Volume 9, Number 1, June 2001

IN•TOUCH®

INFORMATION ON FLEXIBLE POLYURETHANE FOAM

IN•TOUCH® is a regular publication of the Polyurethane Foam Association (PFA). It covers topics of interest to users of flexible polyurethane foam and is designed as a quick reference for background information on key issues. To get more detailed information about a particular topic, consult a PFA member.

Flexible Polyurethane Foam Fabrication: Equipment and Capabilities Update

This issue serves as a companion piece and update to INTOUCH Volume 1, Number 5, entitled Foam Fabrication. The earlier INTOUCH bulletin provides an introduction to flexible polyurethane foam (FPF) fabrication, cutting and post treatment technologies.

In this issue we address advancements in fabrication equipment and provide information on fabrication processing that can be applied by FPF end-users in designing and specifying FPF materials for home furnishings cushioning, protective packaging systems, automotive, specialty and technical FPF applications.

Using current fabrication technology, a variety of shapes can be produced from FPF material.

As fabrication machinery and techniques advance, FPF producers are continuously adopting new fabrication technologies with a focus on their customers' needs for quality, attractive economics, ease of use and design versatility of the finished product. Fabrication machinery manufacturers have in turn developed mechanical means of helping foam producers achieve their objectives by helping to reduce floor space requirements, speed fabrication processes and achieve better control in the manufacturing of FPF products. In addition to these important processing advancements, new machinery has also added more design capability to efficiently produce a greater variety of shapes and forms with extremely close tolerances.

The role of foam fabrication in the business model is not the same for all foam producers. Equipment selection and positioning within the plant are critical to operational efficiency. Some FPF manufacturers prefer to concentrate on product development, foam production and inventory management, working with networks of fabricators who are then able to generate sufficient volume to maintain favorable economics for end-users.

It is also important to keep in mind that the simplest way to create a shape is usually the most economical and best way to serve customers. Traditional cutting and shaping methods using vertical bandsaws, horizontal slitters, convoluters and basic hot wire cutters continue to serve the majority of customer needs. And it is within these machinery categories that the most significant advancements have occurred.

Vertical cutters

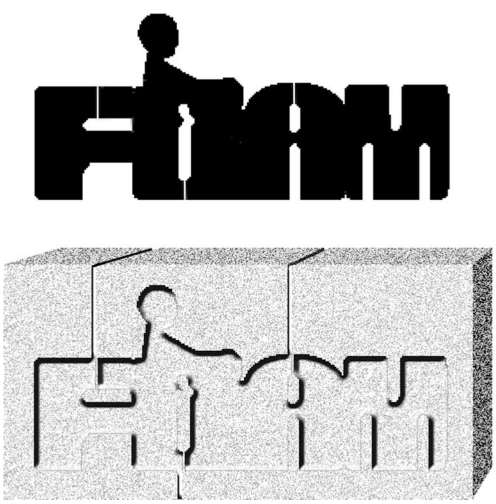
CAD-CNC vertical saws are able to cut buns or sheets and a variety of materials such as FPF, bonded foam and fiber.

Computer assisted automation in now found in many FPF production facilities. CAD-CNC controlled fabrication equipment makes it possible to perform repetitive cutting patterns using high-speed vertical saws without the aid of an operator. Further advancements include the possibility of adding a movable saw head to allow a piece of FPF bunstock to be cut from several directions and angles to further speed the fabrication process. With sawing capability of up to 5 vertical feet, FPF buns can be efficiently reduced with automated equipment to desired part sizes within tolerances that are difficult to consistently achieve using manual operation techniques. By no means does this automated equipment replace manual vertical saws, but it does help to extend FPF fabrication capability.

Horizontal slitters

Semi-automated and fully-automated horizontal slitters and splitting equipment enable users to quickly process large foam blocks. CAD-CNC capability enables operators to store multiple cutting programs and the machinery allows execution of multiple cuts of different thicknesses. Processing speed and accuracy of the cuts is enhanced with auto sensing devices that identify block edges and allow the knife blade, bandsaw or wire to reverse itself in an optimum fashion for best yield, minimizing waste. Vacuum rotary tables hold the foam in place, allow the FPF to be cut efficiently and leave the cut sheets in a manageable stack.

Horizontal slitters allow fabricators to reduce large FPF blocks to sheets.



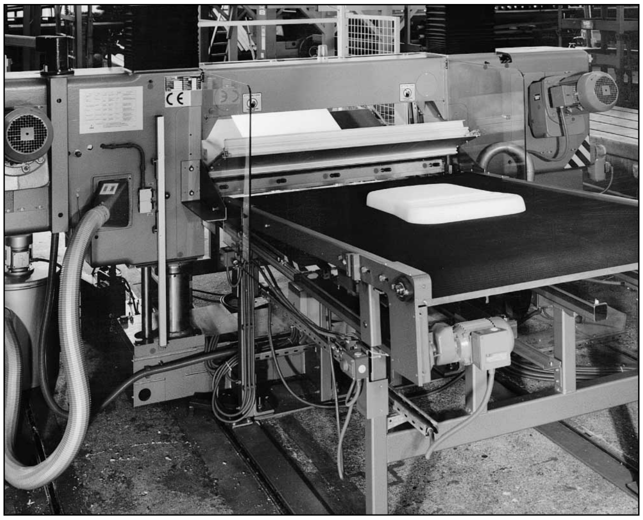
Hot wire cutters can be used to produce intricate shapes. Not all types of FPF lend themselves to hot wire cutting.

Hot wire cutters

For intricate shapes, a hot wire cutter is often used to cut and shape some types of FPF. Hot wire cutters are available as manually operated tools or can be electronically computer controlled. For contoured, 3-dimensional shapes, there are automated machines with multiple heated wire harps. The technology used to cut FPF with a wire is not complicated. A very fine nickel-chromium cutting wire is heated with electricity much like the burner coil on an electric stovetop. The heat from the wire melts the foam without actually touching it. Because of the melting process, finished edges are generally very smooth. Hot wire cutting is not appropriate for all types of FPF and a ventilation hood should be used to exhaust fumes.

Compression cutting

Compression cutting allows FPF bun stock to be fabricated into shapes normally associated with a foam molding process. This technology is sometimes appropriate when a large number of FPF parts must be contoured into a particular shape. To begin the process, an impression of the desired part is cast



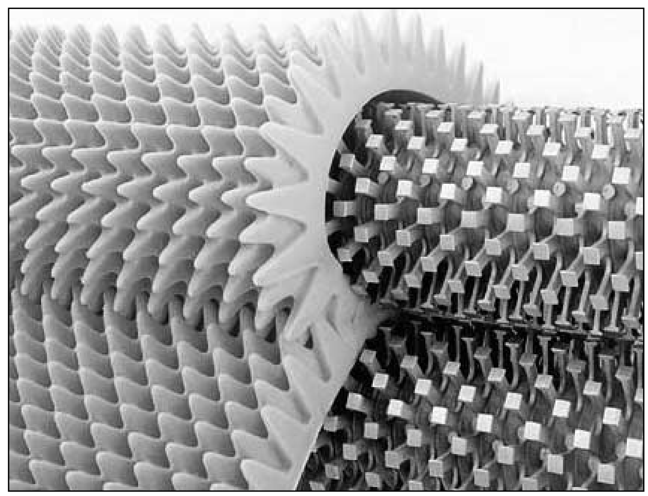
Compression cutting is an efficient alternative to foam molding to produce smooth, contoured shapes.

into an open cavity. Usually the cavity is manufactured from aluminum or a rigid composite material. The FPF product is positioned above the cavity and pressure is applied, forcing the foam to fill the cut-out. A horizontal knife is used to cut the foam flush with the surface of the cavity resulting in A and B parts. Part A

is shaped as the cavity dictates and Part B is shaped as the negative image of the cut-out part. Compression cutting requires sophisticated tooling to shape the cavity and precise control of the force applied so that the foam properly fills the cut-out shape. This fabrication technology is particularly useful in the production of contoured cushions for automobile seating, armrests and headrest pads and for anatomically shaped office chairs. In these applications, large quantities of the specified parts help offset the compression cutting tooling costs.

Convoluting and profiling

Most people are aware of the dimpled FPF pads used to add surface comfort to mattresses and pillows. These end products are produced using convoluting and profile cutting equipment. Convoluted pads result from passing a layer of foam between two opposing cutting rolls. As with compression cutting, A and B surfaces result, but in this case, the patterns on both surfaces are the same, only offset. Convoluting equipment can be set up to produce several different continuous patterns including waves, vertical channels, and dimples with a range of slopes and angles. A convoluting cutter is made up of a number of cutting wheels aligned side-by-side and fixed in place along the convoluting roller. Convoluting cutting wheels must nest on the top and bottom. However, wheels with differing patterns can be arranged across the same roller to create products such as a mattress pad channeled along the perimeter and having dimples in the center. Because convoluting wheels are relatively expensive and alignment is often difficult, your foam supplier must provide information on the availability of profile patterns.



Convoluters use cutting dies to efficiently produce profile shapes from sheets of foam.

Water jet cutting

One limitation to the various fabrication techniques above is that although many different shapes can be created, none of the methods can cut a pattern inside another pattern such as creating the unbroken shape of a doughnut with a hole inside. To do that, there must be a way to enter the foam, piercing it from inside the cutting pattern. Die stamps and boring equipment can be used for some patterns, but others require specialized fabrication technology. One way to achieve intricate cut-outs inside patterns is to use a water jet cutter. A water jet cutter is a sophisticated piece of equipment that is often computer controlled. To cut FPF, a very fine water stream is forced through a coherent jet nozzle under extremely high pressure. The resulting wire-like water stream has precise cutting capability. But there are limitations on water cutting applications for FPF products. Because FPF is a soft, porous product, it tends to absorb energy very quickly causing the water jet to diffuse. As a result, water cutting is limited to a narrow range of flexible foam densities and firmnesses and is not usable with foams having more than about six-inch thickness. Another drawback is the fact that FPF products absorb moisture so drying time after cutting must be allowed.

Due to specialized nature of water jet cutting, this fabrication technology is practiced by a limited number of fabricating companies. If you require water cutting, your foam supplier help you locate an appropriate resource.

Laser cutting

Much like water cutting, laser fabrication supports the cutting of a pattern within a pattern. It is also a specialty technology and application with flexible foam products is limited. Since laser cutting burns the foam, care must be taken to properly exhaust resulting fumes.

Safety procedures

Care should be taken when operating fabricating equipment. The American Standards Institute (ANSI) published B151.28-1995 to set forth mandatory safety requirements for machines that cut, slit or buff plastic foams, pertaining to their manufacture, care and use. The standards also apply to such fabrication equipment that has been modified or remanufactured. If you are involved in FPF fabrication, you should be familiar with the specific requirements of this standard. Note: The standard does not apply to hot wire, laser or water jet cutting machines.

Caution should be exercised in hot wire cutting, laser cutting, bonding, laminating or any other process that exposes FPF to significant heat sources. In such processes, potentially dangerous fumes are emitted which should be exhausted through properly engineered ventilation systems. FPF is flammable and will burn when exposed to open flames or other significant heat sources. Once ignited, FPF can burn rapidly, generating great heat and dangerous and potentially toxic gases that can be harmful or fatal to people if inhaled in sufficient quantities. The fabricator should be guided by a Materials Safety Data Sheet (MSDS) from his foam supplier to determine the proper procedures for handling the foam and to be aware of any special requirements for handling fabrication steps.

Summary

1. The simplest way to create a shape is usually the most economical and best way to serve customers.
2. Fabrication technology advancements make it possible to create a variety of shapes and forms with extremely close tolerances.
3. Computer assisted automation in now found in many FPF production facilities.
4. Vertical saws, horizontal slitters and hot wire serve most FPF fabrication needs.
5. Compression cutting, convoluting and profiling, water jet and laser cutting serve specialized fabrication needs.
6. A number of safety procedures must be followed in fabricating FPF including maintaining safety guards, performing proper maintenance and using care in machinery operation.
7. Caution should also be exercised when fumes are emitted and when FPF is exposed to a significant heat source.

This information is provided as a service of the Polyurethane Foam Association to improve the understanding of key issues that affect flexible polyurethane foam cushioning. To learn more about specific foams, contact your foam supplier.

A complete library of PFA IN•TOUCH issues can be found on the Internet at http://www.pfa.org.

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