VIAS3D – Modeling and Simulation Partner

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Dr. Murthy Lakshmiraju, Technical Director (Simulations) – mlakshmiraju@vias3d.com
Dr. Arindam Chakraborty, CTO – achakraborty@vias3d.com

https://vias3d.com/
https://vias3d.com/services/industry/consumer-packaged-goods-retail/

Who We Are

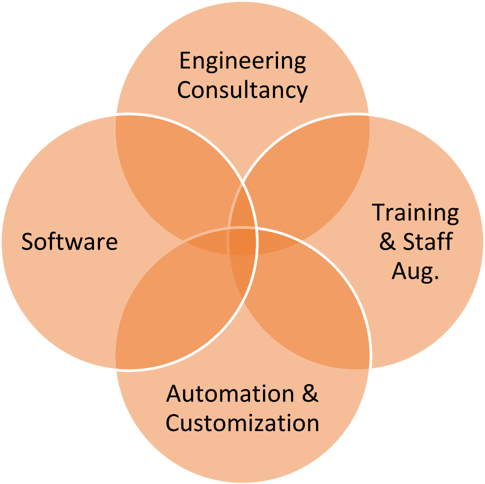
- Multiple Industry Experience – CPG, Oil & Gas, Petrochemical & Process, Industrial Equipment, Lifestyle, Hi-tech, Automotive, Aerospace, Life Science, and Manufacturing

- Global Presence: USA (HQ), CANADA, INDIA, MEXICO

- Global team of 200+ professional with Engineering Consulting team consisting of 40+ professional with majority having PhDs and MSc/MTechs with expertise in Design & Manufacturing, Structural & Solid Mechanics, Fluid Mechanics, Electromagnetics, Material Science and Chemistry, Optimization & Reliability, Data Analytics, System Architecture, Automation, ..

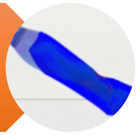
- Dassault Systèmes Platinum Partner – Global Presence – Part of DS Advisory Group

- Provide Engineering consulting & technical resource augmentation, PLM implementation, Training, Software Sales and Support, Automation and Customization

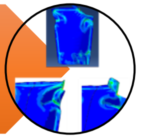


Technical Capabilities – Simulation (FEA, CFD, EM, AI-ML)

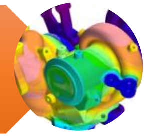
Non-linear FEA / Structural Simulation



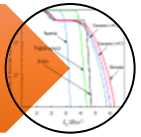
Fatigue, Fracture & Damage



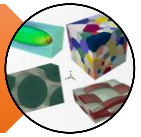
Fluid-Thermal



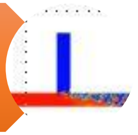
Optimization and Reliability



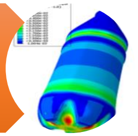
Material Modelling / Multiscale RVE

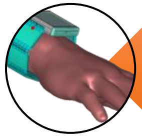


Mixing & Separation, Filling

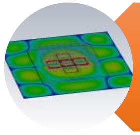


Shelf-Life prediction

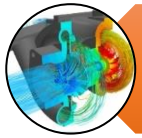




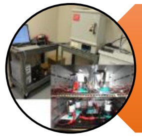
RID/IoT/Sensors



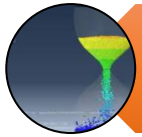
RF/Microwave Heating



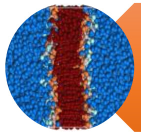
Multiphysics / FSI



Material Testing Support



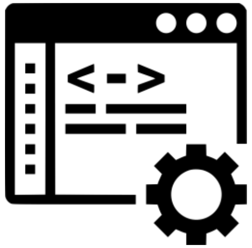
Particle Modeling (DEM/SPH)



Molecular Modeling

Simulation Automation, Surrogate Modeling (Ai-ML)

Engagement Overview

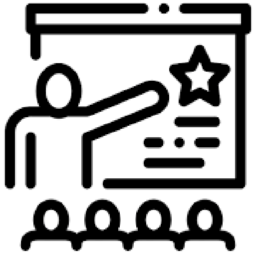


Methodology Development

- R&D+I
- Technical deep dive in nature of problem
- Modelling validation

Development of iterative processes

- Optimization
- Material calibration



Training and Knowledge-Transfer

- Standard Training - Basic and Advanced
- Industry Customized
- Project-based – Execute, Train, Hand-over and Quality watch

Support to perform MODSIM work

- Regular projects
- Overflow work
- Urgent needs
- Dedicated Support / On-site / FTE
- Implementation, On-boarding, and Maintenance

Democratization

- Automation (GUI) and templatization
- Web App Solutions
- 3DX Workflow Development
- Best practices + data management on 3DX
- Add-ons
- Automatic Reports

Why VIAS

- Prompt and complete technical solutions
- Experts with knowledge of industry applications and software solutions
- Rich technical consulting experience & Software Agnostic
- Knowledge transfer through training services
- Adherence to strict quality control (ISO 9001: 2015 Compliant)
- Flexible pricing / startup discounts
- One Stop Shop – 3DX / CAD / FEA / CFD / EMAG / Root-Cause / Optimization

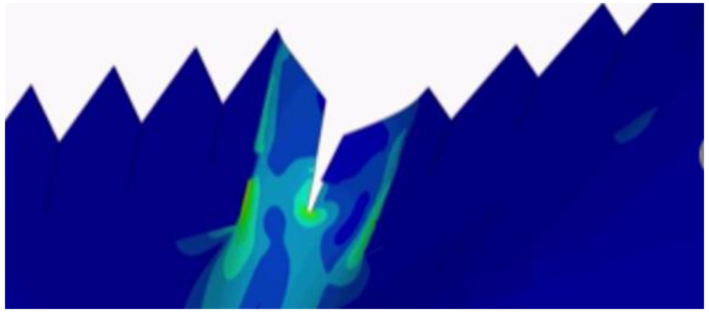
Selected CPG Projects

Flexible Tear FEA

- **Challenges:**
  - Deliver **first time right innovation**, with speed & agility
  - Testing flexible materials.

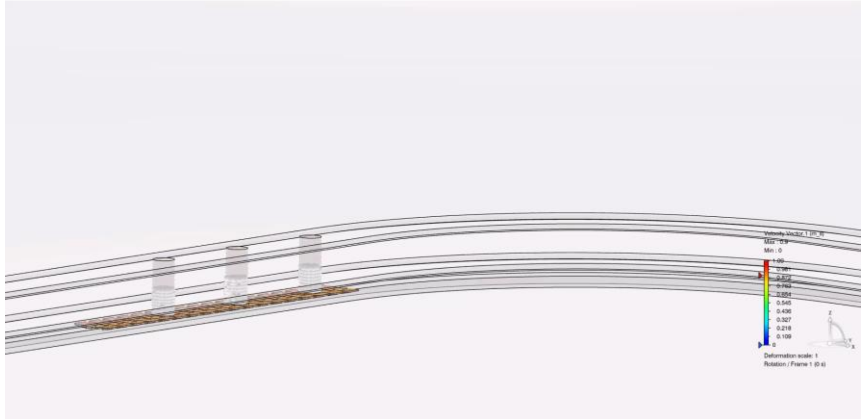
- **Values:**
  - Sustainability & Value Improvement Program in the area of sachets
  - Drive the **plastic reduction agenda**
  - Create a simulation framework to address the **usability of future advanced materials**

- **Solution**
  - Insilco Modeling
  - Testing **program support**
  - Validate and automate the FEA simulation of tear behavior and performance for any new **sustainable materials** to get a view on ease in tear-ability (Consumer tear) as well as Customer tear (Perforation tear).
  - **3DEXPERIENCE** platform with Multiphysics applications

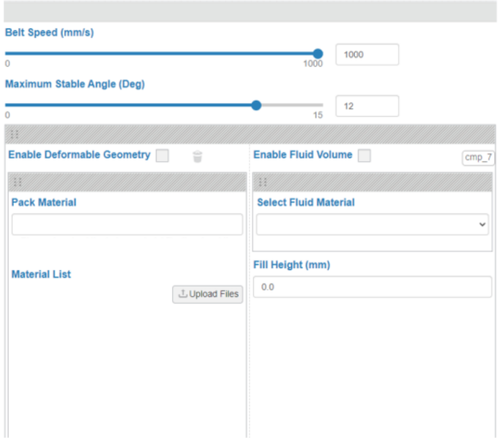


Conveying FEA

- **Objectives**
  - Simulate the conveying process and predict the stability of the product
  - Create user-friendly template for custom applications by non-FEA experts
- **Value Applications**
  - Help reduce damage cost by eliminating bottle tilting, bottle shingling, bottle denting, content spilling, line blockage
  - Reduce computation time for conveyer line topology simulation
  - Reduce overall production cost & time using virtual modeling
  - Predict if various products will pass assembly line without falling



Conveyer Line



Template

Digital Twin, 3DEXPERIENCE Platform, FEA, Templatization

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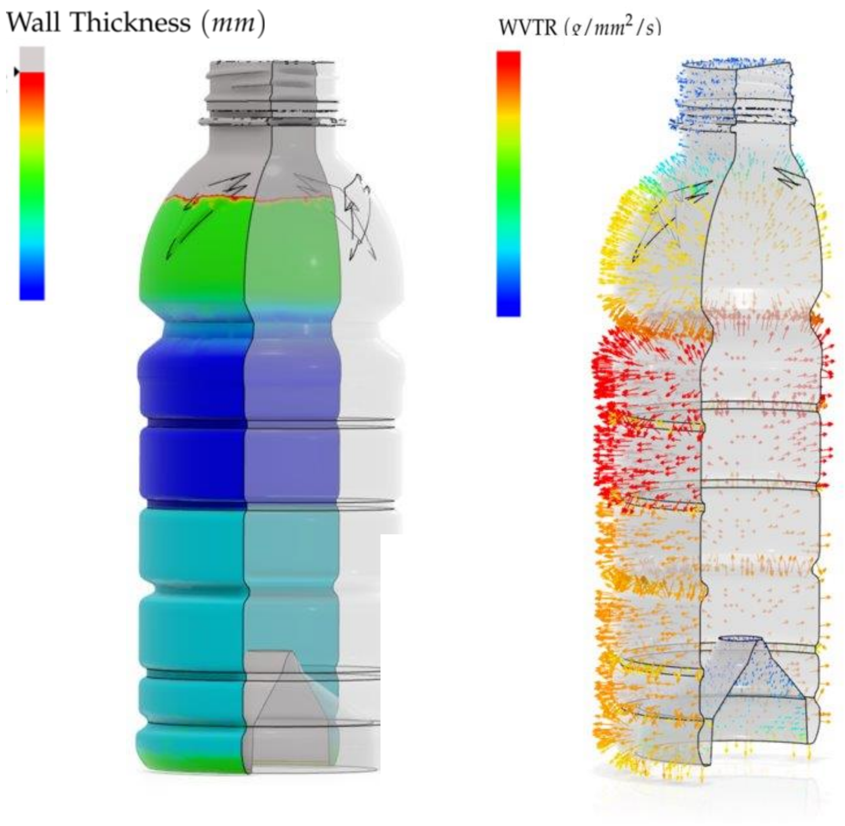
Shelf-life Prediction– Water Vapor Permeation

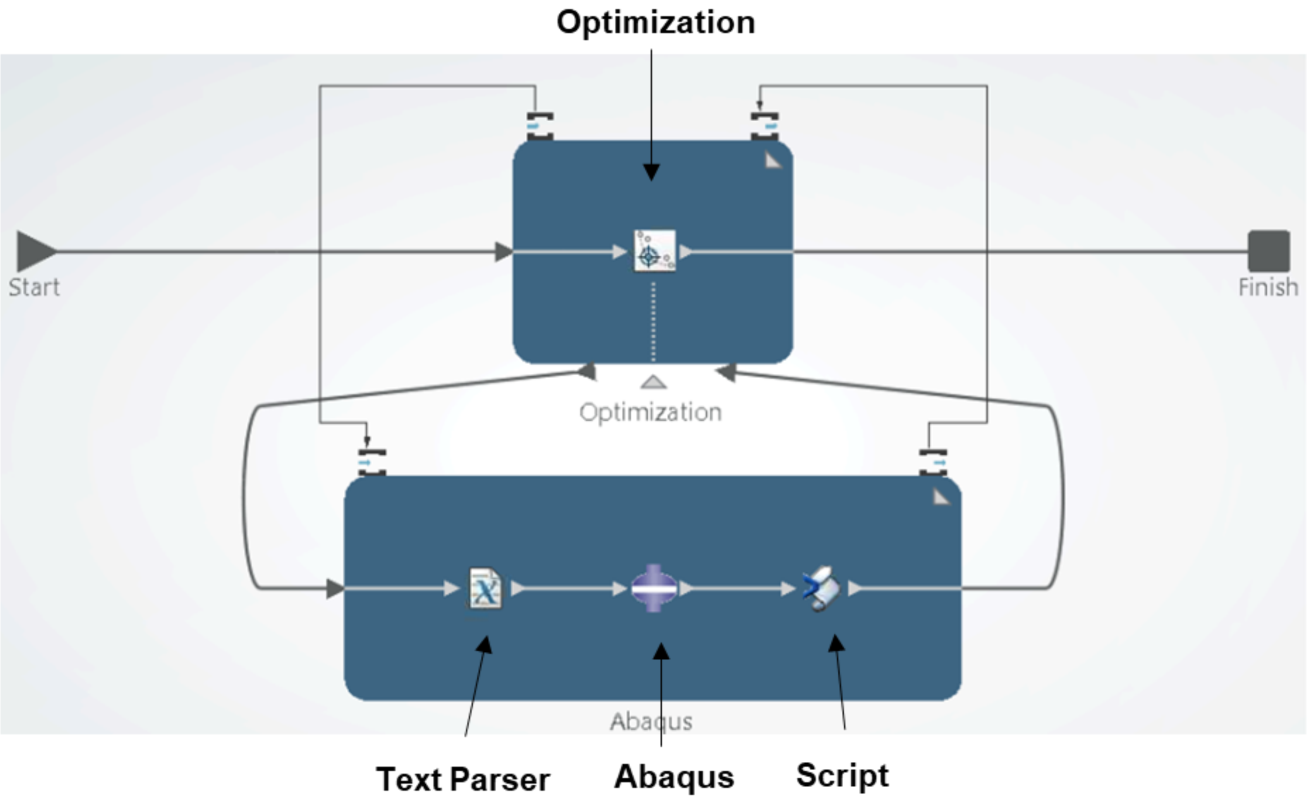
- **Values:**
  - Predict the shelf-life of the PET bottle.
  - Capture the local behavior (creep, strains, etc.,)
  - Calibrate boundary condition (considering different temperature and humidity in atmosphere)
  - Predict the transient process duration and steady state water vapor permeation rate for different wall thickness
  - Automate mass loss integration process to provide efficient tool for PET bottle design and shelf-life prediction



VIAS3D is presenting this work at NAFEMS, 2023

Material Calibration Workflow

- The main objective is to perform a material properties calibration of PET to achieve the target results from test data of top load and thermal creep stability by using the input data provided by the client for the empty bottle condition.
- Validated CO2 loss from the PET bottle
- Developed the workflows in Process Composer environment to automate the process for client to be used for further internal projects.
- Extended the methodology for single layer bottle to multi-layer bottles

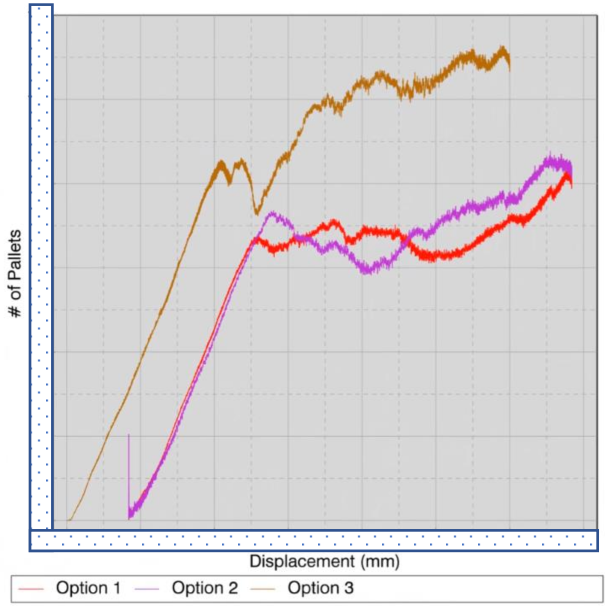


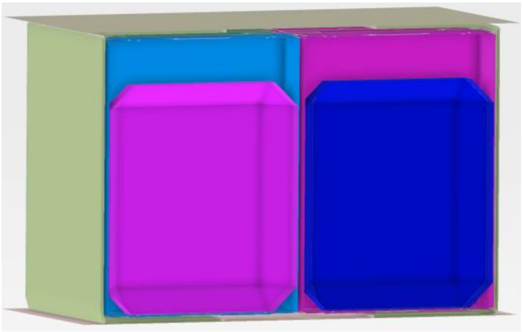
Packaging Optimization

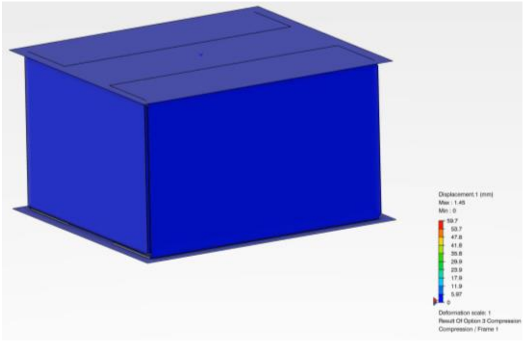
- **Challenges:**
  - Optimizing the packing design for **different load conditions**
  - **Protect the products** from damage while transit

- **Values:**
  - **Reduce damage cost** of the products during shipping.
  - Reduce expensive physical trial and error

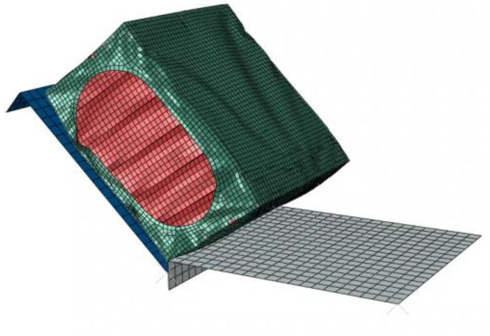
- **Solution**
  - Simulate various scenarios for **primary, secondary and tertiary** packages for compressive loading condition.
  - Evaluate the loading capacity that the package can withstand







Compression Animation for Design Option 3

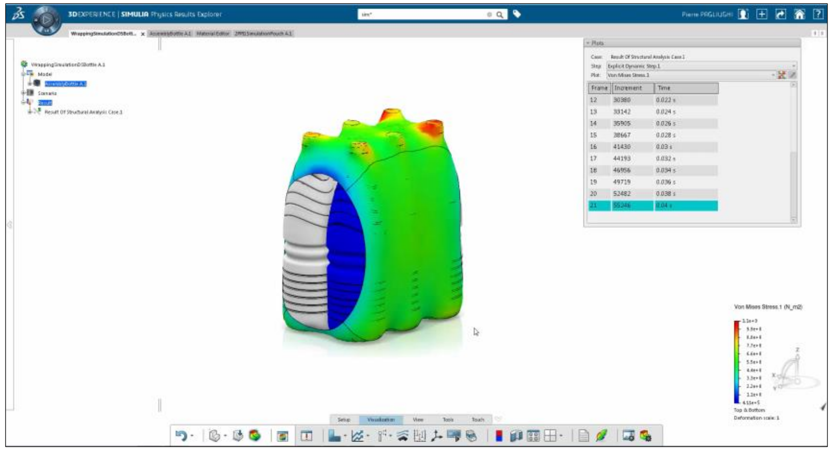


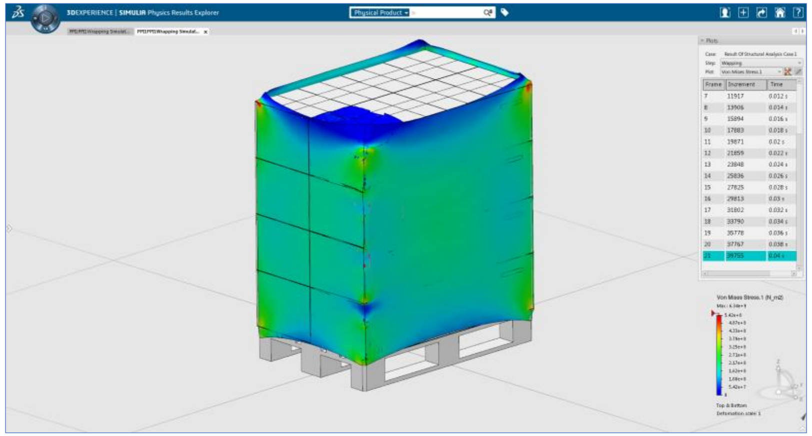
Tilt Simulation (only shrink wrap)

Footprint reduction, Design Exploration, 3DEXPERIENCE Platform

Shrink Wrap

- **Challenge**
  - Predict mechanical behavior of shrink wrap
  - Understand the influence of thickness, temperature etc on package integrity
- **Solution**
  - Reduce damage to primary package
  - Reduce material required
  - Predict if Shrink wrap can sustain the weight of the primary
  - Predict is shrink wrap can be conveniently lifted

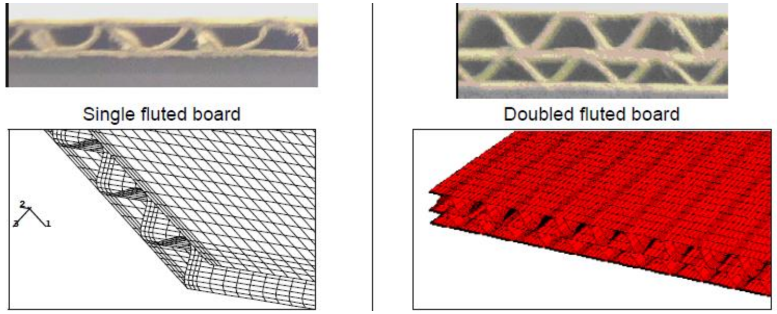


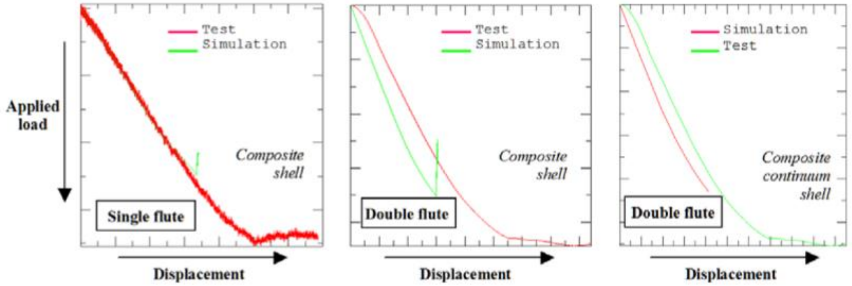


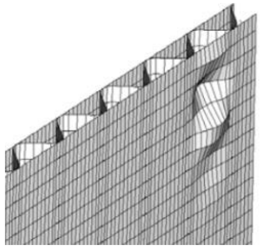
Abaqus, Optimization, DOE

Cardboard Box FEA

- **Challenges:**
  - Design
    - Complex mechanical modelling of paper
    - Corner and glue lines modelling
    - Buckling failure
    - Corrugated structure local and global failure
  - Production
    - Shorten time-to-market
    - Reduce expensive physical trial and error
  - Storage
    - Venting and carrying holes failure prediction
  - Failure
    - Bottom sagging
    - Microstructure deformities arising from manufacturing process
- **Values:**
  - Reduce damage cost of the package / product during shipping



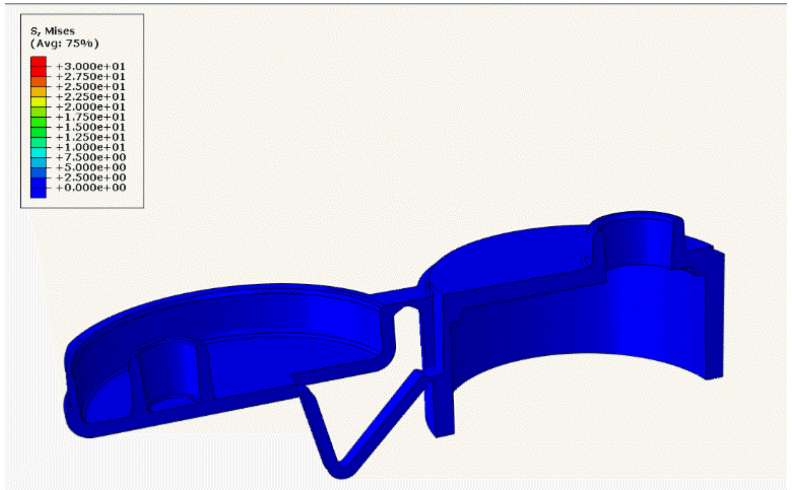


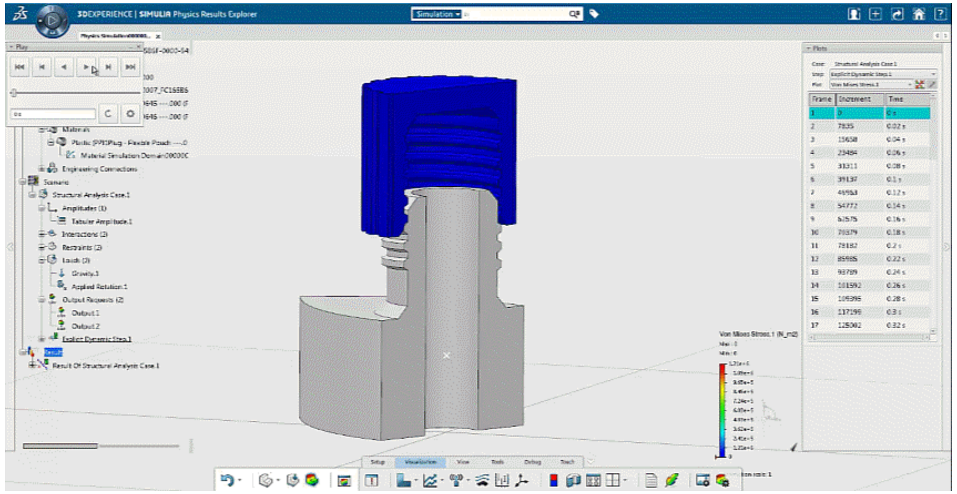


Capping and Twist on Bottle

- **Challenge**
  - Extending the shelf-life of end-products
  - Easy to use sealed cap
  - Customization according to the requirements of specific brand

- **Solution**
  - Design functional & lightweighted closures
  - Predict sealing performance
  - Predict over stressing of the parts
  - Predict torque requirements

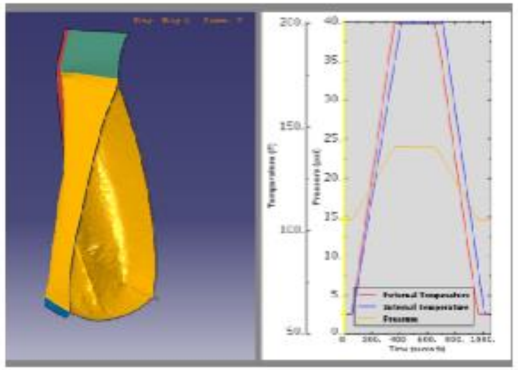


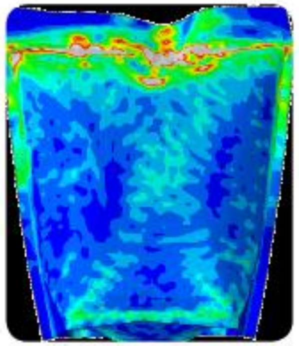


Abaqus, Optimization, DOE

Subroutines

- **Maintain seal integrity** during high pressure and temperature during retort sterilization for Bottles or Pouches.
- Seal size can be sized by observing the location of the high stresses.
  - User subroutine approach (UFLUID for Bottles in standard or VFLUIDEXCH in Explicit)
  - Other subroutines are available

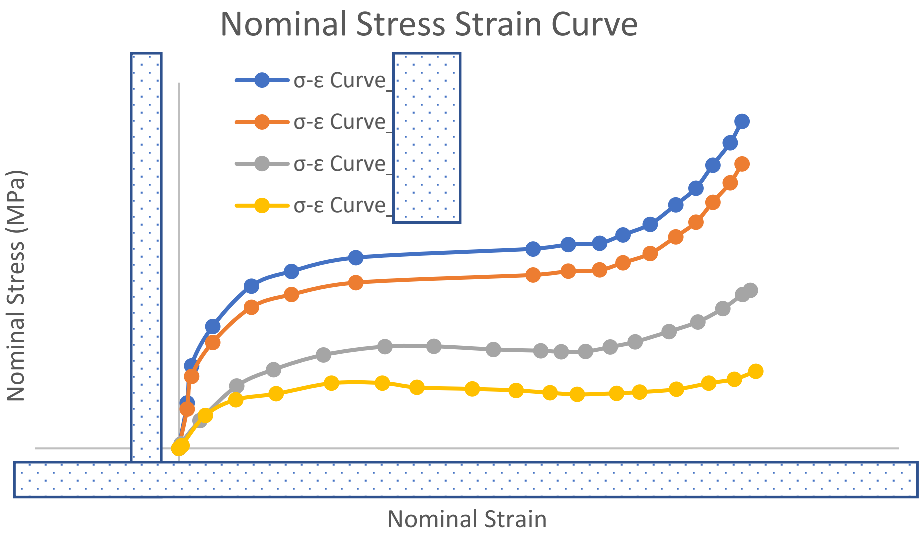




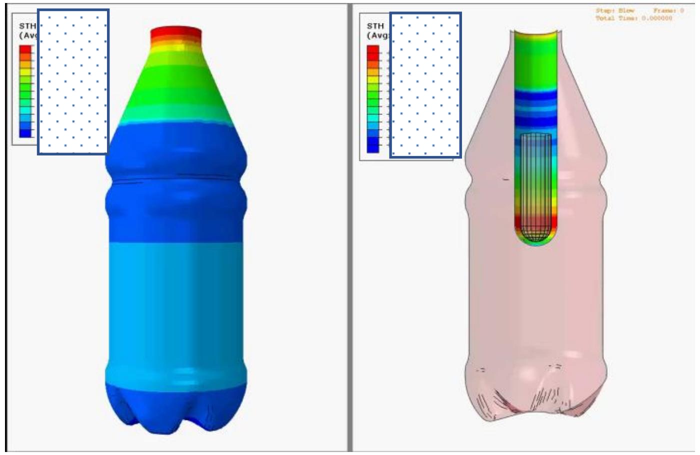
Abaqus User Subroutine	Description
DLOAD/VDLOAD	Distributed loads. VDLOAD is for use with explicit dynamic procedures (Abaqus/Explicit solver).
FILM	Thermal loads.
UMAT/VUMAT	User-defined materials. VUMAT is for use with explicit dynamic procedures (Abaqus/Explicit solver).
UMESHMOTION	Prescribed motion.
UEXTERNALDB/VEXTERNALDB	Interfacing with external resources. VEXTERNALDB is for use with explicit dynamic procedures (Abaqus/Explicit solver).
DFLUX	Distributed flux (heat flux).
UEPACTIVATIONVOL	Volume fraction of material at which an element is activated. UEPACTIVATIONVOL is intended for use with additive manufacturing.
UMDFLUX	Multiple distributed (heat) fluxes. Prescribe multiple moving or stationary heat fluxes for use with additive manufacturing.

Blow Molding Process Simulation

- **Challenges:**
  - Expensive prototype costs
  - Check the new bottle design manufacturability
- **Values:**
  - Reuse the modeling methodology for new designs
  - Reduce physical testing with bad designs
  - Capture realistic thickness distribution
  - Optimize preform shape to get a desired thickness distribution
- **Solution**
  - Simulate the blow molding process using Abaqus for the given configurations and conditions of the manufacturing process



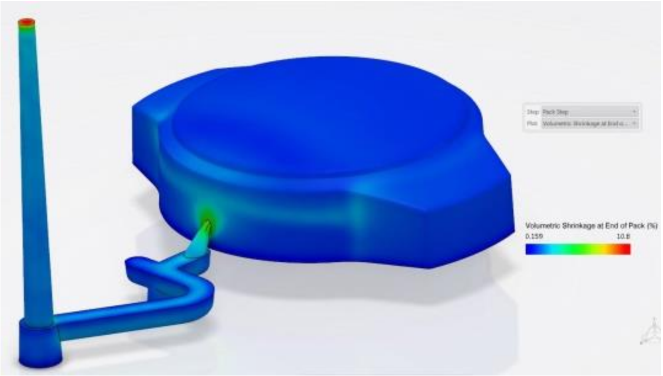
Hyperelastic material at various temperatures



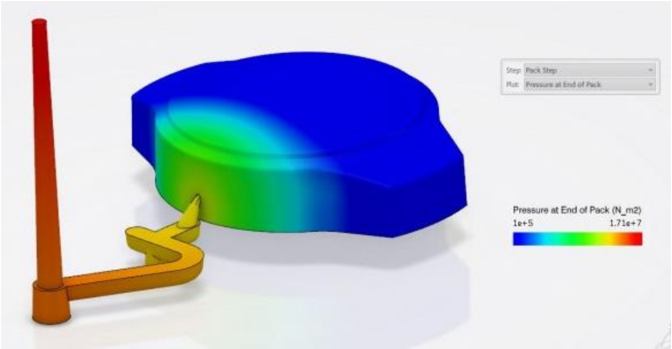
Process Simulation, Abaqus, Automation

Injection Molding

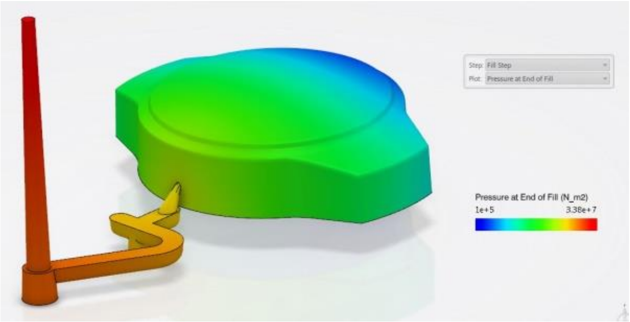
- **Challenges:**
  - Check if the mold will fill
  - Control part shrinkage and warpage
  - Keep production cycles low as possible
- **Values:**
  - Predict pressure and clamp force required to fill the mold
  - Verify the impact of part design and process parameters in the part final dimensions
  - Explore how the mold cooling system influence the part quality and cycle time
- **Solution**
  - Use SIMULIA injection molding solver to predict the entire injection molding cycle to reduce mold and process rework



Volumetric Shrinkage
(Sink Marks)



pressure at end of PACKING



pressure after FILLING

Thermal Performance Optimization

- **Challenges:**
  - Understanding the flow and thermal behavior of the **Merchandiser** through prototypes and testing
  - Shelf life of Hot drinks is small compared to cold drinks
  - Avoid **extreme thermal loading** on beverage cans
  - Maintain uniform target beverage temperatures

- **Values:**
  - Insights from the CFD analysis helped in making informative decisions towards design changes in attaining uniform temperatures
  - Run multiple designs of the merchandiser at a **reduced cost and duration** (compared to testing)
  - Attain **target hot beverage temperatures** in a short time
  - Improve the **energy efficiency** of the unit

- **Solution**
  - CFD Modeling to understand the flow and thermal behavior across different zones of the merchandiser

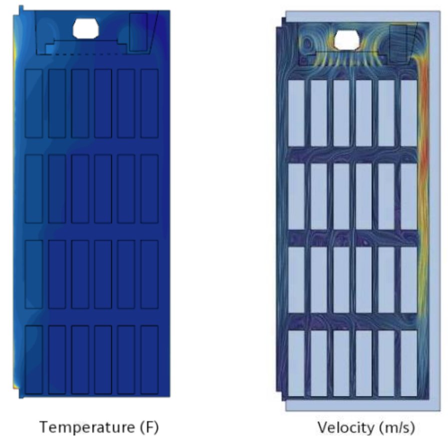
CFD, V&V, Design Exploration

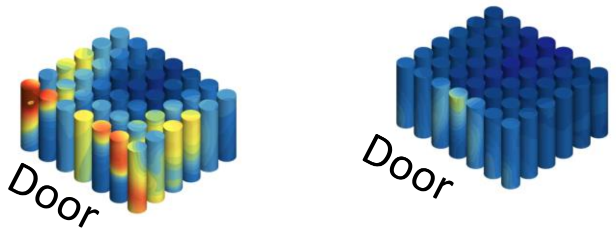
General hot beverage Merchandiser unit

Energy System Optimization for Sustainability

- **Challenges:**
  - Meeting target Zero carbon emissions by 20XX
  - Variables – Insulation material, door types, fan speeds, refrigeration components, different unit sizes, geo-location conditions
  - Minimize the cost
- **Values:**
  - Energy system optimization for **sustainability**
  - Reduce absolute Greenhouse gas **(GHG) emissions** by improving the **energy efficiency** of the coolers
  - Unit **elasticity** with change in key variables
- **Solution**
  - **Science-based approach**, Energy Systems Engineering
  - Perform **DoE** to estimate the performance by varying selected key design and operation parameters

DoE, Energy System Optimization, Multi-Physics





Temperature profile on the simplified bottles (top and bottom shelves)

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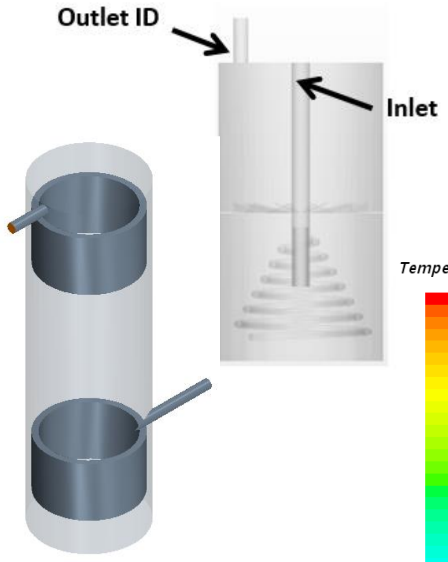
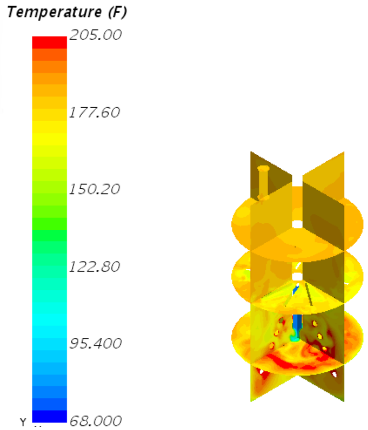
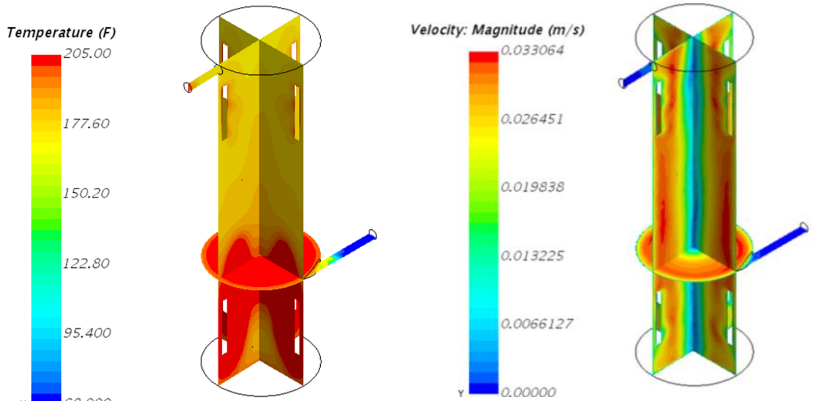
Commercial Coffee Maker – Water Heater

- Compute the temperature output from tank heater during a given number cycles of operation
  - Transient simulation of a water heater simulated and flow behavior visualized in 3D
- Identified areas within the proposed model design that could potentially improve performance
  - Cold spots identified and potential design modifications proposed
  - Comparison of designs including temperature distribution, pressure gradient and streamline
- Parametric design optimization of the following design parameters
  - No. of coil heaters
  - Power input
  - Heater Spacing
  - Spacing of inlet / outlet ports







CFD, Design Optimization

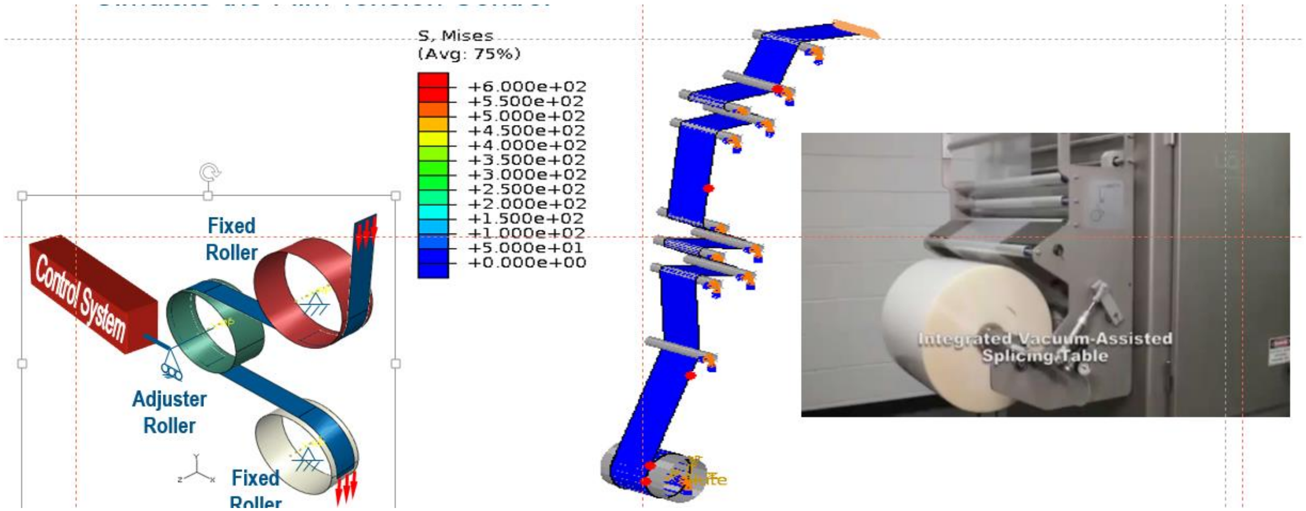
Selected FEA Applications

Flexible Packaging – Simulate Web Film Handling

- Very thin films moving at very high velocity make this a very hard problem to simulate.

- The original Simulation time using tradition FEA techniques was years !!

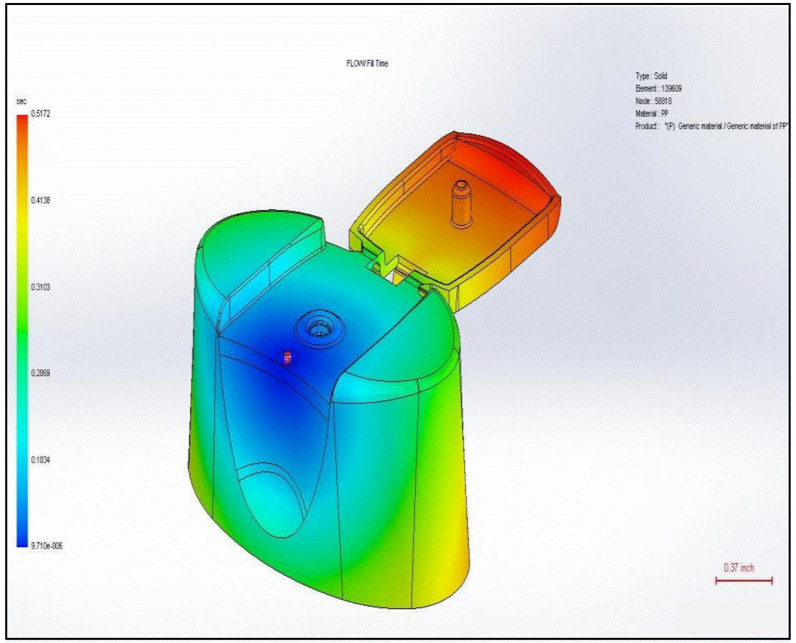
- Reduced it to 2-3 days with modeling tricks.



IN PARTNERSHIP WITH

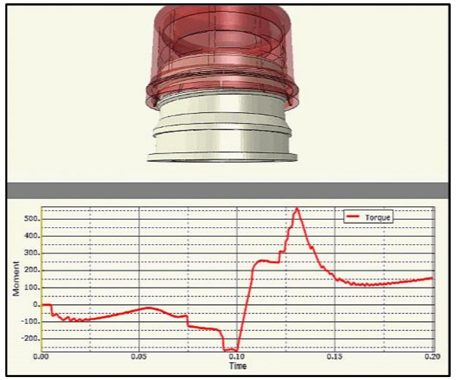
Plastic Injection

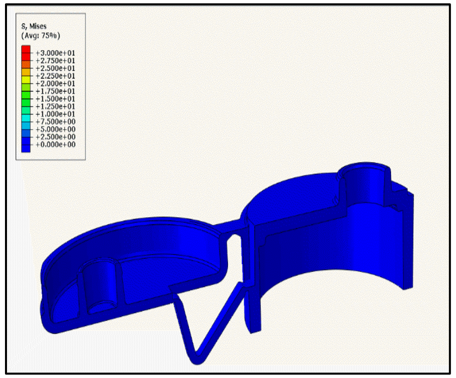
- Challenges:
  - Identify optimal injection locations
  - Mold rework due to design changes
- Solutions:
  - Predict and avoid manufacturing defects
  - Predict pack / mold design impact on manufacturing
  - Eliminate costly mold re-work
  - Improve product appearance & quality
  - Decreasing time to market and optimizing production cycle times
  - Optimize the injection process to produce desired final package

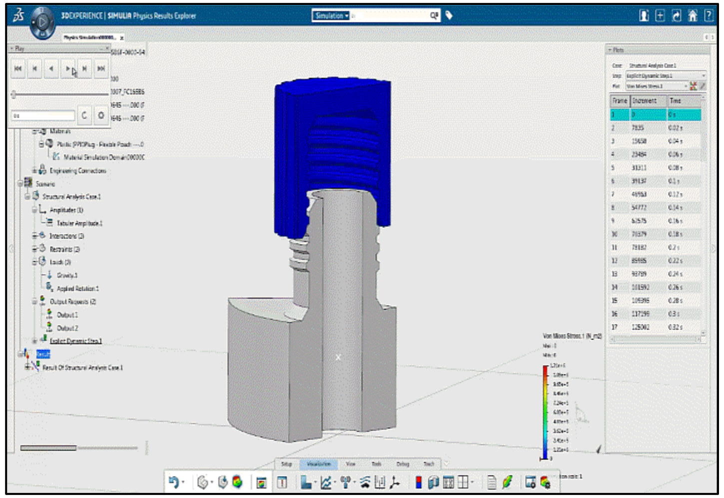


Capping

- Challenges:
  - Extending the shelf-life of end-products
  - Easy to use sealed cap
  - Customization according to the requirements of specific brand
- Solutions:
  - Design functional & light weighted closures
  - Predict sealing performance
  - Predict over stressing of the parts
  - Predict torque requirements
  - Simulate the Opening/Closing Phases & the Result stress on the Cap

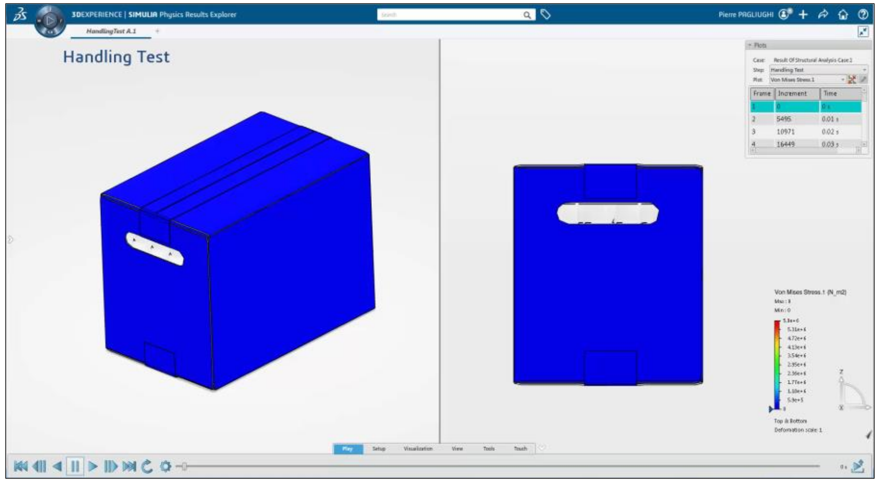


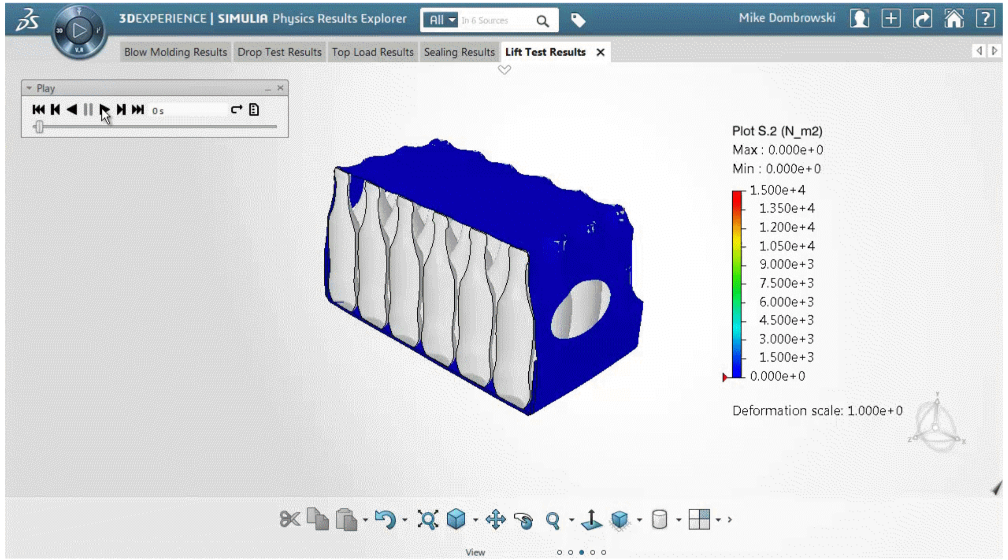




Lifting

- Challenges:
  - Predict if shrink wrap can sustain the weight of package while being lifted
- Solutions:
  - Reduce cost of damage

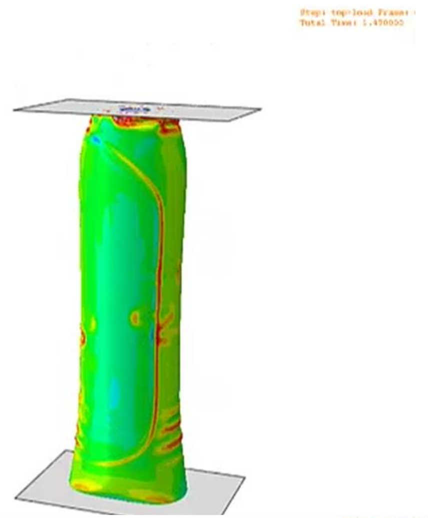


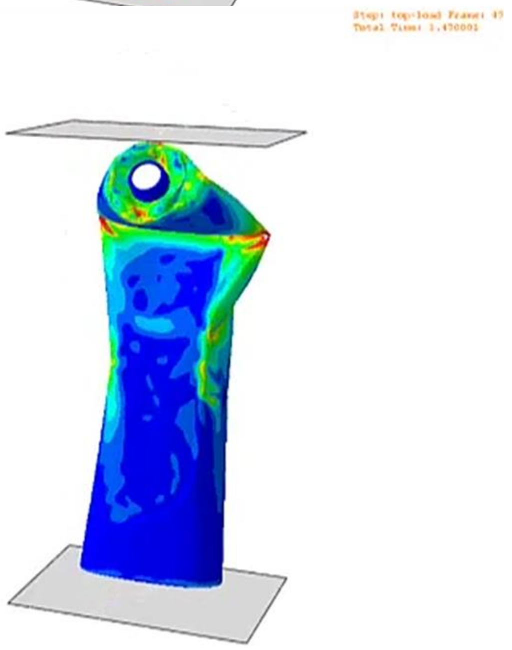


Top Load

- **Challenge**
  - High raw material costs
  - Sustainability & environmental impacts of the CPG brands

- **Solution**
  - Optimize material use against fixed constrains
  - Reduce raw material use in the production phase which lead to important cost reduction over the new product lifecycle
  - Reduce the brand environmental impact

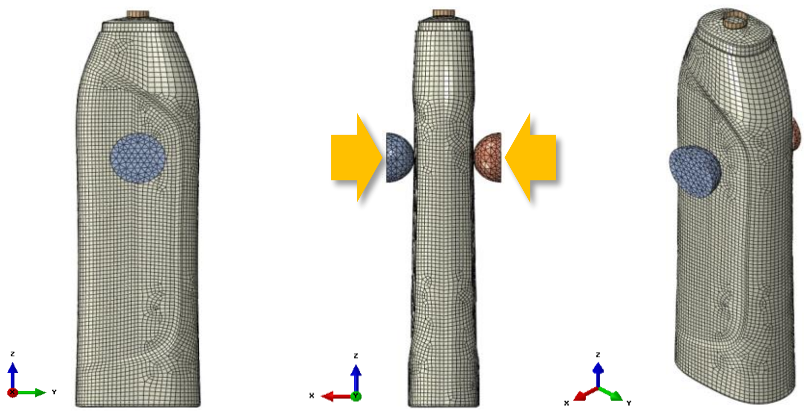




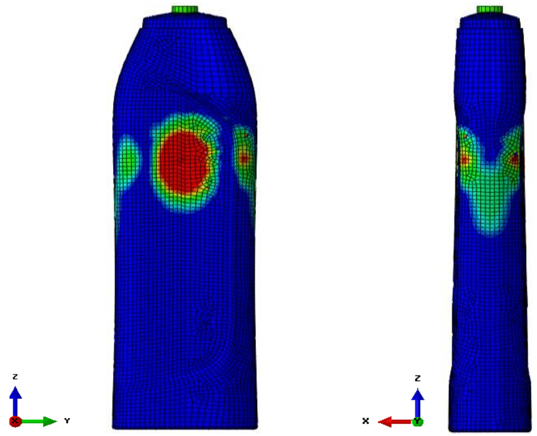
Abaqus, Automation, DOE

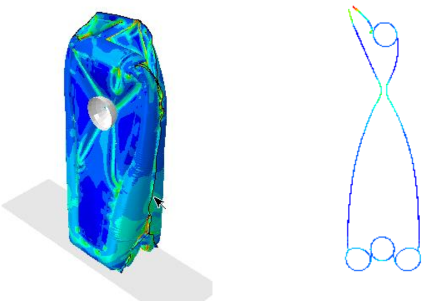
Squeeze Test

- **Challenges:**
  - Ensure brand equity and pack form after a squeeze
- **Values:**
  - Ensure that new pack will tolerate a certain side force
  - Predict if the pack will regain the initial form after the squeeze

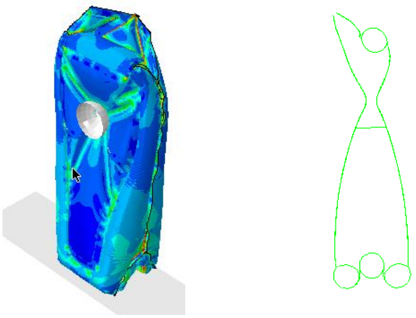


Plastic Pack Squeezing

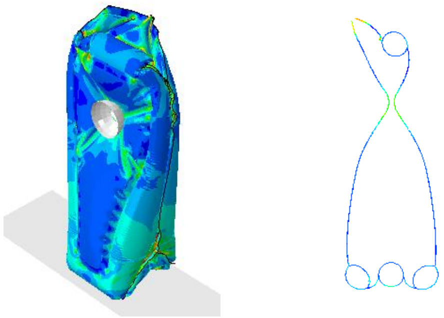




Empty case



Half filling



Full filling

Abaqus, Automation, DOE

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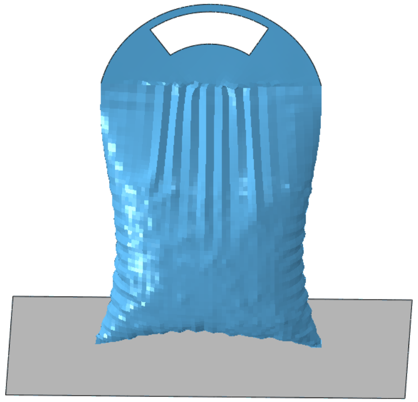
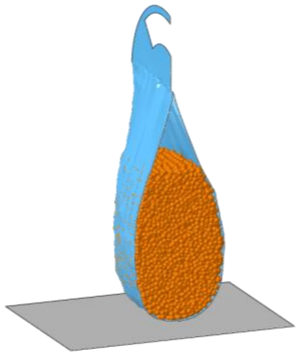
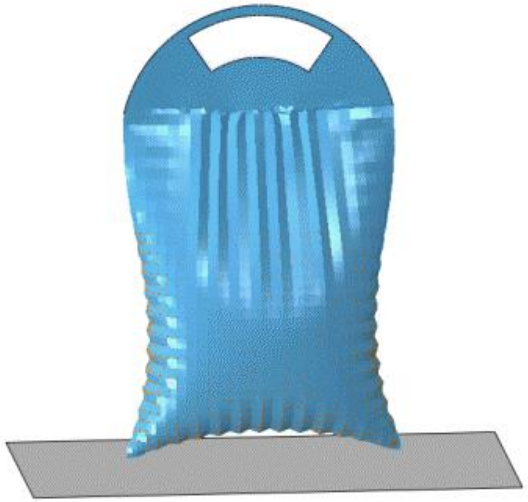
Detergent Bag Drop Test

- Bag is modeled with shell elements with material failure
- Powder is modeled with 3 mm DEM particles
- Initial velocity (1 m/s) applied to the bag

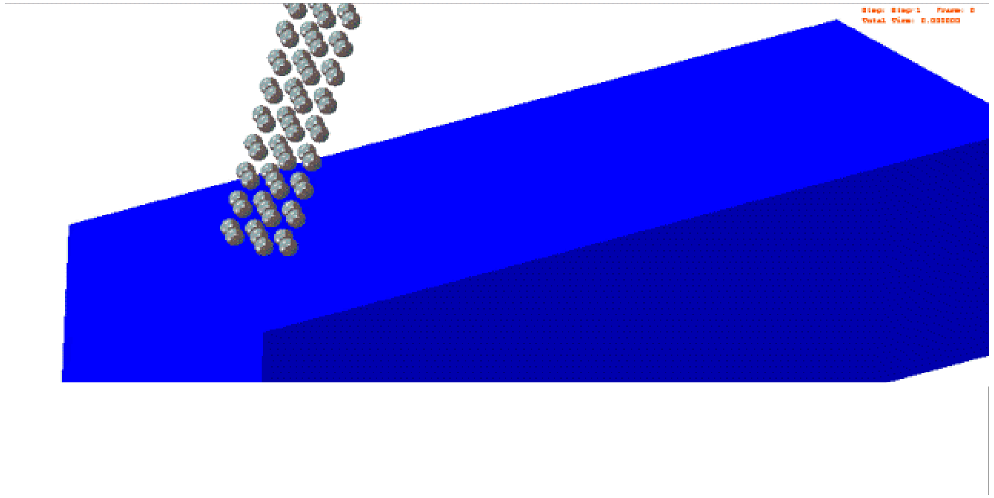






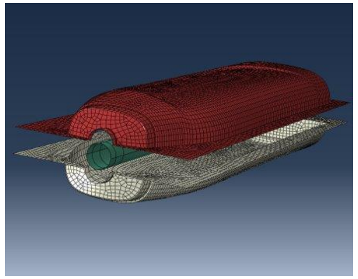
Shot Peening

- Shots are modeled with 0.3 mm DEM particles
- Shot velocity is 50 m/s
- Shots impact the 20 mm thick aluminum plate

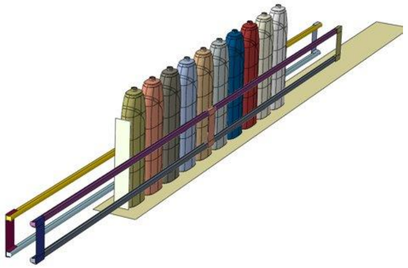


Sample FEA Applications

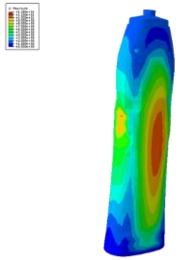
- Palletization and Transportation
- Shelf-Life Estimation
- Packaging Optimization and Material Modelling
- Bottle Light weighting
- Package Filling
- Drop Test
- Blow Molding and Plastic Injection Process
- Conveying
- Bottle Capping
- Thermoforming
- Labelling
- Cardboard Folding



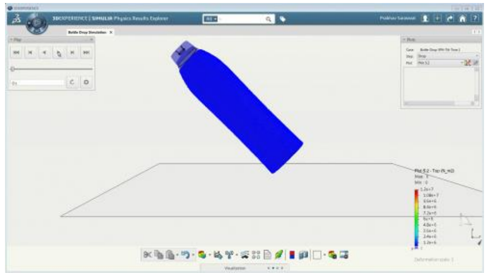
Blow Molding



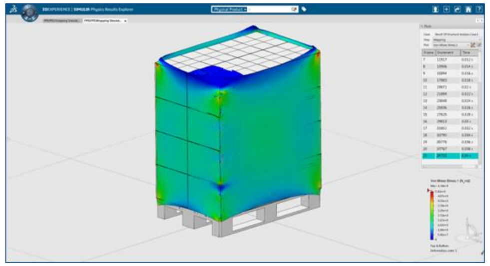
Conveying



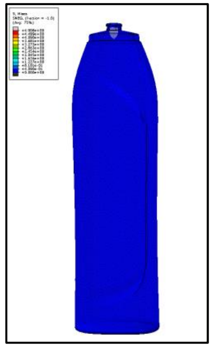
Labeling



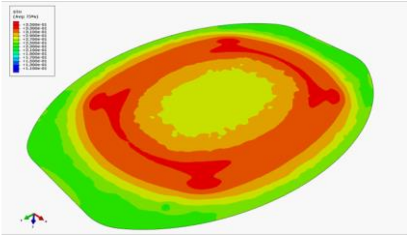
Bottle Drop



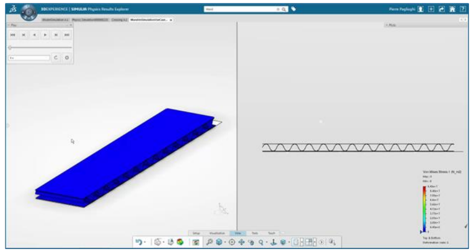
Transportation



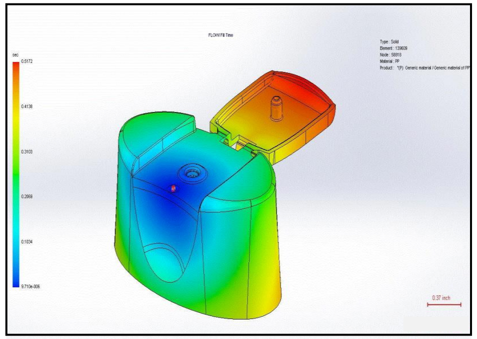
Bottle Filling



Thermoforming



Cardboard Folding



Plastic Injection

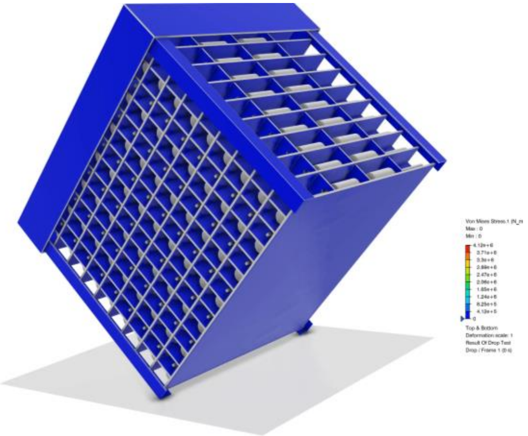
ISTA Virtual Testing

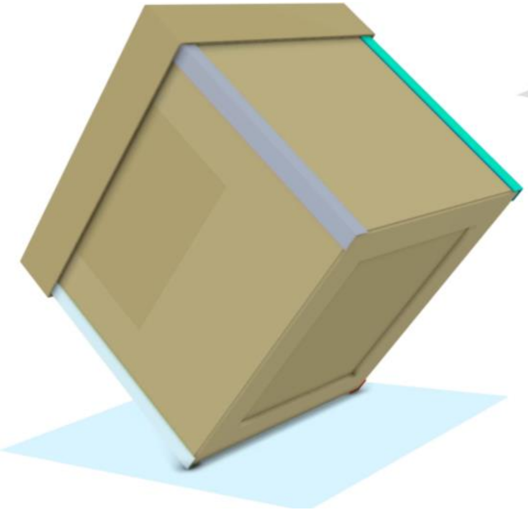
Drop Test

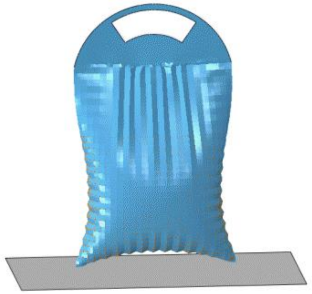
- **Drop Testing**
  - Ensure the package and products it contains do not get damaged upon drop from a height
  - ISTA compliance

- **Challenge**
  - Damage of the primary packages
  - How many times before the package is compromised?

- **Solution**
  - Reduce cost of damage during shipping & handling
  - Predict the sequence of drops and weak areas of the package

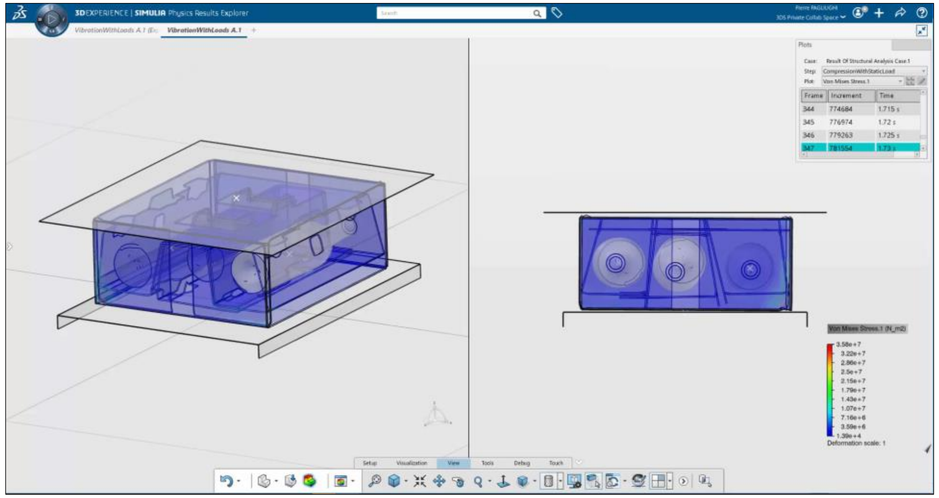






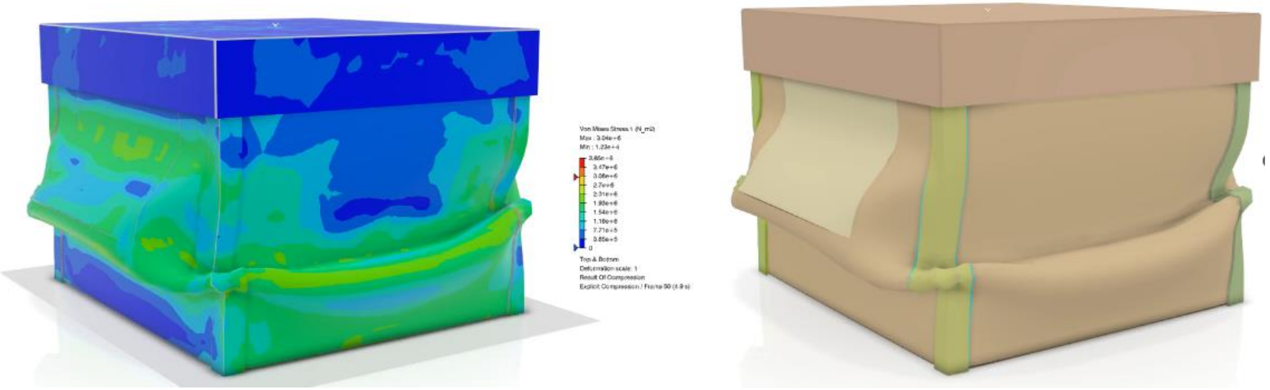
Vibration Testing

- **Vibration Testing**
  - Ensure the package and products it contains are safe during transportation
  - ISTA compliance
- **Challenge**
  - Damage of the primary packages
  - Reduce physical testing for primary arrangement combinations
- **Solution**
  - Reduce damage cost of package breakage during shipping
  - Predict the acceptable duration and max loading during shipping



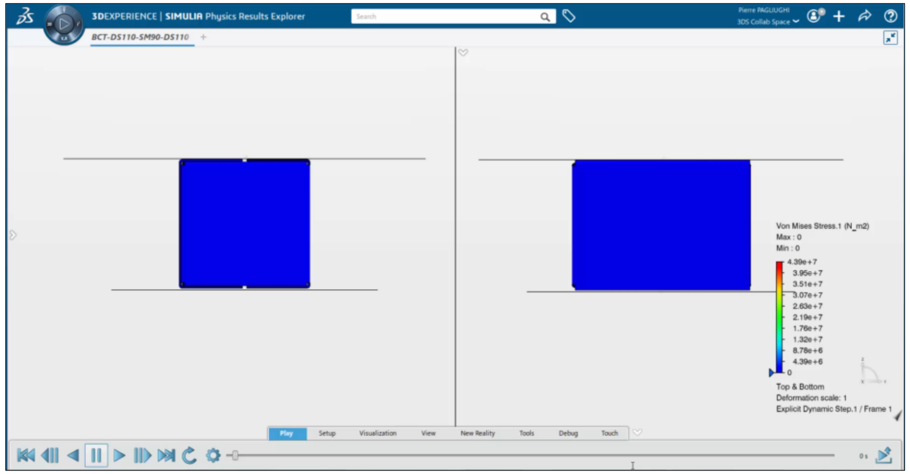
Compression Testing

- **Vibration Testing**
  - Ensure the package and products it contains do not get damaged from stacking weight, forklift handling,
  - ISTA compliance



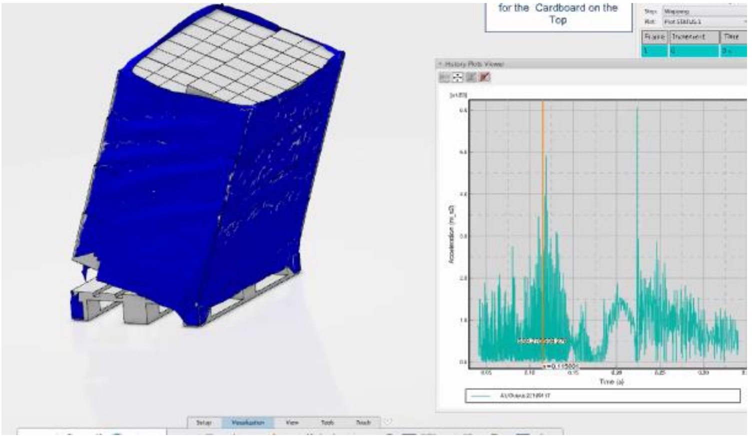
- **Challenge**
  - Package damage due to top stack weight in pallet
  - Damage of the primary packages
  - Convenient carrying while storage/ transportation

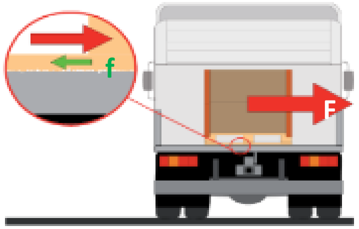
- **Solution**
  - Reduce damage cost of packaging breakage during storage & shipping
  - Predict if shrink wrap can sustain the weight of package while being lifted

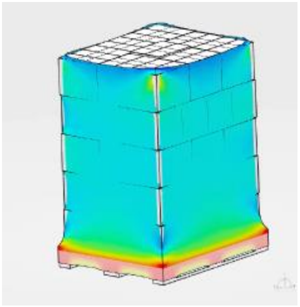


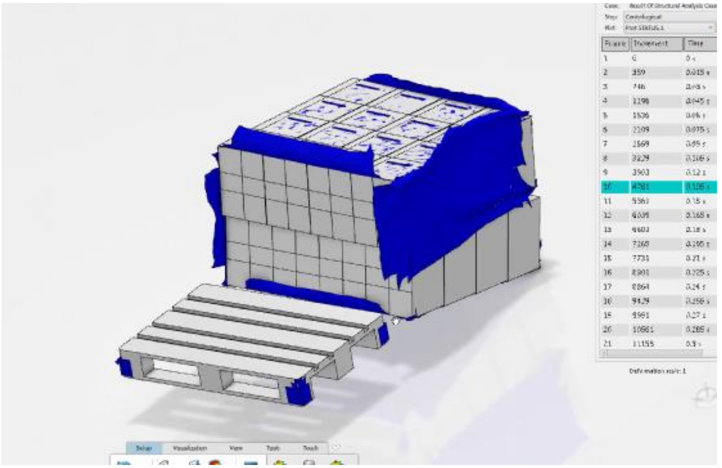
Transportation and Warehousing

- **Vibration Testing**
  - Ensure the package and products are stable during the transportation and warehousing
  - ISTA compliance
- **Challenge**
  - Package damage due to rough roads, braking and cornering the vehicle
  - Damage of the primary packages
- **Solution**
  - Reduce damage cost of packaging during transportation
  - Custom Truck Road Behavior
  - Door Opener for Transport and logistics Optimization







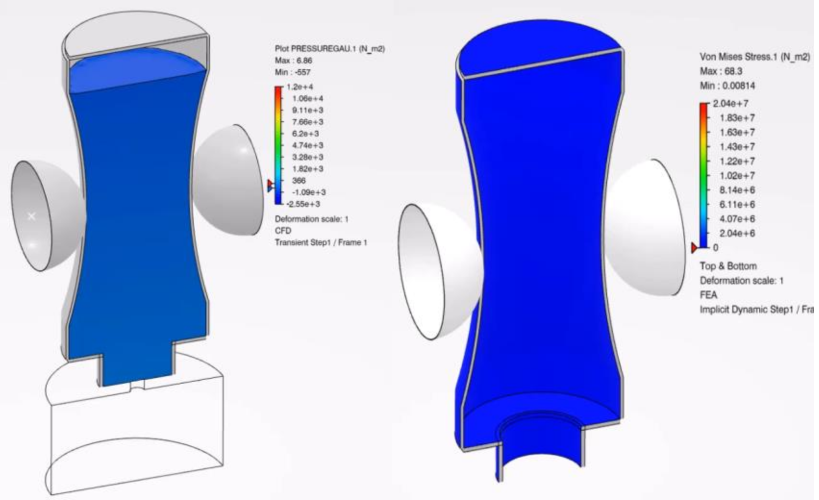


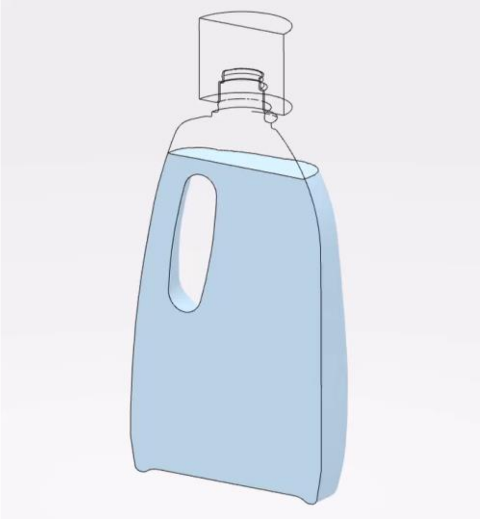
Selected CFD Applications

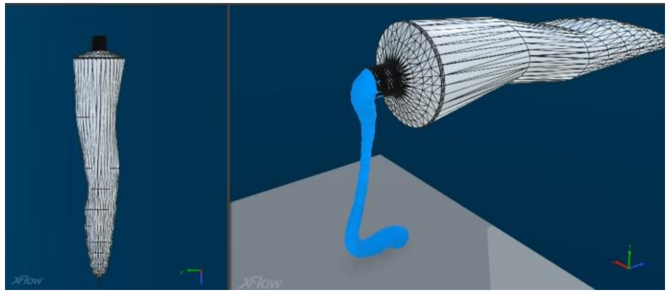
Back to Agenda

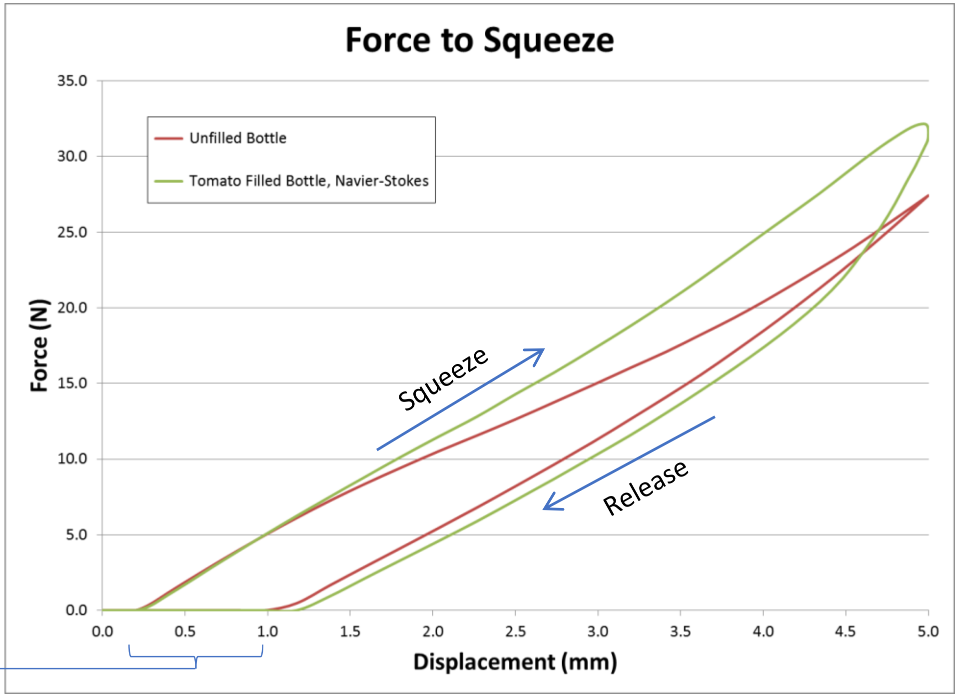
CPG Bottle Squeeze (FSI) and Pouring

- CFD is used to investigate the effect of bottle flexibility, nozzle design and fluid viscosity, on the flow rate and the squeezing force required by the consumer to eject the product from the packaging.
- Pouring characteristics of the fluid - pouring rate and whether fluid drips back onto the bottle itself.







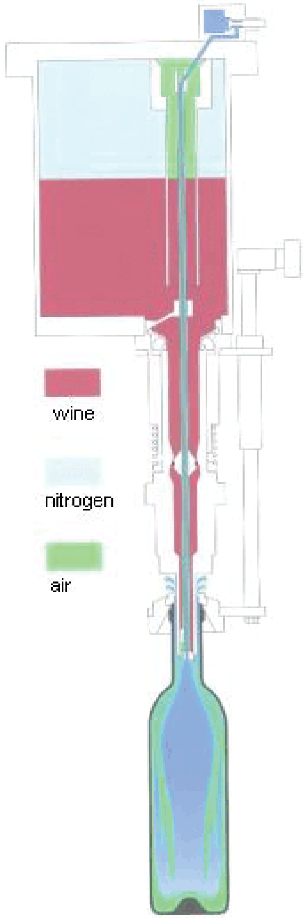


Permanent deformation of the bottle

Bottling & Filling Process

Non-Newtonian Fluids

- Parameters of interest for optimization are Power, time, temperature.
- Assess material damage during processing and ensure no air bubbles in filling process.
- Calculate heat dissipation for thermal degradation.
- Use residence times information from simulations to find dead spots



Bottling & Filling

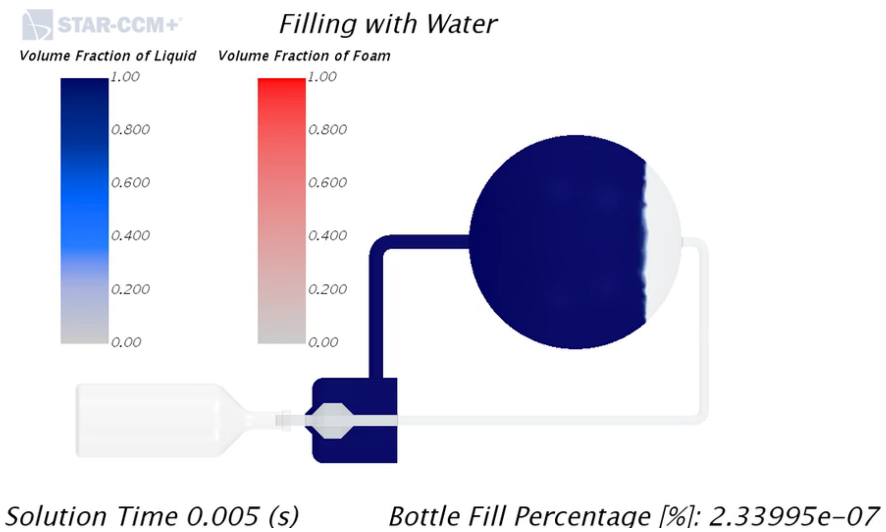
- Oxygen in air trapped inside bottled product is main cause of degradation of wine over time.
- CFD is used to design high speed bottling without damage to product quality.
- Remove oxygen from bottle before filling.

  Solution to the problem is injecting inert gas (nitrogen) into the bottle until all air is flushed out.

  Design targets
  - Speed of filling
  - Best conservation of food.
  - Minimum consumption of inert gas (cost)

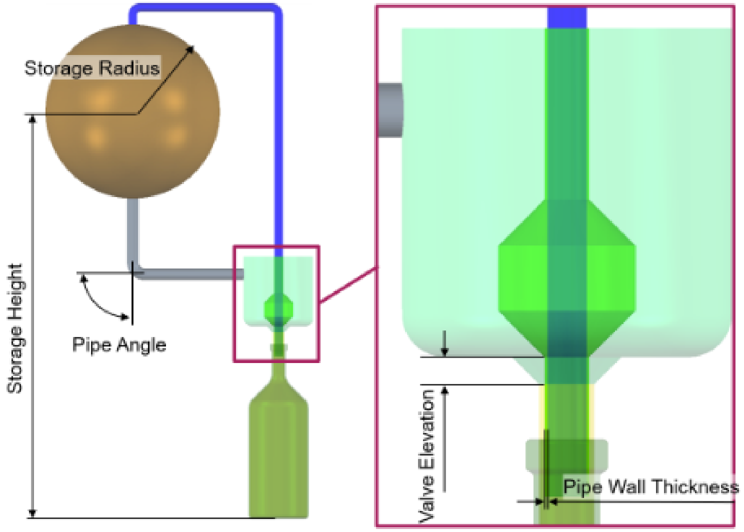
Bottle Filling - Foaming

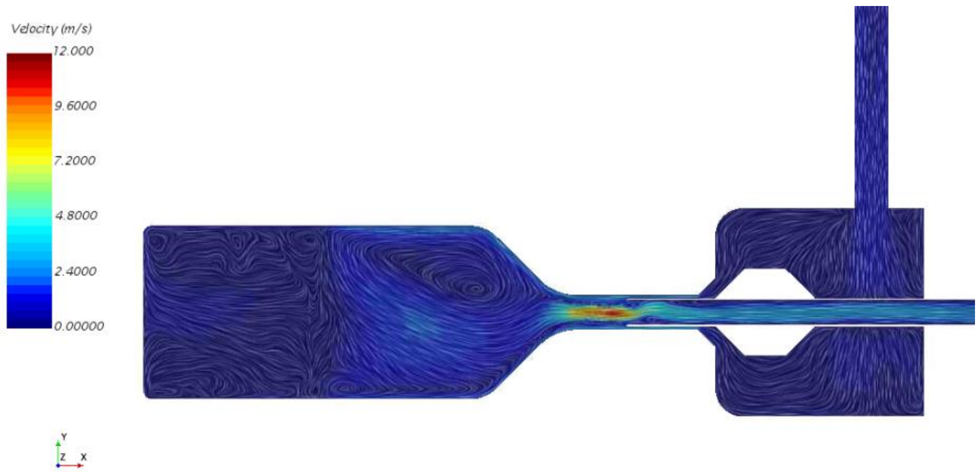
- Carbonated fluids generate excessive foam formation during the filling process and it can negatively impact the filling process.
- Fillers typically operate at system pressures greater than 5 bar to maintain CO_2 dissolution in the liquid after bottle sealing.
- This study demonstrates the use of computational fluid dynamics simulation to assess filling issues.



This shows the simulation of a simplified bottle filler

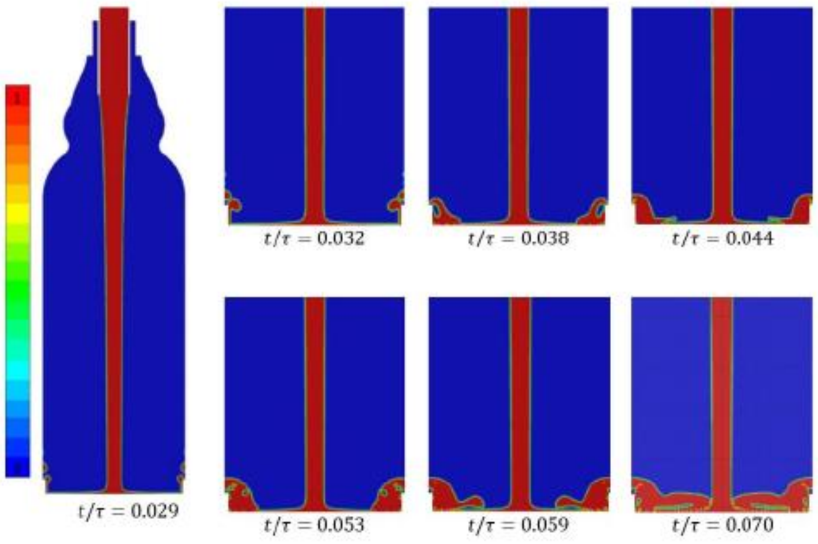
Design Parameters	Range
Storage Height	[0.65 … 1.2] m
Storage Radius	[0.14 … 0.2] m
Valve Elevation	[0.5 … 3] cm
Valve Radius	[1 … 2.5] cm
Pipe Wall Thickness	[0.5 … 2] mm
Pipe Angle	[90 … 120] deg
Diameter Ratio	[0.1 … 0.5]
Liquid	Beer, Lemonade, Water
Temperature	8 °C or 25 °C
Maximize Filled Liquid Volume	
Max. Foam Volume 0.1 l	



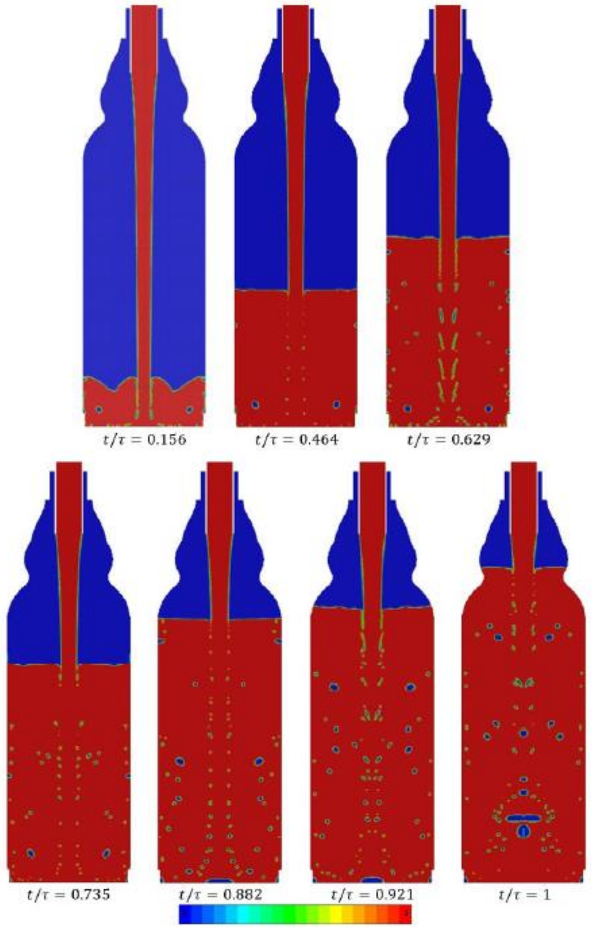


Bottle Filling - Aeration

- CFD simulation aids in analyzing the process by considering all adverse fluid flow phenomena.
- The simulation covers issues such as spluttering on the bottom, air cavern formation, and air entrainment with the incoming liquid.



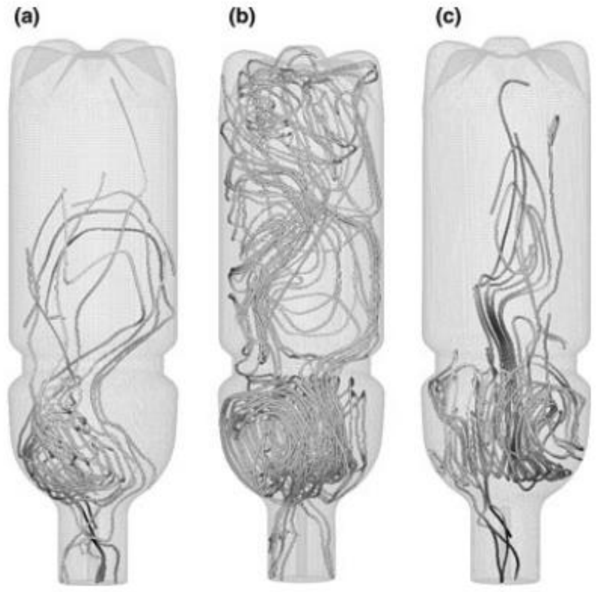
Distribution of water volume fraction for u = 0:51 ms-1, Re = 8032, filling method 1, first steps of the process



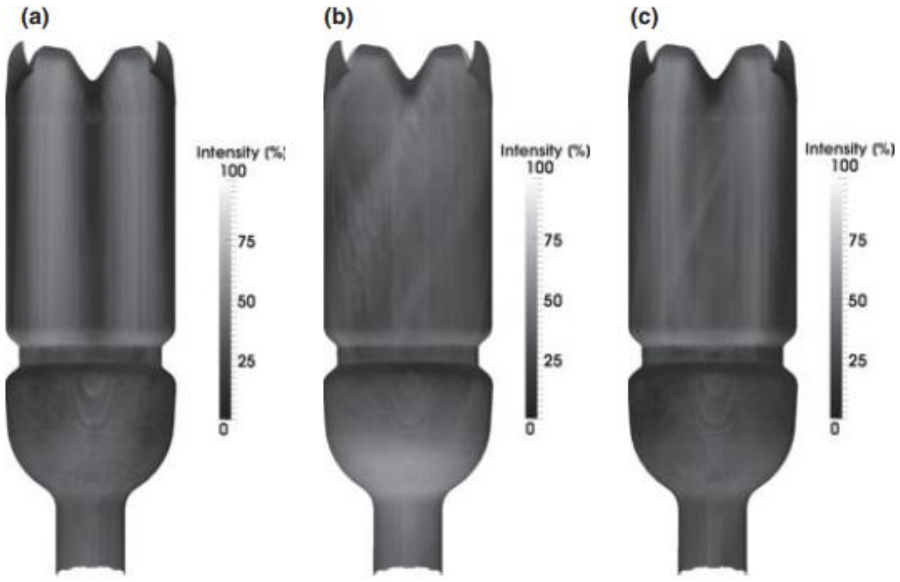
Distribution of water volume fraction for u = 0:51 ms-1, Re = 8032, filling method 1

Bottle Rinsing

- Maps of the interior walls of the bottles showing the distribution of streamlines and wall shear stresses



Simulated streamlines 0.4–1.4 s after the end of the water injection period: (a) standard case, (b) rotational case and (c) pulsating case



Simulated wall shear stresses: (a) standard case, (b) rotational case and (c) pulsating case. The scaling values for the intensities are the following: 16 mPa.s (corresponding to 0% intensity) and 7.4 Pa.s (corresponding to 100%).

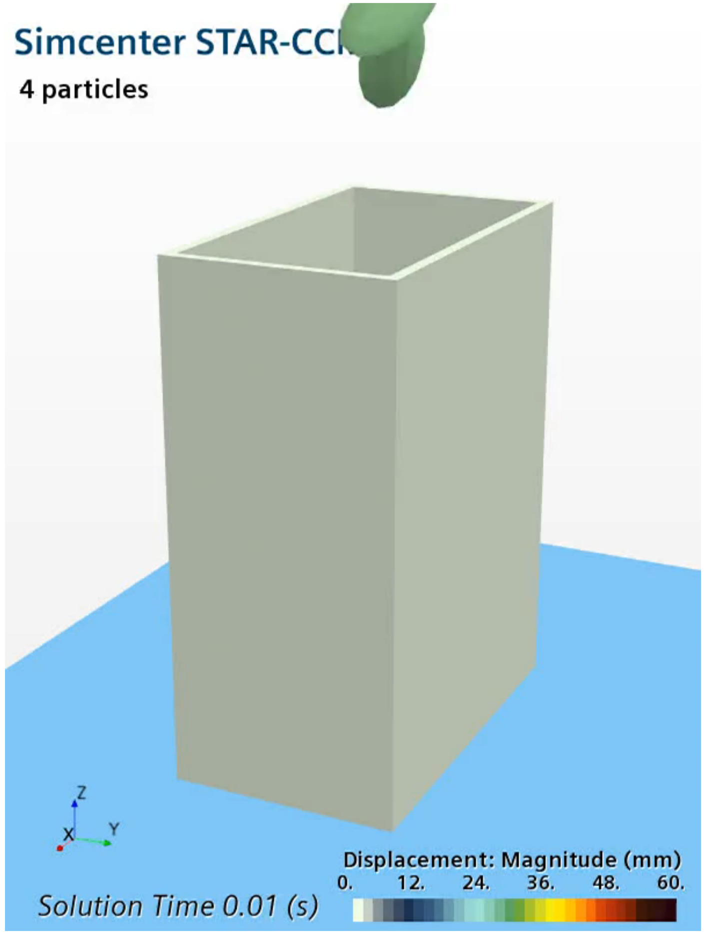
Source : Claus Meister; Kai Velten; Frank-Jürgen Methner (2012). Modelling and simulation of bottle rinsing. , 47(7), 0–0.

Modeling Bag Filling with Solid Particles (Chips)

- **Challenges:**
  - Reduction of the air in the material before filling into bags is one important measurement to reduce the amount of air in the filled bags.
  - Particle-particle interactions leading to force chains, dead zones, jamming, shear, segregation

- **Values:**
  - Reduce probability of jamming, spilling, dead zone formation
  - Maximize particle processing performance efficiency

- **Solution**
  - Resolves the particle flow on the individual grain level and this results in ability to resolve great level of details when simulating granular flows



Source : https://siemens.highspot.com/

Agitators (Mixers)

- Assess the flow conditions in the vessels
- Performance verification of agitator engineering design
- Simulate tests that are not possible with real media for safety reasons
- Optimize stirred tank performance
- Predict shear distribution in stirred tank reactor
- Scale up/Scale down of reactors

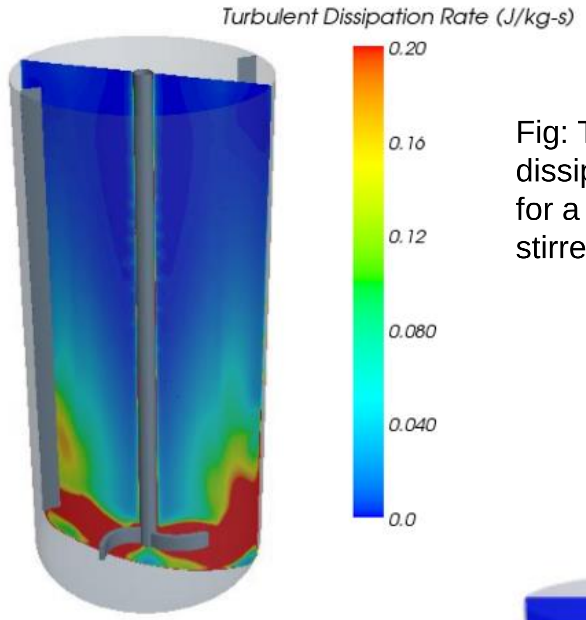


Fig: Turbulent dissipation rate contour for a multi-phase slim stirrer reactor

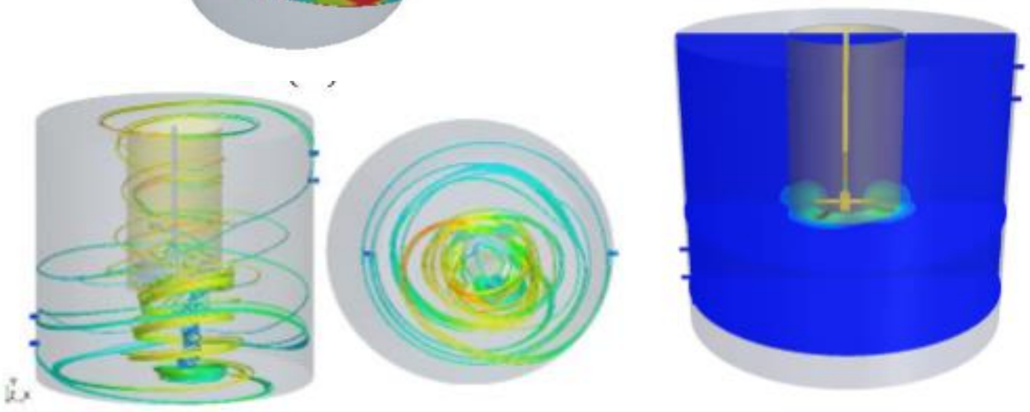


Fig: Stream lines, Average velocity contour in a reactor with mechanical stirrer

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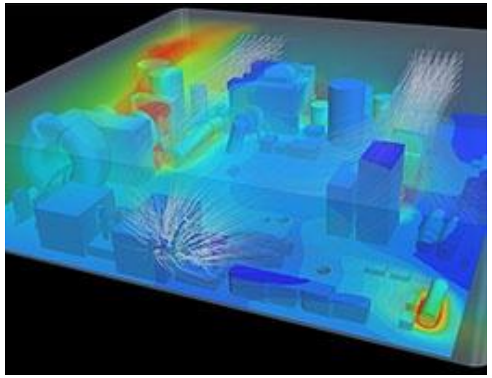
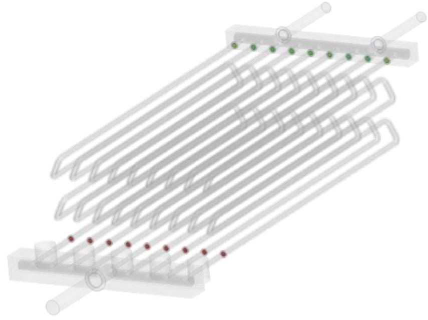
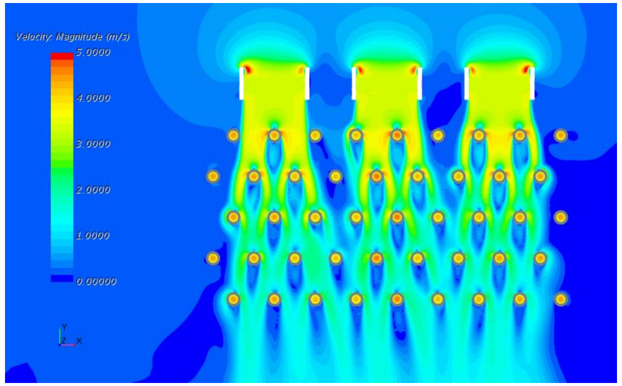
Conjugate Heat Transfer and Thermal Management

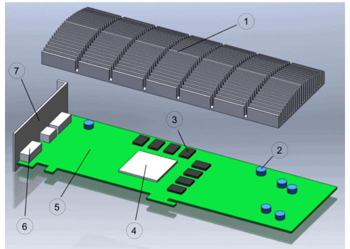
- All cooling approach
  - internal air, external air, or both
- Conduction including contact heat resistance
- Convection - Forced or natural
- Radiation including Solar loading
- Inclusion of heat sources, pressure settings for inlets and outlets, the effects of any fans, ambient temperature, etc.
- Heat Exchangers
  - Improve exchanger efficiency.
  - Study and analyze heat transfer mechanisms
  - Pressure drop within the exchangers can be minimized with CFD techniques.

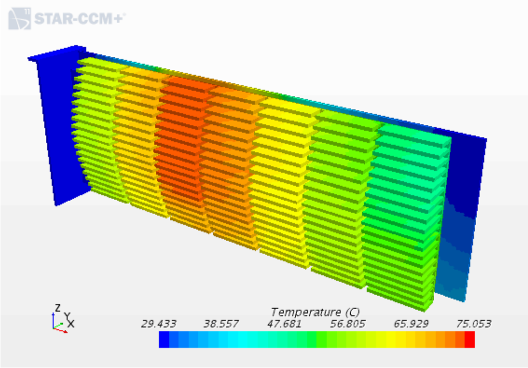






Heat Exchangers





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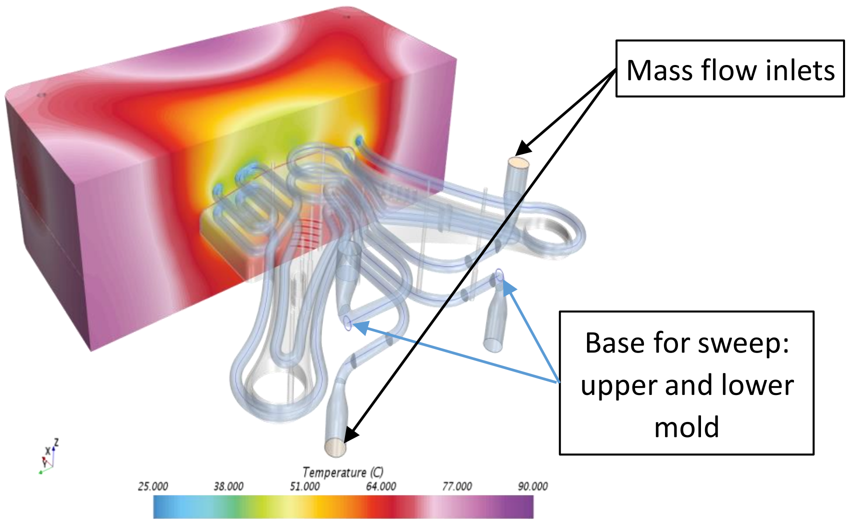
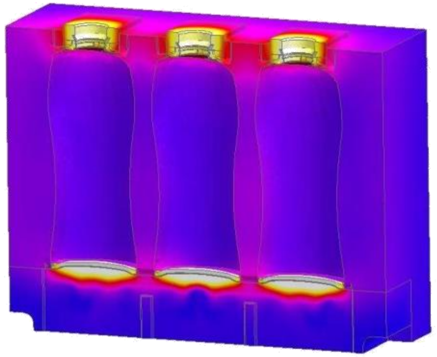
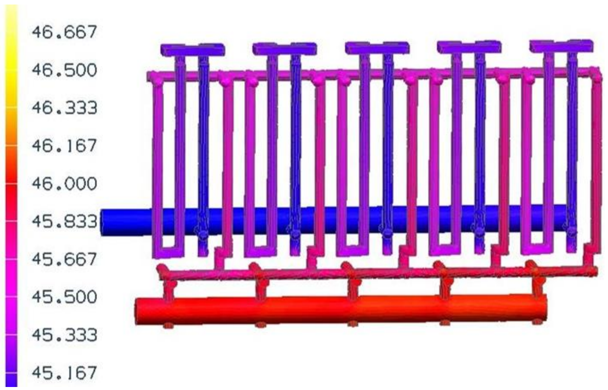
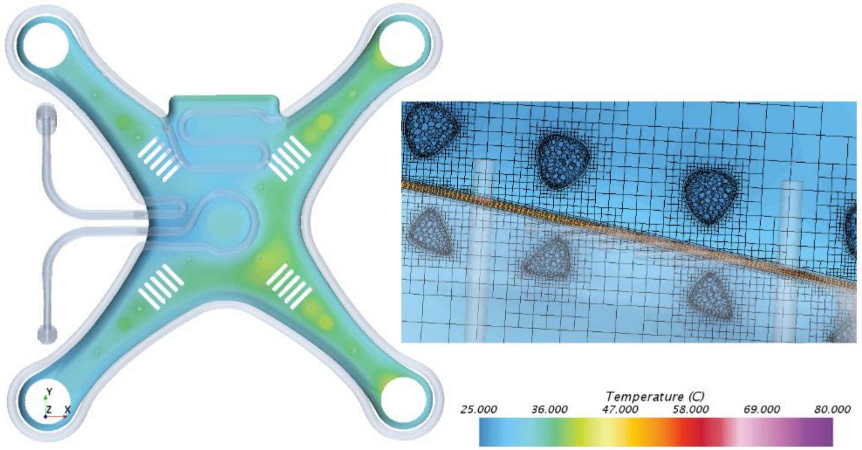
Mold Cooling Performance

- **Challenges:**
  - Uneven shrinkage can cause wrappage and deformation affecting the dimensional stability of the plastic part.
  - Increase in manufacturability of complex products
- **Values:**
  - Optimize the flow distribution and pressure drop in the cooling channel
  - Evaluate the efficiency of cooling system design, including cooling circuits, inserts, mold base, heating rod, etc
  - Efficient cooling systems help overcome these realities, enabling mold designers to balance tradeoffs of temperature, pressure and time to meet the ultimate objective: lower cycle time.
  - Evaluate the effectiveness of mold cooling system designs
- **Solution**
  - CFD helps in Understanding the flow phenomena
  - Conjugate heat transfer & phase change
  - Multiphase and particle laden flows.









Source : https://siemens.highspot.com/

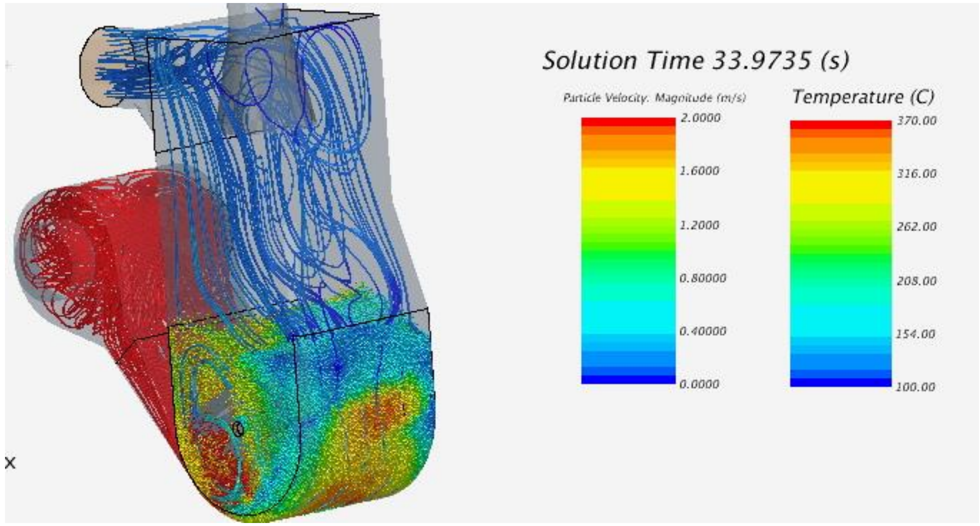
Back to Agenda

Roasting - Example

- **Challenges:**
  - Temperature overshoot can affect coffee taste (quality).

- **Values:**
  - Temperature distribution inside the roaster can be studied.
  - Coffee beans can be modeled as particle.

- **Solution**
  - Heat transfer from hot air to the coffee beans should be maintained which can impact roasting performance.

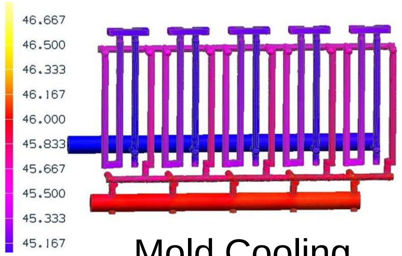


Source : https://siemens.highspot.com/

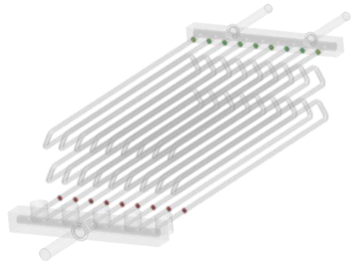
Sample CFD Applications

- Energy System Optimization for Sustainability
- Flow and Thermal performance optimization of merchandiser units
- Pump / impellers to estimate the shear rates during fluid transport
- Mixers, flow separators
- Valves
- Heat exchangers / chillers / heating systems
- Blow molding process / Mold Cooling Systems
- Bottling and filling process
- Fluid Structure Interaction Applications
- Food sterilization
- Drying
- Bottle rinsing
- Improve flow and thermal efficiencies in the processing system

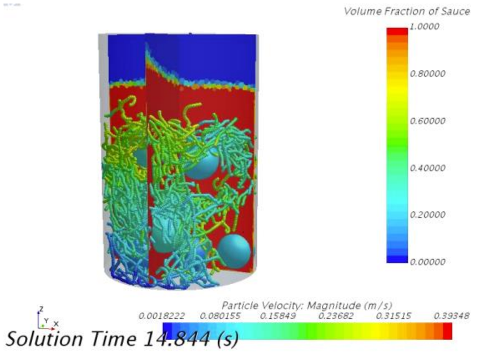
Merchandiser Units



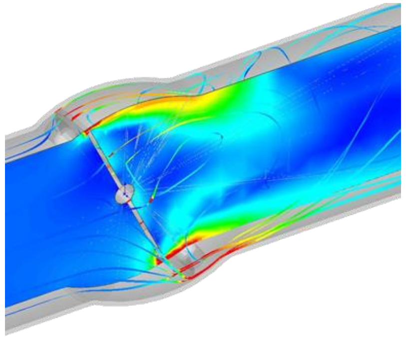
Mold Cooling



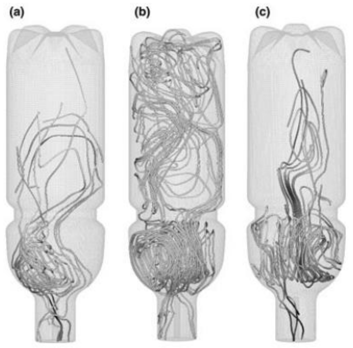
Heat Exchangers / Chillers



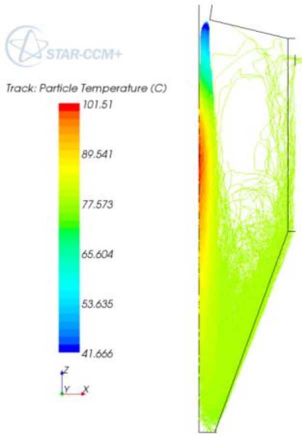
Sterilization of Food Particulates



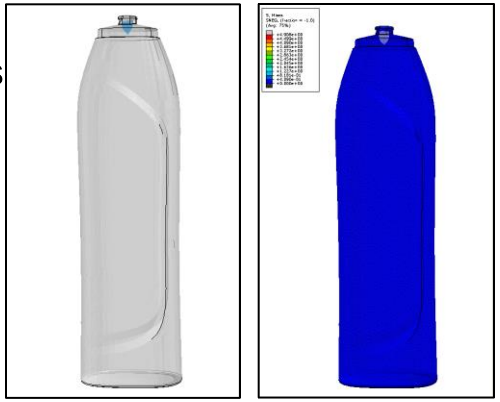
Valve Modeling



Bottle Rinsing



Spray Drying

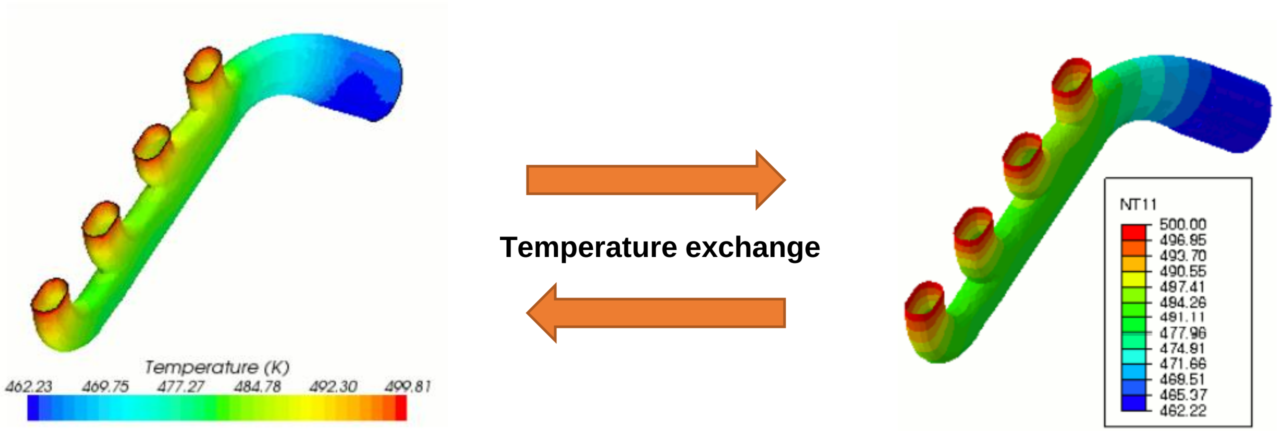


Source : Claus Meister; Kai Velten; Frank-Jürgen Methner (2012). Modelling and simulation of bottle rinsing. , 47(7), 0–0.

Co-Simulation

Objective and Background

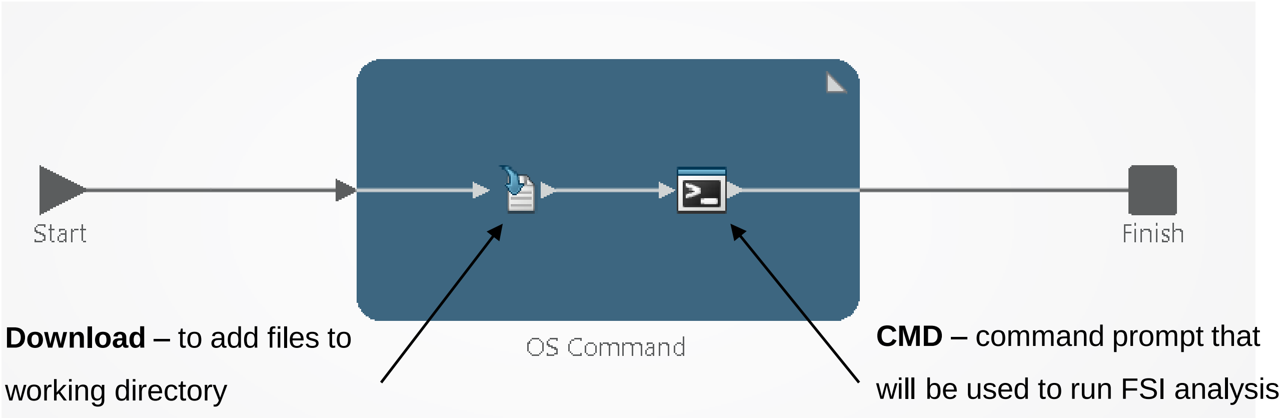
- The main objective is to demonstrate how to run an analysis by coupling STAR-CCM+ and Abaqus on 3DEXPERIENCE Platform.
- Data exchange between STAR-CCM+ and Abaqus occurs at frequent intervals, that are known as coupling steps.
- The coupling is carried out using the SIMULIA Co-Simulation Engine, which exchanges data between the two models automatically during the co-simulation process.



STAR-CCM+ Abaqus

Running Co-Simulation

- Process Composer app. is used to run the co-simulation analysis on 3DEXPERIENCE Platform.
- A simulation workflow process is the type of object created by the Process Composer app to run STAR-CCM+ and ABAQUS, and allows data exchange through **adapters** (Download, CMD).

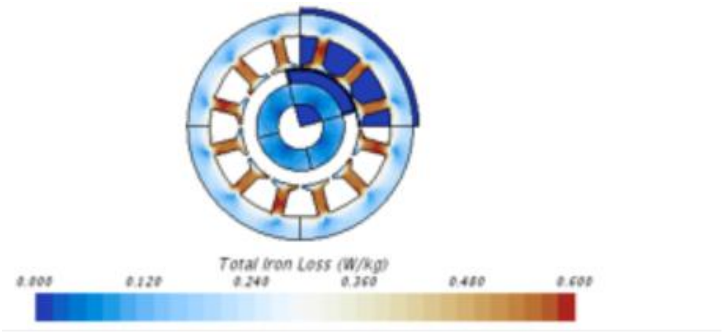


- Using similar approach, a two-way coupled FSI model with deformation can be developed between Abaqus and STAR-CCM+ through 3DEXPERIENCE platform.

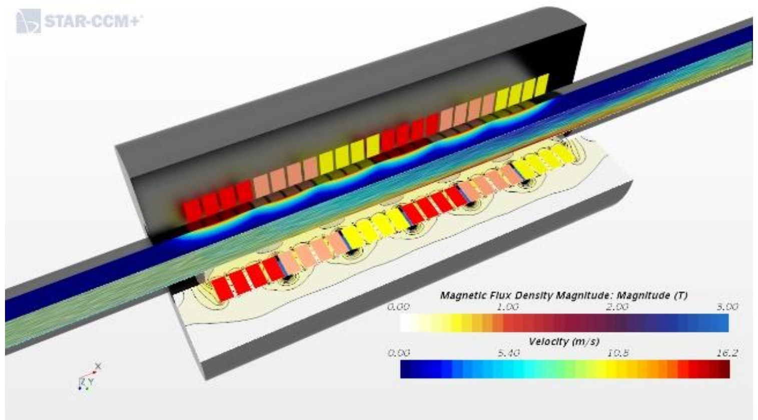
Electromagnetics Capabilities

Sample EM Applications

- Electric Machines
- MHD: Electromagnetic Stirring
- Plasm Torch
- Induction Heating
- Microwave Oven Modeling

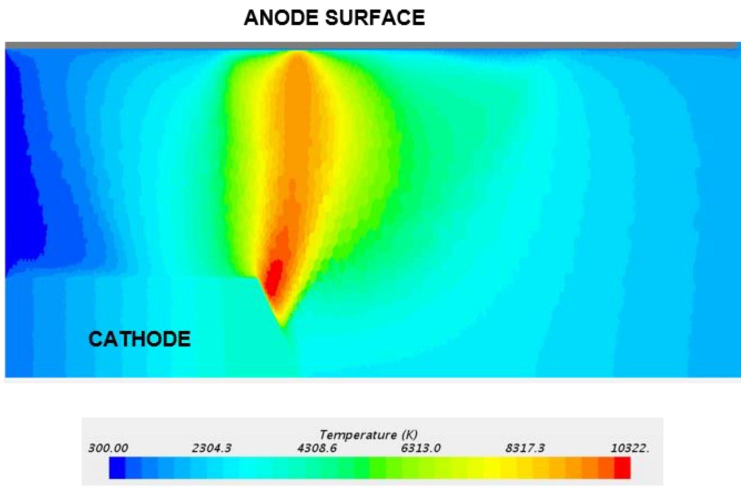


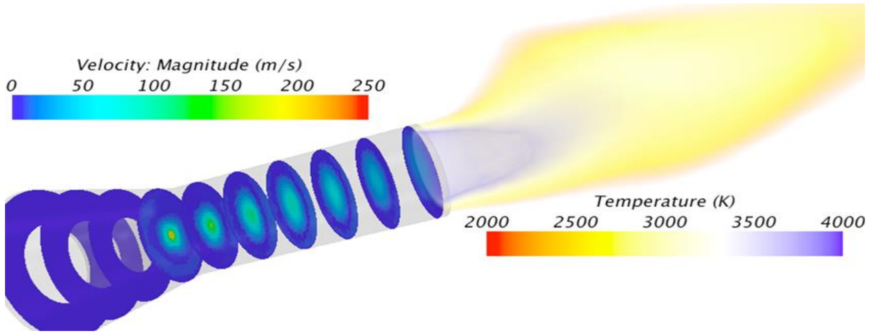
Electric Machines



MHD : Electromagnetic Stirring

Temperature Distribution in Plasma Arc
Axisymmetric Simulation

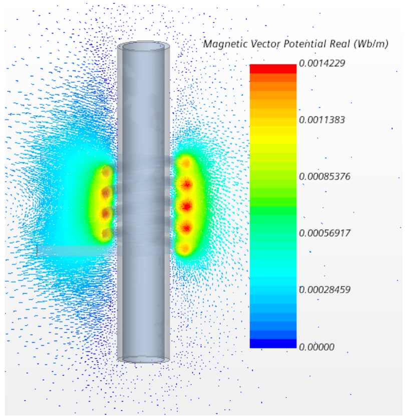


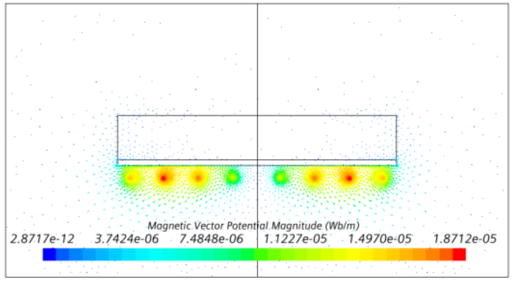


Plasma Torch

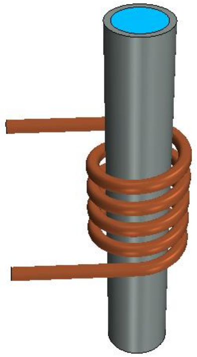
Induction Heating Application - Examples

- Current carrying wires in 2D-axisymmetric on left Induces eddy current in the target plate.
- Induction heating depends on temperature dependent magnetic permeability.

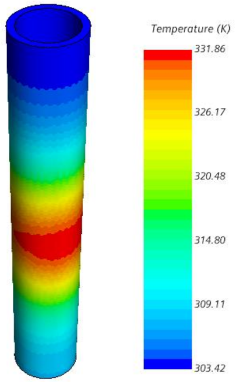




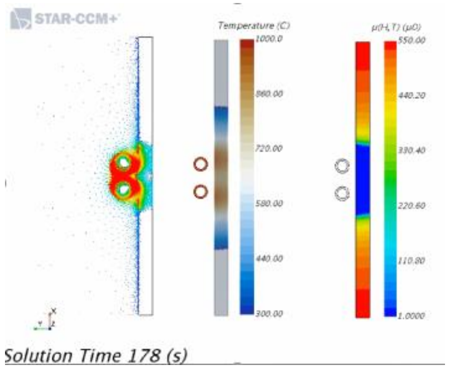
Magnetic Field



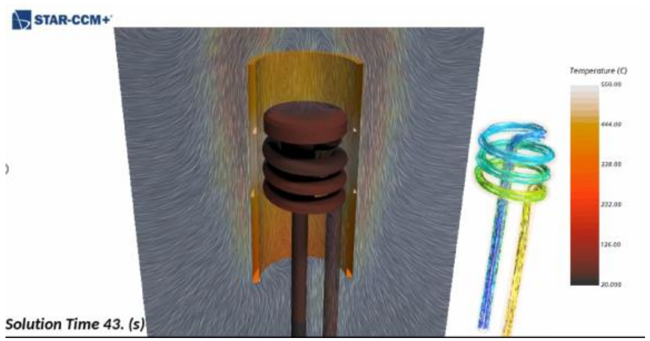
Geometry



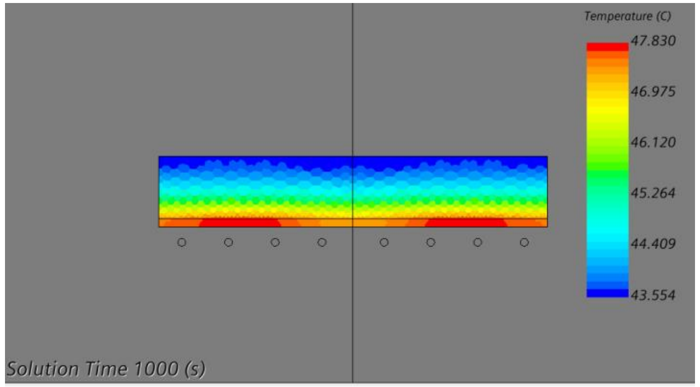
Pipe Temperature



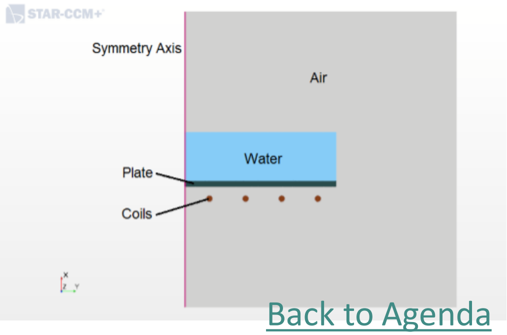
Induction Heating



Induction Brazing



Temperature Rise in Plate and Water due to induction

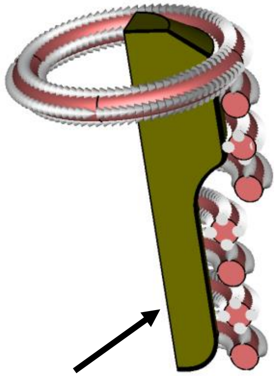


IN PARTNERSHIP WITH

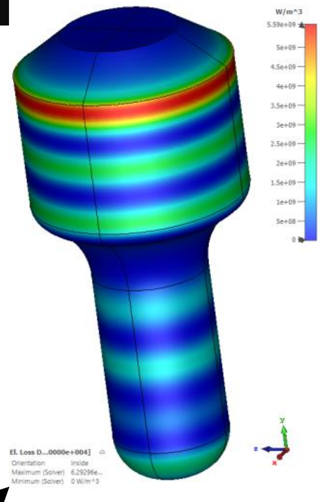
Back to Agenda

Induction Heating/Hardening

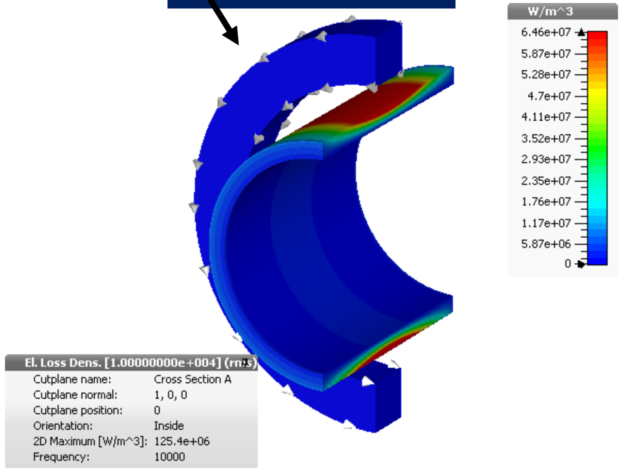
EM Simulation



Temp. dependent material



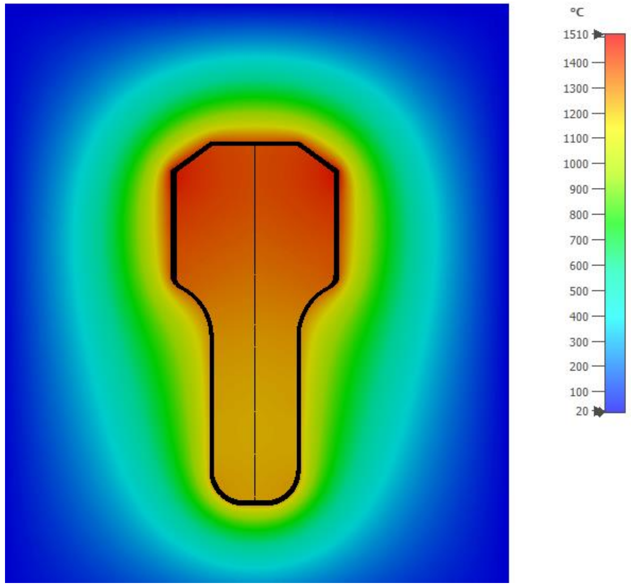
Electric Loss Density

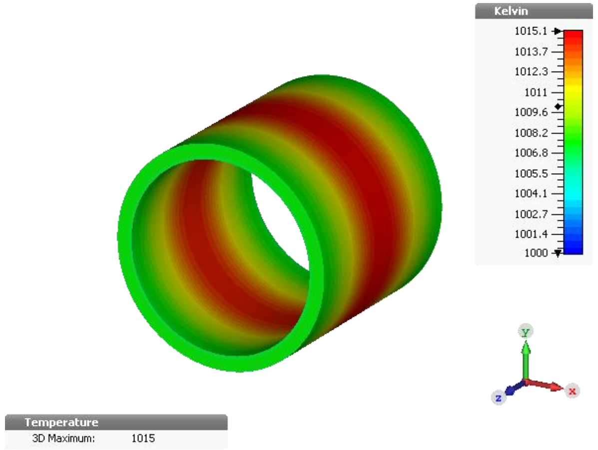


“Is the requested temperature reached?”

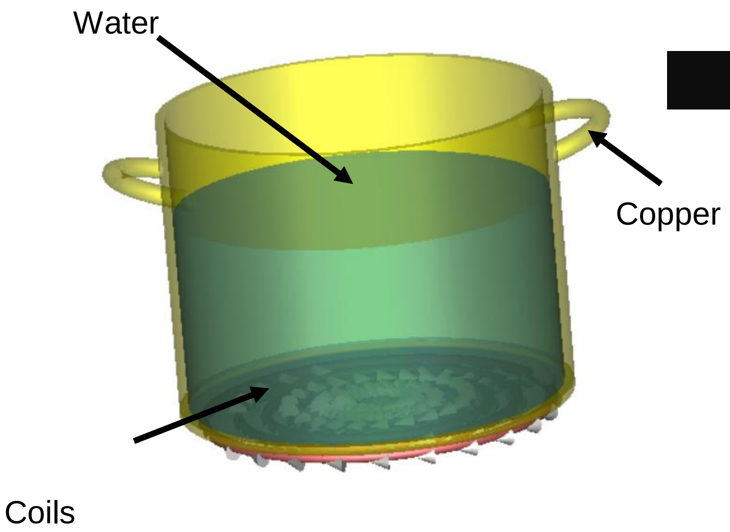
“Are there unwanted hot spots?”

Thermal Simulation

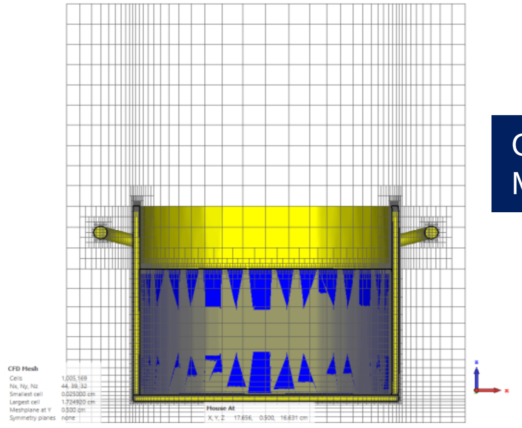




Induction Heating/Hardening

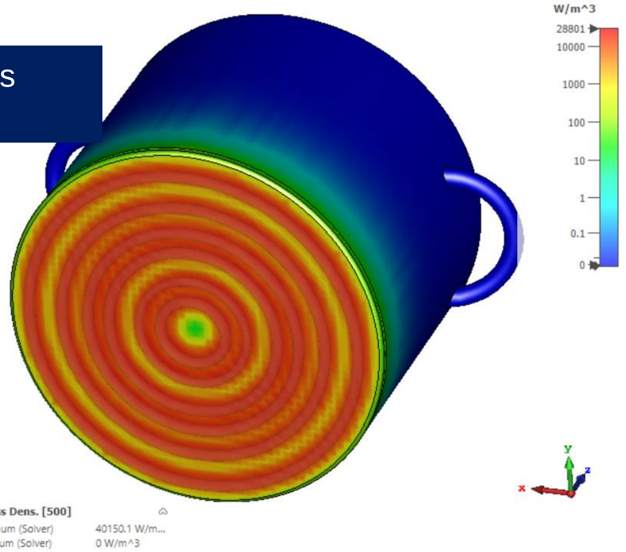


EM Simulation

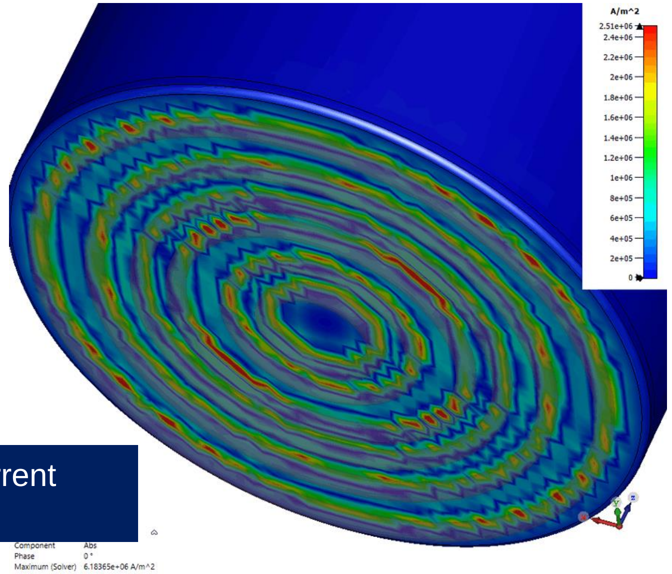


Octree Meshing

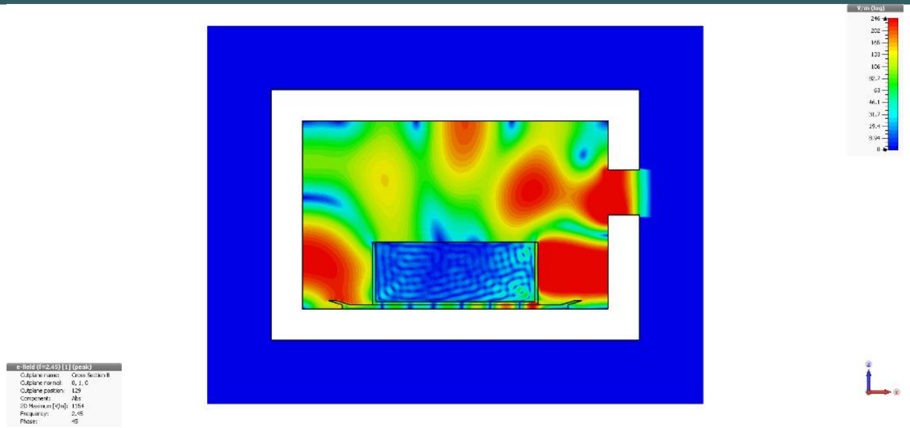
Electric Loss Density



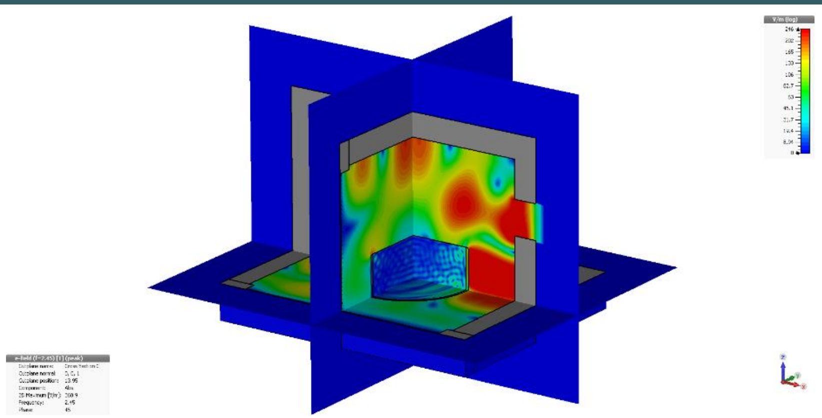
Total Current Density



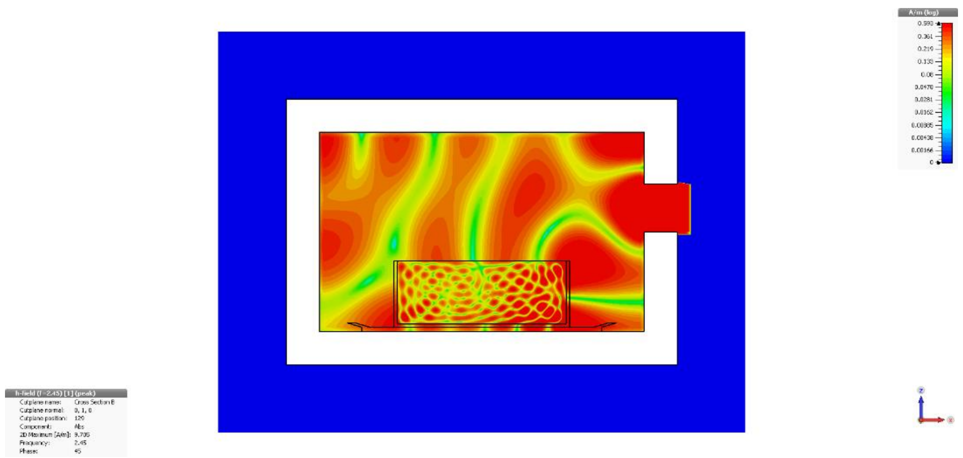
Microwave Oven Modeling



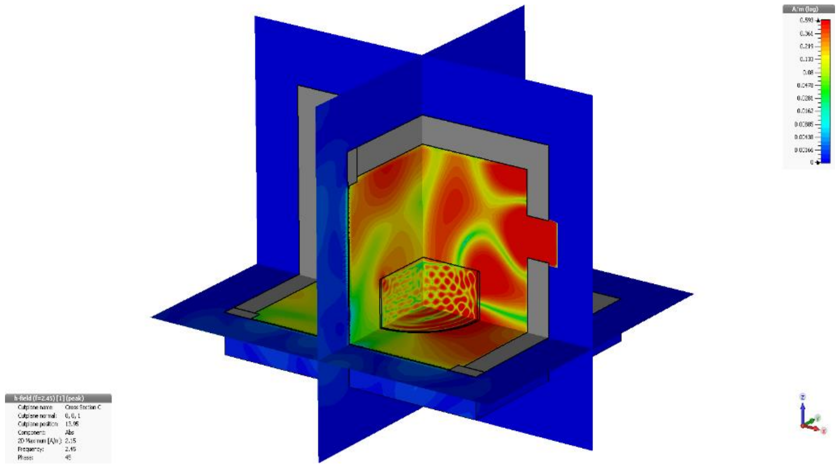
E-Field (Abs) at 2.45 GHz (xz-plane)



E-Field (Abs) at 2.45 GHz (cross-sections)



H-field (Abs) at 2.45 GHz (xz-plane)

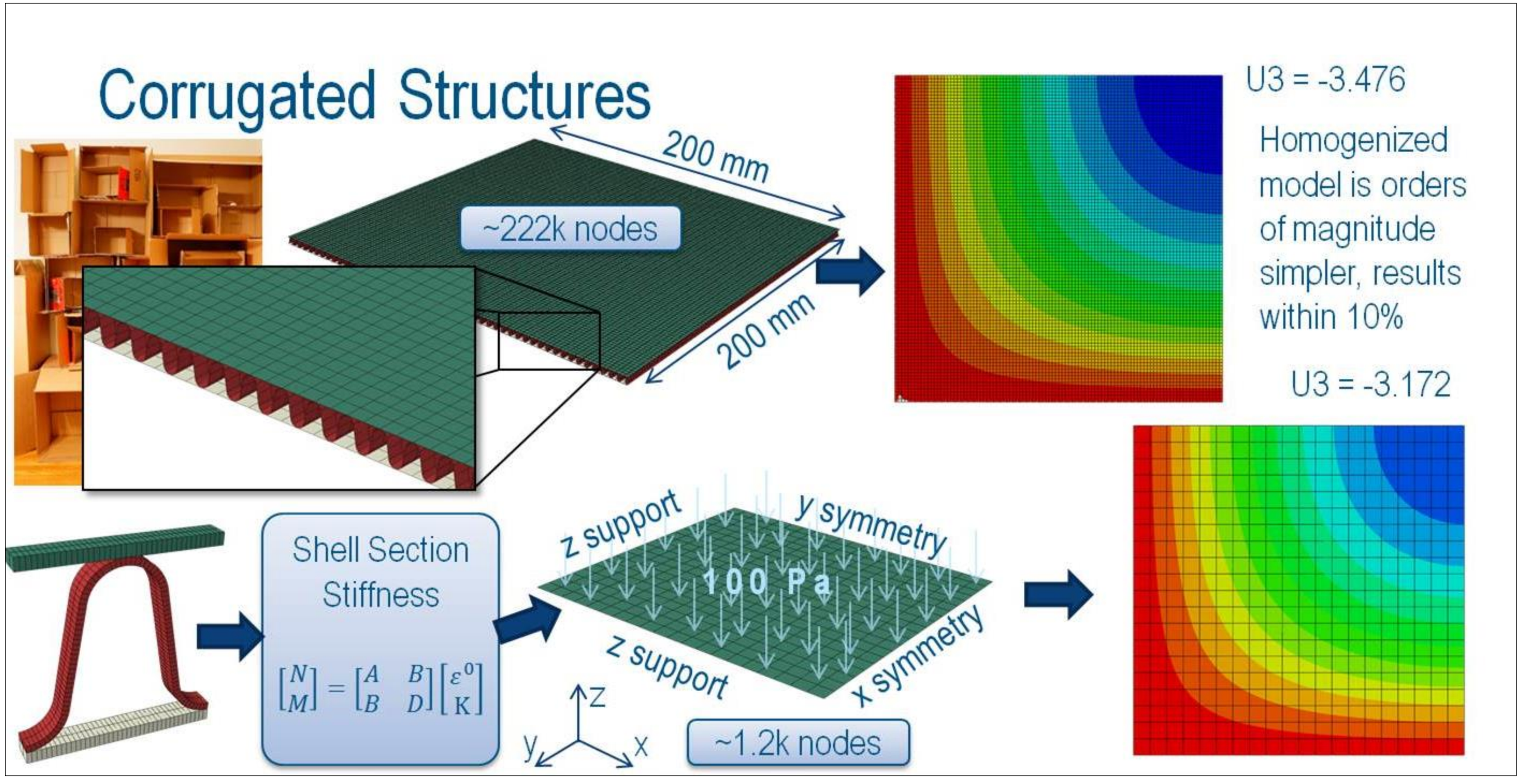


H-Field (Abs) at 2.45 GHz (cross-sections)

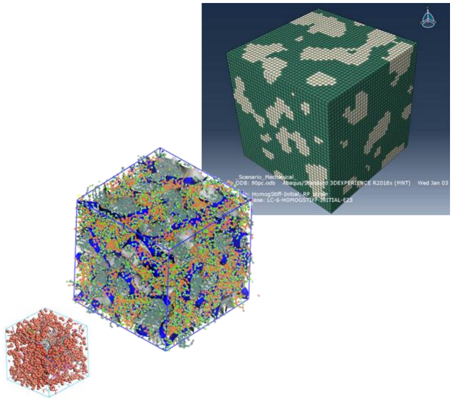
Multiscale Modelling

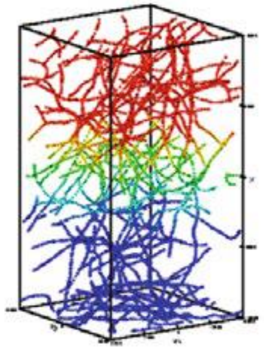
Secondary Packaging Engineering

- Material Science
    - FE-RVE Material Modelling

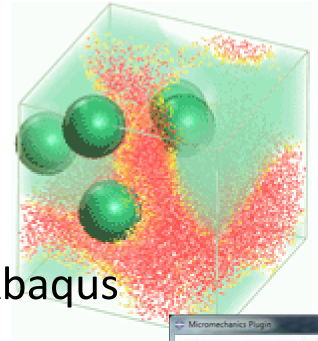


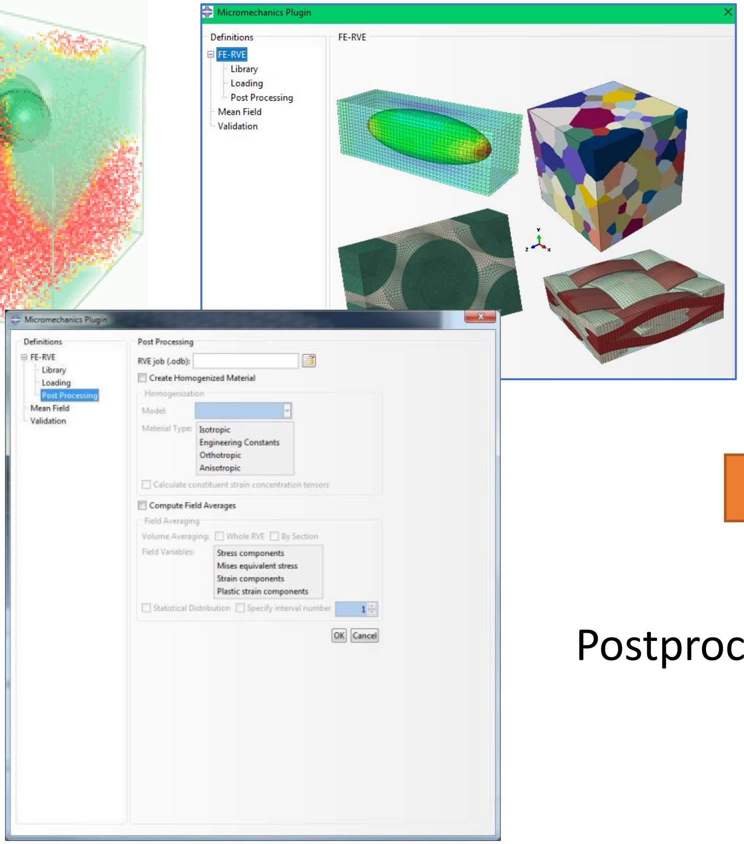
Multiscale Material Modeling Using RVE



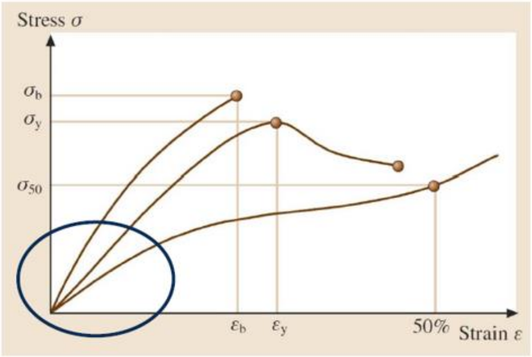


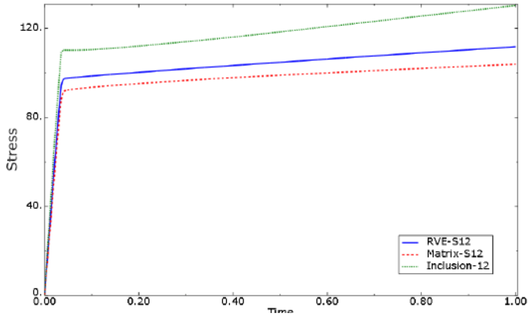
Exported to Abaqus





Postprocessing





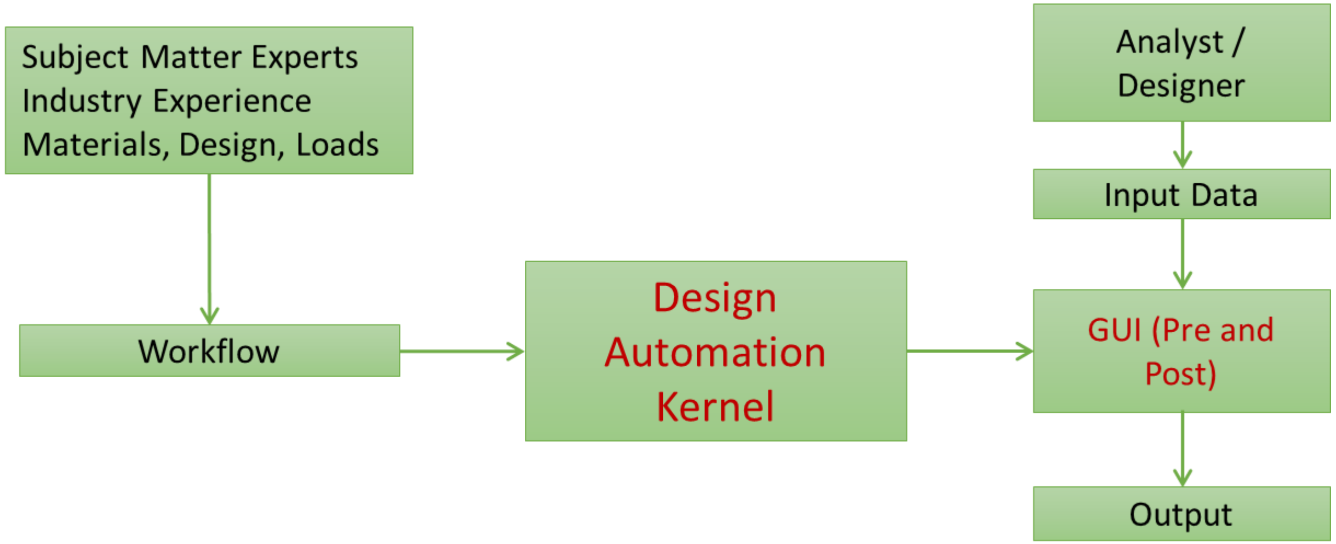
Create RVE (representative volume element) model of Elastomer material in BIOVIA Material Studio

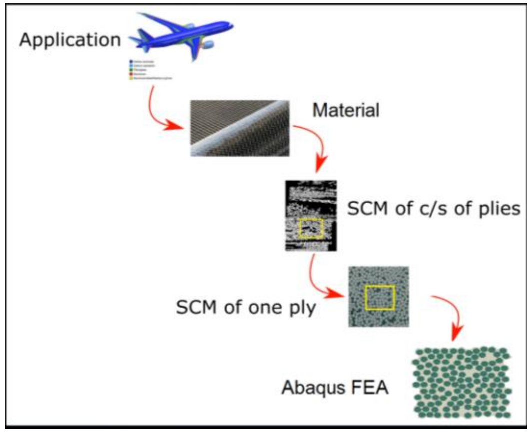
Define material properties and periodical boundary conditions by Abaqus 'Micromechanics Plug-in'

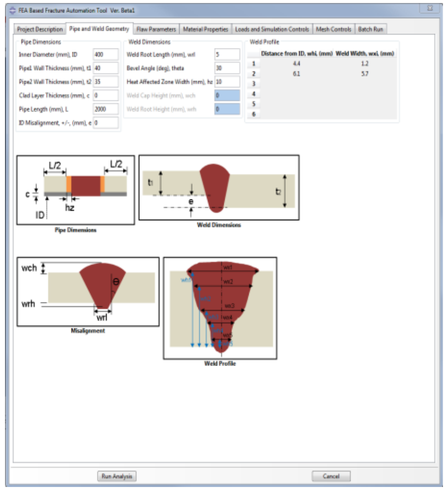
Predict Effective material properties

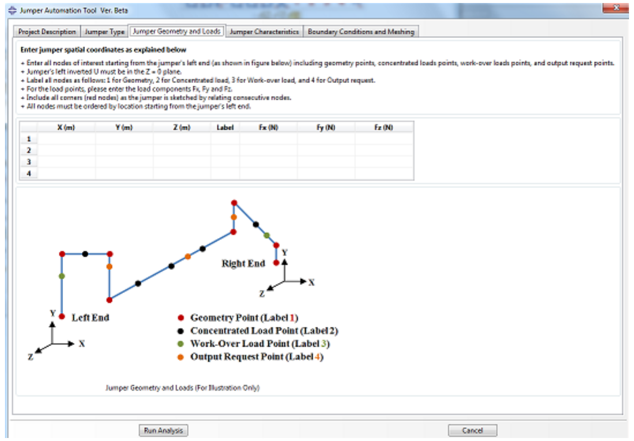
Digital Transformation

Simulation based Design Automation Solutions / Plug-Ins







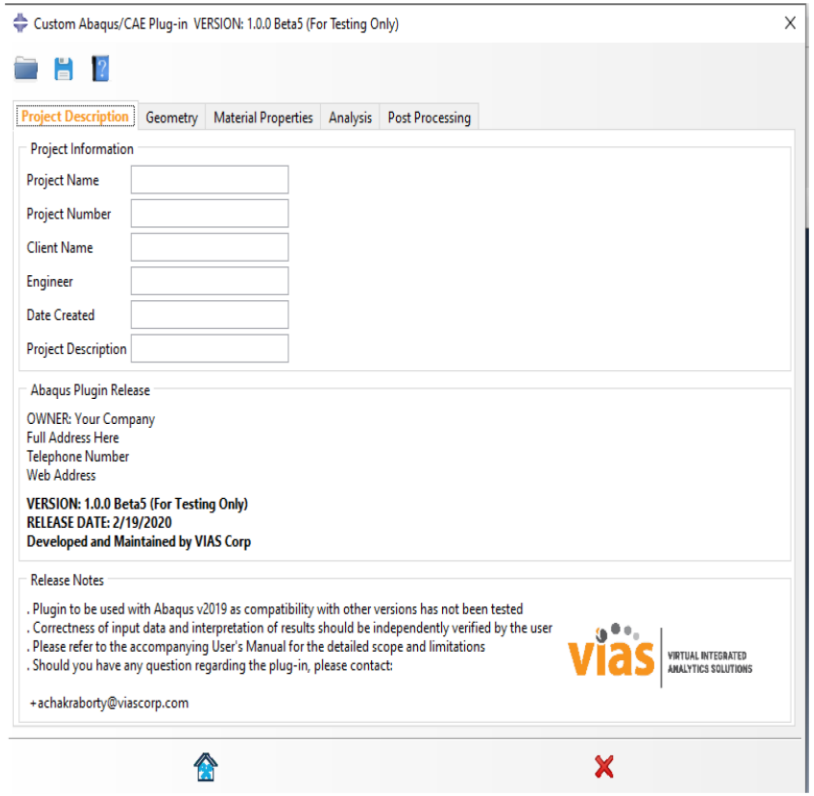


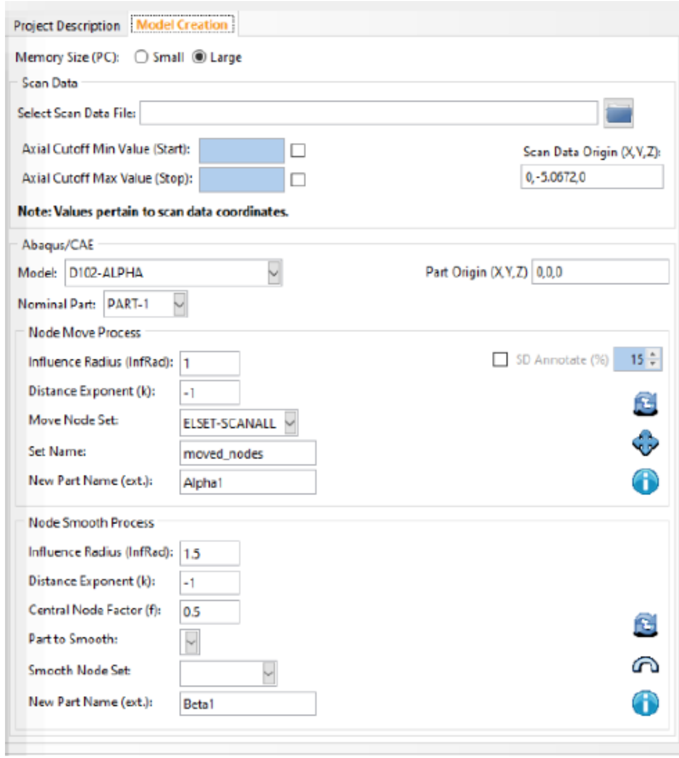
Examples: Abaqus Plug-in Tools

Automation & Templatization (GUI and Kernel Scripts)

Overview

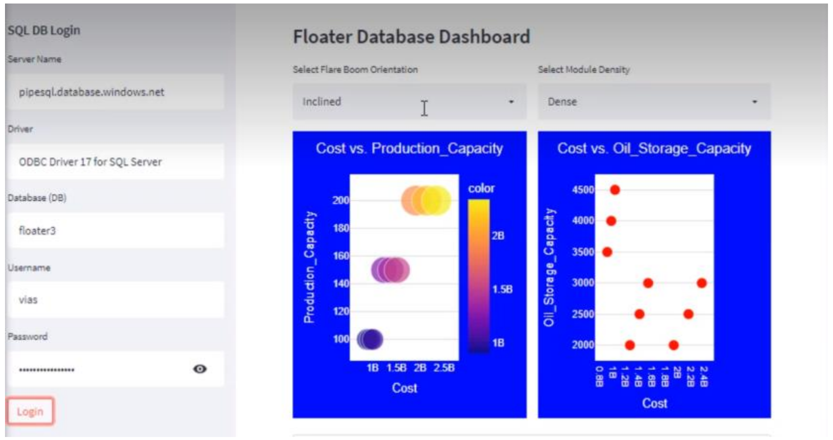
- Custom designed Abaqus/CAE Standard Plug-in
  - ➤ Creates clean interface for user input
  - ➤ Eliminates the need to edit kernel scripts
  - ➤ User does not need to be familiar with Python or coding
- Read/Write capability for input storage/access
- Modern look and feel with custom tool buttons
  - ➤ Link to User Manual
- Dynamic
  - ➤ Widgets update and respond to user interaction
- Project Description Tab allows user to customize job
  - ➤ Data can be exported to csv file





Web Tools Solutions

- Assistance to support software development, testing, website monitoring, data processing and much more.
- Software Architecture and its Complete Implementation.
- The use of technologies according to the project needs (Python, GitHub, Visual Studio, etc.)



Simulation Using AI – Reduce Computation

RAW DATA (INPUT)

DATA STRUCTURING

ML, ANN, autoencoder

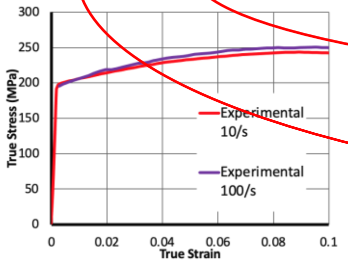
TRAINING

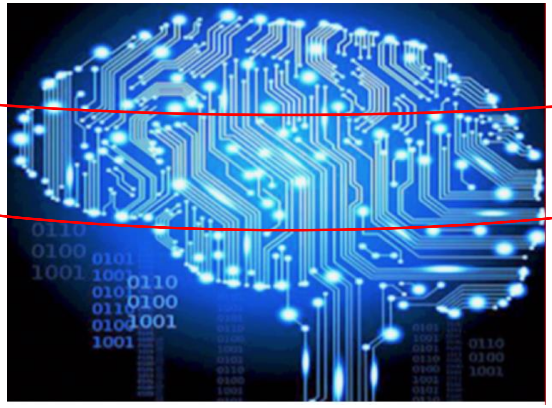
ML, ANN

PREDICTIONS

CNN, RNN

Output of Interest (stress, deformation, pressure,..)





Training Engagement

Your Training Partner

Process Automation and GUI Development

Knowledge share sessions after model execution

Best Practices

Configuration Advice

QA Checkpoints

Method Development

Training

Enablement

Design
- CATIA

Simulation
- FEA
- CFD
- EMAG
- MBSE

Automation and Optimization
- Isight
- Python

Our Training Expertise

- Vias3D have Dassault Systèmes' certified instructors who are also experts in various industry applications providing training for broad range of topics in software solutions and applications.
  - **Introductory** – Getting started with the basic software features, meshing, solving linear problems, output visualization, post-processing, etc. Topics cover solutions like Abaqus, fe-safe, Isight, TOSCA, PowerFLOW, CATIA, Delmia, Enovia, 3DEXPERIENCE.
  - **Expert-Level** – This level features nonlinear problems involving material and geometric nonlinearity, contact and convergence, fracture & damage mechanics, scripting & GUI, CATIA V5 Product and Part Design, etc.
  - **Industry Specific** – Contents are designed for particular industries focusing on problems pertinent to respective industrial applications, i.e., Aerospace and Defense, Oil and Gas, Marine & Offshore, Structural, Hi-Tech, Life Science, Consumer Packaged Goods, etc. Also, courses like FEA for fitness-for-service analysis, FEA for Offshore are offered.
  - **Customized** – Course content are modular and can be a combination of basic to advanced based on client-specific requirement. Typically designed in discussion with our client needs and contains customized examples.

Project Execution with Knowledge Transfer

- VIAS3D offers training / knowledge transfer sessions through long-term collaborations:
  - Working closely with teams in providing continuous technical support
  - Collaboration with the client, identify a work scope and execute the project.
  - After project execution, provide knowledge sharing sessions to the team members on
    - CAD modifications/simplifications
    - Input parameters
    - Modeling techniques
    - Scripting and automation
    - Etc...
  - Offer customized training based on the client's requirements and depending on the expertise level as well as the diverse technical and industry background

Thank You

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