TEXAS STATE®
INGRAM SCHOOL OF ENGINEERING

M2.06 – Calendaring Roll Mill

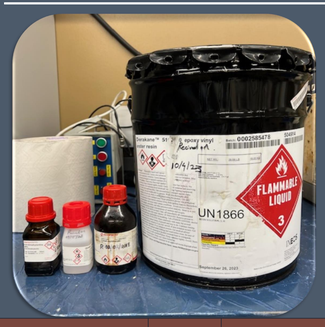
Isaiah D. Garcia
Preston Putman
Nathan Diaz
Dr. Jitendra Tate, Mr. Mark Summers

Goal

- Provide the TXST IHM with a small-scale Calendaring Roll Mill to work in conjunction with the Compression Molding machine.
- Be able to manufacture composite prepreg material.

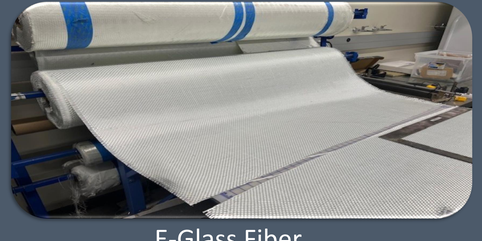
Material Index

Resin Formulation



Material	PHR	Description
Derakane 510A-40	100	Epoxy Vinyl Ester Resin
Cobalt Napthenate-6% (Co-Nap)	0.30	Promoter
Dimethylaniline (DMA)	0.05	Accelerator
Methylethylketone Peroxide (MEKP)	2.00	Initiator

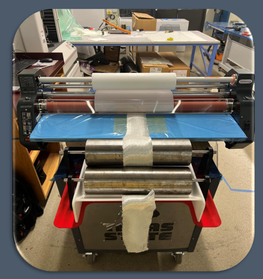
Fabric



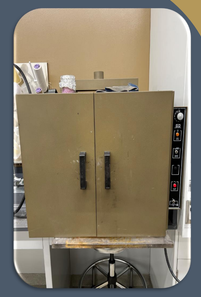
E-Glass Fiber
Weave Pattern: +/- 45 degrees stitched

Process Flowchart

Place resin into vacuum chamber until the resin boils under pressure and air bubbles are removed.



Cut prepreg into four equal sheets, stack and place into machine to be compressed with 2 tons of force at 175°F for 4-6 hours.



Mix Resin (Stage A) → **Vacuum Chamber** → **CRM (Stage B)** → **Compression Mold** → **Post Cure (Stage C)**

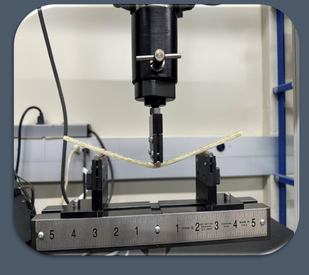
Mix resin per formulation weights while considering volume of the prepreg to be formed.

Prep vat and laminator during vacuum sequence. Pour degassed resin into vat. Run sheet through laminator at 2.50 fpm and heated at 158°F.

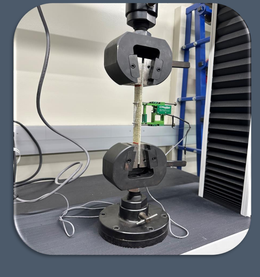
Allow mold to cure at 75°F for 24 hours. Post cure mold at 175°F for 6 hours using a laboratory-rated convection oven.

Testing & Data Analysis

Gel Time vs Temperature



Temperature (F&C)	MEKP to Oven (min)	Total Gel Time(min)
72F(22C)	01:25.2	15:49.2
140F(60C)	01:27.7	04:16.2
150F(65C)	01:24.5	03:39.4
158F(70C)	01:38.8	04:10.5



Flexure – ASTM D7264

3 Point Flexural Properties Test			
Width (in)	Thickness (in)	Loading Span (in)	Mean Flexural Strength (psi)
0.500	0.175	5.60	5,485

Fiber Volume Fraction
0.506

Tensile – ASTM D3039

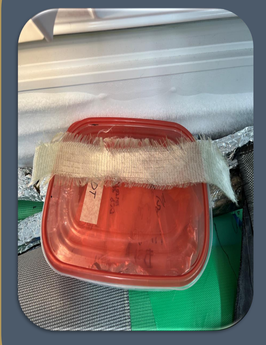
Tensile Properties Test		
Width (in)	Thickness (in)	Mean Tensile Strength (psi)
1.00	0.195	23,902

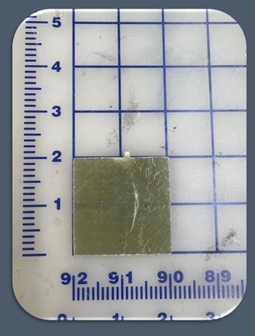
Results

CRM Process Time

Process	Time
Mixed Resin to Vacuum Chamber	00:56.0
Vacuum Time	02:53.0
Transfer to Vat	00:39.0
CRM @70C	03:25.0
Remove Excess Material	00:42.0
CRM to Freezer	00:15.0
Overall Time	08:50.0

Final Product





The Team