FAQs for Recycling Composites

1) Who can recycle my composite byproduct?

A: Who can recycle your composite byproduct will depend on the type of waste that you are seeking to recycle. Please refer to the "Waste Type" column of the Recycling Resources grid to narrow down the companies that would best serve your needs.

2) What type of processes are used to recycle composites?

A: Mechanical, thermal, chemical are the three types of categories of processes used to recycle composites. Please refer to the "Recycling Process" column of the Recycling Resources grid for more information.

3) How are composite materials recycled?

A: Composite materials are typically recycled through mechanical means of shredding and fed through an auger or screw in extrusion for compression molding or injection molding. Depending on the end application requirements the recyclate is appropriately fed with the virgin raw materials at a low percentage rate or down cycled and fed at a high percentage. Or the extruded recyclate can be pelletized and directly fed with virgin pellets and master batch for use in other applications. Thermal means of recycling in a cement kiln or in controlled pyrolysis can also use the shred composite. A recent state-of-the-art review compares composite recycling technologies and potential value at commercial scale.

Link to the most recent Recycling Composites Review:
https://acrobat.adobe.com/link/review?uri=urn:aaid:scds:US:5b3222d0-0404-331b-80e9-dd7fccfda6ff

4) What type of reinforcement fibers are recycled?

A: Glass, carbon, aramid, basalt, polypropylene, polyester, and UHMPE are the various types of reinforcement fibers that are recycled today. Please refer to the "Fiber Type for Recycling" column of the Recycling Resources grid for more information.

5) What are typical products made with recycled composites?

A: There are a variety of products that can be made with recycled composites. Some examples are pellets, fabric, and specific end products. Additional recycled products can be found in the "Recycled Products" column of the Recycling Resources grid.

6) Are all types of plastic, resin, or composites recycled?

A: The plastic and composite material recycling rate in the US is under 10%. Almost all types of plastic or composite materials could be recycled but the supply chain or processes required for recycling them are not at scale or not considered economically viable. Thermoplastic based composites can be reshaped when hot elevated temperatures are applied, similar to candle wax. Thermoset composites can be more challenging to recycle since they cannot be reshaped thermally. Composites by nature are hybrids of material, laminates, foam or balsa cores, and generally must be reduced in size and separated for transport due to the range of constituents.

Composite materials require specialized processes to recycle due to the cost for separation and extraction of constituents. Carbon fiber recycling and repurposing has lead the composites industry in recycling due to its unique characteristics and high embodied energy. The resins can have energy or reuse value as feedstock as demonstrated by several pyrolysis technologies. Glass fibers have demonstrated increased recycling and repurposing advancements, with the expansion of usage by cement kilns incorporating obsolete wind blades into their cement recipe.

Often recycling is not possible with currently available technologies. As technologies evolve with sustainability guidance and economic barriers will be overcome. We desire to make composites the sustainable material of preference.

The use of durable composite materials inherently reduces emissions by 1) providing lighter weight for lower energy requirements, 2) extending service life, 3) reducing maintenance and renovation materials, and 4) recycling or repurposing the raw materials used.

The cement kiln is at scale. Other evolving recycling technologies that are scaling up include Chemical Solvolysis for resins and thermal or microwave pyrolysis for composites.

7) What are the advantages of recycling resin from composites? How does recycling improve the climate impact?

A: Chemical recycling of resin is an emerging technology that complements mechanical recycling. Chemical recycling converts the waste resin back into the molecules used for the virgin resin either using chemical, thermal or photochemical processes. One of the drawbacks of mechanical recycling is that recycled resin is difficult to separate and typically of lower quality than virgin material. Through chemical recycling, resin oligomers, trimers or starting molecules are used for new resin with virgin performance. Small chemical recycling plants are in operation, but the technologies are not yet at industrial scale. Manufacturers considering the use of recycled material need to consider the impact on the LCA (Life Cycle Assessment) for the manufacturer's product. Ideally, the LCA should show a reduction in climate impacts when using recycled material. ACMA's Climate Impacts Project is helping composites manufacturers prepare LCA for their products.

8) How are recycling facilities improving the way they deal with waste?

A: Public waste management has recycling facilities which can divert clean composite materials from landfills. Recycling efficiency is improved as sorting and recycling technologies continue to scale and enable recycling of mixed and contaminated waste streams. Near infrared (NIR) technology is widely used to sort different types of composite or plastic parts as they pass by on a conveyor belt. Each type is chemically different and has its own characteristic chemical fingerprint that can be detected by sensors. Artificial intelligence (AI) can be used through a camera system and a robotic arm trained to recognize and remove contaminants. One of these robots can sort up to 80 items per minute, which is roughly double the capacity of a human worker. Chemical recycling capacity is being built to enable recycling mixed resin and plastic waste into waxes, chemicals, and petrochemical feedstocks for new production.