Composite Materials Recyclability, Challenges and Opportunities

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The Institute for Advanced Composites Manufacturing Innovation
Addressing Critical Challenges

Five/Ten Year Technical Goals

- 25/50% lower carbon fiber–reinforced polymer (CFRP) cost
- 50/75% reduction in CFRP embodied energy
- 80/95% composite recyclability into useful products

Impact Goals

- Enhanced energy productivity
- Reduced life cycle energy consumption
- Increased domestic production capacity
- Job growth and economic development
Our Vision and Mission

Vision:

- Our collaboration of industry, research institutions and state partners is committed to accelerating development and adoption of cutting-edge technologies in recycling and re-manufacturing of composites.

Mission:

- To lead and grow a composite recycling industry that fully diverts fiber scrap and end-of-life composite products into value-added products.
  - **Economic**: Grow manufacturing and create jobs across the composite industry.
  - **Education**: Support the training of a workforce prepared for and accomplished in the skills required by the composite recycling industry.
  - **Environment**: Reduce the amount of composite landfill through re-use in new applications with reduced energy and environmental footprints.
A Quick Question

An aluminum can that is thrown away will still be a can _____ years from now

A) 100
B) 300
C) 500
D) 1000
Increasing volume of materials to be recycled in aeronautics

Increasing volumes of materials to be recycled

- In the mid-term, end-of-life products will need to be recycled
- In the short term, most of the composite waste will come from production scraps
Aeronautics is not the only user of CFRP

Conservatively, 30% of virgin carbon fiber ends up as scrap to be recycled.

Ultimately, 100% of fiber needs to be recycled as end-of-life material.
Sustainable Materials & Manufacturing

Manufacturing → Material → Materials Processing → Recycling Repurposing Processes

End of Life Products and infrastructure → Collection → Excavation → Disposal

Resource stock → Ore → Excavation → Landfill Stock

Dissipation

By-product (Scrap)
Opportunity

• In North America, 29 million pounds (~13,200 MT) of carbon fiber waste estimated going to landfill per year. In the form of

  – Pre-preg, primarily aerospace production scrap
  – Secondary amount is cured production trim
  – Some pre-preg scrap has to be oven cured prior to landfill
  – Regulations vary based on constituents in resin system
  – Adds cost/time burden on composite manufacturers

• It is difficult to estimate amount of end-of-life composite
Recycled Carbon Fiber and Value
Challenges

• Supply Chain, need to know where material comes from and what it contains (fire retardants, etc), and available in what format
  – Sorting, Classifying, labeling

• For value added products, higher fiber volume fraction preform, aligned fibers etc. which could be achieved by new methods of preforming

• Development of standard for products will give confidence to designers and end users.

• Today Landfill fee/tax is not a driver for C-fiber recycling in US. However further legislation or banning landfill will drive recycling

• Life Cycle Assessment studies for recycling processes is needed.
Recycling Proposals Received

Automotive component and 3D printed tool both use reclaimed CF

Recycling aircraft components into 3D printed automobiles

Profitably recycling glass and carbon composites

Automotive component uses CF reclaimed from scrap prepreg

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Driving Forces for 
*Sustainable Materials & Manufacturing*

- Growing public concern about environmental issues
- Corporate social responsibility
- Economical viability
Concluding Remarks

• Well recognized that composite recycling needs “market pull” to elevate demand and value, and improve reclamation business case. It is so critical to develop supply chain.

• Achieving Technological barriers in manufacturing technologies yielding product sales, creating confidence in using reclaimed fibers and, most importantly, fund increased R&D into new product areas.

• Early manufacturing and development efforts will generate standardization and also process knowledge that feeds new applications/opportunities.
Thank you!

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