

## Advances in Thermoforming Machinery

— by Michael P. Alongi —

As the Thermoforming Industry continues to grow, and new challenges are presented, today's thermoforming machinery technology has become much more advanced. The benefits to purchasing new machinery will continue to outweigh those of used or retro-fitted equipment. As the technology advancements have greatly improved in all aspects of today's machines, you simply cannot cost-effectively bring an old machine up to today's standards. Below are some of the more recent advancements or higher standards being implemented into today's machinery. These are just a taste of over 50 major improvements and additional capabilities of machinery and process potential. Some are more application-specific, but all can greatly benefit today's thermoformer. With more process control than ever before, and more options and capabilities, new machinery with its corresponding technology is truly becoming one of the thermoformers greatest assets, and certainly an engine that drives competition to the next level.

### Controls

Machine controls are continually progressing. Proven machine control software has now been implemented for over 20 years, allowing machine manufacturers to provide an unlimited range of functions and capabilities all at the palm of your hand. As more than 100 sheet fed thermoforming machines are being built every year, more and more ideas are requested and more and more improvements are implemented.

The latest technology in computerized machine controls offers huge benefits. Replacing relays and timers, manual buttons, and switches with flat panel touch screen interfaces and innovative software allows thermoformers the ability to change every machine parameter within seconds. This eliminates the manual process of setting up different machine sequences, adjusting limit switches, opening and closing valves, setting oven heat configurations, setting pressures and even reading job setup sheets. Not only can previ-



Computerized Machine Control

ously programmed jobs be brought up and machine parameters changed within seconds, new technology is also reducing initial setup times and allowing the constant tweaking of jobs to make them faster and more user-friendly.

Massive input and output diagnostic systems are now standard, including oven zone burn out displays that allow for the quickest trouble shooting and the least amount of down time. Software is smarter, with built in alarms and warnings that will notify the operator prior to potential human error. Help files, job note sections, machine history reports and statistical process control reports can be viewed on screen or easily printed. Multi-level security systems are built in to restrict or limit the control each operator is granted. Phone modems for remote support and program updates are standard, which greatly reduces costly service technicians and machine down time. All this comes as a result of ongoing R&D and ongoing feedback from our market place. As most control systems and software are now based on an "open architect" type of system, if it is not already standard, it is usually just a matter of what you want, how much it is worth to you, and how quickly or easily it can be implemented.

### Index Drives

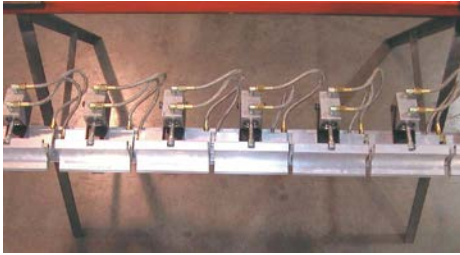
A new standard has been made: nearly 90% of machines being built today are constructed with motor driven index systems. Both shuttles and rotaries are being built with index speeds measured from station to station in approximately 3 to 6 seconds, depending on overall machine size or the application's requirements. In the past, traditional machines were designed using pneumatic systems ranging anywhere from 8 to 14 seconds. These time savings come right out of the overall cycle time. Not only does this feature allow for faster cycles, but allows for better forming of thinner gauge materials and materials that traditionally cool too quickly. In addition, the costly expense of maintaining older pneumatic systems is virtually eliminated. As motor driven systems are smoother and much more accurate, there is less wear and tear and less machine vibration.



Index Drive

## Clamp Frame

Clampframes have been evolving at record speeds over the past few years, making more products capable of being produced in the thermoforming process whereas in the past they may not have been. With over 20 application-specific systems that do everything from



*Clamp Frame*

being infinitely adjustable to tilting, bending, slip sheeting and articulating, clampframes are helping to reduce material thickness, reduce sheet sizes, induce sag, reduce sag and even conform to the molds shape prior to forming.

One of the most popular items available for every application is adjustable clampframes. They have been one of the single hottest items to hit the thermoforming machinery market. You no longer need to store and replace different lengths of clampframe for the diverse sheet sizes required to run different jobs. Adjustable clampframes offer the ability to vary the length of the clamp frames without having to add or remove clamp frame sections from the machine, and with no tools required! Not only can you change these frames in under 5 minutes, but you can also document the position of these clamp frames and easily return them to the exact position the next time the product is run. Adjustable clampframes are continually proving to save anywhere from 1-3 hours of downtime (per mold changeover), depending on the type of machinery or how many stations your equipment has.

In addition to speeding up your clampframe changeover time, all of today's clampframe designs are made to keep sheet sizes to a minimum. Some of the older or poorly designed clampframe systems require up to 2" of material to be clamped in your frames. The standard of clamping on 1/2" or less has been implemented for over a decade but has now become standard!

## Moving Ovens

As oven technology expands, more thermoforming machines are being equipped with lower tracking oven systems. As sheets are being heated, most common materials begin to sag. As sag increases, the lower oven will keep an equal distance away from the sheet until it has reached optimal temperature, and will then index into the form station to complete the process. This feature not only allows for more precise control, but is a great means of saving energy. For excessive sag materials, or large sheets that sag due to size and weight, lower ovens no longer need to be set at 20" or more away from the sheet-line when heating. Traditional ovens are lowered below the maximum sag, which then requires the lower oven settings to be programmed at extreme temperatures just to penetrate heat into the sheet. Ovens can now be set much closer to the sheet-line as they will move downward with the sag. When

this is implemented, typically oven settings can be at much lower temperatures and still within the same heating time - if not faster. This makes for much better use of the heat and uses much less energy to produce the product.

Another moving oven feature that is gaining popularity is referred to as an oven-over or shuttling oven. Traditional U.S. style machines have fixed oven stations, but more thermoformers are finding use and applications for an oven that traverses into the form station. This feature allows an upper oven half to actually shuttle out of the oven station and into the form station. For very thin materials or materials that cool too quickly, an oven-over feature can follow the sheet into the form station to help retain heat. Clients in point-of-purchase have found that not moving the sheet but instead moving the oven half (or halves) to the sheet allows them to hold tighter registration when forming materials with screen printed graphics. In addition to helping the forming process, it can also aid in speeding up the pre-heating of molds rather than just waiting on water or oil temperatures or using sheets of plastic to heat the mold to optimal temperature.

## Platens

The industry has raised the standards in new machine form stations to accommodate some of the more engineered thermoplastics being developed and the new applications being introduced to our market. As the motor driven platen has replaced nearly all pneumatic platen drive systems, it easily has become today's standard. The motorized systems have proven to be more accurate, more consistent, more controllable, faster and unbelievably highly programmable. Not only has the bar been raised to all motor driven platens, but to multiple ways of driving them. Although the motor driven platen system was traditionally based on a chain drive, numerous different drive systems have been created to eliminate chain slack and maintenance as well as to create more precise forming stations. From Direct Drive Twin Synchronized Motors to a single motor with multiple gear box direct drives, a larger variety of application-specific designs are available and have become standard.

Not only have drives been upgraded, but platen strengths and weights have greatly increased to accommodate some of the more challenging applications that use higher pressures, twin sheet forming and even match mold compression forming.

Platen speeds have also increased, by nearly 40%! The need to travel rapidly into the heated sheet has become more critical in today's market place.

Even on the most basic machines, all platen positioning and motor speeds are now controlled through the machine's control system. Gone are the time consuming days of manually adjusting collars or limit switches. Today, motor driven platens are equipped with encoders for fast setups, repeatable speeds and precise positioning. The encoders are interfaced into the control system with real time graphic emulation of platen movement displayed on screen. The platen settings are stored in the controller with each job number for future recall. Encoder driven platens

no longer require homing or zeroing and the machine may be turned off without losing platen home position.

## Larger Machine Technology

Some of the most recent developments in large machine construction have opened new doors for our industry. It is no longer being considered a risk to purchase and implement larger machine sizes. Previous large machine technology was minimal due to the limited demand, and machine manufacturers did not have enough experience to cost-effectively design and build them. With today's technology advancements and increasing market demand this has now changed.



*Large Platen*

Over the past several years more machines are being built to accommodate some of the largest molds or largest thermoformed products ever manufactured in high volume quantities. Today, more innovative companies are discovering the true advantage of larger machines and developing parts that are larger than ever before. In addition to an increasing demand for large parts, these large machines are also being utilized to run multiple molds at once in order to reduce costs and increase parts per hour. For example, one of the higher volume thermoformed parts are pallets. Traditional pallet machines ran 2 to 4 up, but as competition grows companies are going larger with machines capable of running 6 to 8 up. Some of the largest new thermoforming machines manufactured over the past two years are 16' x 8', 19' x 10', 14' x 8', and 21' x 9'. Some of these are straight vacuum formers, some pressure formers, and one is even perhaps the largest twin sheet thermoforming machine in the world with a 21' x 8' forming area.

## Automation

Automation has increased its role in our process and is being implemented more often than ever before. The increased demand for automation helps to reduce costs as many systems have now become standard sub-assemblies rather than "one-of" projects. With large sheets or hard to handle sheets, automated systems are becoming necessary to avoid the need for multiple loading and unloading personnel. In competitive markets where machines are running 6 to 8 up with fast cycle times, auto-



*Auto Loaders*

mation is also necessary to help load the 6 to 8 sheets while simultaneously unloading 6 to 8 finished parts.

Automation has also come into play due to the increased demand for part inserts. These can be various metals, foam or even wood parts that are inserted during the thermoforming process and become part of the actual finished product. Typically these inserts are placed into a mold cavity in the form station before the sheet is formed, or they are placed between two sheets in the twin sheet forming process. Little time is given for these inserts to be properly placed manually, and safety is always a concern when personnel are required to enter a machine in production mode. Automated robots and automated pick and place systems are being incorporated to assist in this aspect to help reduce labor costs, increase personnel safety, gain repeatability and keep scrap rates to a minimum.

## Summary

Today's new thermoforming machines are available with over 150 options, almost four times that of 5 years ago. Some are application-specific, and some are quickly becoming new industry standards. The large array of options and capabilities now being offered certainly allows thermoformers to focus in on features that will help them create a unique machine specification, allowing them to hold stronger competitive advantages. Almost every machine being built today is specified around the thermoformers core market, or specific applications and production requirements. These new innovations are changing the old mind set of buying all-purpose machines. The general purpose machine has lost its place in the thermoforming market. As competition grows, thermoformers are becoming smarter and equipping themselves with new technology in order to create their competitive edges.

Companies who are serious and are here to stay need to invest in new technology. More than half of our industry is operating machines that are over 20 years old, so we do not need to ask why their profit margins continue to decrease. The time has come to get rid of your old thermoforming machine and buy new. Replace that typewriter of yours, and see for yourself how much more efficient and how much more profitable a computer really is!

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*Written by Michael P. Alongi, Sales Director for MAAC Machinery Corp., manufacturers of a wide range of cutsheet thermoforming machinery. For more information, contact MAAC Machinery Corp., 590 Tower Blvd., Carol Stream, IL 60188, 630-665-1700, Fax: 630-665-7799, E-mail: sales@maacmachinery.com, Web: www.maacmachinery.com.*