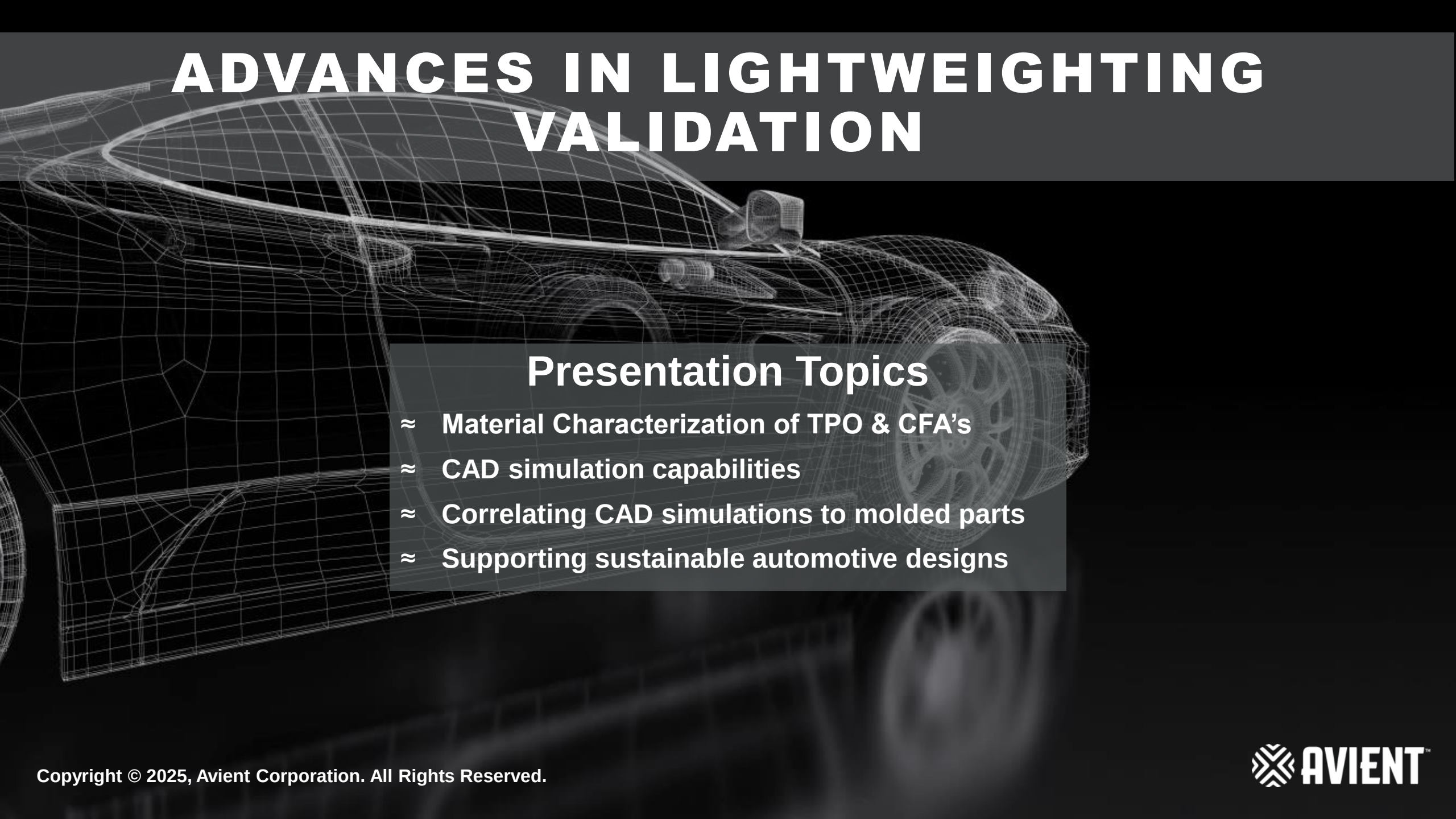
ADVANCES IN LIGHTWEIGHTING VALIDATION



Presentation Topics

- ≈ Material Characterization of TPO & CFA’s
- ≈ CAD simulation capabilities
- ≈ Correlating CAD simulations to molded parts
- ≈ Supporting sustainable automotive designs

AVIENT™

TODAY'S SPEAKERS

SCOTT WEBER & ZACHARY ALDERMAN

Scott Weber

Business Development Manager – Transportation

Collaborates with OEMs and Tier Suppliers on molded-in color effects and performance additives

Certified Lean Six Sigma Black Belt

Focuses on building customer relationships and aligning Avient's services to their needs

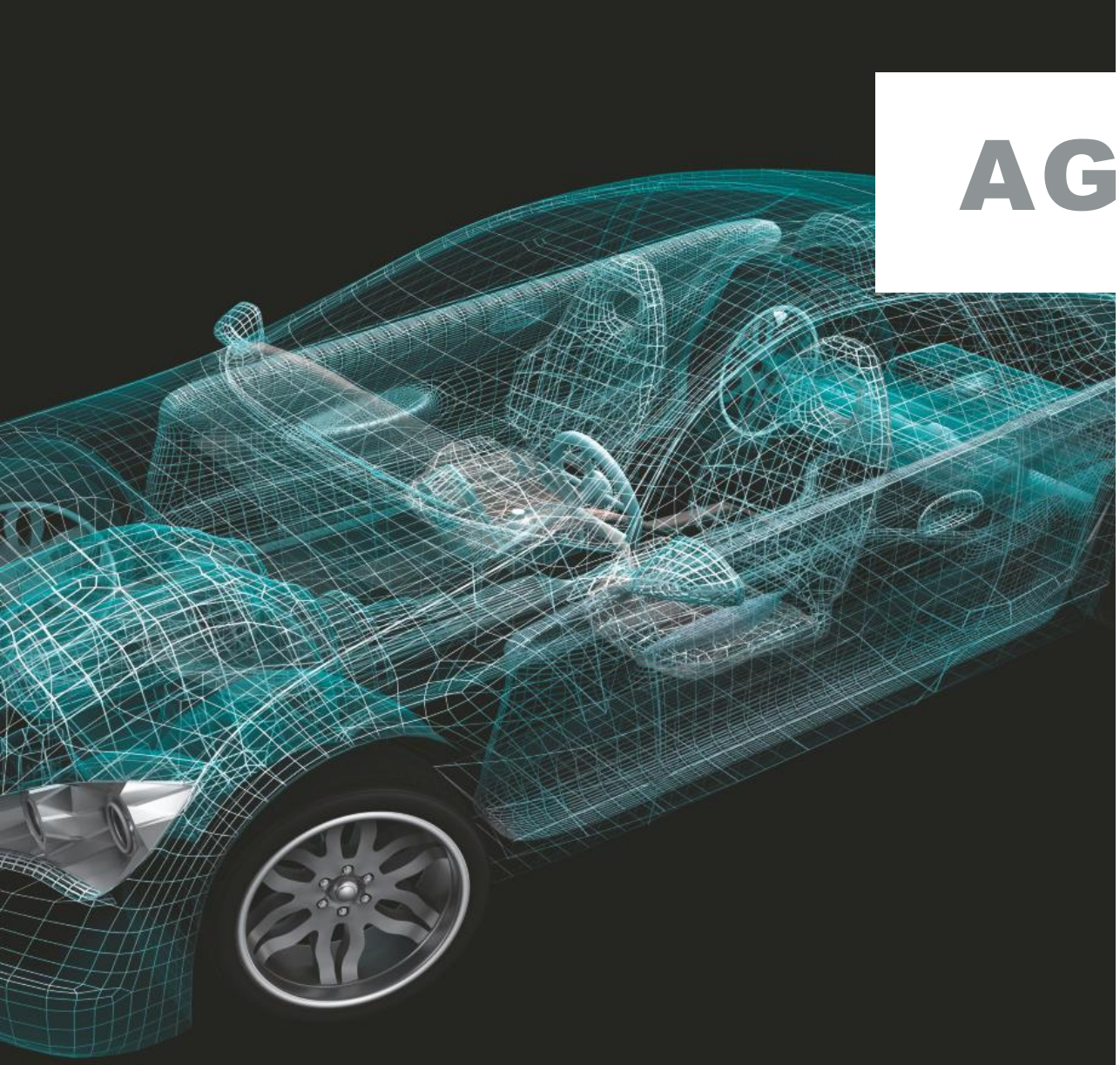
Zachary Alderman

Senior Design Engineer – Avient Design

Specializes in Finite Element Analysis (FEA) and Moldflow simulations

Holds a Graduate Certificate in FEA from the Colorado School of Mines

Certified Autodesk Moldflow Associate



AGENDA

- AVIENT AUTOMOTIVE
- CHEMICAL FOAMING IN AUTOMOTIVE
- AVIENT DESIGN
- CASE STUDY & RESULTS
  - ADVANCES IN CFA SIMULATION
  - SIMULATION WORKFLOW / EXECUTION
  - FUTURE DIRECTIONS
- CONCLUSIONS / Q&A

AVIENT

AVIENT AUTOMOTIVE

INTERIOR

OVER 14,000 APPROVED OEM FORMULATIONS

MASTER PLAQUE SUPPLIER

SMARTBATCH™ ADDITIVES

COLOR, MATERIAL, FINISH

COLORWORKS™ DESIGN CENTERS

COLOR DESIGN GUIDES

CHEMICAL FOAMING AGENTS (CFA) TO REDUCE WEIGHT AND DENSITY

EXTERIOR

PRE-COLOR FORMULATIONS FOR AESTHETICS, FUNCTION, AND HARMONY

SPECIAL EFFECTS TO PROVIDE CUSTOMIZED AND QUALITY AESTHETICS

PAINT REPLACEMENT SOLUTIONS FOR REDUCED VOCS

CHEMICAL FOAMING AGENTS (CFA) FOR LIGHTWEIGHTING AND IMPROVED MPG

UNDERHOOD/FRUNKS

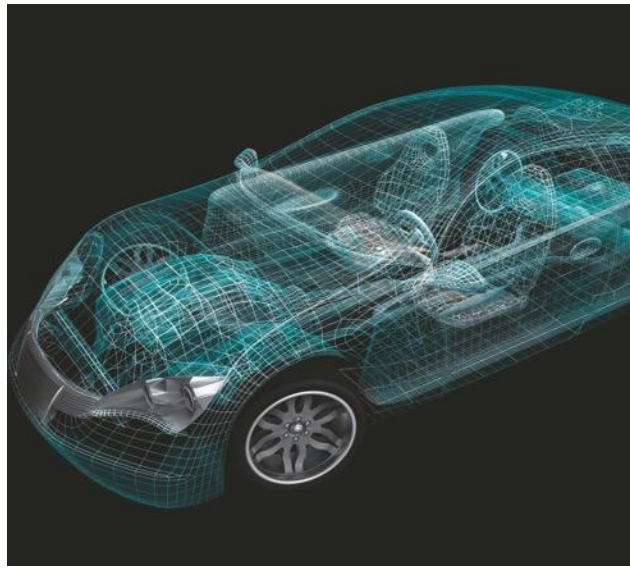
MRP COLLABORATION

FLAME RETARDANTS & UL APPROVALS

MOLDED-IN-COLOR (MIC) METALLICS FOR VISUAL ENHANCEMENT OF ENGINE COVERS

PERFORMANCE-ENHANCED DURABILITY FUNCTIONAL ADDITIVES

CHEMICAL FOAMING AGENTS (CFA) TO REDUCE WEIGHT AND DENSITY



BODY / STRUCTURAL

MOLDED-IN-COLOR (MIC) METALLICS FOR VISUAL ENHANCEMENT

SMARTBATCH ADDITIVES WITH COLORANTS FOR EE, PART LONGEVITY, AND EFFICIENCIES

CHEMICAL FOAMING AGENTS (CFA) TO REDUCE WEIGHT AND DENSITY

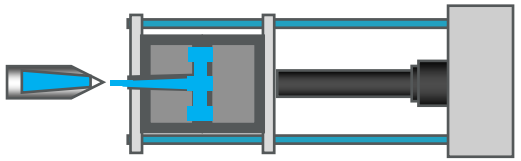
ADVANCED COMPOSITES COLLABORATION

AVIENT

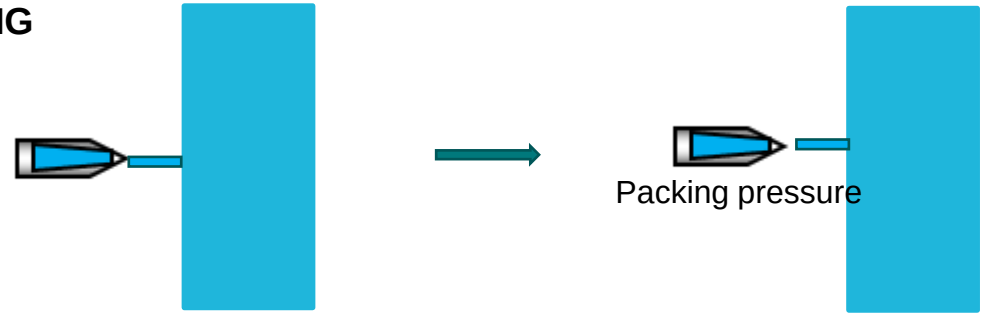
INJECTION MOLDING PROCESSES

COMPACT, SHORT-SHOT, AND CORE-BACK

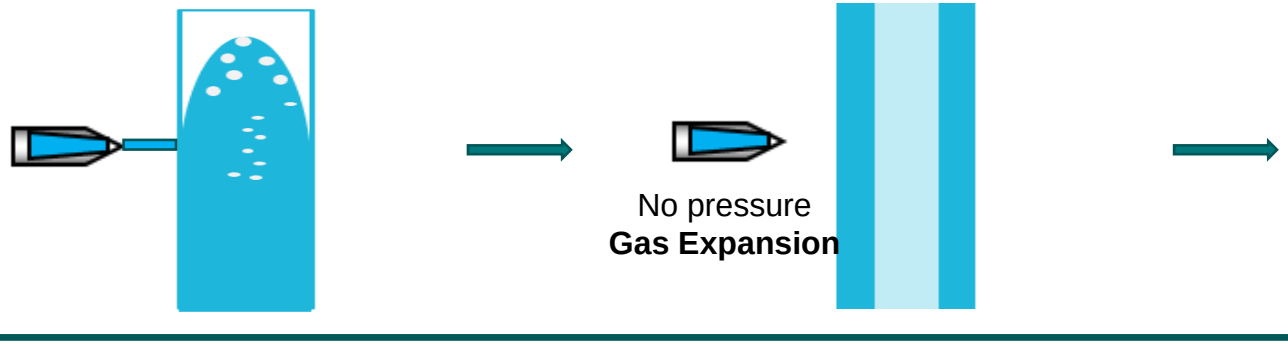
STANDARD INJECTION MOLDING



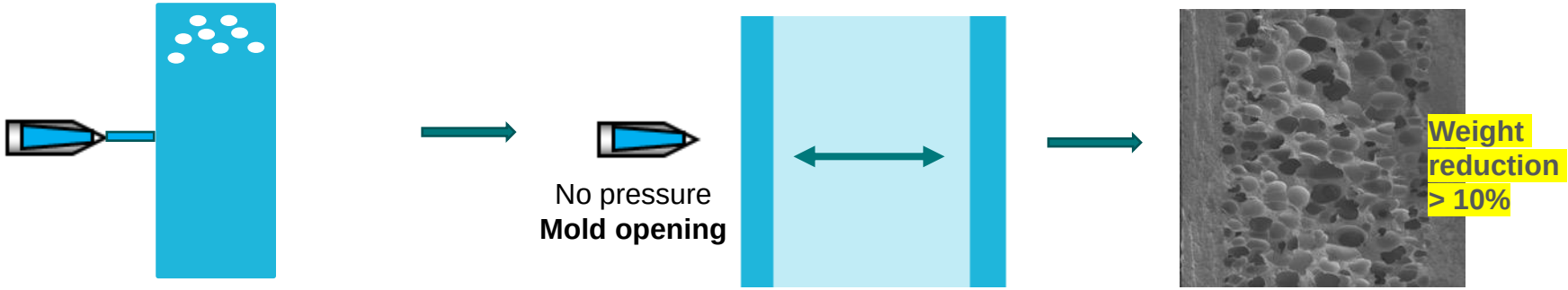
COMPACT



SHORT SHOT



CORE-BACK



CFA VALUE

HYDROCEROL™ & EXCELITE™ CHEMICAL FOAMING AGENTS

Corporate Annual Fuel Economy (CAFE)

- ICE weight savings discussed in pounds
- EV engineers speak in ounces
- Reduced material potential (5 – 35%)

Key Considerations

- Collaborative - Early involvement
- OEM / Tier 1 / Resin Suppliers
- Utilize OEM teams
- **Avient Design**
- Application TDEs

20%
Reduction in weight of dashboards

20%
Reduction In Cycle Time/Energy

Reduced CO_2 emissions

AVIENT

CFA SUCCESS STORIES

LIGHTWEIGHTING WITH EXCELITE & HYDROCEROL

Current Automotive Programs

- Standard injection molding and core-back process
- With / without gas counter pressure
- Class “A” appearance
- 5-20% weight reduction
- Cycle time reduction
- Dimensional stability

INTERIOR TRIM PANELS

IP CARRIERS/SUBSTRATES

GARNISH TRIM, PILLARS

EXTERIOR COMPONENTS

INTERIOR GRAB HANDLES

UNDER THE HOOD & HVAC COMPONENTS

REAR LIFTGATE, FRUNKS AND TRUNKS

AVIENT

AVIENT DESIGN

AN OVERVIEW

ABOUT US

Avient Design is a group of highly experienced industrial designers and project engineers. Our goal is to become your trusted service adviser in product development while utilizing Avient specialty technologies. Our service supplements your development teams. We bring industrial design and engineering together with material and prototyping expertise. Team members come from various professional backgrounds, giving us a unique perspective on many markets.

St. Louis, MO

Lyon, France

CASE STUDY OVERVIEW

STRATEGY

- Correlate CAD simulation studies of Chemical Foaming Agents (CFAs) with the KPIs of Class A surface-approved polyolefin materials

PROCESS

- CAD Simulation design of experiment (DoE); Injection molding of article; KPI measurements; Correlate & validate CAD simulation with molded part data

BENEFIT

- Advance Avient current CAD foaming simulation platform – utilize findings for future product development opportunities, speed to market

AVIENT

SUMMARY & CONCLUSIONS

Case Study Results

- Hydrocerol reduced part weight, reliable 5% to 7% reduction in simulations
- Class A surface appearance approvals are possible
- Foaming simulation is predictable and optimizes new lightweight part design capabilities

Advancing CFA Prediction and Correlation

- Continue to collaborate with Autodesk Moldflow regarding the CFA weight % Limit
- Predict mechanical properties of molded articles using CFA
- Utilize 3D scanning and/or CMM measurements for warpage and shrinkage correlation
- Identify variable nucleation model work needed for CFA cell structure

For more information contact: Scott.Weber@avient.com or Zachary.Alderman@avient.com

AVIENT

THANK YOU

QUESTIONS?