AMT 2106 –AIRCRAFT MATERIALS CONSTRUCTION AND REPAIR II (Composite)

PRELIM PERIOD

LABORATORY MODULE I

Introduction to Advance Composite:

related features

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https://www.fibermaxcomposites.com/shop/index_files/definitionofcomposites.html	**1**
Composites Used in the Aerospace Industry (2013) retrieved from https://www.azom.com/article.aspx?ArticleID=8152	**2**
Arne Hessenbruch.(2002) citation Composite Overview retrieved from https://authors.library.caltech.edu/5456/1/hrst.mit.edu/hrs/materials/public/composites/Composites_Overview.htm	**3**

This module briefly discusses the history or timeline of the Composite Structures to the aircraft. This module also addresses the advantages of fibre composite materials as well as fundamental effects, product development, and applications of fibre composites, including material chemistry, designing, manufacturing, properties, and utilisation of the materials in various applications.

TIMEFRAME

You should be able to complete this module including all the self-assessments, research works, assignments, and other performance tasks within **3.93** hours**.**

LEARNING OUTCOMES

Course Learning Outcomes (CLO)	Module Learning Outcome (MLO)	Topic Learning Outcomes(TLO)
CLO 1. Understand the development of the composite structure and classify its element in terms of properties , advantages and characteristics of each elements. **CLO 3.**Produce clearly written, thorough and concise reports with well-founded analysis and conclusions, that explains the operation, applications of the composite structures to the aircraft **CLO 9**. Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria, methods and techniques.	**MLO 1.** Exhibit memory of previously learned material by recalling the advantages and disadvantages of using composite in application to the aircraft. **MLO 2.** Identify the differences between the matrix and reinforcing material as elements of composite .	**TLO 1.** Show memory of previously learned material by recalling the advantages and disadvantages of using composite in application to the aircraft and classify the differences between the matrix and reinforcing material as elements of composite

LABORATORY MODULE I – INTRODUCTION TO COMPOSITE: related features

Origins of Composites

The rapid development and use of composite materials beginning in the 1940s had three main driving forces.

1. Military vehicles, such as airplanes, helicopters, and rockets, placed a premium on high-strength, light-weight materials. While the metallic components that had been used up to that point certainly did the job in terms of mechanical properties, the heavy weight of such components was prohibitive. The higher the weight of the plane or helicopter itself, the less cargo its engines could carry.
2. Polymer industries were quickly growing and tried to expland the market of plastics to a variety of applications. The emergence of new, light-weight polymers from development laboratories offered a possible solution for a variety of uses, provided something could be done to increase the mechanical properties of plastics.
3. The extremely high theoretical strength of certain materials, such as glass fibers, was being discovered. The question was how to use these potentially high-strength materials to solve the problems posed by the military's demands.

One may conveniently speak of four generations of composites:

- 1st generation (1940s): Glass Fiber Reinforced Composites
- 2nd generation (1960s): High Performance Composites in the post-Sputnik era
- 3rd generation (1970s & 1980s): The Search for New Markets and the Synergy of Properties
- 4th generation (1990s): Hybrid Materials, Nanocomposites and Biomimetic Strategies
- Summary: The Impact of Composites on Materials Research

COMPOSITES USED IN THE AEROSPACE INDUSTRY

Since the birth of aviation, designers have continuously endeavored to improve the lift to weight ratios of aircrafts.

An increasingly important innovation in the aerospace industry is the use of composite materials, as these enable designers to overcome the barriers created by using metals.

Composite materials have played a major role in weight reduction, and hence they are used for both structural applications and components of all spacecraft and aircraft from gliders and hot air balloon gondolas to fighter planes, space shuttle and passenger airliners.

Composites are essentially materials made up of 2 or more phases or constituent parts, predominantly plastics reinforced with carbon fibers.

They can be formed into various shapes to increase their strength and layered with fibers running in a different directions, to allow designers to form structures with unique properties.

The development of next generation composite materials with light-weight and high-temperature resistance will help in designing high-performance, economical aircrafts.

Advanced composites could well be the future of aerospace, if certain costing issues can be resolved

Advanced composites could well be the future of aerospace, if certain costing issues can be resolved.

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A Brief History Of Composite Materials in Aerospace

Fiberglass consisting of glass fibers embedded in a resin matrix is the most common composite material, and first came to prominence in the 1950s for designing Boeing 707 passenger jet.

Compressor blades of the RB211 jet engine developed by Rolls Royce in 1960s were made of carbon fiber, which is brittle and has unique fatigue behavior.

Fibrous composite materials were originally used in small amounts in military aircraft in the 1960s and within civil aviation from the 1970s.

Related Stories

JEC Powers New Fibre Composite and Light-Weight Construction Trade Fair Polysilicon Industry Shifts from Semiconductor Industry to Solar Industry Innovative Composite Technologies to be Showcased in the Asia-Pacific Region .Since the 1980s composites have primarily been used for secondary wing and tail components such as wing trailing edge panels and rudders.

Each generation of new aircraft developed by Boeing has had an increased percentage of composite material, with the highest being 50% in Boeing 787 Dreamliner. The major structural elements of Boeing's 787 Dreamliner are made of more carbon 'sandwich' composites and advanced carbon laminate, a shift away from archaic fiberglass composites.

Aramid fibers, on the other hand, are widely used for constructing leading and trailing edge wing components and very stiff, very light bulkhead, fuel tanks and floors.

Advanced composites consisting of a combination of high-strength stiff fibers embedded in a common matrix material are also widely being used in the aerospace industry.

Advantages of Composites Usage in Aerospace

Some of the key benefits of using composites for aerospace applications include the following:

- Weight reduction up to 20 to 50%.
- Single-shell molded structures provide higher strength at lower weight.
- High impact resistance. For instance, Kevlar (aramid) armor shields planes have reduced accidental damage to the engine pylons that carry fuel lines and engine controls.
- High thermal stability
- Resistant to fatigue/corrosion
- Structural components made of composite materials are easy to assemble.

The Future of Composites in Aerospace

With increasing fuel costs, commercial aerospace manufacturers are under pressure to enhance the performance of aircrafts, for which weight reduction is a key factor.

Based on the progress that is being made in composite construction techniques, it is very likely that the airplane of tomorrow will be manufactured using composite materials.

However, there are still some hurdles to overcome before composites can replace aluminum and other metal alloys completely, particularly in case of large airplanes.

For one, composites are expensive and require a large labor force plus complex and expensive fabrication machines.

Composite technology continues to advance, and the invention of new types of composites such as carbon nanotubes and basalt forms will further accelerate composite usage.

ABOUT COMPOSITES

Definition: A **composite** is a solid material, made out of two or more constituent, different and distinct substances that retain their physical characteristics, while contributing desirable properties to the whole.

Composites and composite fabricating is not new. Actually, it is one of man's oldest engineering methods. Composites, like straw reinforced mud, were used for construction in prehistoric times. Today, composites are everywhere around us. For example, most buildings are composites, made out of newer materials like steel reinforced concrete or various kinds of panels. Likewise, glass fiber reinforced polyester is used extensively for the construction of many products like boats and yachts, tanks or piping.

Composite materials are the constituent materials that are used to fabricate composite products.

Three types of materials are mostly used, or overwhelm the industry today:

- The **matrix** is a form of glue that surrounds supports and keeps together in position the reinforcement.
- The **reinforcement** is usually some type fiber material in the form of fabric that exhibits some special physical characteristics (like mechanical or electrical).
- The **core** is usually some type of solid lightweight material used in-between the layers of fiber reinforced matrix forming a type of sandwich structure.

When matrix and reinforcement are combined in a laminate to form a new material, the imparting special characteristics of each are combined and enhanced by synergism (=working together.) Moreover, core can be utilized to improve the stiffness and strength of the product even further, resembling the effect of steel 'I' beam at a very low weight. Growing demand for better performance on products and materials has led to continuous developments on the field of composites. Advanced, special fibers (like carbon or aramid) or resins (like epoxy) and cores (like PVC foam or honeycomb), and new fabricating methods were developed and utilized to construct other materials or products that have outstanding mechanical properties thought to be "exotic" a few decades ago. Those advanced composites are used in many industries like aerospace, automotive, energy, important sports/recreation and just about everywhere low weight and other special properties are needed.

THE BENEFITS OF COMPOSITES

Year by year, more and more designers and engineers recognize the values of composites over other traditional materials like metal alloys, plastics etc. This is because composite material systems result in performance unattainable by their individual constituents. Fiber reinforced (FRP) products are more reliable, more durable, easy and safe to use, more economic to produce, and individually solve many problems and offer many benefits. As a result, manufacturers are abandoning old materials and fabricating methods and turn to composites. Composites are no longer just the privilege of aerospace, defence and high priced products. They are rapidly becoming a way of achieving high structural performance at a low cost. They are found in most of the cars we drive, in all busses and trains, boats, and recreation and sports equipment such as skis or canoes we use on the weekends.

Composites offer many advantages:

- Higher mechanical properties like strength and stiffness
- Lighter weight, higher performance
- Energy savings
- Durability, fatigue resistance and longer service life
- Impact resistance
- Dimensional stability
- Anisotropic properties
- Good chemical properties, corrosion resistance
- Fire retardance
- High temperature service
- Sevier environment outdoor service
- Low maintenance requirements
- Low thermal conductivity
- Low or custom thermal expansion

- Tailored energy conductivity, (e.g. can be used to amplify or dump vibration)
- Tailored transparency to radio frequency (reflection or dumping properties)
- Tailored electric properties (insulation or conduction capability)
- Tailored electromagnetic transparency
- Tailored properties make composite products irreplaceable for both
- telecommunication and stealth technologies
- Flexible, tailor design, part consolidation and freedom of shape
- Combination of many materials and inserts
- Lower capital investment for FRP manufacturing facilities
- FRP products are simpler, having fewer and larger parts
- Relatively low energy consumption to produce raw materials

PRELIMINARY LABORATORY ACTIVITY 1

FLEXIBLE (INDIVIDUAL ACTIVITY)

Name		Instructor	
Section		Date:	
		Rating:	

MODULE I-ADVANTAGES AND DISADVANTAGES OF COMPOSITE & elements of composite

LABORATORY OBJECTIVE:

- To students should be able to identify whether the statement provided was advantages and disadvantages of using the composite structures

TOOLS NEEDED:

- Activity sheet
- Pen

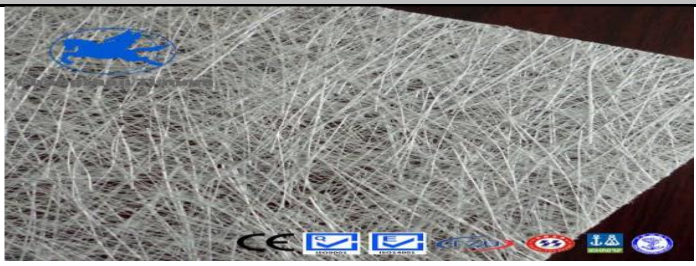
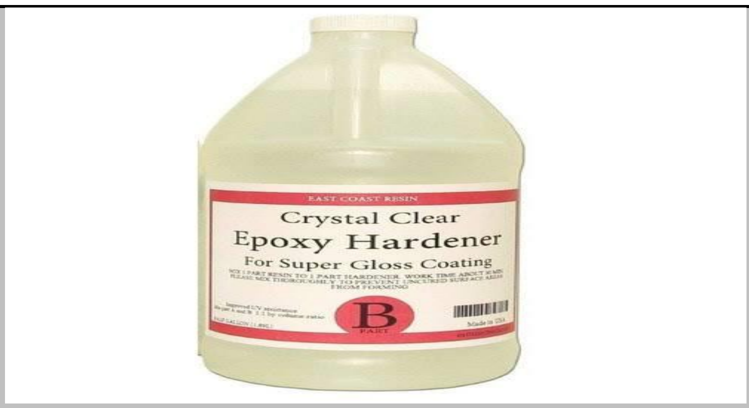
Time Limit: 10 - 20 minutes

Instructions:

Part I : Read carefully the statement below, and base on the discussion earlier . Put a letter **A** if the corresponding statement, is one of the advantages of the composite and **DA** if the statement shows not .

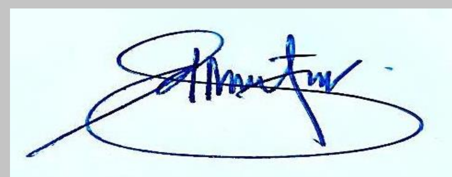
	STATEMENT
	1. the composite materials can resist corrosion
	2. high maintenance cost in terms of repair
	3. dangerous in terms of heath conditions
	4. Durability, fatigue resistance and longer service life
	5. Higher mechanical properties like strength and stiffness

Part II: Identify whether the figure shown is a Reinforcing materials or matrix materials
.

Elements of composite	Figures
	
	
	
	
	

HONESTY CLAUSE

My signature below constitutes my pledge that all of my writing is my own work, with the exceptions of those portions which are properly documented



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Student Signature

Parent Signature