PACKAGING DIGEST

One material is winner for OneFilm

CT uses a 4-cavity water-cooled male mold and an adjustable pressure box with a female grid assist. The machine runs at 10 cycles/min to produce 40 camera blisters/min.

RPETG performs acceptably during thermoforming and RF sealing of Polaroid camera blisters although it has already withstood three heating/cooling cycles.

Blister manufacturer Crystal Thermoplastics' first venture into thermoforming recycled polyethylene terephthalate glycol copolyester sheet is proving to be nearly picture perfect.

The 100-percent post-industrial material is used to produce two-piece blisters for two versions of Polaroid's new OneFilm 35-mm camera.

Cumberland, R.I.-based CT had thermoformed blisters for other Polaroid cameras, using polyvinyl chloride. For the new OneFilm versions however, Polaroid wanted to ease away from PVC and into recycled material, primarily to meet increasing consumer and legislative demands.

After pursuing PVC alternatives, tests convinced CT and Polaroid that RPETG was the best

candidate, despite the fact that it costs about 40-percent more than virgin PVC.

According to CT's vice president of sales and marketing, Michael Brown, this prospect helps "stimulate market demand for recycled PETG that could create business opportunities for our company." It also created challenges. The converter had experience with recycled vinyl and polystyrene, but RPETG triggered concerns of its own:

Who could provide material of satisfactory quality in sufficient quantity?

Would the material pose thermoforming difficulties?

Could it be RF-sealed by CT's newly formed RMB Packaging division?

Could the job be turned around quickly?

Perhaps the most vexing question of all: Could tooling be designed to provide the blisters with strength enough to offset the fact that the PETG material had been extruded three times? That's a heat history of three separate meltings and coolings. One cycle is hard enough on a thermoplastic. Three is rigorous indeed. Plus the final thermoforming cycle.

Some molders might cringe at that thought. Not CT. In fact, it's quite pleased with the RPETG sheetstock it receives from Lustro Plastics. "They've done a good job with the material," says CT's Brown. "This is our first and only current RPETG job. Particulate matter in the sheetstock can be a problem with recycled material, but we haven't seen any difficulties with cleanliness or clarity in the stock. "

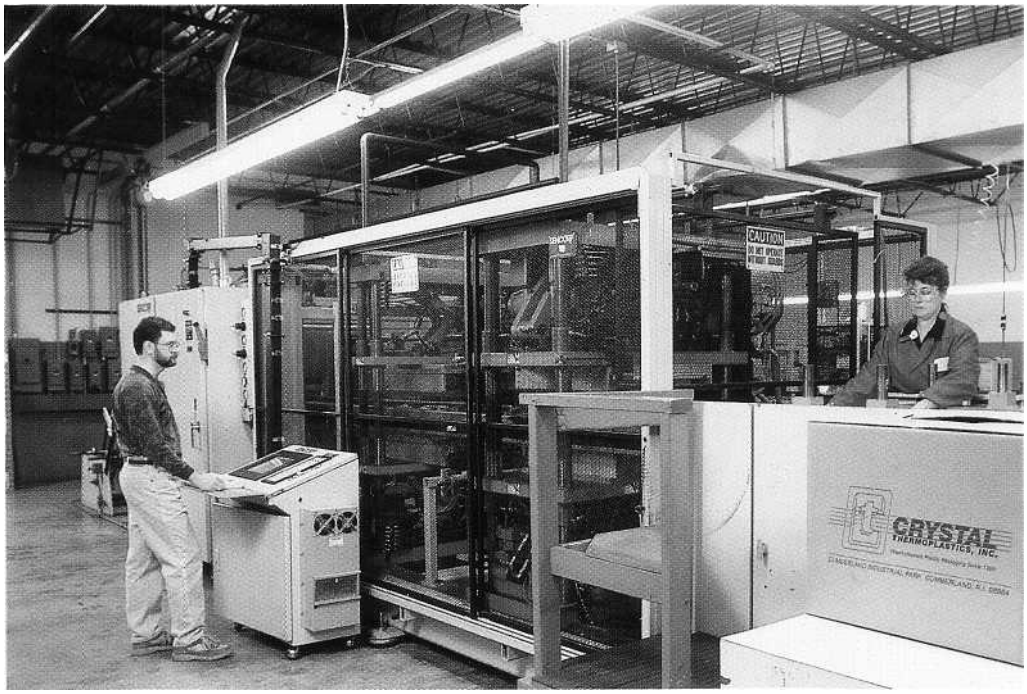
Lustro and CT are partners on many jobs since both do most of their business serving medical packagers that require virgin PETG. Production scrap for those medical customers is a dependable source of post-industrial material. That answered CT's primary supply concern, without most of the handling expenses of post-consumer waste.

Even so, the material's economics are somewhat complex. Virgin PETG carries a price tag in the $1.25/lb neighborhood. Recycled PETG is less expensive. Carl Kitzerow, Lustro's vice president of sales, says: "RPETG saves customers about 20 to 25 percent on the cost of virgin material. We're much higher than somebody buying scrap on the open market, but at least we know what we're working with. Open market scrap could have a very low value, and there is the possibility that you could have contamination from other plastics."

RPETG, however, is still considerably more expensive than recycled or virgin PVC. Polaroid's advanced engineer, Jim Barch, says that, "the material costs about 40 percent more per package, but it's the right step to take environmentally. "

In Polaroid's case, the "green" thinking is more than just words. Says Barch: "We do want to present customers with the most environmentally-friendly package we can, but we are very strict concerning the recycling statements on our packaging because we don't want to mislead the consumer. We are not touting the environmental benefits of the package on the card despite the fact that it is made from recycled material. We are waiting until all of our vendors meet the specific recycled criteria that we've set before we put any verbiage on the package. At that point we will inform the consumer specifically what the package includes.

"Another reason for the change to recycled material," Barch continues, "is to meet potential legislation. We have an environmental group here at Polaroid that selected the toughest potential laws on the table as our minimum recycled content requirement. "



Easy access to the central processing unit permits Crystal Thermoplastics to tightly control blister production.

Extrusion x 3

The recycled sheet comprises set-up and trim scrap generated by Lustro during processing of virgin polyethylene terephthalate glycol (PETG) copolyester. The Kodar® resin is supplied by Eastman Chemical. The finished blister includes the Society of the Plastics Industry's "1-PETE" code.

In a letter to Lustro regarding the use of its resin, No. 6763, Eastman says: "We believe that PETG 6763, as currently formulated, meets the spirit and intention of the Recycling Code 1. Further, due to its very small

The front of the blister (left) is designed to avoid touching the area around the exposed camera lens. The tooling provides 3 flat planes to eliminate sharp angles that might cause the RPETG to become overly brittle. The colorful blister card allows self-service retailing for both camera versions.

percentage of the total PET recycle stream, we would not expect the use of PETG 6763 recycle to affect the properties or performance of that recycle stream."

Lustro extrudes the virgin PETG pellets to produce end products, usually for medical customers. Initially, the PETG pellets have an intrinsic viscosity of .75, ± .03, when they arrive from Eastman. After extrusion, IV drops to .69 or .70.

"The significance of that is that you're shortening the length of the molecule by exposing it to heat and shear as it's melted," explains Kitzerow. "The shorter the length of the molecule, the more brittle the material becomes. On copolyesters of any kind, the secret to successful extrusion is to dry the material for approximately five hours to a dew point of minus 40 degrees Fahrenheit. If you don't do that, you will lower the IV even further."

Following this first extrusion, Lustro gathers start-up and trim scrap from its five PETG extruders. Scrap is ground into flake that measures about 1/8 x 1/8 inches in size, in varying thicknesses. It is dried for five hours to drive off moisture. The dried flake goes through a pelletizing extruder, exiting in spaghetti-like strands. The molten strands are solidified in a water bath and trimmed into pellets.

Kitzerow explains why this second extrusion is necessary: "The flake is too thin to feed into the extruder to form sheet. Unless we create a uniform pellet, the flake won't mix well in the subsequent extrusion."

Pellets are then extruded for a third time to form the 20-mil-thick sheetstock for CT, in 23 1/3-in.-W webs.

Kitzerow says: "After the third heat history, the material has about .62 IV." To assure that the RPETG is suitable for thermoforming, Lustro does more than dry the material. "We try to filter as many gels of resin and smaller fines by using a 200-mesh screen during extruding," he says. Care is also taken in cleaning grinders and labeling gaylords of material to assure that non-PETG materials don't get into the mix.

Working with scrap material is not new to Lustro. As Kitzerow explains: "It's an outlet for the material that we can't use for our medical customers. It's not profitable, but we at least recover something rather than throw away 98-cent a pound resin into a landfill."

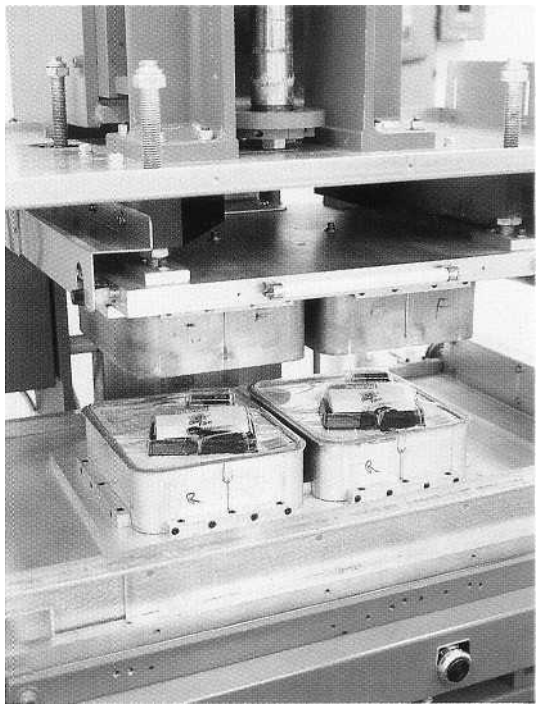
Sheetstock is then shipped to CT. In most cases, a thermoformer in Rhode Island might prefer its suppliers be in closer proximity than Lustro's Evanston, Ill., plant, but Lustro is the only supplier CT has found to provide the RPETG in sufficient quality and quantity. And since the supplier often ships PETG to CT for its medical customers, the RPETG can be shipped along with the virgin material. The larger quantities offer rather reasonable costs.

Designed to work

Kitzerow is confident that the steps Lustro takes results in quality RPETG sheet. Still, he keeps it in perspective. "It's not as strong or perfect as virgin material, but it poses no unusual thermoforming challenges as long as the thermoformer has properly designed tooling. On PETG parts, you have to allow generous areas for flanges, and you don't want to bring it to a sharp angle because the material can become brittle if you don't design the tool right."

Tool design is a specialty at CT.

Blisters are RF-sealed, but a portion of one side is left unsealed to allow for easy opening.



At right, the blister backs for both camera versions are molded to fit the products. The blister card back details "what you get in your 35mm" camera kit. The clear blister lets the customer view all components.

The thermoformer's prior experience with Polaroid and PVC blisters brought the companies together for the One-Film products. "Based on the success of earlier projects, they came to us in late 1991 with their new film, battery and camera project," Brown says.

"We were asked to design and quote the manufacturing and sealing of a clamshell that used the same frame size as their earlier OneStep camera program. They wanted a very clean face that didn't look contoured, with the product retained in the back blister. They also didn't want the blister to touch the area around the exposed camera lens."

Polaroid knew it wanted to get out of PVC, but CT had to find a suitable material in its place. It tested alternatives that would meet Polaroid's environmental concerns yet still provide ample protection and clarity and be RF-sealable.

"Both virgin and post-consumer PET were tested and found to be unsuitable for radio frequency sealing," Brown notes. "The materials crystallize when they're subjected to the heat and energy generated in the sealing machine. Post-industrial and virgin-grade PETG were found to seal well and be recyclable."

After RPETG received the green light, CT made up two prototypes, creating shots, or sample blisters, from epoxy molds made on a small laboratory machine. One prototype was a dome-shaped face that touched the camera at its corners and the film box at certain points. The second sample included three flat planes with a raised plane positioned front and center that cleared the lens area. The latter design won Polaroid's approval.

Brown elaborates on the blister design: "The three planes are very intentional in that we're only touching the camera on two points. The product is contained in the back blister. It's an interesting look."

CT created the blister tooling in house to make about one dozen prototypes. "Polaroid went to its first major customer with these samples," says Brown. "The blisters are customer-driven in that this type of packaging is mandated by the large self-service stores. They don't have a clerk to pull a camera out from under a counter. Instead, the cameras have to be displayed on a rack and be pilfer-proof. "

Once Polaroid's retailer customers approved of the design, CT had to work fast to meet the deadlines. The blister models were used so that CT could cast them into aluminum for volume production. The thermoformer created the frames and precision dimensions via CAD drawings that programmed numerically controlled machinery to recreate the shapes in metal. The patterns for the aluminum are slightly but precisely oversized to allow for shrinkage as the molten aluminum cools during the casting process. Final molds were ready within eight weeks of Polaroid's initial discussion with CT.

Brown elaborates: "Both are four-cavity aluminum tools of exactly the same size. The front frame is male and the back is relieved so that it fits into the front."

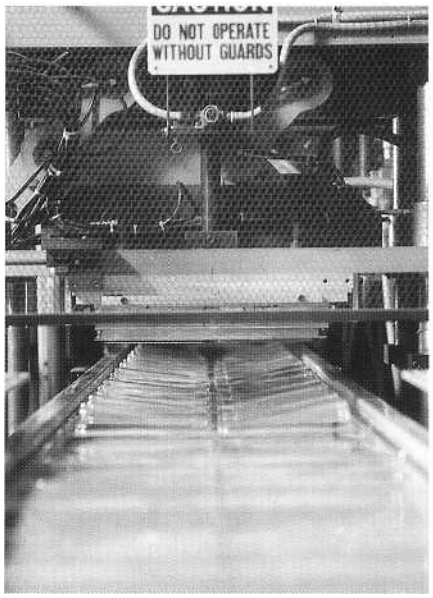
Trouble-free thermoforming

CT thermoforms the blisters on a newer Sencorp 2500 machine. The roll of sheet is put onto the machine's unwind stand. A set of grippers grasps the edges of the sheet. A chain-rail system pulls the material through a 72-in.-L heating tunnel.

The RPETG is heated by top and bottom quartz ovens. Sencorp's Sentroller 11 monitors, controls and records all process parameters to assure part repeatability during runs and allows CT to duplicate all settings for subsequent runs. CT holds precise temperatures independently within 14 separate top and bottom zones, at temperatures ranging from 800 to 1,300 deg F.

Heated material proceeds into a molding station that includes a four-cavity male mold at the bottom of the press with a female grid assist at the top that pushes the material down around the cavities to assist in forming. This close-fitting grid assist is contoured to within 1/32 in. of the male cavity shape.

Brown explains: "We mechanically assist the material around the mold, which gives us



Molded blisters proceed towards a die-cutting station where they are trimmed to ± 1/32-in. accuracy.

even material distribution. The press stays closed while the pressure and vacuum come on. It stays closed for a second or so while the material sets up on the mold and is chilled by water at about 65 degrees."

During forming, as the mold station closes, vacuum is pulled from underneath while 60 lb of pressure is blown downward from the top.

Brown adds: "We always form parts with the form facing up. That's so as they come out of the machine, they aren't damaged. One of the reasons is that in the subsequent die-cutting station where the relieved bottom platen elevates up and the top platen has the die in it, pieces will drop easily out of the die."

The machine indexes forward and the next position comes into the forming station. CT runs the four-up mold at 10 cycles/min to produce 40 blisters/min. The blisters measure approximately 8 in. W x 10 in. H.

"Initially we had concerns with brittleness," says Brown. "But we found that processing went reasonably well with the same settings that we used with virgin PETG. Forming seemed similar, and the recycled took heat like the virgin material."

Silicone to the rescue

What is different is RPETG's tendency to cling to the mold. Denesting and die-cutting are also more complicated than using PVC.

Lustro adds a silicone solution coating to both sides of the sheet, hastening discharge from the mold. "If it weren't coated, it would be very sticky," says Brown. Air is blown through vacuum holes to further help eject molded parts off the tool.

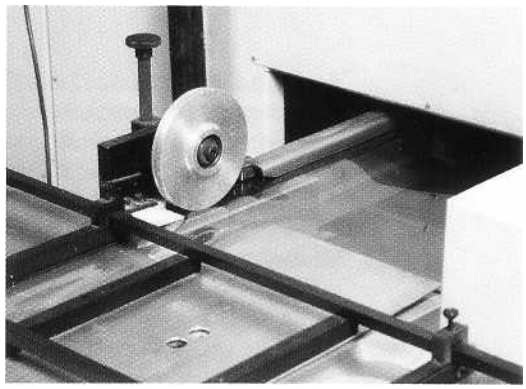
Blisters exit the mold and are ready for die-cutting. Again, RPETG's brittleness was rather problematic. CT developed a self-locating die tool that assists in the process. The tool comprises nylon locators within loosely mounted die frames that float and locate the part automatically. The tooling lets CT trim to ± 1/s2-in. accuracy. Brown says cracking has not been a problem with the Polaroid blisters.

Die-cut blisters index to an unloading station where operators manually lift the separated parts out of the machine and stack them. The coating comes in handy once again, as it allows efficient nesting despite the material's tendency to stick to itself. Automatic upstacking of finished parts is being developed.

As the thermoforming process concludes, edge trim is wound at the end of the machine. Brown estimates that 80 to 85 percent of the sheet actually becomes blister. The remaining scrap and edge trim is baled and resold to a local scrap dealer. Brown says it's ultimately reused but doesn't know of any specific end uses.

Operators pack the blisters into corrugated reshippers supplied by several vendors, and they are delivered to CT's new RMB Packaging Div. "We used to do blisters only, but we began to realize that we needed to offer full service to our customers," says Brown. With RMB, "we now provide any ancillary services related to blisters that our customers might require."

In OneFilm, Polaroid supplies cameras, film, batteries, a wristband and instruction sheets. RMB operators put those materials



Grooved wheels force RPETG sheet onto a chain-rail system that pulls the material through a heating tunnel.

into the proper compartments on the back blister. A blister card of recycled .018 board fits snugly into the blister. Supplied by Somerville Packaging, it is clay-coated on both sides and measures 7.7 in. W x 9.8 in. H. It's offset-printed in five colors on the front, one on the back, with an aqueous coating. Die-cuts accommodate camera components.

Filled blisters are automatically RF-sealed on an A & G Thermtron 10-kw KF-75AS5 sealer. Sealing, a primary concern for CT when it began using the RPETG, is still a challenge. Brown explains: "It's a tougher material than PVC. It's hard to bond. We've found that it takes a four-second cycle with a one-second preheat at 250 degrees with our RF power cranked up to 50 percent to do the job." Still, Brown says seal strength is not as strong as PVC.

To allow for easy opening, the RF tooling is adjusted so that roughly half the left side of the blister is not sealed.

Customer satisfaction

Finally, six sealed blisters are placed into a 200#-test, C-flute corrugated RSC, supplied by Premier Corrugated. The RSC measures 14 1/16 in. L x 10 3/8 in. W x 8 in. D. It's flexo-printed in black.

Barch says 200,000 units will be shipped for sale nationwide this year. Initial distribution will be to Wal-Mart Stores. Most other Polaroid-stocking retailers will

carry the new cameras after production increases. The OneFilm line includes an Autofocus camera that carries a $54.95 suggested retail price and Focus-free for $39.95.

"We hope that the blister-packed cameras will serve as a vehicle of distribution for our film to consumers and retailers who might not otherwise purchase our brand of film," explains Barch. "The camera itself is a good camera that targets point-and-shoot photographers."

Though the product is new and still in the initial stages, the Polaroid/CT/Lustro collaboration is proving a happy one. Polaroid's Barch says: "We built the blisters around the camera lens to keep the area free and to prevent scuffing. Its clarity and performance has been excellent, as has our initial response from the field. It's helped us reinforce our position as a total imaging company with camera, film and imaging systems. We are very pleased with it."

Ditto for CT, which continues to make revisions to improve the blister. Says Brown: "We've rounded off areas and have added a 1/4-inch radius at the foot of the three panels because that's the sharpest point on the blister and we wanted to break that edge a little. All along the outside around the entire blister we added a s/16-inch radius as well."

Die-cut RPETG blisters are manually filled with camera, batteries, a wristband and instruction sheets by Crystal Thermoplastics' RMB Packaging Div. RMB extends Crystal's business beyond thermoforming to contract blister packaging.

The continual learning experience with RPETG benefits CT and Lustro, preparing them for what will surely be an expanding market for post-industrial recycled materials.

More information on the thermoformer is available from: **Crystal Thermoplastics, Inc.,** Cumberland Industrial Park, Box 7007, Cumberland, RI 02864, 401/333-6363, FAX 401/333-6592.

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