEIGHT IN COMPOSITE PARTS

COMPOSITE ENVISIONS

REDUCING WEIGHT

INTRODUCTION

As part of building anything out of composites, (and some form of competitive nature) the question always comes up, “Can it be made lighter, can we go faster?” Good News: The answer is usually always YES. However, the routes of reducing weight in parts are not always a clear-cut path. As in everything in composites, there is a trade-off with optimizing cost to performance. There may be a thousand different solutions to reducing weight and rarely is there a strict right or wrong way to go about doing this. Intimate details and knowledge of a part’s structure makes all the difference in how far the envelope can be pushed to find the optimum strength to weight needed.

Research on a part must be done before diving into modifying a composite design or part. Even replacing Fiberglass parts with higher performing materials such as carbon fiber involves a certain amount of knowledge before simply making a part lighter. There are consequences that may be unforeseen

OPTIMIZING RESIN TO FABRIC RATIO

Making the existing composite part to its utmost design capabilities lies in optimizing the resin to fiber ratio. When performing wet layups, too little resin will result fibers not being adequately covered, leading to improper distribution of loading and could lead to complete failure of the part. Too much resin and the part will simply carry a load of excess resin with no benefit to the structural integrity of the part. Researching optimum ratios of resin to fiber are integral in promoting the most effective composite components.

SELECTING THE FABRIC

Kevlar, Carbon, and Fiberglass fiber types physical traits and differences are well documented. What takes more research is how these fibers are bound into fabrics and this corelates to the fabric’s final material characteristics upon lamination. Each fiber type and fabric have optimum characteristics such as strength, modulus, and flexibility. Selecting an optimum fabric from the choices will result in the possibility of less resin usage and less fabric, as possibly eliminating a few plys from the layup scheme. While many of the stronger fabrics cost more, what makes the most effective solution is up to who is fabricating it.

With that said, replacing fiberglass composite parts with that of Carbon Fiber or Kevlar is going to knock some weight off any part. Kevlar and Carbon Fiber are simply lighter and stronger fibers and result in lighter parts.

Reducing weight in a part comes with knowing the intimate details of how the part is used. It is important to know how and where loading is going to be applied. Once part needs and design details are known, fiber orientation plays an integral role in optimization of

part weight. Uni-directional tapes provide a “one-way ticket” of fibers oriented to do a job (carry loads) in a specified direction. Use of Uni-directional tapes in composites optimizes strength where it is needed, but not all around. (unless it is laid in all directions with multiple plys) In the direction opposite to the fibers, a panel of Uni-directional tape may easily fail in directions away from the fibers. It is a viable option for adding rigidity and strength to parts with little weight addition.

RESIN SELECTION

The highest performing general temperature resin in regard to overall strength and high modulus application is Epoxy resin. Gram to Gram, it simply outperforms Polyester and Vinyl Ester resins, especially when paired into Carbon Fiber or Kevlar layups in terms of strength to weight. (For flexibility in parts, one may still want to stick with a polyester.) There is an array of different epoxy resins available and many factors that go into selecting the perfect one for any application. Find the material properties in a resin that meets the design needs by digging into a manufacturer’s technical data sheets. Again, achieving the proper resin to fiber ratio in the selected epoxy is going to yield the composite most effective.

OPTIMIZATION IN COMPOSITES

The optimum route of achieving the lightest parts possible is using preimpregnated fabrics (prepregs). Resin is already introduced to the fibers and to the utmost character of material properties. The optimized fiber to resin ratio results in products that are generally leagues beyond what can be done repeatedly for wet layup or infusion processes. Rest assured, what is designed from a Prepreg standpoint will be accurate to that of the final part in the aspect of weight and repeatability. Prepreg information comes from the manufacturer with a cured ply density that is known and documented for estimations of weighing the final part before the first ply is ever cut. An accurate figure in the design phase on Wet Layups and Infusion processes is hit or miss based on several processing factors. Leaving the possibility of weight reduction up in the air until final parts are made.

ADDING CORE

Adding materials, such as core, seems like it is counteractive to achieving lighter parts and reducing weight. Adding core to an existing design is going to add weight to a layup. However, core materials are often used to strengthen parts and add a high degree of rigidity to any composite component. Some core types add significant weight in resin along with rigidity, while some are meant for the highest degree of composite performance. It is well known that adding core to weaker areas of the part properly will result in a much stronger part. Of all cores available, Nomex Honeycomb cores offer the highest degree of true performance, hit the news & blog section for “Core Materials -Part 2 – Nomex Honeycomb Core” for more information on its capability of taking your project to the next level. With

REDUCING WEIGHT

Nomex Honeycomb there may be a little more processing involved, but the result is undeniable given the strength to weight it achieves. Core materials may also be replaced from a heavier, resin-soaked core to that of a lighter core, and weight may easily be reduced in this fashion.

Composite Envisions LLC
8450 Development Court
Wausau, WI 54401 USA
+1 715-842-0101
info@compositeenvisions.com
https://compositeenvisions.com/

COMPOSITE ENVISIONS