3rd Composites Asia Conference, Bangkok-Thailand

Epoxy Resin Systems for Composites in Construction

Aditya Birla Chemicals (Thailand) Limited (Epoxy Division)

Outline

- Market Overview of Composites in Construction
- Epoxy Resin Systems for Composites in Construction:
  - Composites Rebar
  - Pultruded profile (FR – non FR system)
  - GRE Pipes & Conduit (Low Pressure Application)
  - Panels/Roofs/Sandwich Construction (FR – non FR system)
  - Adhesive for Composite / GRE Pipe Repair
  - Fiber Impregnation Epoxy System for Concrete Repair
  - Clear Castings & Decorative
- Summary
- Brief Profile of our Company

Composites in Construction : Market Overview

- **Global Construction Composites Market is projected to reach USD 8.98 billion by 2026, growing @ CAGR* of 6.00%, from 2016 to 2026.**

- **Growth Drivers:**

  Increased penetration due to long life, low manufacturing & maintenance cost , improved product performance over traditional building materials.

  Composite Materials being lightweight, durable, corrosion resistant offer flexibility to engineers, architects & designers, to bring out innovative designs not constrained by material limitations.

  Rapid urbanization and the Economic boom in developing Countries.

- **Glass fiber is the leading type of fiber used for various construction composite applications due to the lower cost and good overall properties such as strength, durability, stability as well as resistance to heat, temperature, and moisture.**

- **Epoxy resins as matrix material complement with their versatility to suit different process and performance requirements especially for highly corrosive applications subjected to harsh environmental conditions.**

- **Typical applications of Epoxy Resins in Construction include :**

  Roofing for structures and domes, sandwich panels, pultruded profiles for modular structures, rebars, infrastructure & refurbishment or strengthing of aged building & bridges.

**Compound annual growth rate* (CAGR).

Data Source: MarketsandMarkets

Epoxy Resin Systems for Composites in Construction

Composite Rebar

- **Features of Epoxy Resin Systems:**
  - 3k Infusion System , Tunable Reactivity
  - Suitable for Varying Profiles (rebar of different cross-section)
  - Low mix viscosity and long pot life at ambient temperature
  - Excellent fiber impregnation properties and easy to process

- **Benefits of C-Rebar (in comparison to Steel Rebar):**
  - Lightweight
  - Higher Tensile Strength
  - Built-in Corrosion Resistance
  - Electromagnetic Neutrality
  - Thermal Insulator

GRP
glass rebars

BRP
basalt rebars

RP
sand-coated glass or basalt rebars

RP
combination of glass & basalt

FRP
glass or basalt composite mesh

Composite Rebar

- **Composite rebar: Modern replacement of metallic rebar**

- **UP-TO 40% CHEAPER**
- **LIGHTER 9 TIMES**
- **SHIPMENT IS 6 TIMES CHEAPER**
- **PASSES RADIO WAVES, NO CORROSION**

Is 9 times lighter than metal counterpart;
up to 40% cheaper than steel;
shipment is 6 time cheaper .
Produced according to GOST 31938-2012 "Composite polymeric rebars for reinforcing of concrete constructions"

Tensile Strength of GFRP rebar in 3 times higher than of metal

GRP=1200 MPa
Steel=390 MPa
Allows replacement of metallic with GRP rebar with smaller diameter

600% shipment savings

The weight of 1 meter of steel rod 12mm is 0,888 kg.
The weight of 1 meter of GFRP rod 8mm is 0,11 kg.
Difference between steel and GFRP is 8 times
The truck with a loading capacity of 20 tons can be loaded with 22520 meters of steel rods or 150000 meters of GFRP rebar
Shipment savings - 6 times.

Data Source: SG Line

Composite Rebar

- **GFRP Rebar Properties :**

Property of GFRP	Unit	ASTM	CSA	Test Results
Cross Sectional Area	mm^2	71	71	**72**
Ultimate Tensile Force	Kg	6014	5428	**8396**
Tensile Strength	MPa	831	750	**1144**
Mean Tensile Modulus of Elasticity	MPa	44800	40000	**61639**
Bond Strength	MPa	8	8	**16**
Transverse Shear Strength	MPa	131	160	**191**

Note: Diameter of rebar 10 mm

Note : Test results of Rebar provided by P.J. Composite Co., Ltd.

Composite Rebar

- **Application :**


Offshore platforms


Wastewater treatment Plant

Structures Exposed to Corrosive Environments

Composite rebar

High Strength & Light Weight Structure

Electromagnetically Sensitive Applications


Nuclear Power Plants


Street Bridge


Application in Road Construction


Electrical & phone transmission towers


Airport Tower

Pultruded Profiles

Features of Epoxy Resin Systems :

- 2k/3k component Fast Reacting Systems
- Excellent mold release properties
- High mechanical strength and stiffness
- Excellent moisture resistance
- High dielectric properties, surface and volume resistivity
- FR compliance UL 94, ASTM E 84

Application :

- Pultruded Composite Profiles for Structural Construction

Manufacturing Process: Pultrusion


Walkway in Plant


Structural for bridge

Properties of Pultruded profile (% Resin content = 28-32)

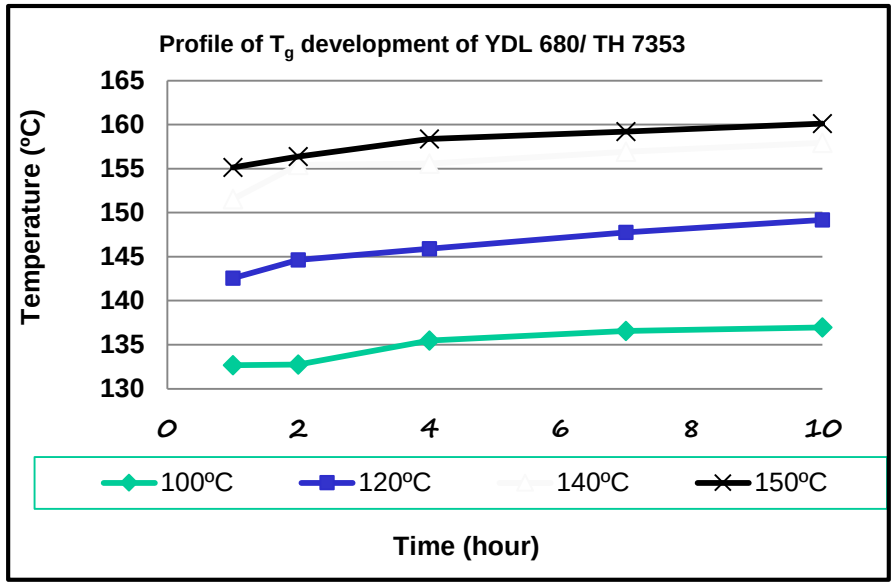
Property	Method	Unit	Specification
Tensile test (vertical)	ISO 527		
Tensile strength		MPa	>450
Tensile elongation		%	>1.2
E– modulus		GPa	>3.5
Tensile test (horizontal)			
Tensile strength		MPa	>140
Tensile elongation		%	>1.2
E– modulus		GPa	>1.5
Flexural test	ISO 178		
Flexural strength		MPa	>450
Flexural elongation		%	>2.0
E– modulus		GPa	>2.0
Izod Impact	ASTM D 256	KJ/ m^2	>1.5
Flammability	UL 94 – HB	mm/ min	<75
Compressive strength	ASTM D 695	MPa	>300


Pultruded Profiles

GRE Pipes & Conduits (Low Pressure Applications)

Features of Epoxy Resin Systems :

- Optimized viscosity (improved wetting, minimal dripping)
- Good mechanical and thermal properties
- Exhibit low moisture absorption



Application :

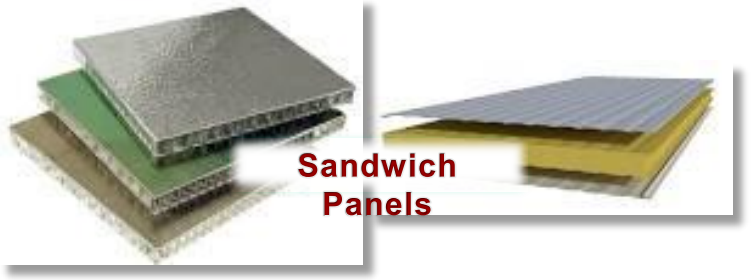
- Fluid transportation
- Concealing Wires, Cables (OH pipe-racks/Underground)

Manufacturing Process: Filament Winding

Panels/Roofs/Sandwich Construction

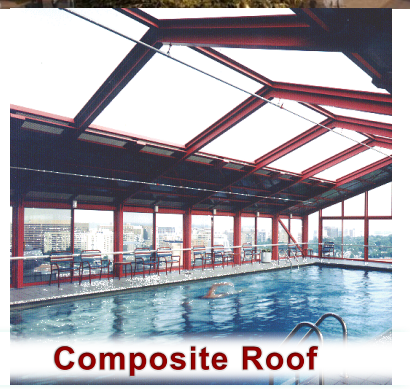
Features of Epoxy Resin Systems :

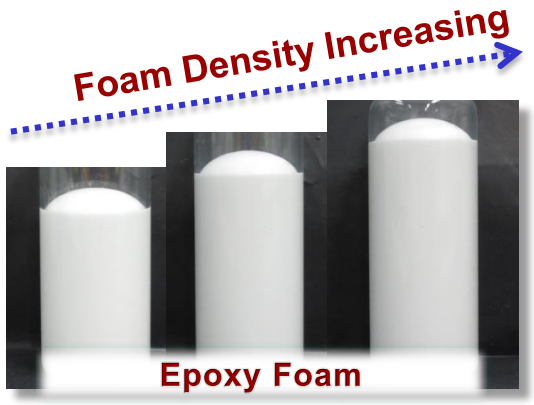
- Infusion and HLU resin systems with hardeners of different reactivity
- Optimized viscosity to aid in processing
- Outstanding mechanical strength and stiffness
- FR compliance UL 94 , ASTM E 84 specs.
- Closed cell Expandable Epoxy Systems ranging from density 130 kg/m3 and above



Applications :

- Composite roofs/domes – hoods
- Sandwich panels for infrastructure, house-hold and industrial applications



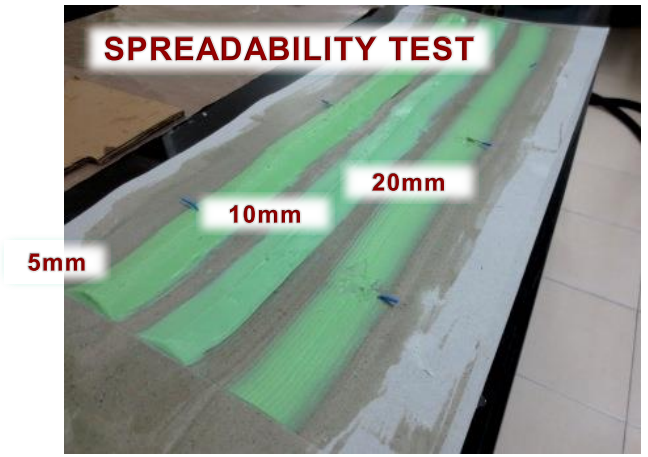


UL 94 is the Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing

Adhesive for Joining Composite Structures

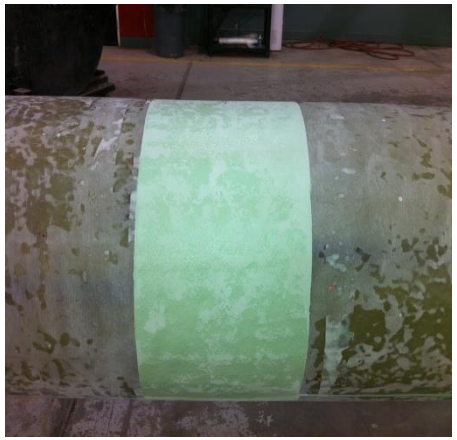
Features of Epoxy Resin Systems :

- 2k thixotropic ambient cure system,
- Feasible to mix using static mixers
- Sagging and Slump resistant up-to 45C
- Suitable for bonding thickness up-to 20mm
- Excellent mechanical and adhesion properties
- Exhibits low curing shrinkage



Application :

- Joining composite or metal pipes/panels – on site
- Sealant (defect filler) for in-situ pipe repairs
- Bonding of Composite Panels



Process :

- Application by Manual or Dispensing Machine

Epoxy System for Concrete Repair and Refurbishment

Features of Epoxy Resin Systems :

- Optimum Processing Viscosity
- Suitable for wet lay up under varying environmental conditions
- Can be applied to vertical surfaces with minimal dripping
- High Mechanical Properties
- Curable at Room Temperature/ Ambient Conditions

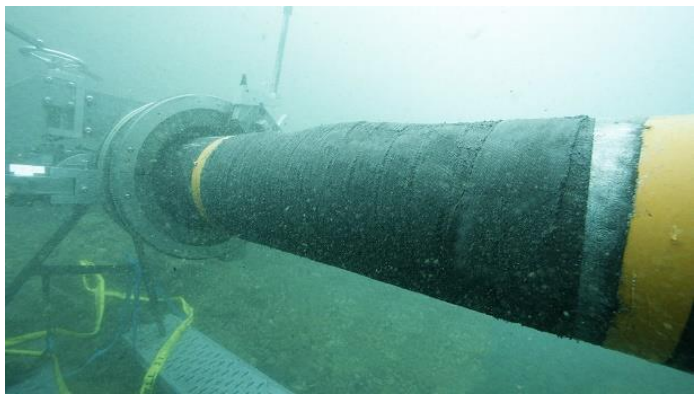
In-Situ Repair

Application :

- Repairs of Concrete Structures : Bridges, Pillars, Beams

Process :

- Wet lay-up



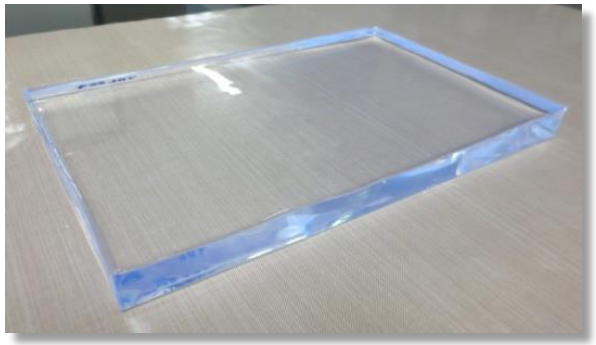
Concrete – Bridge Repairs & Reinforcement

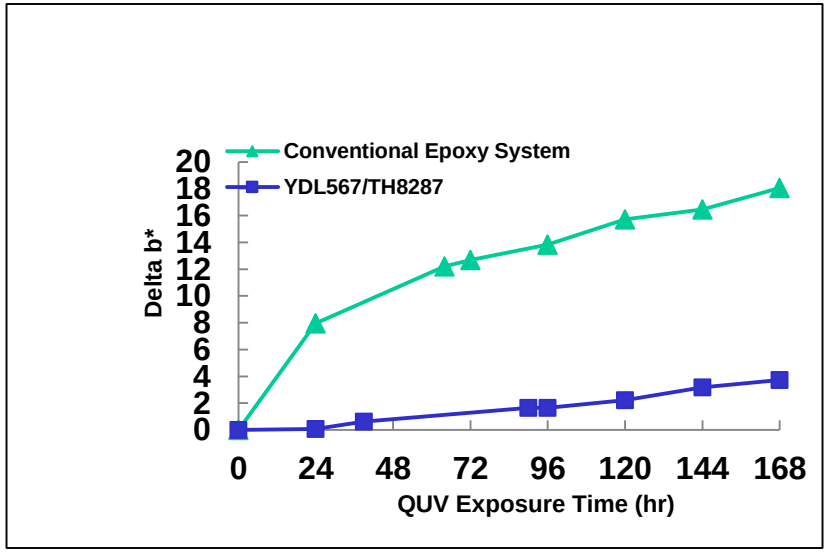
Clear Castings & Decorative

- **Features of Epoxy Resin Systems:**

-Ambient cure resin system

- Designed for low processing viscosity, long working time (pot life >300 mins., 100gms.mix)
- Cures with low exotherm
- Provides high resistance to amine blush
- Excellent bond strength with wood and glass
- Outstanding UV resistance and optical clarity





- **Application :**

- Clear Casting Objects
- Decorative, panels household- interiors

- **Process :**

- Casting

Summary

- **Construction Composites Market is on a High Growth Trajectory.**

- **Composite Materials are being increasingly considered as substitutes for conventional materials in building and construction.**

- **Epoxy Resin Systems can be designed to meet process and performance requirements for variety of Construction Composite applications.**

- **Critical Success Factors:**

  Industry – Industry , Industry-Academic Collaboration

  Involvement of all Stakeholders

  Constant Support & Incentives from State & National, International Organizations

Company Overview : Aditya Birla Chemicals

- Part of Multinational Premium Business Conglomerate **" Aditya Birla Group"** , US $ 44.3 billion Corporation in league of Fortune 500
- **Largest manufacturer of Epoxy Resin and Systems in SE Asia**
- ISO 9001,ISO 14001 and OHSAS 18001 certified
- **Manufacturing in Thailand (1992) , India (2013), Germany (CTP/CTP-AM)**

Thailand Plant

India Plant

Superior Technology + Precise Process Control = Consistent Product Quality

Our Solutions

BUILDING BLOCKS

Bisphenol A Epoxy resins
Low - High molecular weight

Bisphenol F Epoxy resins
Un-modified and Modified
Low to High molecular weight

Multifunctional Epoxy resins
Epoxy Phenol ,Cresol Novalacs

Epoxidized Reactive Diluents
Mono, Di and Tri functional
(Aliphatic and Aromatic)

Hybrid resins
Epoxy-Silicon, CTBN modified etc.

Curing Agents
Polyamines, Anhydrides, Polyamides

CUSTOMIZED SOLUTIONS

Coatings
- Industrial
- Protective
- Marine
- Can & Coil

CORROSION RESISTANCE

Composites
- Wind energy
- Aerospace
- Defense
- Recreational
- Infrastructure

LIGHTWEIGHT, HIGH STRENGTH

Construction
- Floorings
- Adhesives
- Grouts
- Road Markings

CHEMICALS RESISTANCE

Electrical & Electronics
- Laminates
- Transmission & Distribution
- Power Generation

ELECTRICAL INSULATION

VALUE CHAIN

Industries We Serve

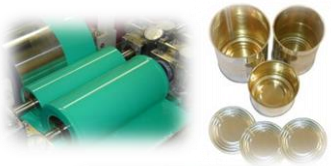
EPOXY
RESINS & SYSTEMS

AEROSPACE & DEFENSE

POWER

OIL & GAS

COATINGS



AUTOMOTIVE (COMPOSITE & COATING)

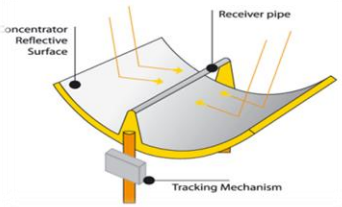
ELECTRONICS

CONSTRUCTION

ADHESIVE

DECORATIVES

RENEWABLE ENERGY



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