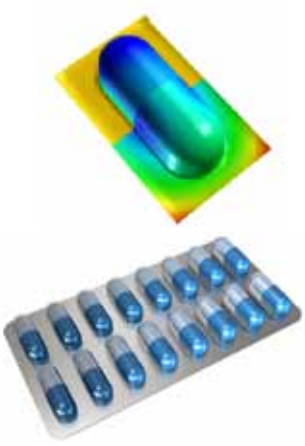
Realize Your Product Promise™

Polyflow

ANSYS

Powerful fluid dynamics software reduces the cost of polymer, glass, metals and cement processing.

ANSYS Polyflow accelerates design while shrinking energy and raw material demands to make your manufacturing more cost effective and environmentally sustainable.



You can model the manufacturing process and virtually test packaging to evaluate and optimize performance as well as reduce waste.

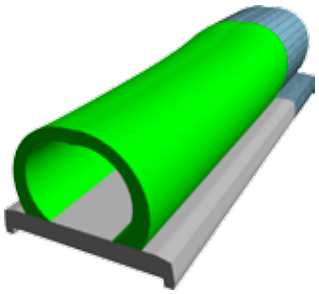
Polymers, glass, and even food and metals exhibit complex nonlinear behavior while being processed. Accurately assessing each material's performance — well before manufacturing begins — requires tailor-made software with appropriate material properties models, the capability to accurately capture flow domain deformations, and robust solvers. Companies throughout the world in the polymer, glass, metals and cement processing industries reduce manufacturing risk by employing ANSYS Polyflow® as an integral part of their product design and optimization process. They use this proven technology to optimize extrusion, thermoforming, blow molding, glass forming, fiber drawing and concrete shaping.

Developing Better Packaging

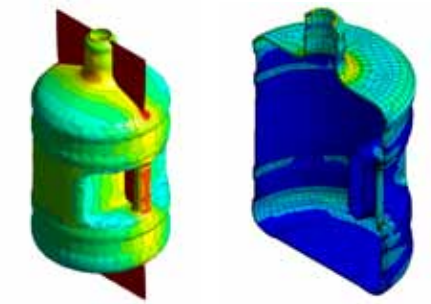
Packaging is important to protect products from damage — but it is also a sustainability issue as well as an additional cost to goods suppliers. Deploying virtual prototyping using Polyflow enables you to model the manufacturing process. By coupling this solution with ANSYS explicit dynamics software and ANSYS Mechanical™, your R&D team can evaluate and test a design's behavior and durability. You can take corrective action at the design or manufacturing phase, or both, to quickly and cost effectively design lighter packaging with better performance.

Increasing Extrusion Line Efficiency

To meet tight tolerances that the market requires, some companies resort to trial-and-error methods for (co-)extruded plastic and rubber profiles. This approach is time intensive and costly, and it can negatively impact the environment. Using engineering simulation, including our unique inverse die design capability, you can gain a significant reduction in trial-and-error iterations for your extrusion lines. Some companies that apply our solutions have decreased the number of iterations from seven to two. Insight gleaned from visualizing polymer flowing throughout the die allows you to quickly troubleshoot unexpected problems.



Co-extrusion of soft (green) and dense (grey) rubber for automotive application



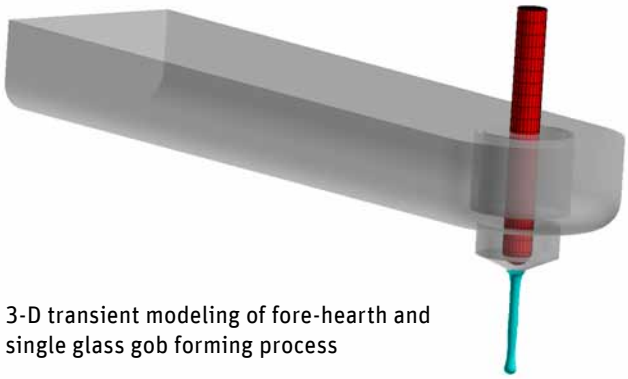
Simulation helps companies to reduce product failure risk early in the design cycle by providing insight into critical parameters/characteristics, such as material distribution (left) and top load stress distribution (middle) in a five-gallon blow-molded water cooler bottle (right).

Polyflow makes it possible to study the behavior of plastics and other materials, such as this example of injection stretch blow modeling using shell elements. The image shows thickness distribution.

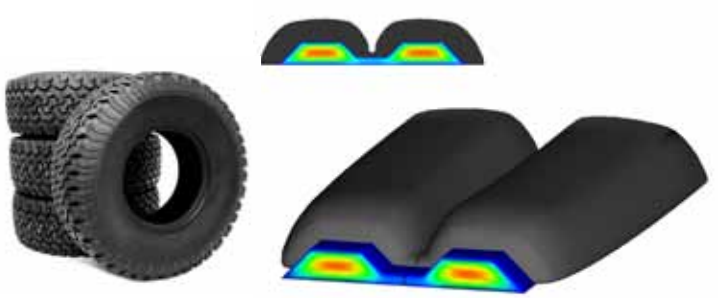
Improving Performance with a Digital Material Laboratory

Polyflow helps you to investigate behavior of new plastics and elastomers for applications as diverse as extrusion, blow molding, thermoforming, fiber spinning and film casting. Simulation allows you to test the ability to process new resins, even before they have ever been produced, by comparing prototypes for different materials to see if they match or outperform existing and competitive materials. You can reverse-design a resin to maximize end-product performance while minimizing costs and environmental impact.

To understand and accurately characterize material behavior, ANSYS provides a vast library of mathematical material models that aid in simulating materials.

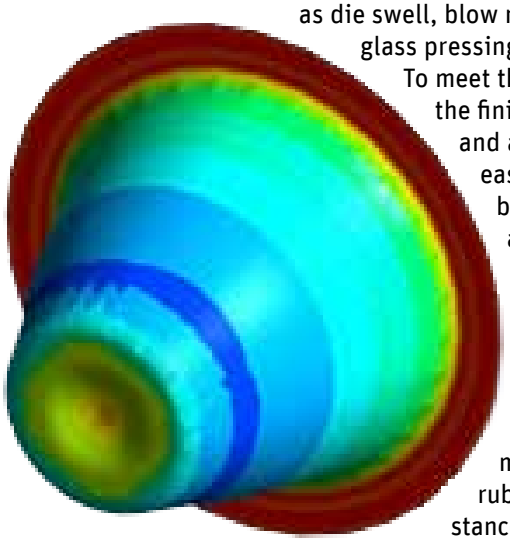


3-D transient modeling of fore-hearth and single glass gob forming process



Polyflow's advanced numerics technology allows modeling of nonlinear behavior, such as velocity distribution in a die land and large die swell induced by stress relaxation in a tire application.

An advanced, application-tailored solver and extensive models deliver the capabilities you need to optimize your manufacturing processes.



Polyflow accounts for material contact in optimizing a design, such as determining final material distribution for a plug-assist thermoformed cup.

Solvers and Numerics

Complex rheological, thermal-dependent material behaviors, or large deformations (such as die swell, blow molding, thermoforming or glass pressing) are inherently nonlinear. To meet this challenge, Polyflow uses the finite element analysis method and a robust solver. The software easily accommodates deforming boundaries through its robust arbitrary Lagrangian–Eulerian deforming-mesh capabilities.

Visco-Elasticity and Complex Rheology

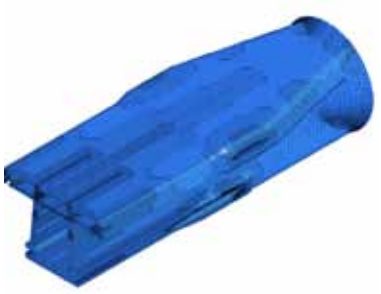
Flow characteristics of materials such as plastic, rubber, glass, metal, food substances and concrete depend on both the material itself and its process properties, such as shear rate and thermal history. Polyflow offers many material properties models, including generalized Newtonian power, Bird–Carreau and Cross laws as well as visco-elastic models (Giesekus–Leonov, PTT and pom–pom). These models accurately quantify large die swell encountered in some extrusion processes or extensional behavior typical in forming, film-casting and fiber-spinning applications.

Contact Detection

The manufacturing/forming process often involves contact between tools and materials. Therefore, the model must accurately detect contact between the deforming material, molds, and other tools as well as changes in mechanical and thermal conditions before and after contact. Polyflow combines advanced nonlinear contact detection with a robust, adaptive remeshing technique that automatically addresses these challenges. It also calculates mold motion.

Mesh Superposition Technique

Single- and twin-screw extruders are geometrically complex devices in which the flow domain changes continually. Thermal and mechanical interactions with the barrel or rotating screw(s) are important in achieving high-quality extrusions. Our software contains a validated mesh superposition technique (MST) that allows you to easily build a virtual extruder, then model the fully filled section of the screw in a 3-D environment. Dispersive and distributive mixing models together with particle tracking and statistical analysis deliver reliable tools to quantitatively compare different extruders and mixing devices.



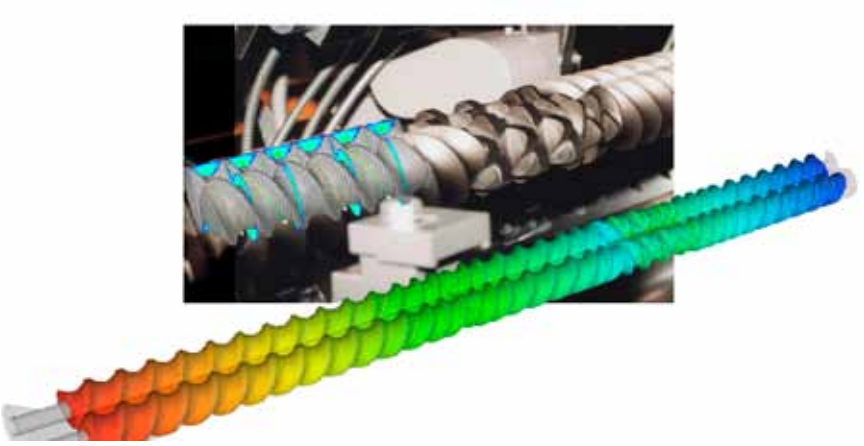
Complex PVC extrusion die

Polyflow simulates nonlinear thermal effects, which is especially important when temperature distribution is not uniform.

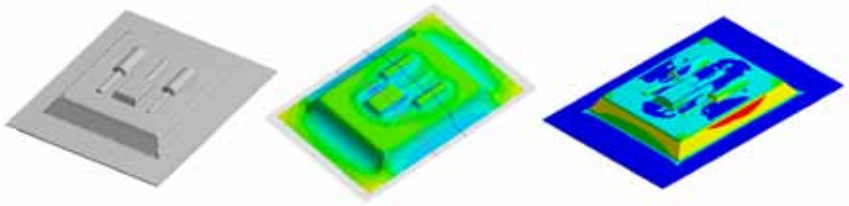
Nonlinear Thermal Effects Including Radiation

Polyflow models include viscous heating to allow you to detect potential deterioration of a polymer grade or undesired rubber curing. Accurate modeling of high-temperature processes, such as glass forming, requires the use of advanced nonlinear material properties, accurate radiation prediction (using, for example, the discrete ordinate radiation model) and the Narayanaswamy model that accounts for material stress relaxation during the cooling process.

PVC pipes

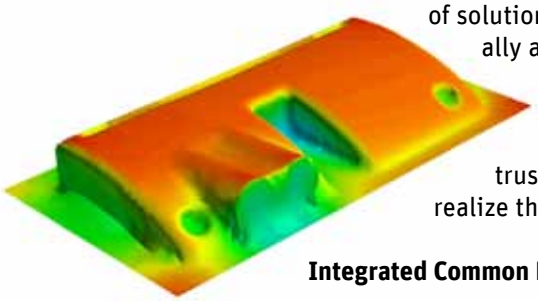


MST in Polyflow accounts for complex thermal and mechanical interactions for single- and twin-screw extruders.



Users can couple ANSYS Polyflow and ANSYS Mechanical to perform structural analysis within the ANSYS Workbench environment.

Polyflow works with other ANSYS tools to streamline your design cycle through Simulation-Driven Product Development.



Polyflow assists in optimal thermoforming of an automotive dashboard design. Areas shown in blue are less thick, demonstrating potential design weakness.

ANSYS fluid dynamics tools are one part of our suite that delivers advanced functionality — depth, breadth, a plethora of advanced capabilities and integrated multiphysics — providing confidence that your simulation results reflect real-world outcomes. The comprehensive range of solutions provides access to virtually any field of engineering simulation that a design process requires. Organizations around the world trust ANSYS to help them realize their product promises.

Integrated Common Environment

Polyflow software is fully integrated into the ANSYS Workbench™ environment, so you can easily set up any problem — from standard fluid flow analysis to complex interacting systems simulations — with simple drag-and-drop operations. Within Workbench, multiphysics applications can access common ANSYS tools, such as CAD connections, geometry tools and meshing capabilities. You can use ANSYS CFD-Post™ to compare results and perform final data analyses. These capabilities enable Simulation-Driven Product Development™, which drives innovation and enables you to perform virtual prototyping, process optimization, and virtual part-testing in a scalable and cost-effective manner.

Fluid–Structure Interaction

Polyflow includes native fluid–structure interaction (FSI) to model thermomechanical interactions between flowing materials and surrounding solids in a fully coupled approach. When large deformations occur within the elastic zone, the mesh resolution is automatically refined to improve results quality.

You can significantly reduce time to market by seamlessly exporting Polyflow results to ANSYS Mechanical software to perform structural analysis. Using the data within ANSYS explicit dynamics tools, you can conduct virtual drop tests and calculate top-loading deformation.

Optimization and Design Exploration

Designing equipment and processes for best results involves evaluating multiple designs and optimizing flow and geometric parameters. With ANSYS Polyflow, you can declare any scalar as an optimization variable, including rheological parameters, boundary conditions and mesh displacements. Then you can use the built-in optimization algorithm to automatically minimize or maximize a given objective function based on input parameters.

ANSYS Polyflow

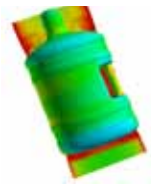
Geometry

Flow volume automatically extracted

Mesh

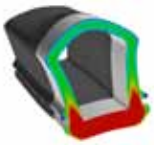
Multi-zone meshing combines the strength of various meshing tools to automatically generate a hybrid grid for a tidal turbine.

Multiphase Flow



Blow molding of water fountain canister

Inverse Die

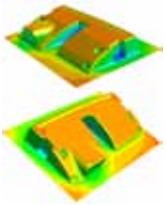


Die land auto-matically created to generate correct extrudate after all deformations

Properties

Wide range of material properties and rheological models

Post-Processing



Final thickness of thermoformed dashboad component

Pre-Processing **Simulation** **Post-Processing** **Archive**

Other ANSYS Engineering Simulation Capabilities

CAD

ANSYS DesignModeler™ and ANSYS SpaceClaim DirectModeler provide modeling and geometry creation functions for fluid dynamics analysis. The entire ANSYS suite is CAD independent, enabling data import from various sources. In addition, we collaborate with leading CAD developers to ensure an efficient workflow.

Integration

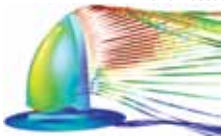
ANSYS Workbench is the framework for the industry's broadest and deepest suite of advanced engineering simulation technology. It delivers unprecedented productivity, enabling Simulation-Driven Product Development™.

Multiphysics

To help ensure a successful product, R&D teams must accurately predict how complex products will behave in a real-world environment. The ANSYS suite captures the interaction of multiple physics: structural, fluid dynamics, electromechanics, and systems interactions. A single, unified platform harnesses the core physics and enables their interoperability.

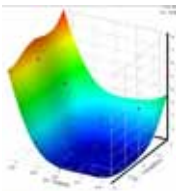
HPC

Courtesy I.M. Viola & Luna Rossa.



High-performance computing enables creation of large, high-fidelity models that yield accurate and detailed insight. ANSYS offers scalable solutions and partners with hardware vendors to ensure that you get the power and speed you need.

Design Optimization



Good design starts with identifying the relationship between performance and design variables. ANSYS DesignXplorer™ enables engineers to perform design of experiments (DOE) analyses, investigate response surfaces, and analyze input constraints in pursuit of optimal design candidates.

Data Management

ANSYS EKM addresses critical issues associated with simulation data, including backup and archival, traceability and audit trail, process automation, collaboration and capture of engineering expertise, and IP protection.

ANSYS®

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ANSYS is dedicated exclusively to developing engineering simulation software that fosters rapid and innovative product design. Our technology enables you to predict with confidence that your product will thrive in the real world. For more than 40 years, customers in the most demanding markets have trusted our solutions to help ensure the integrity of their products and drive business success through innovation.

MKT 100