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Shortages, Demand, Investing in Technology All Part of Business for Thermoformers in 2021

By Frank Esposito, Plastics News Staff

This interview between Division Chair Steve Zamprelli and Plastics News correspondent Frank Esposito first appeared in PN in September 2021. It is reprinted with permission in our Q4 issue.

The thermoforming market, like other plastics sectors, is looking for ways to improve products while making it through a global pandemic and handling supply chain challenges. This is no easy task, but Steve Zamprelli and other thermoforming leaders are up to the challenge.

Zamprelli is vice president of engineering and product development at Formed Plastics Inc. in Carle Place, N.Y. He also serves as chairman of the thermoforming division of the Society of Plastics Engineers. The division recently hosted it annual conference, Sept. 20-22 in Grand Rapids, Mich.

In a series of emails with Plastics News, Zamprelli discussed key topics important to thermoforming in 2021.

Q: What machinery improvements are the most promising for thermoforming?

Zamprelli: Automation and better controls for temperature and speed to improve throughput and part quality. Also, quicker setups for die changeovers and equipment that works within a cell to minimize operator involvement.

In the area of part trimming, CNC routers and robotics have improved dramatically to decrease time and improve part quality. There also have been many advancements within the thin-gauge industry for full automation and less labor.

AI interactive options for real-time results for FAT and SAT have helped significantly during the pandemic with remote participation and problem-solving. There’s been a major push for equipment utilizing features to minimize labor and exposure due to concerns from the COVID pandemic.

New advancements in materials have been optimized plug assists for improved material distribution and down gauging.

Q: Are there other areas that still need improvement?

Zamprelli: Molds and tooling need to be able to talk to machines. Machines need to be able to provide all feedback to the user. Heavy-gauge processing equipment typically doesn’t have these features.

Process optimization is key to control cost and throughput.

Advancements that have been incorporated into the equipment within the thin-gauge industry would also significantly improve efficiency within heavy-gauge thermoforming equipment. We need to find ways to make the technology more cost-effective. And there’s always an ongoing request for continuous improvement, ease of setup and quicker throughput.

Q: How have thermoformers responded to the COVID pandemic?

Zamprelli: Thermoformers have responded to the needs of COVID quickly. A major shift in production to first-response products was ramped up for PPE. Many processors were making face shields and masks, ventilators and respiratory equipment, protective intubation shields and even beds.

Q: What have been the biggest challenges for these companies?

Zamprelli: Delays in getting tooling, material to make the parts, retaining adequate personnel to produce the products. Challenges of keeping teams together during pandemic and maintaining schedules and commitments were critical.
Employees were very concerned to come to work and others were out unexpectedly throughout the worst of the pandemic when these products were needed most. Many companies had to lay off personnel to survive or lost key team members due to abrupt retirements or due to government incentives. Many continue to struggle with this issue.

Q: What other supply chain issues are thermoformers facing this year?

Zamprelli: Supply chain nightmares is a better description. We cannot get anything. This all starts at the raw material level.

Our suppliers commit to dates and we forecast schedules from this. Suppliers are not able to deliver as promised because they cannot get their materials either. There’s also been volatility of raw materials and unpredictable pricing.

Equipment maintenance and downtimes have increased due to inability to receive replacement parts quickly. Cost and lead time of any new equipment and tooling has increased due to raw material shortages.

We’ve seen man-made energy issues due to government restrictions. California, for example, has to balance its energy consumption through wind, natural gas and electricity. Between mother nature and government restrictions, this situation continues to be a perfect storm.

Q: What’s the outlook for the rest of the year and for 2022?

Zamprelli: Many of us are very busy and some, quite frankly, are busting out of the seams. I’ve been told the same line from many in our industry: “We have so much work, but can’t produce due to lack of material and personnel.”

However, others will say business is down, but sales are equal dollars due to the increasing costs of resins. Impacted markets are agriculture, medical and industrial. So, 2022 should be an interesting year for the thermoforming industry.
Pactiv Evergreen to Acquire Fabri-Kal

September 08, 2021 – Pactiv Evergreen Inc. (NASDAQ: PTVE) today announced that its wholly-owned subsidiary, Pactiv Evergreen Group Holdings Inc. has reached a definitive agreement to acquire Fabri-Kal, a leading manufacturer of foodservice and consumer brand packaging solutions. The transaction, valued at approximately $380 million, subject to adjustments for cash, working capital and indebtedness, is expected to close late in the third quarter or early in the fourth quarter of this year, subject to regulatory approvals and satisfaction of other customary closing conditions.

“Combining these two complementary companies will further expand Pactiv Evergreen’s position in the Foodservice segment, broaden our sustainable packaging product offerings and customer base, and increase our manufacturing capacity and distribution capabilities,” said Mike King, Pactiv Evergreen CEO. “Fabri-Kal is well known for its high-quality products, longstanding customer relationships and sustainable packaging solutions. We look forward to the Fabri-Kal team joining Pactiv Evergreen and working together to drive increased value for our shareholders, customers and employees.”

Approvals

The transaction is expected to close late in the third quarter or early in the fourth quarter of this year, subject to regulatory approvals and satisfaction of other customary closing conditions.

Advisors

Debevoise & Plimpton LLP served as legal advisor for Pactiv Evergreen. J.P. Morgan Securities LLC served as exclusive financial advisor for Fabri-Kal, and Clark Hill, PLC acted as legal advisor.

Follow the SPE Thermoforming Division on Twitter @SPEThermo

Partners share Open-source PFAS-free Packaging Technique

By Amanda Jasi, The Chemical Engineer

September 14, 2021 – FOLLOWING nine months of collaboration, partners Solenis and Zume have open-sourced a recipe and method for manufacturing non-plastic PFAS-free food and consumer packaging.

The partners say the unveiling of this process marks an important milestone for the industry.

Per- and polyfluoroalkyl substances (PFAS) are used in a variety of applications, including as coating for paper and cardboard containers for fast-food and to-go boxes. However, PFAS have been linked to harmful health effects, including decreased fertility, weakened immune system response, and increased risk of certain cancers.

In a co-written report, specialty chemicals company Solenis and Zume outline a method to be used in a single process flow to produce oil- and grease-resistant (OGR) moulded fibre packaging. The resulting product is additionally fully compostable within 90 days of disposal. Zume is a sustainable solutions company working to replace single-use plastics with 100% compostable, plant fibre-based products.

The companies identified five parameters needed to achieve OGR without using PFAS, which include thermoforming; freeness; chemistry management; charge management; and part formation. Using these parameters, they produced moulded fibre packaging that resisted oil at 60°C for 2 hours. According to Pam Horine, VP of Product Research & Compliance at Zume, this matches oil holdout in PFAS-containing products.

Thermoforming is the process of heating material to its forming temperature and then applying force to shape the material. The researchers discovered that OGR action of Solenis’s OGR imparting TopScreen coating technology could be boosted by using a hot pressure at a minimum 11.5 MPa in Zume’s patented Molded Fibre Cell technology – used to produce products such as food containers to...
replace plastics – and a set of Zume designed products. Solenis’s existing TopScreen OGR barrier coatings are a new alternative to polyethylene film and PFAS used in paper, paperboard, and moulded fibre packaging.

The report adds that a higher pressure is recommended if there are no negative effects, e.g., decrease of part aesthetics. Horine explained that part aesthetics refer to the appearance of a part. “At higher pressures, the part may develop areas of local discoloration that would not be acceptable to consumers.”

The team determined that optimum OGR was achieved when the pulp slurry used to produce the moulded-fibre products is managed to a Canadian Standard Freeness (CSF) of 200–300 CSF. Horine said that CSF is a standard test used in the pulp and paper industry that describes how quickly water drains from a known quantity of pulp.

Achieving optimum OGR further requires managing the sequence of chemical addition and mixing times; keeping the charge of the slurry and white water within recommended ranges (-100 to -2 mEq and -30 to 15 mEq, respectively); and ensuring uniformity in the fibre matrix and minimising void volumes.

The technique outlined is specific to the brands identified.

John Panichella, CEO of Solenis, said: “Our goal is to encourage any manufacturer in the world to start using this technology as quickly as possible.”

“Through this joint initiative with Zume, global brands can meet their commitments to eliminate the use of PFAS faster than ever before.”

Zume also announced that it would no longer manufacture products containing PFAS at its California packaging facility, effective immediately. The company is collaborating with partners around the world to ensure production is PFA-free by the end of 2021.

While PFAS use currently persists, industries and organisations are making moves to avoid them, including in food contact applications.

In July 2020, the US Food and Drug Administration (FDA) announced that three manufacturers of certain PFAS used in food packaging were beginning a 3-year, voluntary phase-out of sales of these substances for food contact purposes, in January 2021. This followed a study which revealed the potential health risks of chronic dietary exposure to PFAS. A fourth manufacturer informed the FDA in 2019 that it had stopped sales of short-chain PFAS products in the US.

**Placon Buys Former Sonoco Packaging Operation in North Carolina**

*PlasticsToday Staff*

October 13, 2021 – Thermoformer Placon announced today that it is expanding its production capacity and employee base with the acquisition of a former Sonoco packaging operation in Wilson, NC.

Placon, which has its headquarters in Madison, WI, has reached an agreement to purchase substantially all operating equipment and hire more than 80 employees at the 112,000-square-foot location. The deal will help meet existing capacity needs in the retail and medical markets and further expand Placon’s role in thermoforming sustainable post-consumer recycled PET packaging, said the news release.

“The acquisition boosts Placon’s production capacity overnight to serve rapidly growing demand for our unique, sustainable packaging solutions,” commented Dan Gilbert, Chief Financial Officer at Placon. “In addition to expanding our national footprint into the southeast, Placon is thrilled to have such a talented pool of employees join our family.”

Placon reports that it is experiencing accelerated growth in all of its primary markets — consumer brands, food, and healthcare. The Wilson facility will immediately serve to better balance the demands of these markets. Longer term, the acquisition aligns with Placon’s business strategy to grow and serve food processor customers with product offerings such as laminated barrier solutions, OxyStar mono-recyclable material, and EcoStar 100% PCR materials.

Placon also announced today that new cleanrooms at its Elkhart, IN, facility will be operational on Nov. 1, doubling its capacity in the medical market. The company has manufacturing operations in Madison, WI; Springfield, MA; Plymouth, MN; and Elkhart, IN.
Thermoforming In The News

Thermoformer D6 Moving HQ to Texas

Jim Johnson, Plastics News

October 18, 2021 – One of the country’s larger thermoformers is spending $27 million to relocate its headquarters from Oregon to Texas.

The move by D6 Inc. will create 231 jobs in Sulphur Springs, Texas, and is being called “a major economic boon to northeast Texas” by Texas Gov. Greg Abbott.

D6, is relocating its headquarters from Portland, Ore., and will receive a state grant of $1.43 million to help with the project.

D6 has a network of locations in North America as well as locations in Asia, Europe and the Middle East, according to a map on the company’s website. D6 relies on recycled PET as well as other resins to create new clamshell packaging.

CEO Edward Dominion said in a statement his company “will build the first fully closed loop recycling site for single-use PET clamshells in Sulphur Springs.”

“We know this will boost our economy by providing new investment. We also appreciate that these jobs will be paying higher than the average weekly wage,” Robert Newsom, Hopkins County judge — a job similar to that of a chief administrator — said in a statement.

Dominion could not be reached for additional comment Oct. 18.

D6 was No. 23 in Plastics News’ most recent ranking of North American thermoformers with sales of $120 million, nine plants and 98 production lines, according to information provided by the company.

Thermoformer Reflex Packaging acquired by Nefab Group

Source: smart_extrusion

Oct 29, 2021 – Nefab Group AB has acquired Reflex Packaging Group, the leading company in sustainable thermoformed cushioning. Reflex Packaging will continue to operate as separate entities within the Nefab Group.

“The market demand for sustainable cushioning solutions in industrial packaging is increasing fast. Reflex Packaging’s state-of-the-art cushioning trays, made from 100% recycled and ocean bound plastic, combined with Nefab’s global presence, will make sustainable cushioning solutions available for the market worldwide,” says Staffan Pehrson, President and CEO of Nefab Group.

Reflex Packaging have operations in Americas, Europe, and Asia. They specialize in designing and manufacturing solutions using recycled, and ocean bound plastic as the raw material source for their products.

“We are excited and proud to be part of the Nefab Group. Their value proposition to reduce costs and environmental impact, on a global scale, is the ideal platform for expansion of Reflex Packaging’s products,” says Forrest Smith, Founder of Reflex Packaging.

The Reflex Packaging acquisition, in addition to the earlier communicated European acquisition of Szkaliczki in 2020, positions Nefab to be the world’s leading company in sustainable thermoformed cushioning. Nefab will now be better equipped to address customer demands in high growth markets such as Electronics, Datacom, Telecom, and Lithium Batteries.

With the acquisition of Reflex Packaging, the Nefab Group will have over 4000 employees spread across 35 countries, with a yearly turnover of nearly 7 BSEK.

Food packaging Group Acquires £13m Turnover Business

Ben Ormsby, The Business Desk (Yorkshire, UK)

November 16 2021 – Food packaging specialist PFF Group is set for expansion following the acquisition of Sedgefield-based Sirap UK.

The £13m turnover company was part of the Italian Sirap Group and is a leading producer and supplier of thermoformed rigid plastic food packaging.
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The Keighley-based PFF Group is one of the UK’s largest independent food packaging manufacturers supplying supermarkets, multi-national food manufacturers, food service and fresh produce companies across the country.

The group, which is family owned, also recently launched a health division with an investment of £2m and has been producing millions of disposable polythene aprons at its Washington site for use by frontline NHS and social care workers.

Kenton Robbins, managing director at PFF Group said: “We’re delighted with the acquisition of Sirap UK which allows us to combine two long-standing and highly regarded businesses in the packaging sector.

“This investment forms a key part of the Group’s continued growth strategy, increasing our brand share of the UK’s thermoforming sector, and a fantastic opportunity for us to manufacture a wider variety of products to a more diverse range of customers.

“We look forward to realising the significant synergies that Sirap UK and PFF Group have and the opportunities for growth and scale that this presents for the Group.”
The Thermoforming Division Board of Directors hosted an invitation-only executive forum to explore technical, commercial, and financial aspects of both thin- and heavy-gauge thermoforming. Chaired by Roger Jean and Steve Zamprelli, participants engaged each other via roundtable discussions with moderators. Small groups of 4-5 business leaders talked about topics facing our industry today such as labor shortages, succession planning for small or family businesses, software and technology changes, and lean manufacturing practices. Macro-level topics such as the perception of plastics among the public and general sustainability themes were also discussed, but with less emphasis given the manufacturing focus of the participants. In keeping with the history of collaboration among thermoformers, there was plenty of knowledge sharing and open discussion about how companies can help each other to the broader benefit of the thermoforming process.

The notes below offer a summary of the discussions that we are pleased to share with our readers. We encourage business leaders to join us in future roundtable sessions as the collaborative approach is shown to deliver real results for companies of all sizes.

LABOR

Most of our discussion with business leaders centered on the challenges we are facing together concerning labor shortages or supply chain issues, and how to plan in this tumultuous environment.

In the area of labor shortages, an executive of a large organization told us about a recent survey of employees that indicated the most important issues to them are employee accountability and working for a caring company. This was interesting since many of us are focused on increasing wages for both the current workforce as well as starting new hires at higher entry pay to attract people. Some of the creative ways that employers are using to try to recruit include signing bonuses, weekly attendance bonuses, total compensation statements, more frequent employee evaluations/salary reviews, tapping into a selected immigrant workforce, and employee celebrations. Some have had success through government grants for training and have helped to bring in educators to train employees instead of other employees training. We are often good at our jobs but may not be the best educators.

Employers need to get creative to find new talent. Using referral incentives and posting jobs on social media helps to connect prospective employees and companies. Tiktok has worked for some, while many companies now have a strong social media presence that can put them at an advantage due to the search habits of a younger generation. Showing what companies do and how their employees view them on social media is important, though it is critical to keep an eye on review: one bad review can create a major hiring problem.

Executives and company owners agreed that we all share the same issues. We all have an aging work force and we do not have the luxury of a younger generation beating down our door to take over key positions in manufacturing. Some in the group recommended that SPE offer more training for the next generation. As one example, companies complain about the inability to find talented CNC programmers. They would like to see SPE do better job of teaching and educating in this area because even though institutions like Penn College offer in-house training, it doesn’t always align with companies’ discrete needs. Several board members pointed out that the division has developed some training assets over the years, including “Thermoforming 101” manuals and training videos to show the basics before they go to run machines. In short, there is a big focus on training and it needs to occur before the employee is hired by the organization.

Additional conversation covered the problem of losing legacy employees who handle many tasks. It was agreed that these employees should be incentivized such that they will stay with the company. Losing key employees who seek better opportunities is very costly. “Retraining verses retaining” is often the better approach to take. Other incentives to retain motivated employees include labor shift options. Some companies have had success with providing employees 3 days off without impacting throughput. This utilizes two different teams and enables factories to run 7 days a week.

Other retention strategies include allowing employees to “know their business”, e.g., how much each job brings in for the company and how each employee takes a part in making this happen. If an employee knows the bigger picture, they will be able to do more for the organization as most people generally want to be helpful and contribute to shared success.
Thermoformers need to integrate and develop employee ideas and show them that they are valuable to organizations. Their voices should be heard and their ideas are worth consideration. Conversely, the use of recruitment firms or temp agencies to find talent is deemed sub-optimal or is viewed negatively by some. Temp agencies often do not know what companies need and will often send wrong candidates who waste time for the interviewer.

CULTURE

Creating a company culture is one of the most difficult things to achieve when building a business, though once it is established, it is also very difficult to change. In terms of hiring, some companies offered the use of a “Culture Index.” This concept is designed to help identify the right future employees for an organization; to examine how they will fit within your current culture and where they would be best suited. This has helped employers determine who to interview based on preliminary findings. The candidate is asked a series of questions and the answers are reviewed by either the human resources department or by an outside agency. They are graded with “A”, “B”, “C”, “D”. The A candidates are the best fit and B would still be considered. C & D would be eliminated as they would not fit within the company or its culture.

LEAN MANUFACTURING

There was a lot of discussion about the issue of cellular manufacturing in thermoforming and how companies can manage bottlenecks in production flow. Specifically, the routing/cutting operations were identified as areas of concern. Because thermoforming machines can far outrun trimming operations, it creates obstacles to efficiencies in the overall forming process. Basically, it seems that one’s choices are to either add “a ton more cutting stations” or to throttle back the forming.

Several participants shared their experiences with cellular manufacturing and challenges with rearranging existing equipment. When thermoformers are doing more to add value to parts, more assembly is typically required and this leads to the need for additional work cells. If processors can standardize on one machine brand, it can reduce operational headaches due to commonalities in tool changes, programming set ups, and operator expertise.

Inventory management often comes up when discussing lean practices, and this session was no different. Processors reported that a primary issue with inventory is having the space for it. A lot of people have challenges with where and how to store tooling to make more room for finished parts and/or raw sheet goods. Many companies are using off-site storage for tooling, though the downside is that it is difficult to quickly change schedules due to the distances involved. At a high level, inventory was not a focus for many given the raw material shortages and increased demand in today’s environment. Many companies simply accept that having high raw material inventory is a given, just to make it through the current shortages and long lead times.

AUTOMATION

Peter Jasinksi of Dart Container Corporation shared some key points of thin-gauge high-volume automation practices. Though these are not always directly applicable to heavy-gauge processors, it is illustrative to share the areas where automation has been successful. A key issue is part consistency. If parts are not consistent, processors will either struggle to get them through the automation systems, or they will have to add labor to inspect the parts coming through the conveying systems. The process in changing over automated lines from one product to another in our industry is somewhat complex and time-consuming. There are times when converters will run lower volume products without automation because the volumes will not justify the expense and labor commitment to change it over.

Challenges for heavy gauge processors might include the following:

- Short run / frequent changeovers
- Part size and weight are larger/heavier than some robotics can handle
- Require difficult-to-find skilled labor to program the robotics
- Automation speed slower compared to a person performing the same work
- Quality control might require human visual inspection prior to pack-out
- Downtime on automation due to the difficulty in procuring parts during a break down (particularly acute problem if the automation is built overseas)
- Product stacking/nesting issues
Some of the successful process improvements mentioned are as follows:

- Implement new technology that reduces cycle time and improves labor utilization
- Restructure work cells to better utilize existing labor
- Automate other downstream processes, e.g., adhesive application or other value-added activity done after the part is formed and while it is being assembled
- Improve or add software to streamline manufacturing, e.g., AI or ERP systems
- Use of more cost-effective solutions, e.g., collaborative robotics or flexible work cell automation that is not dedicated to one activity

Returning to heavy gauge operations, robotic or CNC cutting was discussed in a favorable light, though a lot of people don’t see the benefit of robotic loading/unloading of machines. It takes people minimal time to load/unload manually while the robot can sometimes take longer on changeovers from one job to the next. This can cancel out the benefit it has unloading/loading during the job.

PLANNING

Many company leaders discussed how they are working to secure better long-term agreements (LTA) with customers that better address how to align extended lead times with accurate forecasting. Inflationary pressure is a real concern when trying to plan for increasing demand with capital investment. How do you normalize the budgeting and planning process with abnormal activity?

Our industry is competing very closely with other processes. We have to be very careful to maintain our costing structure to satisfy our customers. We also have to be aware of succession planning and planning for future generation of workforce within our organizations. Our labor costs directly affect pricing to our customers. How do we attract new hires while keeping our current pricing structure?

Succession planning at the factory level (not ownership) tends to focus on skilled labor to train younger employees with a cost-effective approach. Legacy employees who want to retire may train younger employees to learn same job function, but they might require incentives to do so. This increases payroll costs due to two employees doing same job, but the goal is to treat this as a temporary phenomenon while “tribal knowledge” is passed down. In many cases, the best employees may not be good at educating others how to do their jobs. Personalities and possessiveness come in and create obstacles. Companies have lost employees in such a transfer because the transition time between a legacy retirement and a significant promotion can take too long. This results in a double loss.
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Our team participated in the student design competition at the 2021 SPE Thermoforming Conference in Grand Rapids, Michigan. The team was tasked with designing and producing a thermoformed shell for an RC car that would be judged on complexity and presentation. Our student team consisted of two senior mechanical engineering students, Avery Tolboe and Timothy McGough, from Central Connecticut State University. We were advised by our professor, Ned Moore, and sponsored by Ian Munnoch from MSA Components.

**Design**

During the initial stages of the design portion of the project, we decided to draw inspiration from 1920s to 1940s-era American automobiles. The competition was in Michigan, after all! After sketching multiple designs, we settled on a car with large fenders and running boards. We wanted to push ourselves to use a complex mold and decided that the large drawdown to the running boards, the tight radii along the running boards and fenders, and the details in the windows with overhangs would challenge us. Using a CMM arm to map all the critical points on the RC car chassis, such as the shell mounting points and any possible interference with the tires, a CAD model of the mold was made based on our sketches. The CAD model was then imported into a nonlinear ANSYS simulation of the thermoforming process to prove that an initial sheet thickness of 0.040" would give us a designed minimum part thickness of 0.020". Using guidance from our sponsor and our ANSYS simulation, we decided to utilize PETG because of its ease of forming.

**Mold Manufacturing**

After designing the mold, a decision on its manufacture had to be made. We were at the height of COVID-19 lockdowns and had limited access to equipment. Initially, we planned on 3D printing our mold; we had successes when testing the thermoforming process using 0.040" PETG sheets with ¼ scale molds made from ABS filament. The full-scale mold was significantly larger than our available print bed sizes, requiring us to print the mold in eight separate pieces. With the clock ticking down to our deadline, the incredibly long print times, complications with printing ABS, and difficulties producing a mold with a fit and finish to our standards, we concluded that the 3D printed mold was not an adequate solution. After searching our local contacts, we gained access to a 3-axis CNC wood router and shifted our focus to producing a mold from MDF due to its low cost and ease of machining. With the limited Z-travel of the router, the mold was split into multiple layers that were glued together after machining. Ultimately, the MDF mold had a good fit and left a nice surface finish on the thermoformed parts.
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Graphics

The other part of the competition besides high part complexity was presentation. To be competitive, our sponsor introduced us to distortion graphics: printing an image on the plastic sheet prior to forming to create detailed, complex, and repeatable graphics. Two companies were an integral part of getting our desired graphics from concept to our final part: Distortion Arts and IT Supplies. Distortion Arts specializes in manipulating 2-D graphic concepts into a flat, continuous image that puts the decal art in precisely the correct spot when thermoformed. IT Supplies utilizes HP latex printing technology to print artwork on plastic sheets. The process began with printing a dotted grid on sheets with the same specification as those used in production. A setback came when we discovered that our roll of 0.040” PETG stock could not be sufficiently flattened for the printing process. Alison Svoboda at Apogee Plastics graciously offered to supply us with 0.050” flat polycarbonate (PC) sheets, which put us back on schedule. After receiving the PC dotted sheets, our team formed them to our mold and sent the formed parts to Distortion Arts to analyze the distortion and apply it to our 2-D graphics. IT Supplies then printed our distorted graphics onto unformed sheets to use when forming our final product. We were lucky we switched to a wooden mold, as the ABS tool we originally envisioned may not have withstood the temperatures required to form polycarbonate.

Thermoforming

The thermoforming of the final parts opened our eyes to the complexity of the process. One unexpected challenge was the influence of the latex paint color on the heat transfer processes when forming. The initial distortion mapping was performed on clear polycarbonate, but the final part was made with a base coat of white, still visible on the bottom, and a mix of colors dominated by blue and yellow latex paint on the top. This caused the painted parts to heat differently than the parts used to generate the distortion map. This resulted in changes to the mechanical properties of the material and thus the final form of the part. For good parts, we learned repeatability was key. Variations in room temperature were especially detrimental to the consistency of the parts. This was especially evident with the checkered banner that ran down the center of our shell, which ended up bowed on the final set of parts.

After months of working with PETG, we also needed to quickly adapt and learn the nuances of polycarbonate and the challenges that come with using thicker stock. The key trick for us was to lower the duty cycle of the top bank of heaters on our MAAC ASP thermoforming machine so that we could mimic the heating behavior of the original clear sheet. Although the 0.050” PC sheets were more difficult to work with than the original 0.040” PETG, we managed to create great looking parts that were almost indestructible when mounted on the RC car due to the superior properties of polycarbonate. And at the competition, the car took a beating and kept on going.

Competition

Despite the obstacles we faced, our team prevailed and earned the People’s Choice and Best Design Awards. We could not have done it without the help of our advisor Dr. Moore, and our sponsor, Ian Munnoch from MSA Components, Bob Rychel from IT Supplies, Alison Svoboda of Apogee Plastics, and John Davidson and Neil Compson from Distortion Arts. The opportunity provided by the SPE Thermoforming Division to compete was invaluable, with many educational opportunities both throughout the project and at the conference itself.

Why Join?

It has never been more important to be a member of your professional society than now, in the current climate of change and global growth in the plastics industry. Now, more than ever, the information you access and the personal networks you create can and will directly impact your future and your career. Active membership in SPE—keeps you current, keeps you informed, and keeps you connected. Visit www.4spe.org for details. The question really isn’t “why join” but ...
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- Form-Trim Models
- Linear Trim Presses
- Linear Vertical Presses
- Heavy Duty Presses
- Tilt Bed (IML)
- Linear Pre-Punch
- Linear Scoring Station
- Rotary Drum Former

PROCESSES
- PP, PET, HIPS, OPS
- PLA, HDPE, PS Foam
- In line/Roll Fed
- Cups, Car Cups, Lids
- Retort Products
- Tamper Evident
- Hinged Trays
- Storage containers
- TIML

VALUE
- Energy Efficient
- Production Rates
- Move Times
- Ease of Access
- Reliability

SERVICE
- Training Classes
- On line help
- Process Training
- After hours help
- Included start up service
**Editor’s Note:** We are pleased to introduce our readers to a new department within TQ. “Designer’s Corner” is, ahem, designed to give processors and machine operators a deeper insight into the challenges associated with converting those brilliant napkin sketches into 3D reality. If you have a design question that you would like to have answered in this column, send me an email and we’ll see what we can do. cpcarlin@gmail.com

Tangent Design Group is an industrial design consultancy with experience serving large scale transportation markets such as automotive, marine, RV, and agriculture. In this inaugural edition of “Designer’s Corner”, we plan to illustrate some of our heavy gauge thermoforming work. This could range from process / material conversion to thermoforming, overcoming design and engineering challenges, to just cool examples of design for thermoforming.

For our debut article, we’ll focus on a 775-horsepower truck - the 2021 Shelby F-150. Fig. 1 is a computer-generated rendering that gives a good overview of the types of materials we work with. Tangent was responsible for styling, designing, and developing all Shelby-branded components which are not stock items for the Ford F-150. First, the hood is stamped aluminum with injection molded vents. Second, the fender flares are all thermoformed. Next, the grill assembly is injection molded along with the side fender vent. Last, but not least, is the bumper assembly, which is thermoformed and includes an injection molded grill with accent pieces.

The Shelby bumper is actually a cover piece that gloves over the existing bumper sheet metal and structures (Fig 2). The design aesthetic had to be performance-themed for the Shelby brand while covering up the standard bumper and its existing styling. Considerations for airflow, park sensors, adaptive cruise sensors, and more added to the difficulty of developing an automotive OEM quality thermoformed part. Making sure all the material stack-ups work with material thinning was critically important for the interfacing injection molded parts and fastening methods. It all had to be precision-engineered to achieve the tight assembly tolerances for proper fit and finish.

Tangent’s near 20 years of experience designing for heavy gauge thermoformed parts and assemblies is why this could be achieved. In addition, early supplier engagement with the custom former was very important in the success of this project. This allowed the designers to make informed, achievable, aesthetic decisions that were friendly to the former’s production processes. From draft angles to trimming specs, we aim to understand all aspects of the production process. This in turn makes us better designers and sets the former up for success during production.

For more information about Tangent Design Group, visit www.tangentinc.com.

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3D Printed Thermoforming Tools Save Time & Money

Additive manufacturing has completely changed the way thermoformers and OEMs view tooling in terms of production time, cost, and quality. When compared to traditional metal tooling, Catalysis, a tool fabricator, can 3D print tooling in half the time for half the cost while maintaining the same level of quality. 3D printing also allows for the design of more complex tooling for low-to-medium volume production parts, removing constraints inhibited by traditional tooling design.

Our Story

Catalysis Additive Tooling was founded in 2015 by Darrell Stafford and Rick Shibko, who, after spending a combined sixty years together at Honda, joined forces to bring disruptive innovation to the tooling industry.

At Honda, Stafford & Shibko witnessed the increased focus on the reduction of product development schedules. The result was a need to reduce tooling lead times which created higher prototype tooling costs. With Honda introducing more new products and the increasing frequency of model changes, the prototype tooling costs and associated lead times became a challenge to reduce.

This experience in Honda's Tooling Division, North America R&D Division for Additive Manufacturing and Purchasing has allowed Stafford & Shibko to create 3D printed tooling technology to revolutionize the thermoforming tooling industry. This technology is saving customers cost and time, providing benefits that traditional tooling methods are unable to provide.

The Catalysis Difference

3D printed thermoforming tools can be manufactured in less than 2 weeks and have significantly lower costs than aluminum tools. 3D printed tooling can be a good alternative to traditional RenShape, wood, or aluminum tooling, but it is only one tool in the toolbox and will not replace traditional tooling.

Catalysis uses a variety of 3D printing technologies for its tooling. Project quantity, part size, and materials being formed will dictate which technology is best for the application. Although other 3D printing technologies will work for thermoforming tooling, the best option from a speed and cost is typically binder jet 3D printing technology with a Catalysis coating package. This proprietary coating package gives the base 3D binder jet print the needed strength and thermal characteristics to withstand the thermoforming process. In some applications, different 3D printing technologies can be combined in a single tool.

3D printing is the simplest part of a Catalysis tool. The tool concept, tool design, and manufacturing process are critical components in the development of a reliable 3D printed tool. One example of how this approach led to customer success was in the development of multi-part project with an incredibly short lead time.

The Opportunity- SEKISUI KYDEX & BUTTERFLY Project

SEKISUI KYDEX had partnered with BUTTERFLY® Seating Solutions to rapidly prototype the shell for an entire lie-flat suite in time for the April 2020 Aircraft Interiors International (AIX) show in Hamburg, Germany. BUTTERFLY® is a flexible seating solution that allows instant transformation between premium economy/ regional business class, and long-haul flatbed suites. Lars Rinne, BUTTERFLY® Co-Founder and Commercial Director, and James Lee, Co-Founder and Creative Director moved towards finding a prototyping partner after winning the highly-coveted Crystal Cabin Award with the initial design concept and after developing a refined version for certification and customer presentation.

Rinne and Lee began their prototyping journey with a visit to the SEKISUI KYDEX appLab™ innovation center to explore thermoplastics. They were introduced to the material
differences and capabilities, processing options, and methods for design parts for manufacturing. The unique and flexible design of a BUTTERFLY® single-aisle suite requires customization and spatial optimization of each part.

During a second visit to the appLab™, Lee and the team looked at individual part geometries to discuss how the parts would connect and perform. The appLab™ engineers made recommendations on where pressure forming would be better than vacuum forming and provided modifications to the part geometries to adjust undercuts, split lines, and hidden edges. This ultimately resulted in the need for over 30 different thermoplastic parts.

The challenge was not in the number of parts or even their complex geometries, but with time. Normally to build a suite of this scale would take over two years. The build was expedited into less than six months to prepare the prototype for AIX. Initially, SEKISUI KYDEX intended to CNC route all of the parts from RenShape in the appLab™.

As with any new project, part design and enhancement can continue throughout the build process. As the SEKISUI KYDEX team began to affix the pulled parts to the prototype, they identified six last minute part design changes, that required quick tooling. They turned to Catalysis to help them achieve their timeline.

The Countermeasure

After getting the call from SEKISUI KYDEX and understanding the project requirements, the Catalysis team quickly developed a project Specified Action Plan (SAP) that detailed the project steps and timeline needed to meet the tight project schedule. Our first step was to organize the Catalysis tooling engineers to quickly begin the tooling concept and design activity. Multiple tool engineers worked on all the tooling designs simultaneously.

We reviewed the Project SAP Plan with SEKISUI KYDEX and worked with the team to expedite the tool approval process and meet the required trigger dates of six tools in 18 hours. This was a key step to help facilitate the 3D printing of multiple tools at the same time.

In less than 24 hours from tool approval to print we had begun the Catalysis tool post-processing function that includes the quality control of the prints and coating of the tools with the Catalysis proprietary coating package. The Catalysis coating package is a high-temperature material that adds strength to the tool.

For the SEKISUI KYDEX Butterfly Tool Project, Catalysis chose binder jet 3D printing technology with the coating package. Due to the nature of the binder jet process, the tooling has no vacuum holes, yet offers uniform material distribution, ideal print accuracy, and surface finish with no delamination and no required cooling.

The next step in the project SAP was to simultaneously work on the design, production, and assembly of complete bases for all of the tools.

When the SEKISUI KYDEX tools had finished the post-processing requirement, the Catalysis team worked into the evening to expedite the assembly. Each of the SEKISUI KYDEX tools were affixed to the bases and the tools were prepped for shipment the next day. This allowed the SEKISUI KYDEX team to begin thermoforming parts immediately.

Binder Jet Printing Advantages

- Print size = 70”x39”x27”
- Print time = 18 hours
- Print Quality = +-0.012” print accuracy
- Print Surface Finish = 100RA (finished tool)
- Tool Temperature Resistance = 350° F (176° C)
- Base 3D Print Temperature: Made of Silica Sand and able to withstand 1700° F (926° C)
- Catalysis Coating Package: 350° F (176° C) Tg
- Tool Strength = “Strong enough to drive a truck over them” with 10,400 PSI tensile strength.
The Result

While the molds were being produced, Shawn Gum, Applications Engineer at SEKISUI KYDEX, made a wooden frame to retrofit the parts. Lee provided engineering drawings for the aluminum frame that would ultimately be used in the final prototype. Gum used these drawings to duplicate a frame out of wood meeting the short lead time required.

With the six tools in hand, the appLab™ engineers formed each KYDEX® Thermoplastic part for the prototype and trimmed them using a CNC router.

The appLab™ engineers inspected each part and worked to retrofit them to the wooden frame. Because there were so many intricate and unique parts for the design, it was important that the team had a frame for testing. By retrofitting them in-house, they could make adjustments to the parts before sending them to BUTTERFLY®.

Once the appLab™ team confirmed the parts were accurate, they shipped them to BUTTERFLY® to be added to the final prototype. BUTTERFLY® had their aluminum frame ready and retrofitted the parts for their final prototype. Because this frame was more accurate, they were able to locate the areas where part adjustment was required. This adjustment was minimal, as the appLab™ was able to identify some of these potential inconsistencies with the use of their wooden frame.

Ronn Cort, President and COO of SEKISUI KYDEX, offered his take on the project. “Our KYDEX® appLab team, focused on a fast-track project, was presented with a seemingly insurmountable challenge. A last-minute design change meant we needed six thermoforming tools produced in four days. We turned to the one partner that could provide the quality, precision, and quick response required – Catalysis Additive Tooling. And they delivered more than we imagined within 48 hours. A true partner for our rapid development innovation model.”

Without Catalysis’ quick turnaround of the parts, SEKISUI KYDEX would have been at risk of missing their deadline. Because all six of the Catalysis tools were designed, 3D printed, post-processed, assembled and delivered to SEKISUI KYDEX in 48 hours, the appLab™ team was able to thermoform the requisite number of parts to meet the BUTTERFLY® seat assembly timeline.

Butterfly® Flexible Seating Cofounder and Commercial Director, Lars Rinne shared, “It is through partnerships across
the entire supply chain that we are able to execute a finished prototype using flight-ready materials. We are thankful for companies like Catalysis who helped us to meet such a tight timeline. While this 2020 AIX show was canceled, we were still able to put a full prototype on display in our new Belfast office and are ready to showcase at the 2022 AIX show.”

What’s Next for Catalysis?

Catalysis is continuously developing new applications for 3D printed tooling. These include CNC trim fixtures, QC check fixtures, assembly fixtures, ultrasonic weld fixtures, composite part manufacturing and foam part manufacturing.
2021 PARTS COMPETITION AWARD WINNERS

Photos: Dallager Photography

PEOPLE'S CHOICE AWARD

Plastics Unlimited, Preston, IA
Hagie Sprayer Rear Engine Enclosure Assembly

VACUUM FORMING - SILVER

Hammer Plastics, Mishawaka, IN
Dashboard

VACUUM FORMING - GOLD

Plastique Art, Sainte-Claire, Quebec, Canada
Ventilator

PRESSURE FORMING – SILVER

Profile Plastics, Lake Bluff, IL
Covers for Automatic Paint Dispenser
PRESSURE FORMING – GOLD

Ray Products, Ontario, CA
Multi-Part Medical Cart

TWIN SHEET – SILVER

TriEnda Holdings, Portage, WI
Battery Cell Cover

TWIN SHEET - GOLD

Wilbert Plastics, White Bear Lake, MN
Over-the-Road Storage Shelf for Sleeper Area

3D PRINTED TOOLING – SILVER

Plastics Unlimited, Preston, IA
Guard

3D PRINTED TOOLING – GOLD

Catalysis Additive Tooling, Columbus, OH
Pallet

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If you are interested in becoming a Thermoforming Division Board Member, please contact me. You will need to send a short biography, high-resolution photo (jpeg format preferred), and a letter stating your desire to serve on the Thermoforming Board by December 15th.

Laura Pichon
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- **Width:** 36 - 68 inch sheet widths

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- **Process:** Inline Rotary Sheet Extrusion or Thermoforming
- **Resins:** PS, PP, HDPE (...and more!)
- **Gauge:** 9 - 25 MILS
- **Structure:** Mono- and/or Co-extrusion
- **Rates:** 1000+, 2000+, 3000+, & 4000+ pph
- **Width:** up to 55 inch sheet widths

**ROLL STOCK**
- **Process:** Sheet Extrusion
- **Resins:** PS, PP, HDPE & PET (...and more!)
- **Gauge:** 9 - 60 MILS
- **Structure:** Mono- and/or Co-extrusion
- **Winding:** 1 & 2 Up
- **Rates:** 1000+, 2000+, 3000+, & 4000+ pph
- **Width:** 36 - 68 inch sheet widths

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NEW AMUT COMI ACF 980-P Roll Fed Thermoformer
Form, Trim, Robotic Stacker, In mold cut capable, Deep draw, and Large forming size

Currently Available Machines

- 2018 MAAC 5’ x 8’ Double Ender Thermoformer Pressureformer
- 2000 MAAC 4’ x 5’ Single Station Pressureformer
- 2005 DMS 5’ x 5’ Twin Table 5 Axis CNC Router
- CNC Router DMS 5 Axis Single 5’ x 10’ Table

“HIGHEST QUALITY EQUIPMENT AND SERVICES IN THE INDUSTRY”

BLOW MOLDING  THERMOFORMING  INJECTION MOLDING  EXTRUSION  GRINDERS/SHREDDERS