



THERMOSET TOPCON
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Presented by SPE Thermoset Division



Aromatic Thermosetting CoPolyester ***AV™ Thermoset Foam***

Presented by Frederick Deans, Director Emeritus SPE Automotive
& Composite Divisions
On behalf of ATSP Innovations, Inc., Houston, TX

ATSP Innovations, Inc

Founded in 2010 at University of Illinois Research Park; Currently located in Houston, TX

30+ years of research, 5 foundational issued patents, with 1 patents pending

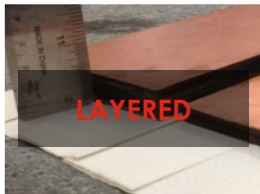
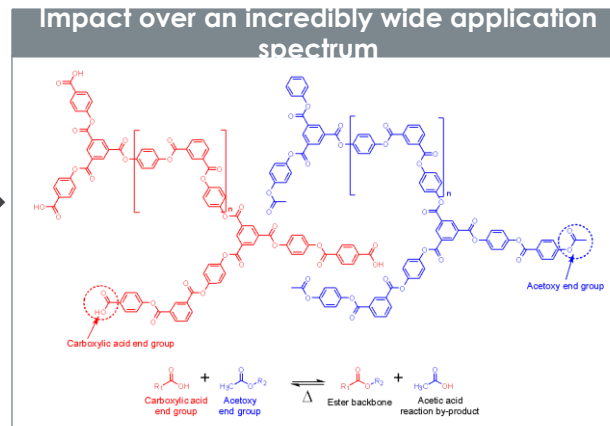
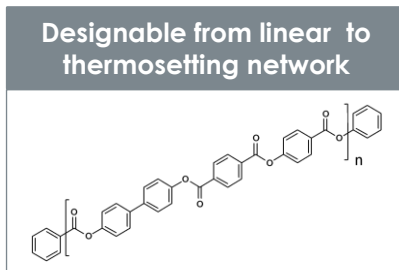
Performance validated and utilized by major federal technology agencies

ATSP Staff combines inventors from initial polymer era and new generation materials and product developers and industrialists

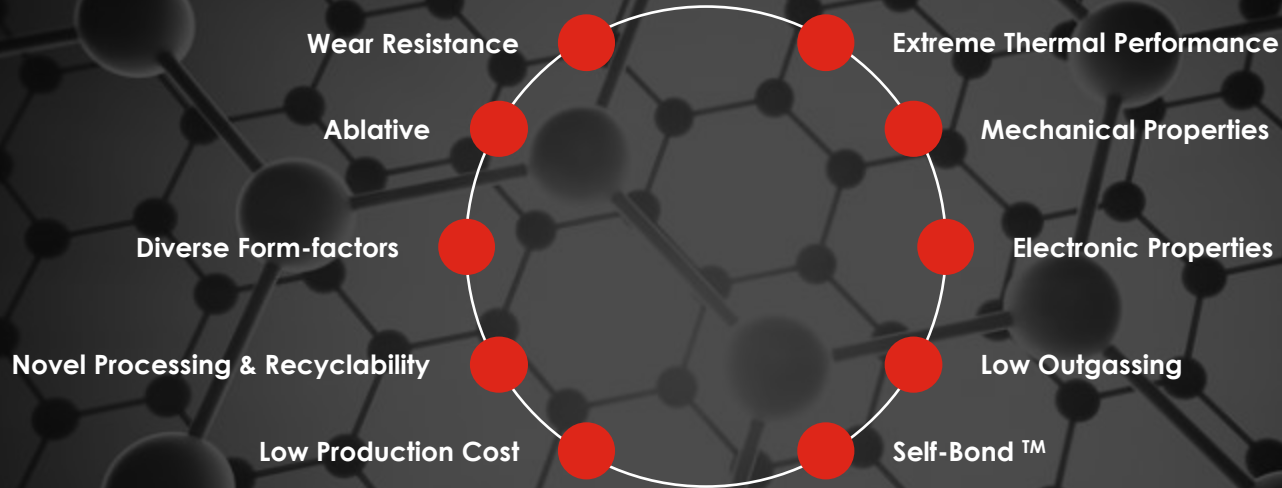


What is ATSP? Aromatic Thermosetting CoPolyester is an uncatalyzed, condensation-cure oligomer containing both amorphous and crystalline segments that can be cross-linked (like a thermoset) and also can be reprocessed like a thermoplastic.

Tailorable properties based on Cross linkable oligomer architecture enables processability, performance, and cost structure unmatched by traditional high temperature materials



ATSP's Resins Unique Mix of Properties



- Designed for **high temperatures** (up to 350 °C in air, with Tg of up to 310°C)
- **Liquid crystalline** character results in lower residual stresses at interfaces – producing stronger bonds and tougher composites
- **Flammability resistance** superior to aramids, epoxies, phenolics and other high temperature polymers (limited oxygen index: 40%)
- Strong **adhesion** to metal surfaces
- **Tribological** performance combining low friction and low wear

ATSP POLYMER Products

ATSP Thermosetting Co-Polyesters are cross-linkable and capable of recyclable under heat. The Co-polyesters provide alloy improvements when compounded with various thermoplastics thus creating new and improved properties that exhibit properties of each polymer



**Powder coatable,
rebondable structural adhesives
capable of high shear and bond
strength to metals**



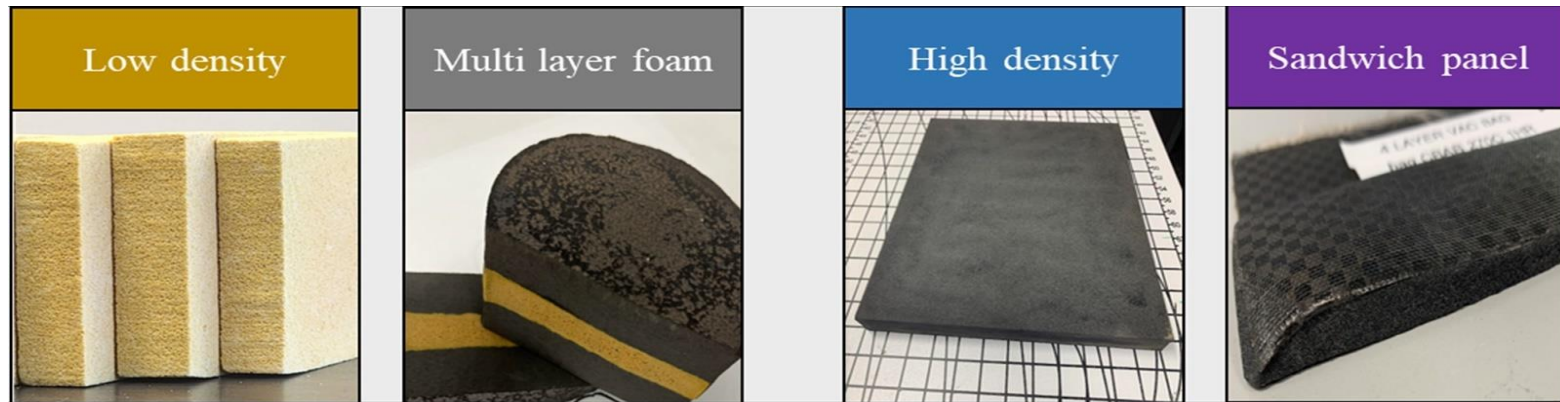
**Wear resistant bearings
for extreme conditions. Alloy
capable with a variety of
thermoplastics**



**High temperature stable
advanced polyester powder
capable of thin protective
coatings for heat and corrosion
protection**

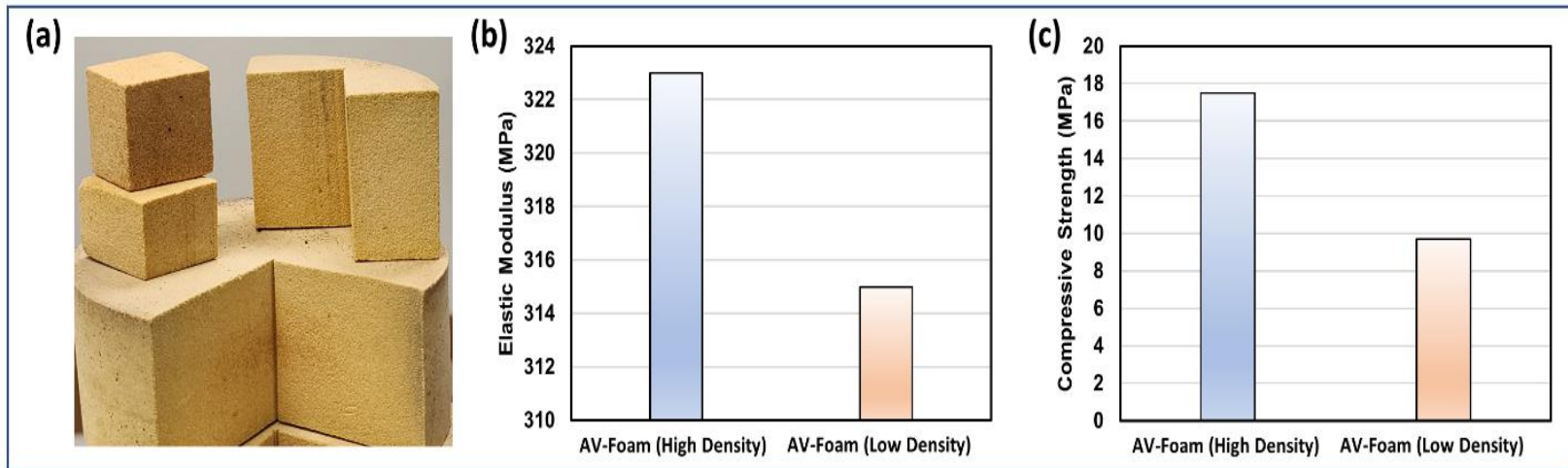
ATSP AV Foam: Using ATSP's by product of polymerization and cross-linking a light weight, open cell foam can be produced. Various foam product variations can be produced.

- Density Range: 0.007 to 0.025 lbs/in³ (Can be filled with additives)
- Can be block formed (for shaping) or shape molded
- Can be laminated to composite "skins" to form high performance sandwich panels
- Conductive fillers can achieve EMI performance
- Natural color, low density, shown below
- Low thermal conductivity



Mechanical Properties: AV Foam's Elastic and Compressive properties vary with desired density values

- Elastic Modulus: 323 MPa (high density) to 315 MPa (low density)
- Compressive Strength: 17 MPa (High density) to 10 MPa (low density)



Fire Performance: AV Foam is naturally flame retarded

- ATSP Limiting Oxygen Index (LOI, the minimum concentration of oxygen that will support combustion of a polymer) : 40%, and 85% as ATSP/C composite
- Among the highest neat LOI for non-halogenated unfilled polymers

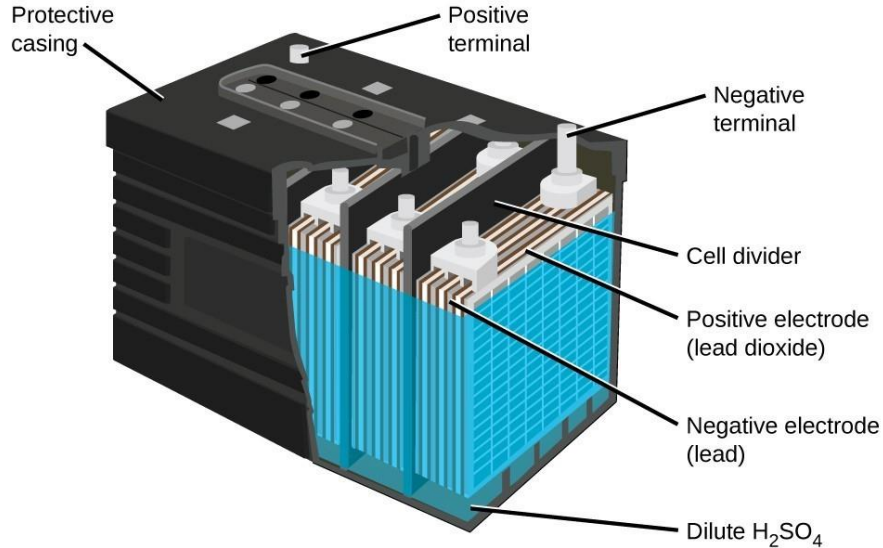
Polymer	LOI (%)
Polyethylene	17.4
Polybutadiene	18.3
Polystyrene	18.3
Cellulose	19.9
Polyethylene terephthalate (PET)	20.6
Nylon 66	21.5
Polycarbonate	29.4
Polyetheretherketone (PEEK)	24
Nomex	29.8
Kynol	35.5
ATSP	40
Benzimidazole	41.5
Polyvinylidene fluoride	43.7
Polyvinyl chloride	47
Polyvinylidene chloride	60
Polytetrafluoroethylene (PTFE)	95

Unfilled 5wt% mass loss point -
537°C (N₂) - 527°C (air)



<https://www.youtube.com/watch?v=V-Mx78VxPLM>

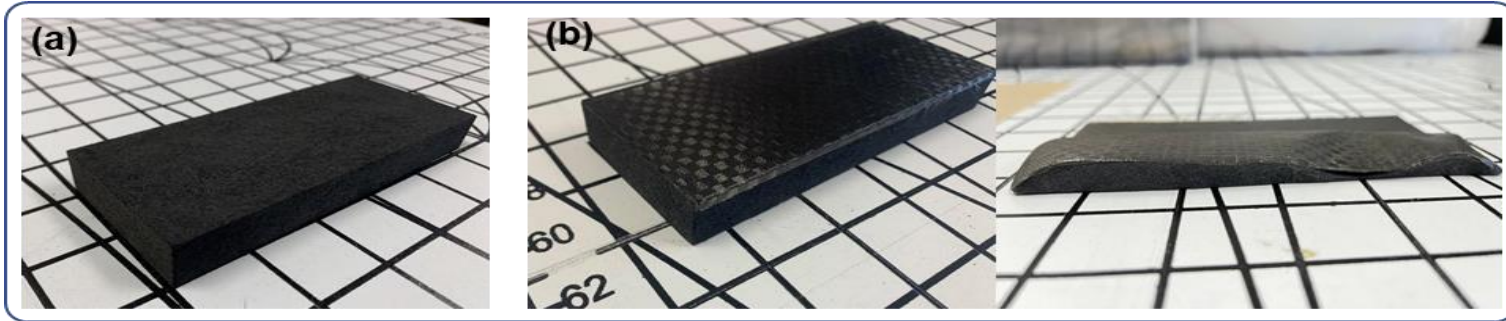
ATSP AV Foam Applications



EV Battery Cell “Dividers” – The performance properties of ATSP AV Foam – High temperature (+300C), FR behavior, high compressive strength, low mass, make it an ideal EV Battery separator. In other EV applications AV Foam’s EMI behavior is an added benefit.

ATSP AV Foam Applications

High Strength Composite Laminates – The ability to laminate AV Foam to both thermoplastic and thermoset composite “skins” will produce light weight, high impact, structure applications for automotive, aerospace, construction, and industrial applications. The AV Foam laminate structures are being characterized and evaluated for use in the development of blades for axial- and cross-flow marine and riverine turbines.



ATSP AV Foam – Next Steps

Overcoming traditional polymer issues such as fire retardancy, low melt temperature, and structural strength/stiffness, ATSP AV Foam has opened new application development opportunities in many market segments



For further information and support, contact ATSP Innovations at 832-344-3635 or Allied Composite Technologies, authorized commercial representative, at 248-760-7717