Chemical Resistance and its Role in Resin Selection

Tuesday, November 1, 2022

Presented By: Cliff Watkins & Jeremy Bland

Chemical Resistance and its Role in Resin Selection

- 40-year plastics industry veteran
- Past owner of custom compounder TP Composites
- PhD Chemistry
- 14 years with PPG Fiber Glass

Cliff Watkins PhD
Direction, Application Development
(302) 528-2036 / cliff@polysource.net

- 23-year plastics industry veteran
- Pittsburg State University-Plastics
- Process engineering expertise
- Six Sigma Black Belt

Jeremy Bland
Materials Technology Manager
(515) 782-2056 / jeremy@polysource.net

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The PolySource Webinar Series

HOW TO SURVIVE THE STRUCTURAL PA66 SHORTAGE

HOW TO IMPROVE YOUR MATERIAL SELECTION PROCESS

COMPARING NYLON-POLYAMIDES, INCLUDING SPECIALTIES

SELECTING THE RIGHT RESIN TO MEET YOUR APPLICATIONS REQUIREMENTS

RESOLVING PROCESSING AND PART PERFORMANCE ISSUES BY CHANGING MATERIALS

POLYKETONE (POK) – A MATERIAL OPTION VS EXPENSIVE AND SCARCE ENGINEERING THERMOPLASTICS

COMPARING RESIN MATERIAL TOUGHNESS AND HEAT RESISTANCE

MATERIAL OPTIONS VS SCARCE ENGINEERING THERMOPLASTICS

FLAME RETARDANT THERMOPLASTICS '101'

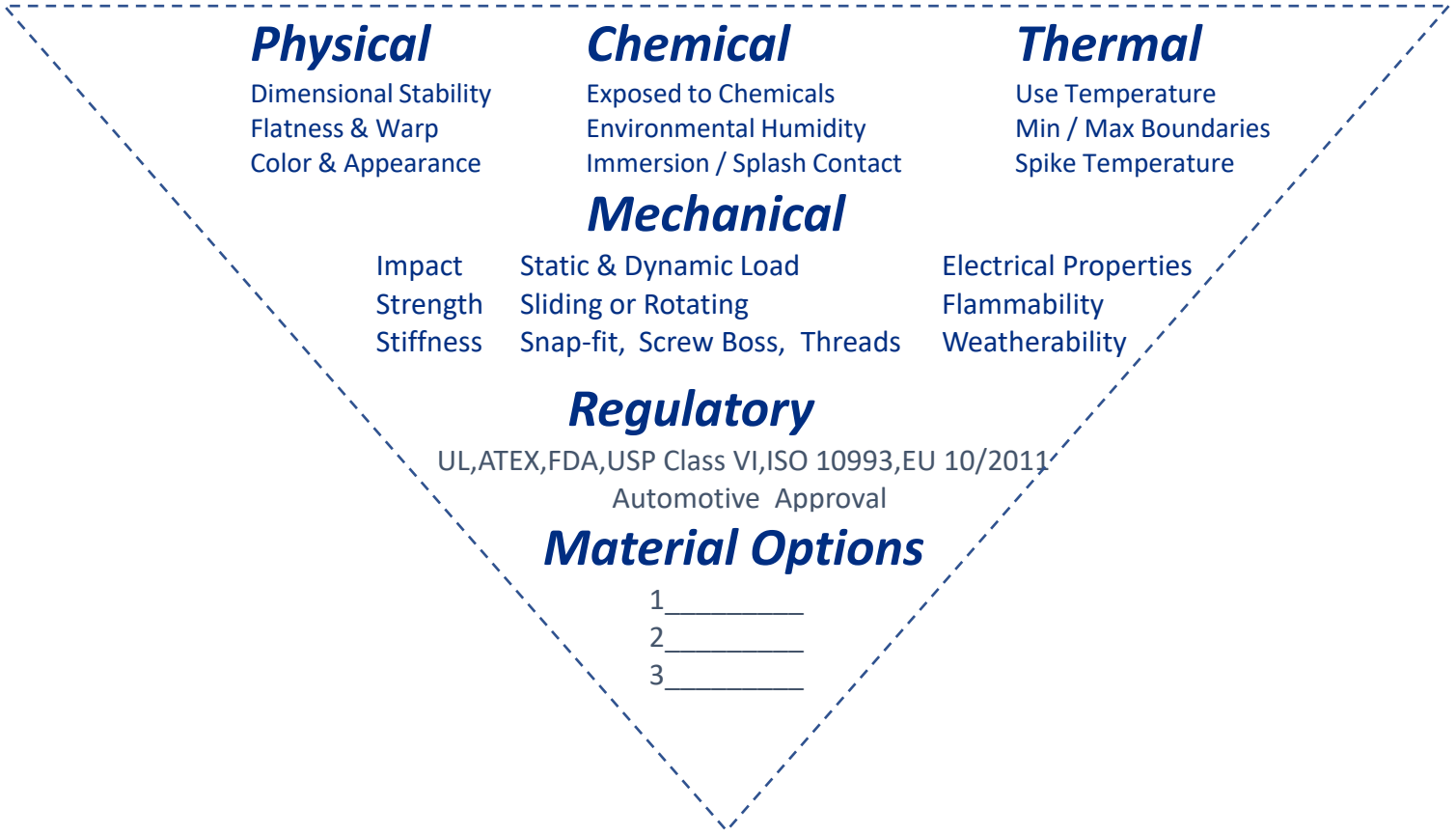
CHEMICAL RESISTANCE AND ITS ROLE IN RESIN SELECTION

https://polysource.net/resources/?type=webinar

Agenda

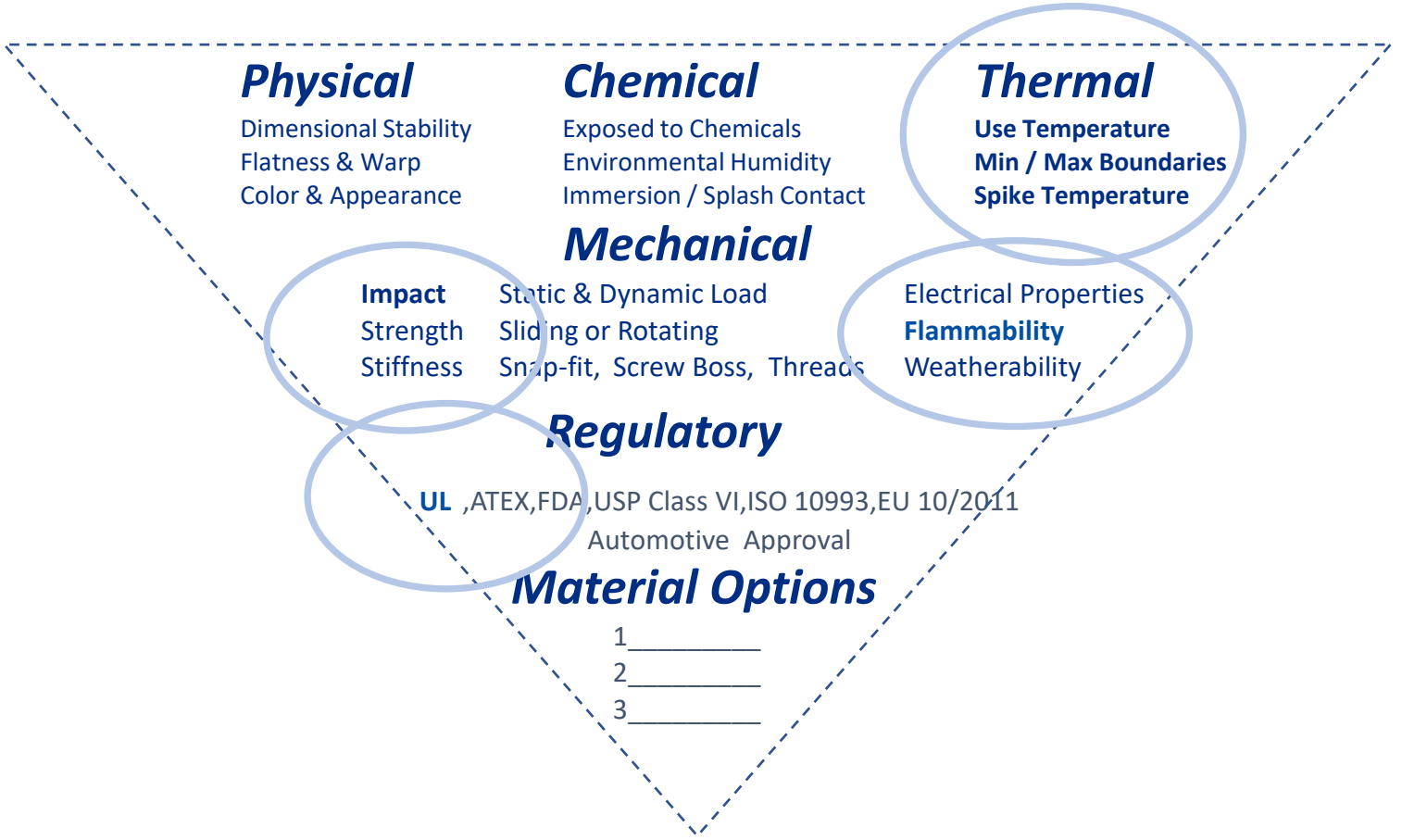
- Review of PolySource Design Funnel Methodology
- Chemical Resistance - Design/Material Selection/Processing/End-Use Considerations
- What is Chemical Resistance?
- Why is it Important?

The PolySource Design Funnel

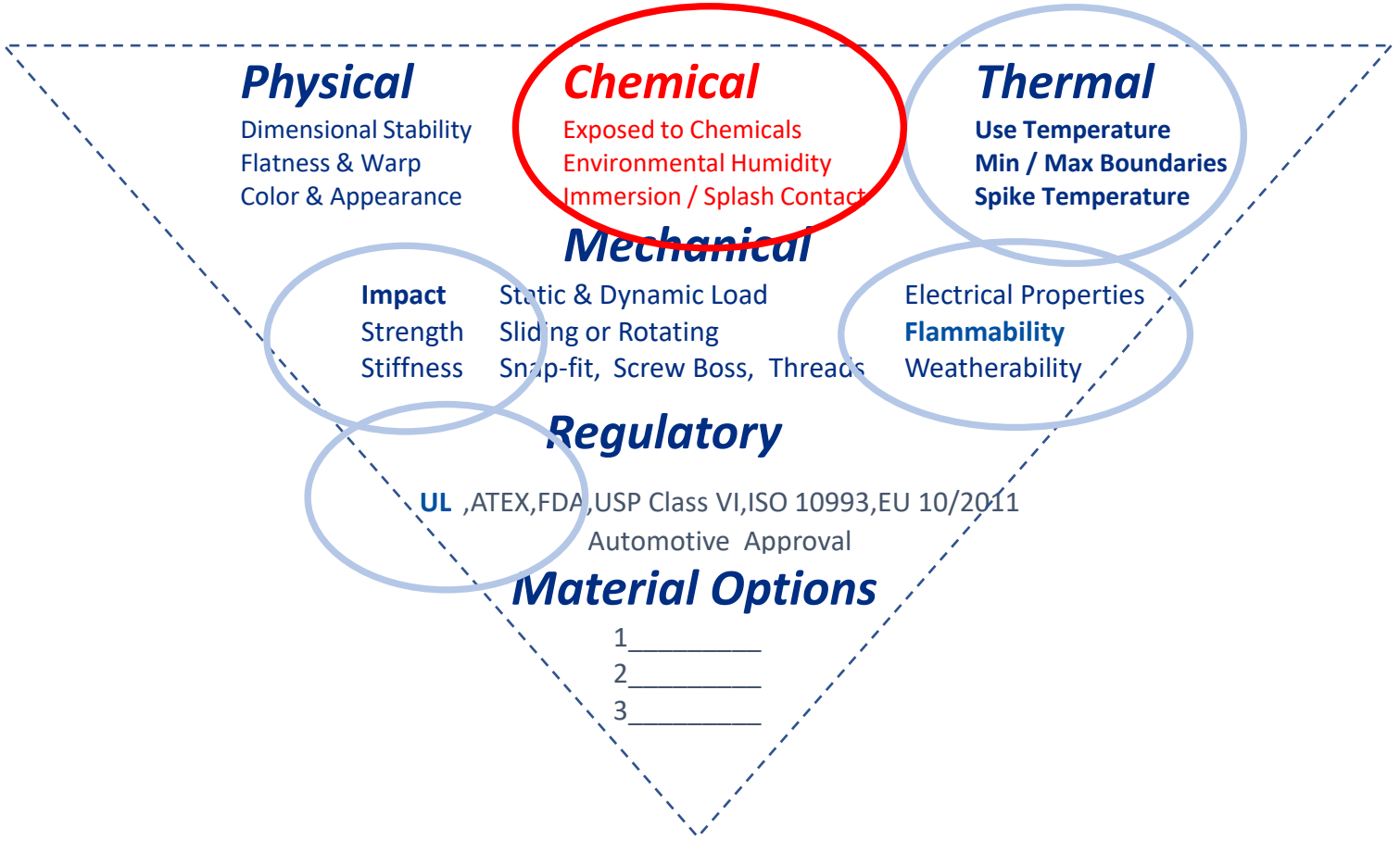


Continuation of the use of ……”The PolySource Design Funnel”

The PolySource Design Funnel



The PolySource Design Funnel



Chemical Resistance and its Role in Resin Selection

PolySource

Chemical Resistance Test Methods

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Chemical Resistance Test Methods

Environmental Stress Crack Resistance (ESCR)

(ASTM D1693, ISO 22088-3) – exposure while strained – visual inspection for surface cracks and crazing

Solvent Compatibility

Solvent	ABS	LDPE	HDPE	PC	PMP	PP	PS	PTFE
Acetaldehyde	D	C	B	C	C	C	D	A
Acetic Anhydride	C	D	D	D	B	B	D	A
Acetone	D	C	C	D	A	A	D	A
Acid, Hydroflouric	C	A	A	D	A	B	D	A
Acid, Trifluoroacetic	D	D	C	D	D	D	D	A
Acid, Acetic Dilute 50%	A	A	A	B	A	A	B	A
Acid, Hydrochloric 37%	C	A	A	D	B	D	C	A
Acid, Nitric	B	C	B	B	A	D	C	A
Acid, Sulfuric	D	B	A	C	B	C	C	A
Alcohol, Ethyl	A	B	A	B	B	B	B	A
Alcohol, Isobutyl	A	A	A	B	A	A	B	A
Alcohol, Methyl	D	A	A	B	A	A	C	A
Alcohol, n-Butyl	A	A	A	C	B	A	B	A
Alcohol, Propyl	B	A	A	D	-	A	A	A
Ammonium Hydroxide	B	B	A	-	B	B	B	A
Aniline	D	B	B	B	B	B	D	A
Aqua Regia	D	D	C	D	D	D	D	A
Benzaldehyde	B	B	A	C	B	A	D	A

A	No Effect, excellent compatibility
B	Minor Effect, good compatibility
C	Moderate Effect, fair compatibility
D	Severe Effect, not recommended
-	No data available

Qualitative Visual Data

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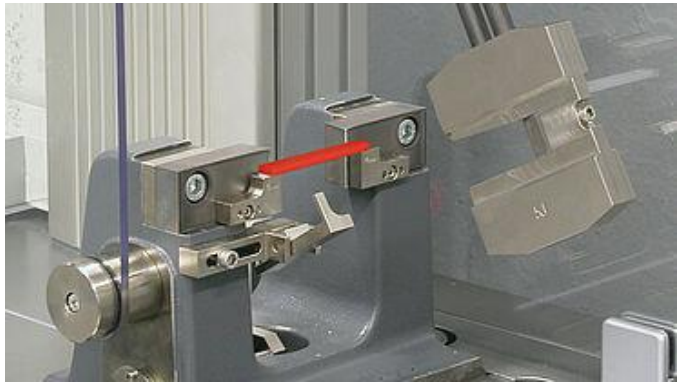
Chemical Resistance Test Methods

Immersion (ASTM D638, ISO 527, for example) – quantitative measurements for changes in mechanical & physical properties as a function of time, temperature and concentration. Soaking tensile bars in the chemical of interest, is most common, then measuring:



% Change in Strength, % Change in Elongation, % Change in Dimensions, Appearance

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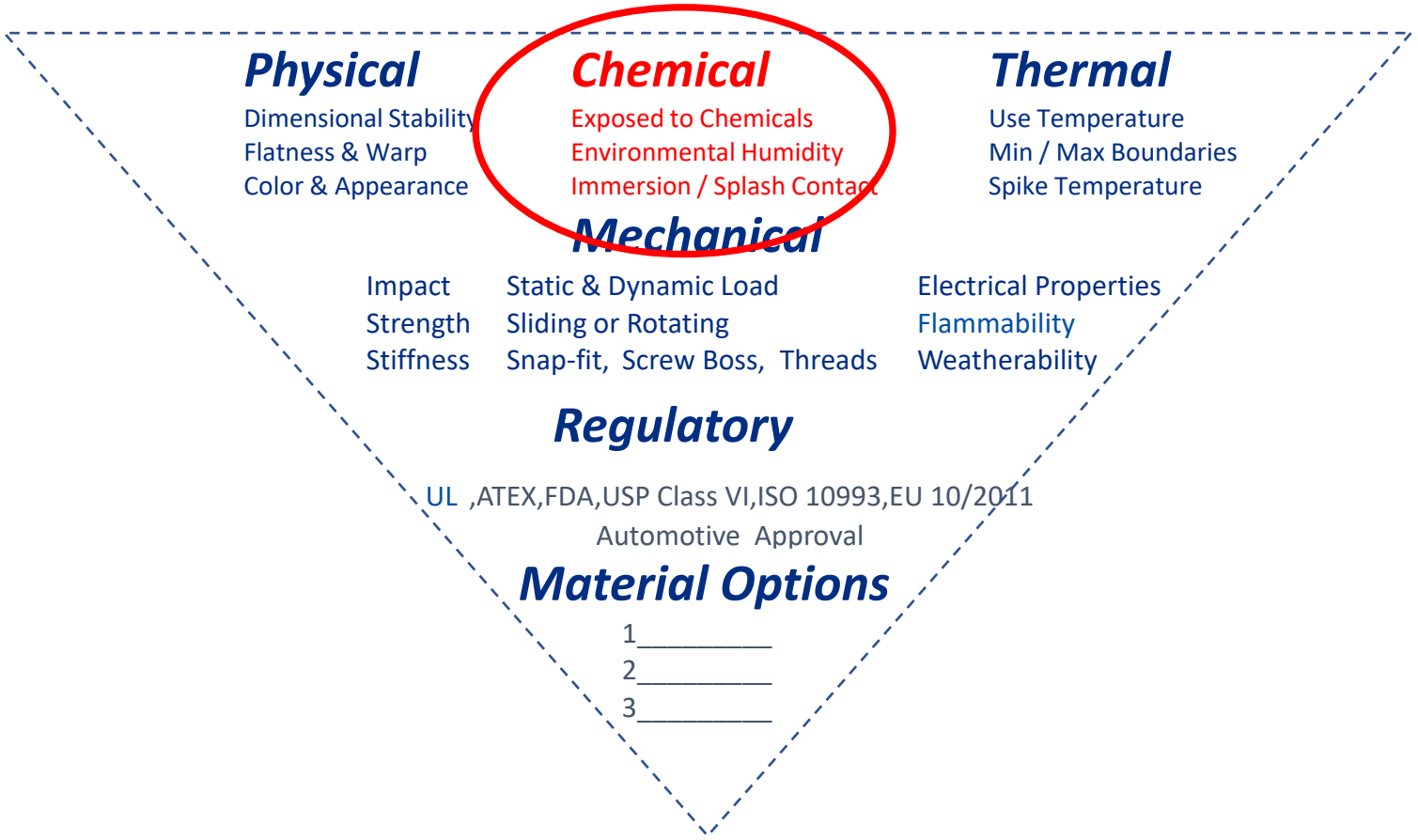
So, how do I find the Right Material?

The PolySource Design Funnel



Chemical Resistance and its Role in Resin Selection

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Choosing the “Best” ETP for a specific chemical cannot be simplified down to choosing a semi-crystalline instead of an amorphous resin.

- What is the temperature environment?
- Is there a load on the part?
- Was the material molded correctly?
- Part thickness/dimensions/design?
- What is the concentration of the chemical?

Don’t Forget the Pink Elephant in the Room…. HUMIDITY!

Not Simply a Question of Semi-Crystalline vs Amorphous!

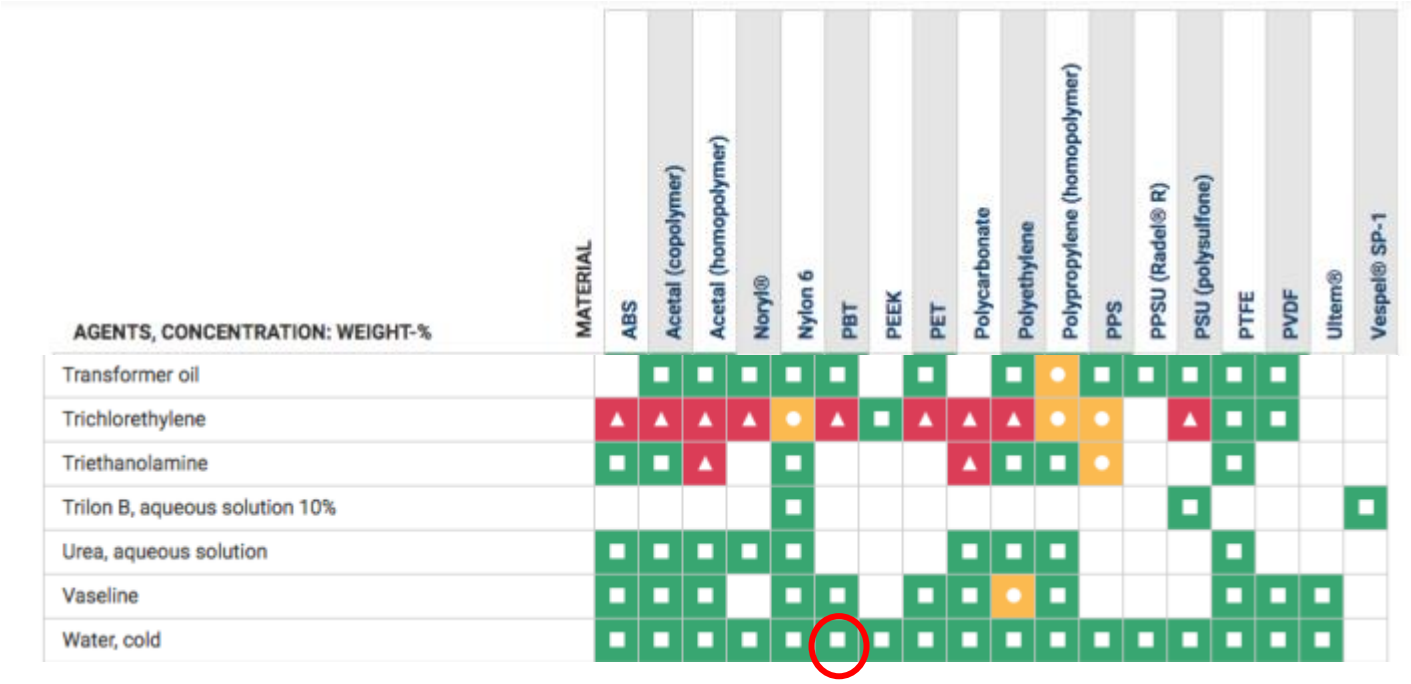
Chemical Resistance and its Role in Resin Selection

PolySource

Choosing the “Best” ETP for a specific chemical cannot be simplified down to choosing a semi-crystalline instead of an amorphous resin.

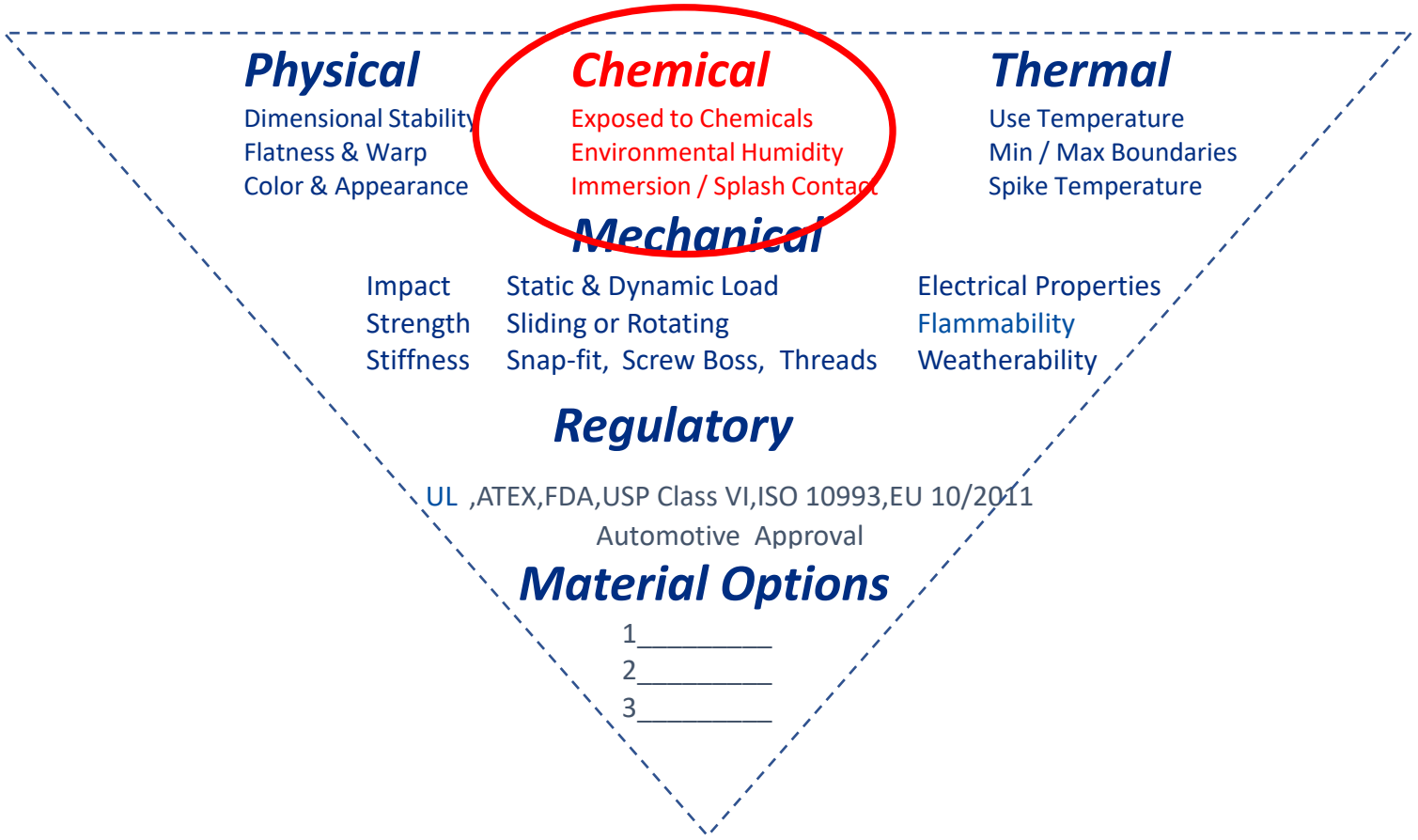
Problem: New application, customer selected PBT, because of this chart. They over-looked the use temp. at 90 C in the design spec.

Solution: The PolySource solution: Use PPE/HIPS (XYRON from Asahi Kasei), because PBT degrades in hot/wet environments above 80 C and XYRON is rated to 120 C.



Chemical Resistance – Amorphous Wins in Certain Applications

The PolySource Design Funnel



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The PolySource Design Funnel Questions

- What type of chemical?
- Is the chemical in a solvent?
  - Aqueous (waterborne)?
  - Organic?
  - Aerosol?
- What is the concentration?
- Duration of exposure?
  - Immersion?
    - Minutes/hours/days/weeks…?
  - Splash?
- Use temperature?
  - Constant versus cyclic?
- Applied stress?

Continuation of the use of ……”The PolySource Design Funnel”

Chemical Resistance and its Role in Resin Selection

Some Examples of Chemicals Causing Problems

Bio Fuels – POM to PPA
The issue: Canola and Rapeseed oils: erucic acid “C22 fatty acid”

Operating temperatures and the inherent acidity forced the conversion away from POM to PPA-based materials $$$

Mouthwash Cap – Not Solved Yet
The issue: ethanol, quaternary ammonium compounds or “quats”, benzoic acid, etc contained in mouthwash attack the plastic causing leaks. The ubiquitous foil layer under the cap prevents attack and ensures a tight leak-proof seal

Trying to consolidate the design to eliminate the foil inner cap liner is proving a real challenge

Unexpected Chemical Interactions Created Lots of Extra Work

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Some Examples of Chemicals Causing Problems

Lithium grease – PC to PC/PBT Blend
The issue: The mineral oil carrier used in the lithium grease had enough aromatic impurities to attack the PC

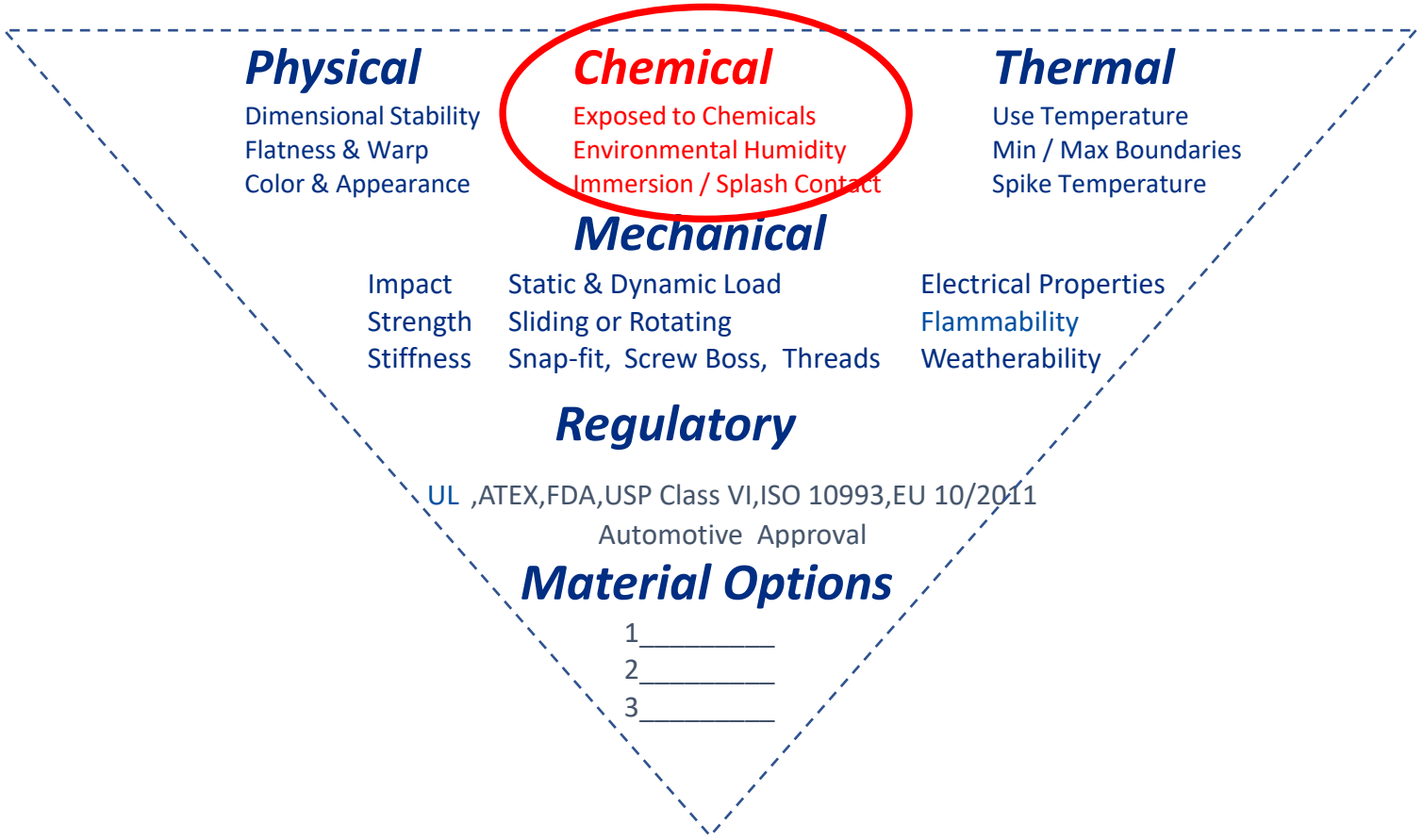
Adding grease to fix a 'squeak' in a gear train led to an 18-month delay

Synthetic whip cream - PC to PC/PBT Blend
The issue: Unsaturated fatty esters are used in Cool Whip-type synthetic whipped cream and these additives caused stress cracks and crazing on commercial beverage bezels. The contact occurred as a result of the barista using the same sponge or cloth to mop up spills and then wiping down the machine.
Shout out to Jeff Jansen at The Madison Group for the very elegant lab analyses

The surge in the demand of specialty coffee caused a major surface crazing issue and re-design

Unexpected Chemical Interactions Created Lots of Extra Work

The PolySource Design Funnel



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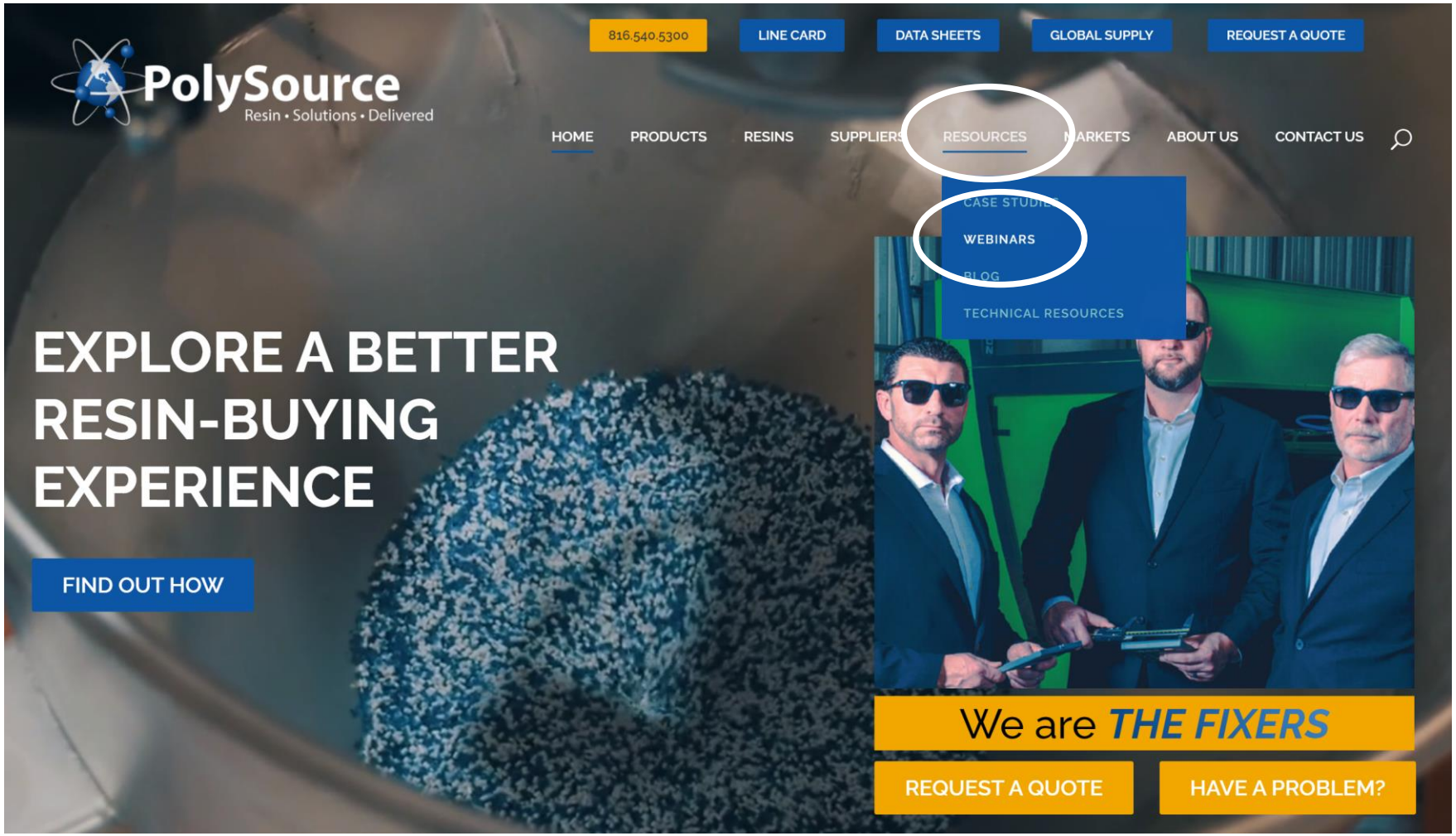
Today's Webinar



Please Find the Presentation @www.polysource.net/resources/webinars

Thank You for Joining the Discussion Today!!

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QUESTIONS????