TRIMMING - I - GENERAL COMMENTS[1]

So far, we've defined the polymer characteristics, then we've heated it, stretched it, and cooled it on the mold surface. It is now necessary to remove the formed part from the sheet around it. The polymer material that is not a portion of the formed part(s) is known in the industry as trim, web, or skeleton. It is not known as scrap, since this material is destined to be reground and reprocessed into sheet or used in non-thermo-forming applications. This discussion is part of three parts on trimming[1].

THERMOFORMING 101

What Exactly is Trimming?

Trimming is usually the mechanical separation of the formed part from the unformed sheet. Mechanical separation is a kind way of saying that we break or fracture or sever the part from the web. Technically, we begin with a single structure containing both part(s) and non-part(s) and end up with at least one part here and one non-part there.

As we noted in the heating and stretching articles, we can treat the technical aspects of the process without primary regard for gauge thickness. That is, breaking is breaking, whether the sheet is 10 mils thick or half-inch thick. It is the gauge of the sheet that dictates the way in which we break the sheet.

To reinforce this, consider trimming of thin-gauge sheet. Steel-rule die cutting is the common method of trimming. As we see below, this is done by forcing a sharpened steel blade perpendicularly into the sheet, fracturing or breaking the sheet into two pieces. Now consider trimming of heavy-gauge sheet. Routing and drilling are the common methods of trimming. As we will see later, this is done by pressing a rotating toothed bit against the sheet, forcing the teeth to fracture or break the sheet into two pieces by splitting out smaller pieces.

Do All Polymers Trim in the Same Fashion?

No. There are several polymer material considerations that must be considered when trimming parts from sheet. Typically brittle plastics such as acrylic and polystyrene break easily. As a result, trimming tends to be easy and trimming forces tend to be low. However, the breaking process can yield jagged edges and local microcracking. And substantial trim dust which can be quite tenacious. On the other hand, tougher polymers, such as ABS, rigid vinyl, Noryl® and polycarbonate can require substantial trimming forces. The fracture surface is usually less jagged than brittle plastics. Surprisingly, very soft polymers, such as polyolefins, flexible vinyls and thermoplastic elastomers, are frequently more difficult to trim than tough polymers. Soft polymers "flow," can stick to cutting tools and drill bits, and the cut edge is frequently quite irregular. When cutting any polymer, sheet thickness and the modulus of the plastic at the trimming temperature usually dictate the type and the cutting speed of the trimming device.

Is Trimming Speed a Factor?

In thin-gauge trimming, the rate at which the steel rule die is pressed into the plastic is guided somewhat by the nature of the plastic. Brittle materials can be "snap-cut," that is, cut at a high rate. Tough plastics do better when the steel rule die speed is slowed. However, in general, trimming speed is a minor factor in thin-gauge thermoforming.

Very frequently, trimming speed is an important economic factor when trimming heavy-gauge parts. From a processing view, one should always strive for parity between the forming time and the trimming time. That is, ideally it should take no longer to trim a part than to form it. The greater the length of the cutter path relative to the surface area of the part and the thicker the part, the more the per-part trimming cost will be and the farther from parity the trimming/forming ratio will be. In practical terms, this means that either there will be more trimming presses than forming presses, or the forming presses will be sitting idle for a portion of the trimming time. From a technical point, the objective is to maximize the rate at which the *volume* of plastic in the cutter kerf is removed. Trim speed that is too low may cause the cutter head to overheat, which in turn, may cause plastic fragments to momentarily stick, which in turn, may cause cutter head chatter.

Keywords: Fracture, steel rule die, router, cutter speed

[1]Ed. Note. This issue contains two other articles on trimming. The Moskala-Barr technical article focuses on steel rule die cutting of thin-gauge PET, PETG, and OPS. The Van Niser Industry Practice article focuses on router cutting of heavy-gauge plastics.