



Introduction

Conventional epoxy resin and curing agents are the products of fossil fuel-based industries that are raising sustainability and toxicity concerns. Studies [1] have shown the toxicity effects caused on human beings. Various green epoxy resins have been introduced to composite market but are having limitations. One of the main drawback is availability of paired curing agents or hardeners to these green epoxies. Research [2] have shown development of various green curing agents derived from renewable resources as shown in the following table:

Table 1: Different cuing agents obtained from bio-based materials

Raw Material	Curing Agent
Amino Acids	Amine/Acids
Grapeseed oil	Polyamine
Polysaccharides	Furanic Amines
and sugars	
Terpene/Rosin	Anhydrides
Fruit juices/Fatty acids	Carboxylic acid
Tannic Acid	Polyphenols

Fig.: Different areas of application of bio-binder







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Green Composites: A Sustainable Solution (NSF Award #2000138)

Nachiket S. Makh, Dr. Ajit D. Kelkar, Dr. Lifeng Zhang Joint School of Nanoscience & Nanoengineering, North Carolina Agricultural & Technical State University

Fabrication and Testing

A 12" x 12" composite panel was made using VARTM process as described in reference [3]. Using 12 layers of plain weave carbon fabric, the panel was laminated. Two different panels were made. The first panel was made using Epon-862 and curing agent-W while the second panel was made using Epon-828 and biobinder, a commercially available curing agent derived from natural, renewable feedstock. A solution of resin and curing agent was prepared by mixing it in the amount as specified by the manufacturer and then were infused by VARTM method to make the panel. Both the panels were cured at 300 °F. The fabricated panels were then cut into tensile coupons as per ASTM D3039 standard using water jet machine. Using strain gauges the water jet cut samples were tested according to ASTM D3039 standard using Instron electromechanical testing system.











(d)(c)**Fig.** (a): Infusion of resin by VARTM process; (b) Strain guage mounting on coupon; (c) Sample mounted for tensile test; (d) Sample after tensile test





Table 2: Elastic properties of the coupon

Coupon Material	Tensile Strength (MPa)	Tensile Modulus of Elasticity (GPa)	f
Epon862 and Epikure-W	786.48	60.67	
Epon-828 and Biobinder	717.88	56.54	

It can be observed that the strength of panel made from conventional resin & curing agent system is higher than that made using biobinder but the use of bio-binder completely replaces the conventional curing agent. So, use of these bio-binder can help in achieving the sustainability goal.

References

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1.2

1.36

