THERMOFORMING MACHINERY

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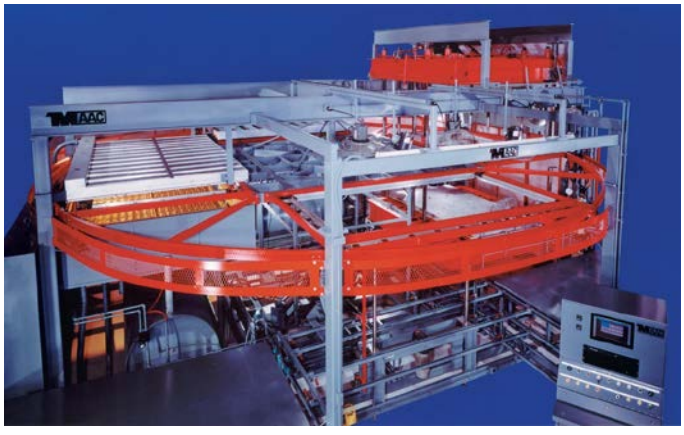
Heavy Gauge Twin Sheet Forming

— by Michael P. Alongi —



The twin sheet process is generally used to form structural, hollow thermoformed parts.

Twin sheet forming is a process of vacuum and compression forming two sheets of plastic simultaneously with a separate mold on the top platen and a separate mold on the bottom platen. Once the plastic sheets have been vacuum formed, they remain in their respective molds. While both sheets still remain at their forming temperature, the two molds are brought together under high platen pressures and the two sheets are bonded together wherever the mold-designed knit areas dictate. This will result in one single product with hollow areas and no secondary bonding required.

The twin sheet process creates 3-dimensional parts with formed features on both sides. The parts are typically very strong, rigid and lightweight. Application specific to the material type, material gauge and machine configuration, foreign components or hardware may be inserted into the interior of the part during the forming process. Some of the hardware being inserted into twin sheet products today is wood, aluminum, steel and foams. More advanced applications are now inserting tracking devises, measuring devices and mechanical sub-assemblies.

Typical twin sheet applications include: pallets, industrial dunnage, portable toilets, medical housings, surfboards, fuel tanks, air/ventilation ducts, electrical enclosures, recreational boats, cases, toys, marine products, doors, tables, spine boards and numerous transportation-related products.

The differences between twin sheet forming versus blow molding or rotational molding are typically cost-related. Twin sheet forming is very competitive with blow molding and much faster than rotational molding, especially with large, thick gauge products.

Versus Blow Molding

When comparing the blow molding process to twin sheet forming, tooling and machinery are usually more cost-effective for small to mid-size production runs. Each sheet can be a different thickness and/or even different colors. In some applications the twin sheet process will allow you to even use two different materials to form a single product. The twin sheet process allows more flexibility with parting (or bonding) line structure. The twin sheet process also allows the insertion of more elaborate hardware inside the final product before the two sheets are bonded together.

Versus Rotation Molding

When comparing the rotation molding process to twin sheet forming you get much higher production rates, and have the ability to use co-extruded sheet, many more resin types and you can design more structural beams or designs into the product.

Although the twin sheet process has many advantages over competing processes, there are still restrictions and many different ways the twin sheet process is accomplished. Further, different types of twin sheet machinery

may be required for specific applications. This is dictated by material gauge, material type, material heating to cooling ratio, material hot melt strength, bonding properties, material shrink, part size, part design, the mechanics in tooling, cooling the interior cavity, amount of pressure required, tolerance required of bonded surfaces and tolerance of mold mating.

Single Oven Twin Sheet (SOTS)

The SOTS process utilizes the simultaneous heating of two sheets, one above the other in a single oven (upper and lower heater banks). There are two different styles of SOTS forming: one utilizing 2-sets of clampframe and the other using 1-set of clampframe. Different products and/ or different applications may lend themselves to more efficient processing benefits when utilizing one over the other:

With A Single Clampframe

Two sheets of plastic are loaded into a single set of clampframes. A regulated probe is introduced to allow air pressure to be applied between each sheet while the vacuum is drawn simultaneously on each mold to form a hollow part.

With Two Sets of Clampframe (See Figure 1)

Two sheets of plastic are loaded individually in separate sets of clampframes, one set placed a few inches above the other. No regulated probe is required since the two sheets are not clamped together. This technique provides more options when considering the insertion of foreign objects between the two sheets, along with more control of the sag on each sheet.

When using the single oven technique only one side of each sheet is being heated, limiting the material gauge to approximately .160" per sheet. This is dependent on the different types of material and mold configurations being utilized. Most conventional machines do not allow the ability to insert something between the two sheets in the SOTS process; however special machinery and/or tooling modifications are available to accomplish this.

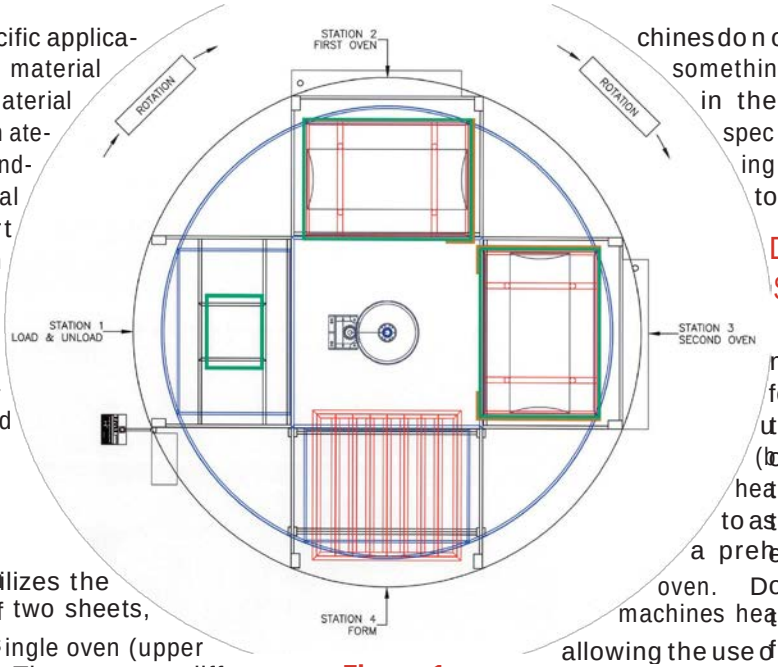


Figure 1

Double Oven Twin Sheet (DOTS)

The DOTS process is most commonly done in a four station rotary machine utilizing two sets of ovens (both with upper and lower heating banks), often referred to as two final heat ovens versus a preheat oven and final heat oven. Double oven twin sheet machines heat the plastic on both sides allowing the use of thicker sheets or starting gauges.

This process is most commonly referred to as a skip frame sequence (see Figure 2).

1. The first sheet is loaded and indexed to oven #1, while heating in oven #1 the second 2nd sheet is being loaded.
2. Once the 2nd sheet is loaded the machine will index again putting the 1st sheet into oven #2 while the 2nd sheet is moved into oven #1.
3. After the 1st sheet is heated to its forming temperature (in the 2nd oven) the machine will index again placing the 1st sheet into the form station and the 2nd sheet into oven #2.

At this point the first sheet is vacuum formed, then released from the clamp frames and retained by its respective mold. Simultaneously the 2nd sheet is being heated to its forming temperature in oven #2.

4. The second sheet is then indexed into the form station, is vacuum formed to the opposing mold, then compressed with the first formed sheet resulting in a twin sheet product. The DOTS sequence requires material heat retention time to exceed or equal mold closure time.
5. The twin sheet part is then cooled and indexed to the unload station.

In this type of machine and process every other index will deliver a formed product. These types of machines allow for

Figure 2

much higher outputs by utilizing the simultaneous use of each station.

Different Types of Twin Sheet Machinery

Each twin sheet machine design and configuration has its advantages and disadvantages for different applications and different end-users. A full assessment of product requirements and production volumes certainly needs to be evaluated in order to choose the correct machine and machinery options in order to maintain a profitable operation. The engineering department of the machinery manufacturer should have the ability to design and specify the machine and process to assist decision making.

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