ThermoPlastic Composites (TPC) at Solvay
WHAT IS A "COMPOSITE"?

An heterogeneous mixture of (at least) 2 materials:

- a **MATRIX**
- a **REINFORCEMENT**

E.g. concrete: cement + stones
WHAT IS A "COMPOSITE"?

Wood: cellulose + hemicellulose (+ lignine):
OUR COMPOSITE MATERIALS

In Solvay, matrices we work with are POLYMERS (not metals or ceramics).

Our polymers can be either THERMOSET or THERMOPLASTIC.

We use 3 main types of reinforcements:

Continuous fibres
Short fibres/Whiskers
Particulate

Our focus for today
WHAT IS A "POLYMER"?

Macromolecule made of multiple repeating units (monomers)

For example, the simplest one:

Poly-ethylene

\[ [C-C]_n \]
THREE TYPES OF POLYMERS

- Thermoplastic
- Elastomer
- Thermoset
TWO TYPES OF PROCESSING  

1) THERMOSET

E.g. epoxy or phenolic resins used today by our Composites GBU
TWO TYPES OF PROCESSING

2) THERMOPLASTIC

Heat

Force

No chemical reaction
(reversible transformation)
LOOKING INSIDE A THERMOPLASTIC POLYMER
Optimizing the interface is critical to optimize properties of composite materials...
... and we have a lot of competencies in this area!
"Perfect" (i.e. strong) adhesion:

The crack barely "sees" the fiber $\Rightarrow$ rigid but brittle composite
THE ROLE OF THE INTERFACE  HOW A COMPOSITE BREAKS

Optimized adhesion:

- Larger fracture area
- Fiber pull-out friction

⇒ MORE ENERGY CONSUMED BY THE FRACTURE PROCESS
THERMOSET AND THERMOPLASTIC COMPOSITES

THERMOSET:

Great properties but ...
- Long processing time (chemical reaction)
- Very hard to recycle

THERMOPLASTIC:

Less rigid matrices but ...
- High productivity processes
- Recyclability

Both are complementary and address different applications
Thermoset and Thermoplastic Composites

Properties

- Thermoset Composites
- Standard TPCs
- High performance TPCs

Processing (⇔ cost, recyclability)

Combination of the benefits of thermoplastic processability and the exceptional properties of our high performance polymers.
WHAT IS SPECIAL ABOUT OUR HIGH PERFORMANCE THERMOPLASTIC POLYMERS?

In our high performance polymers, we eliminate weak chemical bonds to make them mechanically strong and highly resistant to heat and chemically aggressive environments.
Solvay thermoplastic composites

**FAST CYCLE TIME**
- Robust cost-effective fabrication
- Enables higher build-rates
- More efficient part assembly

**ENVIRONMENTAL RESILIENCE**
- Resistance to aggressive fluids
- No corrosion
- Improved recyclability

**PERFORMANCE AND DURABILITY**
- High strength
- Unrivaled toughness
- Outstanding crash performance

Broad portfolio of specialty polymers
Fiber/Resin interface
TP prepreg manufacturing
Application Engineering

Proven technology

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WE HAVE THE "RIGHT TO WIN" IN TPC
Questions?
UNMATCHED PORTFOLIO OF TECHNOLOGIES

Unrivalled Support & Collaboration

Compatibility High Value Materials

COMPOSITE PRODUCTS

- Resin & Polymer Formulations
- Carbon Fibers
- Thermoset & Thermoplastic Prepregs Engineered Product Forms
- Tooling
- Process Materials
- Bonding and Adhesives
- Surfacing & Lightning Strike Protection
- Extensive Field Technical Services
- Application & Virtual Engineering

COMPOSITE ECOSYSTEM & ENABLERS

Manufacturing Tools

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COMPOSITE MATERIALS RESEARCH & INNOVATION

Multidisciplinary & Multi-scale

Formulation Chemistry
Polymer Science
Fiber Science

Interfacial Properties
Composite Toughening
Product Architecture
Processing Science
Product Forms

Fracture and Failure Analysis
Manufacturing R&D

Structures
Application Engineering

‘Atoms to Airplanes’

‘Molecules to Vehicles’

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APPLICATIONS - Aerospace

Reaching new heights with composites

**Interiors**
- FST composites
- Adhesives
- Thermoplastic films and resins

**Engines**
- High service temp composites
- Impact resistant resins
- Sealants and adhesives

**Fuselage**
- Damage tolerant composites
- Bonding primers
- Surfacing films
- Adhesives

**Empennage**
- Composites
- Adhesives
- Radii filler

**Wing**
- Composites
- Liquid resin infusion
- Tailored textiles and preforms
- OoA prepregs
- Lightning strike protection

**Manufacturing Enablers**
- Composite tooling
- Process materials
- Ancillaries

**Adhesives**
- Bonding primers
- Surfacing films
- Adhesives
- Damage tolerant composites
- Impact resistant resins
- Sealants and adhesives
- Thermoplastic films and resins

**Composites**
- Liquid resin infusion
- Tailored textiles and preforms
- OoA prepregs
- Lightning strike protection
APPLICATIONS – Oil and Gas

Composite materials that go deeper and further

**MATERIALS**

Lightweight thermoplastic composites
Evolite F1050 PVDF Carbon Fiber prepreg.

**BENEFITS THAT COMPOSITES BRING**

- Weight reduction
- Resistant to corrosion
- High fatigue performance
- Design optimization
- Enables lower total installed costs
- Enables access to ultra-deep water
APPLICATIONS - Automotive

Driving the world towards a more sustainable future

Closures:
- hood, trunklid, doors
- Design freedom
- Class A finish
- Meet crash and safety performance

Secondary structures / Battery tray:
- transmission tunnel, leafspring, spoilers, diffusers, wings, seats
- Stiffness and impact performance
- High energy absorption levels
- Noise and vibration reduction

Body in White:
- Pillars, bulkheads, floor pan, body side, roof rails, door sill
- Meet crash and safety performance
- Structural integration
- More flexible around vehicle architecture

Trim:
- Dashboard, door inner, rocker panel
- Stiffness and impact performance
- Fatigue performance
- Design freedom
APPLICATIONS - Motorsport

Composite materials that help boost performance

- Engine cover & components
- Exhaust shielding
- HANS device (on driver)
- Front suspension
- Rear suspension
- Side impact structure
- Air ducts
- Floor pan
- Front impact structure
- Monocoque
- Rear wing & support
- Rear impact structure
- Front suspension
- Front wing

Up to 75% of race cars are composites.
- Stiffness
- Lightweight
- Impact strength
- Energy absorption
- Temperature resistance
- Strength
- Design freedom
- Rapid prototyping
- Manufacturing flexibility

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HOW DO WE ANTICIPATE AND DEVELOP SOLUTIONS

TOTAL COST
SPEED
ECOSYSTEM

Application Engineering
Products for Automation
Modelling Testing Life Cycle
External Collaborations
Novel Chemistry

More than a material supplier we are a technology integrator
TO GROW FURTHER, COMPOSITES MUST DELIVER MORE VALUE

Beyond lightweighting, composites bring additional benefits:

- Aerodynamics
- Fatigue life
- Corrosion resistance
- Design freedom
- Part integration
- Function integration
- Increased passenger comfort

CHALLENGES FOR THE FUTURE

MANUFACTURING TECHNOLOGIES

JOINING

SIMULATION

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WHY DO WE HAVE THE "RIGHT TO WIN" IN TPC?

Best portfolio of high performance thermoplastic polymers

Differentiated properties for high value-in-use applications

Strong presence in composites and carbon fibers

Ability to adapt fibers and access to composite experts

Core competencies in surface and interface engineering

Unique solutions protected by strong IP
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