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ROLES OF MACHINE MANUFACTURERS IN SUSTAINABILITY

Case Study:
September 10, 2025
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40TH spe ANNUAL BLOW MOLDING CONFERENCE
PITTSBURGH
SEPTEMBER 8-10
2025
SHERATON PITTSBURGH HOTEL AT STATION SQUARE

AGENDA

- Appreciation
- Plastic Industry Observations
- Holistic OEM Solutions “Three Piece Recipe”
  - Machine
  - Mold
  - Product
- Machine Case Study
  - Drive 2 5
- Mold Techology
  - CFD/FEA Mold Cooling / Cycle Time Reduction (complementary to Drive 2 5, but not exclusive)
- Product
  - Weight Reduction Technology
    - Structure
- Wrap-Up / Q&A

APPRECIATION

I want to thank SPE for this invitation to speak to you.

As other countries around the world continue to increase the regulations on plastics…

- We want and need a **united voice** to educate the consumers, our customers, and governmental agencies—*WE CAN DO THIS*
- We thank all of these organizations and partners of our industry for their support

THANK YOU.

Special thanks to converters, resin producers, supply partners and Uniloy global customers for the input and assistance provided for this presentation.

PLASTIC INDUSTRY OBSERVATIONS

PLASTIC

Plastic is the most effective and lowest GHG solution for the vast majority of product packaging.

- The UN is developing a global treaty
- Many other countries have more precise and more demanding requirements, with fees or taxes imposed ultimately on the consumer
- Per McKinsey, more than 80% of the world's plastic is from countries with no or mismanaged waste management systems. ***Based on global industry indicators, the U.S.A. is one of lowest recycling countries in the world****.
- Despite the legislation that is passed or proposed, the plastic reuse and waste problems ***cannot be solved without "multi-layer" cooperation*** by governments, brand owners, resin producers, converters and consumers.

* % of plastics collected form consumers for recycling

STATE OF THE PLASTIC INDUSTRY

Circularity—no longer optional and teamwork among all industry participants is essential.

Consumers expect brand owners and retailers to drive package sustainability.

Increasing demand for recycled resins (mechanical, bail, clean flake, re-pelletized, erema, advanced).

All parties in the ***supply chain*** must work closely to ensure recycled resin and the means to use it will be ready when customers demand.

Shortages of ***working staff***, experience, and talent, as a generation of
staff retire.

Need for improved ***methods*** to maintain aging machine fleets.

Need for ***upgraded equipment's*** as converter margins may become squeezed due to material and conversion cost increase as everyone copes with the higher costs of reprocessed material usage.

CIRCULARITY AND LOWER GHG CHALLENGES

Lower plastic production to reduce GHG—***HOW?***

- Less virgin produced and consumed, more recycled
- Lower-weight bottle designs
- Use less energy in plastic production

The public, consumers, and governments must be better informed so they can improve waste collection and recycle efforts

More recycled plastic waste converted to recycled resins—**better yields**

Converters and molders must be better equipped to produce products with recycled resins

- Improved product design and revised ***"fit-for-use"*** standards
- Improved **workforce training and better tools** to meet new expectations
- Production **equipment improvements** to meet new expectations

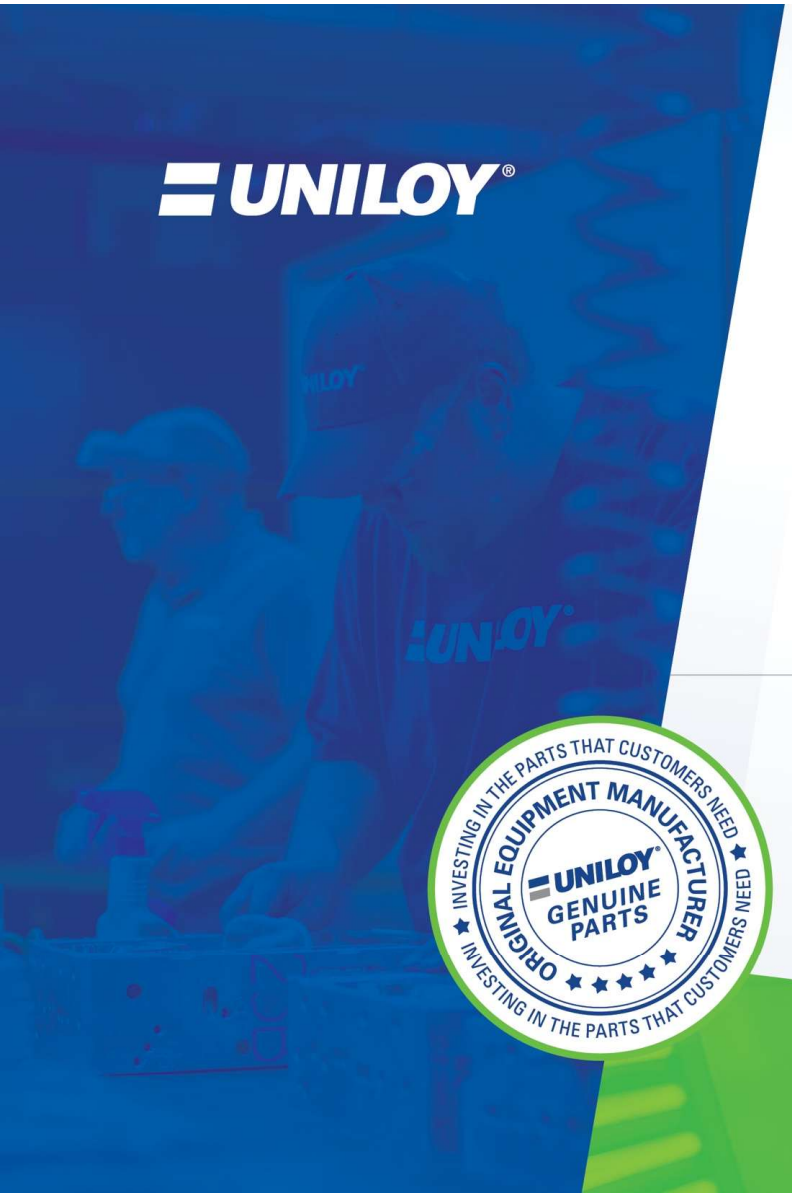
RECYCLING OUTLOOK

Global brands are making commitments to use 30%-50% recycled resin.

- The investments to add recycling capacity will continue the PREMIUM PRICE for reprocessed resin—PCR to virgin premium~20% - 30%
- Who pays for the progress?

As everyone commits and plans to increase production of products using recycled resins, and plans are made to increase resin production, next comes the EASY part:

*Converters and blow molders have the **"simple"** task of re-inventing their production processes to accommodate ever-increasing recycled resins.*



HOLISTIC OEM SOLUTIONS
“THREE PIECE RECIPE”

MACHINE *"OUR COMMITMENT TO A GREENER FUTURE"*

- OEM Machine Technologies is dedicated to integrating sustainability into every aspect of our operations, from design to delivery. We prioritize eco-friendly practices to reduce environmental impact while delivering high-quality machine solutions.

Key Sustainability Topics:

- ✓ ***Energy-Efficient Manufacturing***: Utilizing advanced technologies to minimize energy consumption in production processes, achieving ***up to 30% reductions in power usage***.
- ✓ **Recycled and Sustainable Materials**: Sourcing components from recycled metals and sustainable suppliers to lower resource depletion and **promote circular economy principles.**
- ✓ ***Waste Reduction Initiatives***: Implementing zero-waste strategies, including recycling programs and lean manufacturing techniques to cut down on industrial waste.
- ✓ Carbon Footprint Minimization: Tracking and offsetting emissions through renewable energy adoption and efficient logistics, aiming for ***net-zero operations by 2030***.
- ✓ ***Sustainable Supply Chain***: Partnering with environmentally responsible vendors and conducting audits to ensure ethical and ***green practices throughout our network***.

MOLD

- Efficient Mold Cooling for Sustainability

  - **Cooling can account for up to 70% of cycle time** in blow molding, so optimizing it reduces energy use, shortens production times, and minimizes defects, contributing to sustainability by lowering electricity consumption and waste.
  - **Cooling Channels and Systems**: Design conformal cooling channels that follow the mold's contours for uniform heat dissipation, **reducing cycle times by 20-40%** and energy use. Use water-based systems with recycled fluids to cut water waste. Advanced chillers provide precise temperature control while being energy-efficient and compliant with environmental regulations.
  - **Air Recirculation and Fast Cooling**: Implement fast cooling systems that recirculate compressed air, transferring heat from the product's interior to exterior, improving quality and **reducing energy by up to 40%.** For PET preforms, optimize cooling for high-precision control, avoiding excess water use.
  - ***Energy-Saving Features***: Integrate variable-speed pumps and electronic expansion valves in chillers to match cooling demand, ***saving 20-30% on energy***. Audit for leaks and insulate lines to further reduce losses.

- ✓ Efficient cooling not only boosts productivity but also enables processing of sustainable resins which require precise thermal management.

PRODUCT

❖ Design Optimization for Sustainability

- ***Optimizing mold design*** focuses on lightweighting, material efficiency, and compatibility with eco-materials, using **simulation tools to minimize trials and waste**.
- ***Lightweighting and Material Distribution***: Design molds for thinner walls in products, ***reducing resin use by up to 60%,*** which lowers material costs and emissions. Incorporate Base technology with additional air ducts to improve airflow, ***reducing blowing pressure by 30%*** (e.g., from 30 bar to 20 bar) and energy for compressors.
- ***Compatibility with Sustainable Resins***: Optimize for recycled or bio-based materials like rPET, PHA, or bio-resins by adjusting mold temperatures and using multi-layer extrusion heads for PCR integration. This supports ***up to 100% recycled content*** without quality loss.
- ***Simulation and Advanced Tools***: Use CAD/CAE software and 3D printing for prototypes to predict flow, cooling, and stress, ***reducing physical iterations and waste***. Hybrid or all-electric machine integrations ensure no idle energy use.

✓ ***These optimizations can cut energy by 40-60%*** and enable mono-material designs for easier recycling.

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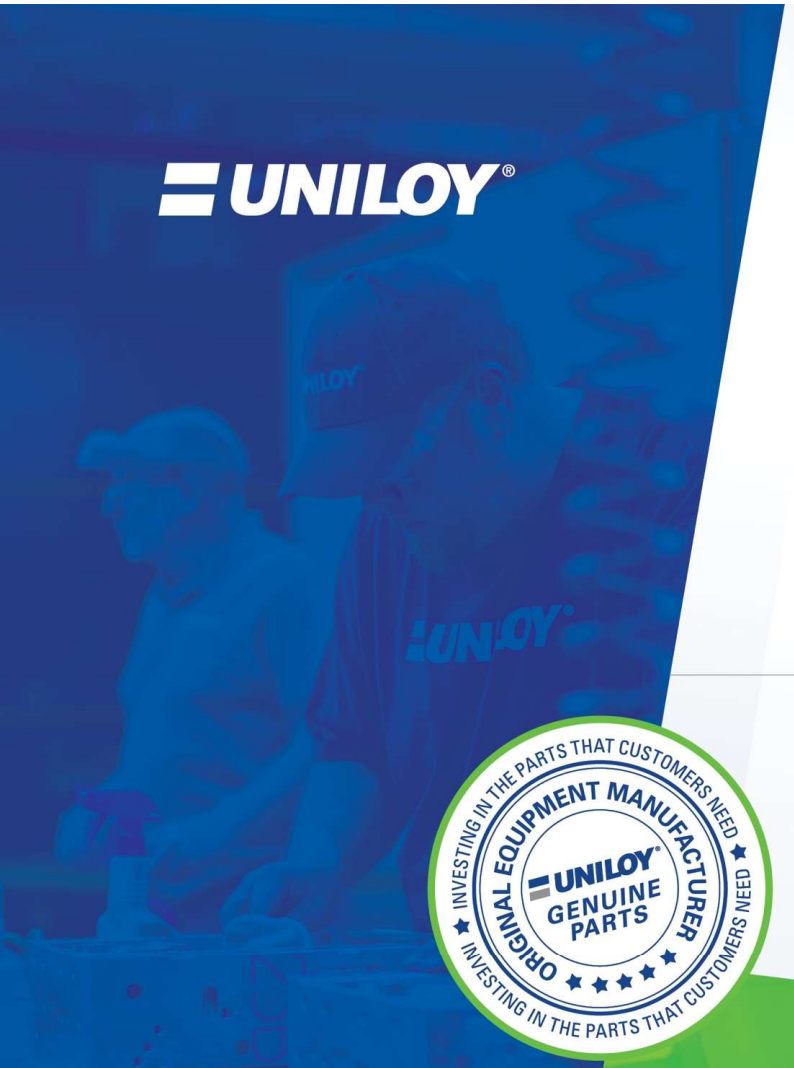
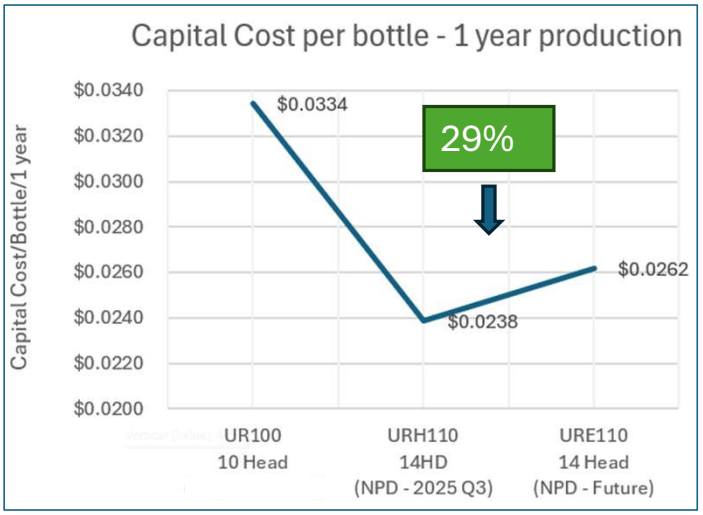
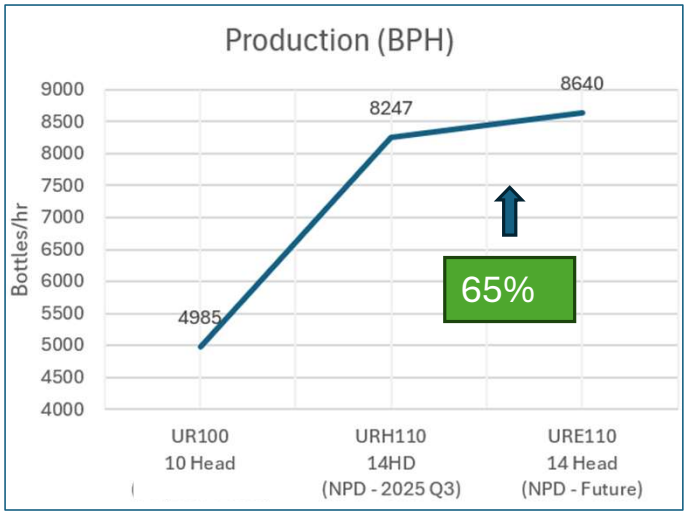


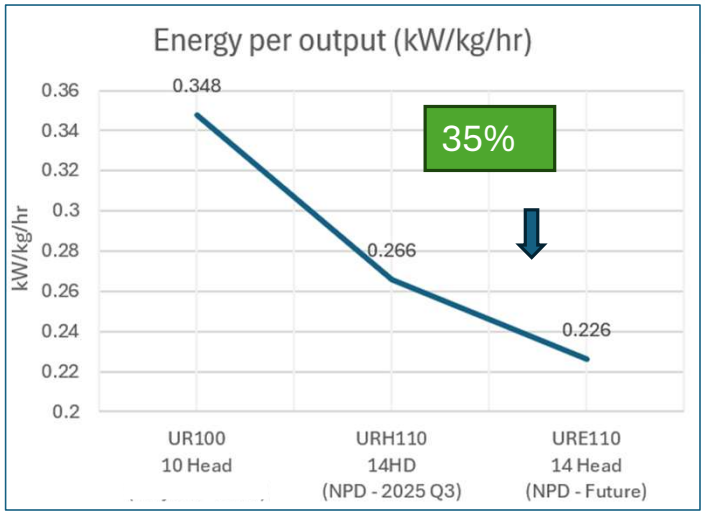
MACHINE CASE STUDY

VALUE PROPOSITION

As an OEM Machine Technology provider, Uniloy is dedicated to integrating sustainability into every aspect of our operations, from design to delivery. We prioritize eco-friendly practices to reduce environmental impact while delivering high-quality machine solutions and maximizing productivity

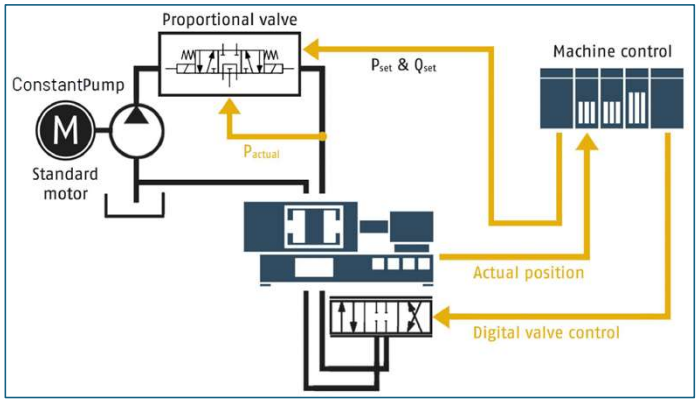


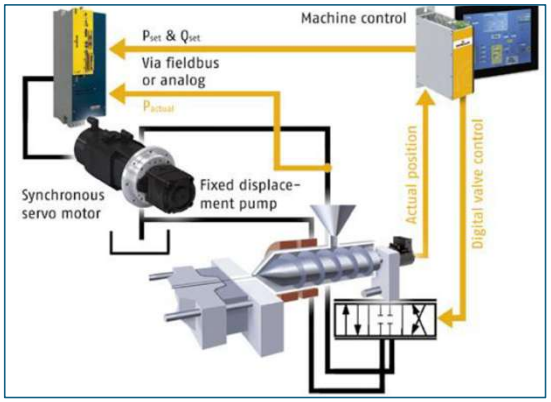




DRIVE TO FIVE – SERVO HYD POWER UNIT

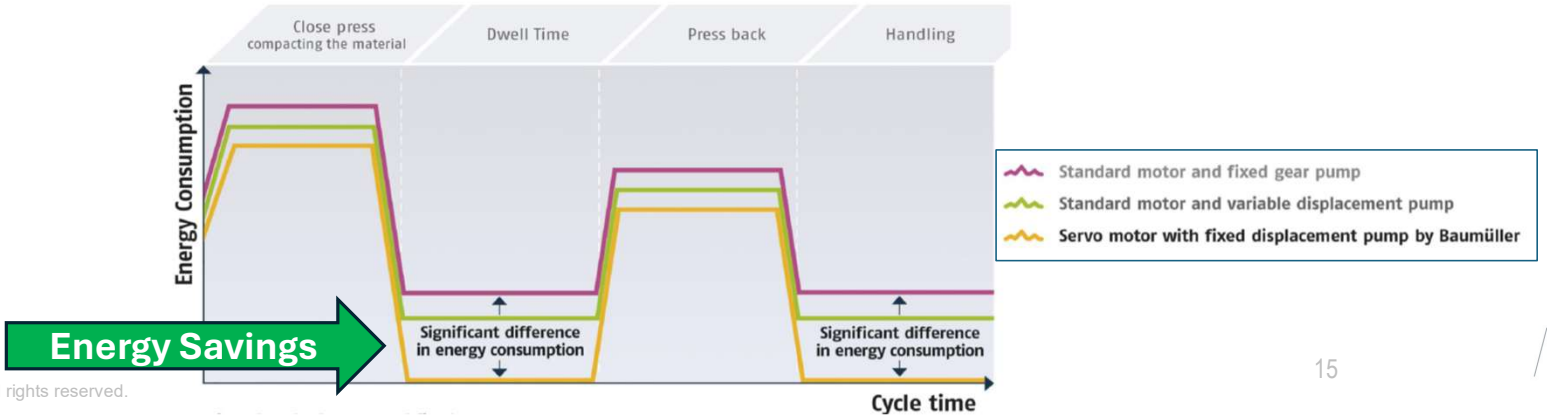
Traditional Hydraulic Power Unit w/induction motors **vs** **Servo-Hydraulic Power Unit w/Baumuller motors**





Advantages:

- ✓ **Replaces always-on 50hp power unit.**
- ✓ **Eliminates proportional valves**
- ✓ **Eliminates accumulators**
- ✓ **Modular design. Scales with options.**
- ✓ **Energy efficient.**
- ✓ **Direct pressure & flow control**
- ✓ **Low Noise**



DRIVE TO FIVE - EXTRUDER - BAUMULLER MOTORS

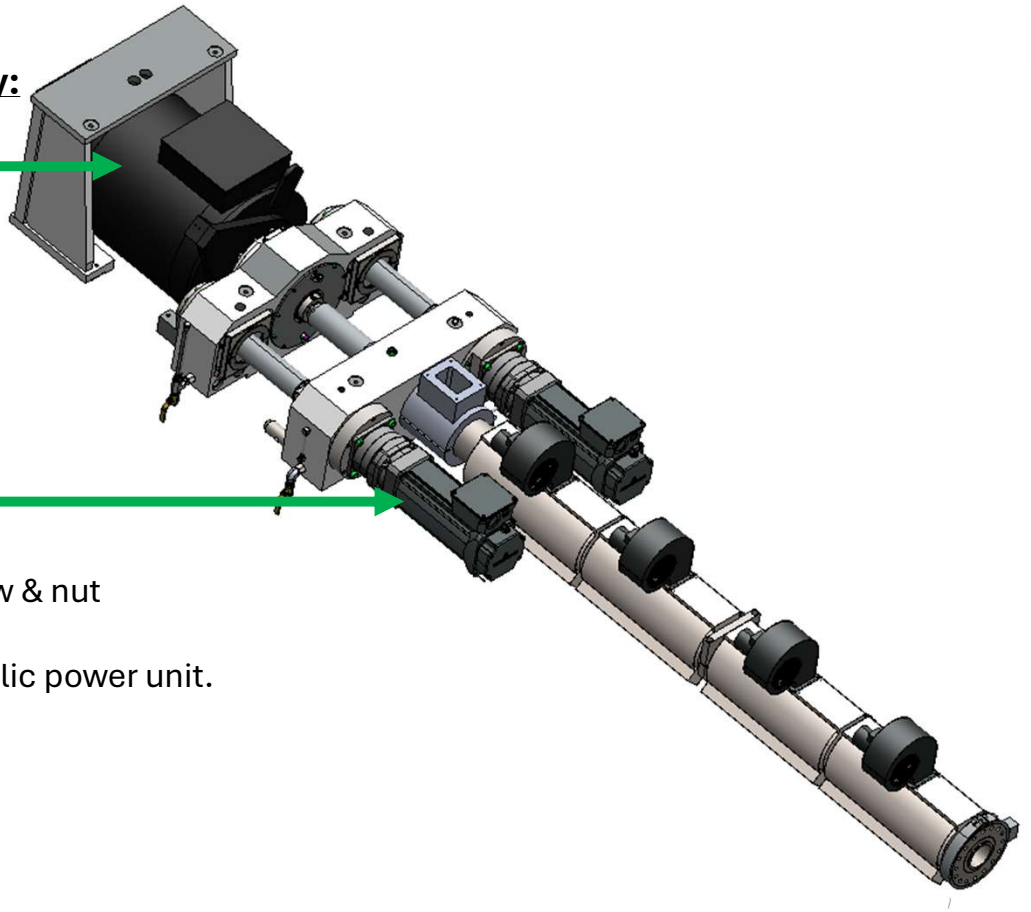
Baumuller Servo Motors in the URH Extruder Assembly:

Extruder screw rotate.

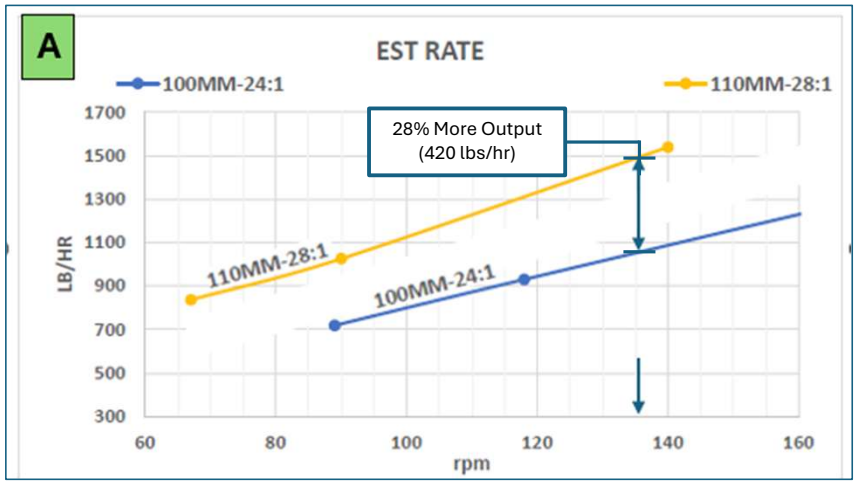
- 120hp, water cooled, hollow shaft, direct drive , servo motor
- Advantages:
  - 14% more energy efficient
  - Replaces 150hp traditional induction motor,
  - Eliminates gearbox, belts & sheaves
  - Shortens blow molder's footprint

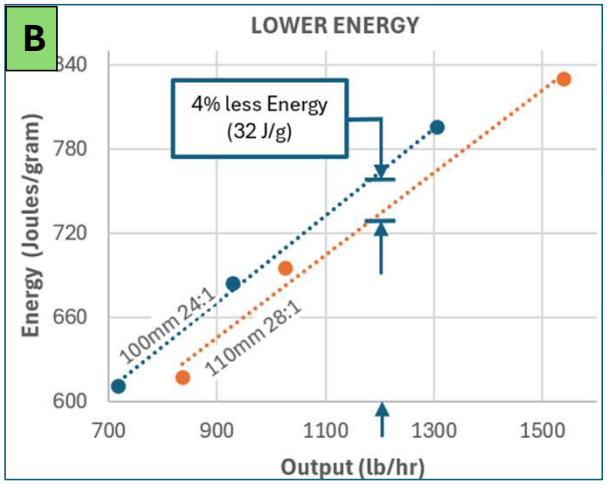
Extruder injection

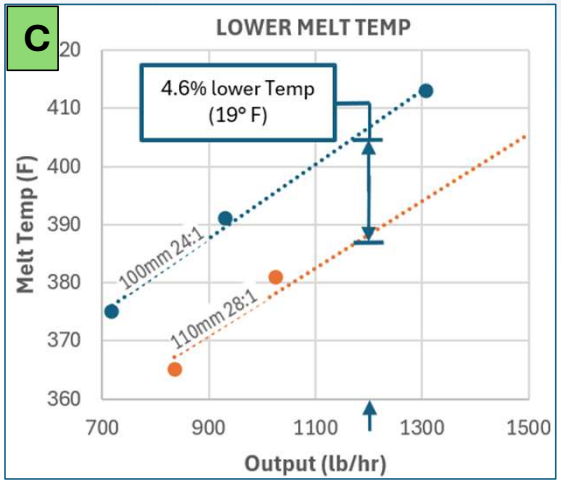
- Electric Option:
  - (2) 79hp, water cooled, servo motors driving roller screw & nut
- Hydraulic Option:
  - (2) 6" bore hydraulic cylinders powered by servo hydraulic power unit.



DRIVE TO FIVE - URH FEEDSCREW







Feedscrew Advantages of 110mm 28:1 vs 100mm 24:1

- **A** 28% more output (1500 vs 1080 lbs hr @ 135rpm)
- **B** 4% more energy efficient
- **C** 4.6% lower melt

- ***These (3) decrease cycle time!***

MOLD TECHNOLOGY

THE WHAT

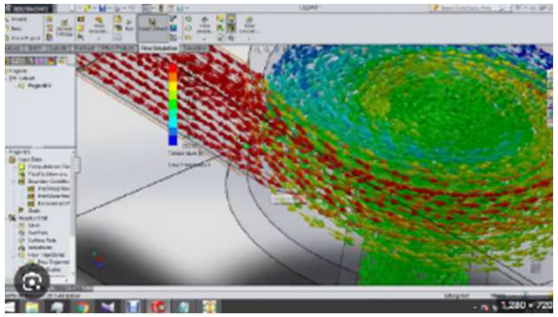
COOLING SYSTEM OPTIMIZATION

Redesign Cooling Channels: Redesign cooling lines to bring them closer to the problem areas.

Conformal Cooling: Implement conformal cooling technique to enhance cooling efficiency at the hot spots.

Increased Water Flow Rates: Optimize flow rate to obtain turbulent flow.

Advanced Venting Methods: Properly placed venting will allow for faster contact and improved cooling time.



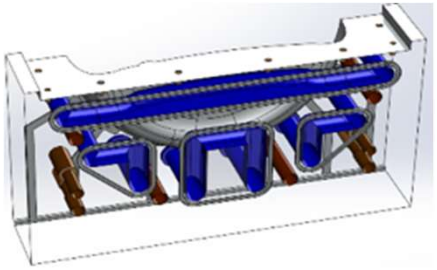
THE HOW

SIMULATION, FEA AND CFD ANALYSIS

Blow Simulation POLYFLOW or B-Sim: Simulates the blow molding process, predicting the wall thickness distribution and potential defects in the final product.

FEA: is used to evaluate the structural integrity of the blow-molded part under different loading conditions. It helps determine if the product can withstand expected stresses and strains.

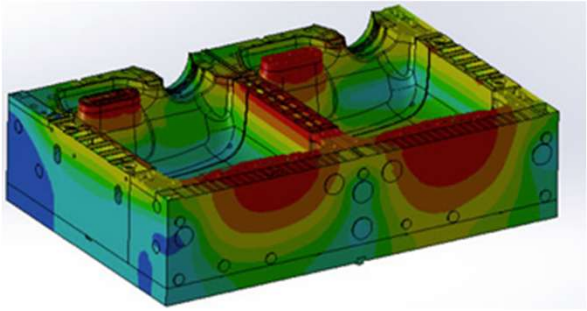
CFD can be used to model the cooling process of the blow-molded part, which affects the final part's mechanical properties and dimensional stability. Optimizing cooling improves cycle times and part quality.



THE RESULTS

COST AND TIMING REDUCTION STRATEGY (ACHIEVING A 30% REDUCTION)

- ***Timing Reduction:***
- ***Cooling Time Reduction:*** *Focus on hot spot areas to shorten the cooling phase significantly. If cooling time can be cut by 30%, this will directly reduce cycle time.*
- ***Simultaneous Optimizations:*** *Implement improvements concurrently in the shoulder, handle, and tail to achieve a cumulative 30% cycle time reduction.*

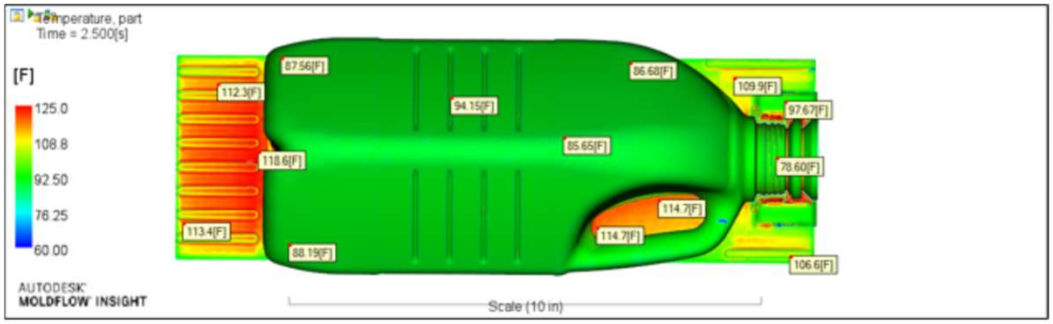


CFD / FEA MOLD COOLING / CYCLE TIME REDUCTION

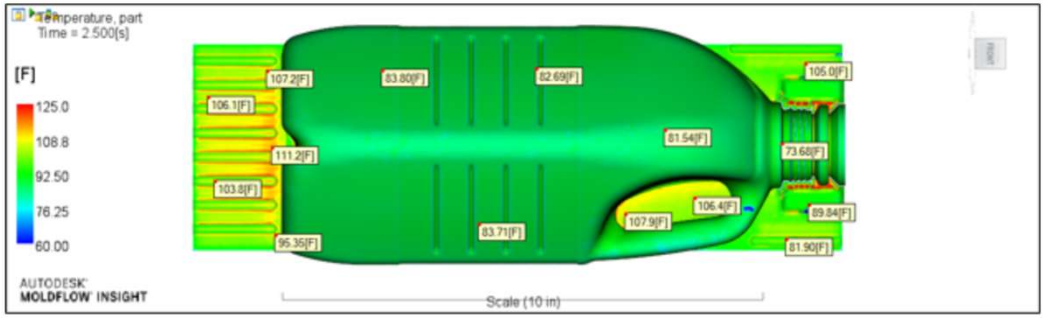
> ***Enhanced Mold Cooling***

- Preliminary CAE assessment indicate cycle time saving
- Complementary to Drive to Five, but NOT exclusive

Base Line

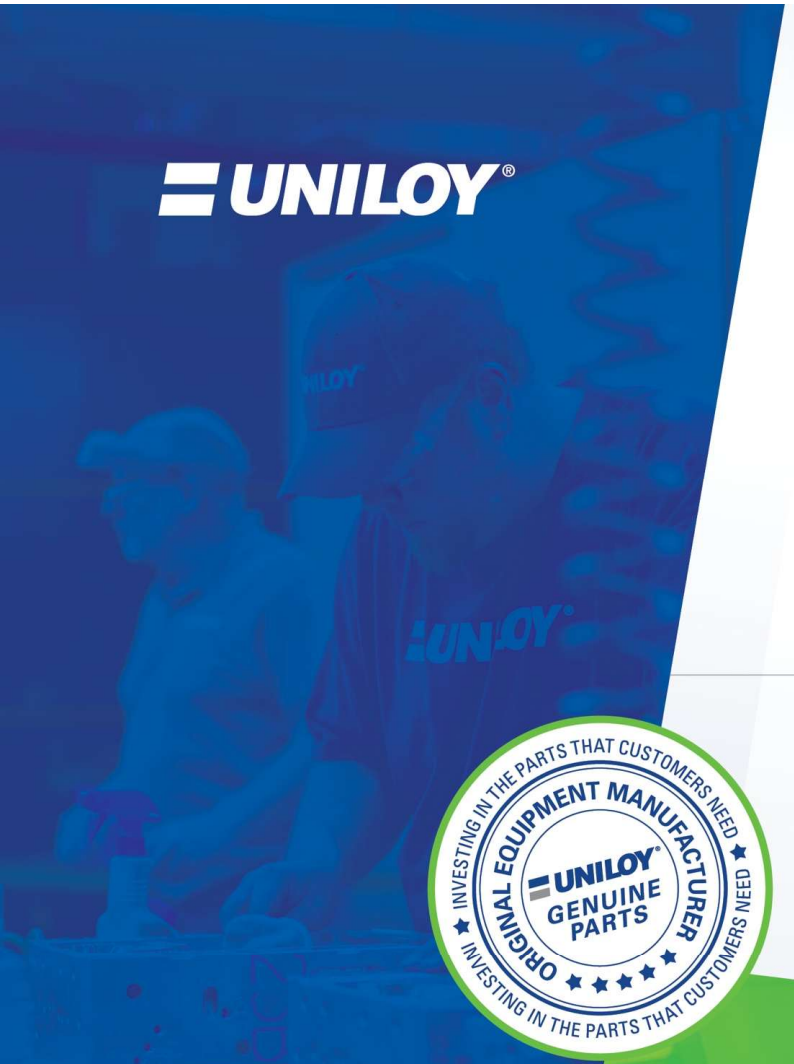


Multivariable “Best Fit”



Final Recommendations

1. Raising Raynolds numbers in current process is critical to raising cooling efficiency.
2. Future mold construction can be simplified
3. Placement of cooling lines will aid in cooling.



PRODUCT

Weight reduction technology

STRUCTURE

- USING FEA WE CAN RUN CONTAINER PERFORMANCE MODELS AT DIFFERENT WEIGHTS.
- Following example is using the 20 litre edible oil container at 1050 grams
- The results show that IF a theoretical uniform wall thickness of 1.7mm could be maintained. The weight would be reduced by 25% without compromising the Topload.

While uniform wall thickness may not be possible

it does indicate some opportunities.

- Current wall thickness:- 3.0mm maximum to 1.5mm minimum

CASE STUDY.
PRODUCT DESIGN OPTIMIZATION USING FEA ANALYSIS.

Current Jerrycan

Product Sample

Six-surface marked and SCAN outer surface to create 3D model and 2D drawings

Sectioned and SCAN inner surface to create 3D model and 2D drawings

Wall Thickness Measurement

PRODUCT DESIGN OPTIMIZATION USING FEA ANALYSIS.

Uniloy Simulation using a suggested even wall thickness of 1.7mm

- Actual part sample would come out at aprox– *778 gms – 25.5% reduction*
- Material tensile strength 25 MPa. The maximum stress is at 10.06 MPa, less than the theoretical tensile strength. The Jerrycan can withstand 100kgf without failure.
- Slight warpage of 2.97mm at the center of the Jerrycan, moving inwards

WRAP-UP / Q&A