From raw material to a refined shape

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InsituCore desk tray and mould

Jason Walker, senior application engineer at L&L Products looks at how best to engineer the ideal foam core composite manufacturing solution.

Processes that involve CNC cutting, vacuum moulding, bladder moulding, and liquid-resin layups have benefits for certain products and design requirements. However, each of those processes comes with significant drawbacks and challenges. Some are wasteful, others are messy. Many are costly and most of them require secondary finishing operations.

Navigating these shortcomings can be complex, as they occur at every stage of the manufacturing workflow. From preparation to processing to finishing, each technique introduces inefficiencies that could negatively impact cycle times, production and labour costs, and the structural integrity of your product.

With these pain points in mind, the team at L&L Products worked to develop an innovative one-component, heat-activated foam core adhesive platform of materials that could greatly simplify your end-to-end production workflow. InsituCore, a new family of materials from L&L Products, reduces waste, cycle times, and production costs.

Pain points: preparation stage - CNC foam-cutting applications: The core materials - the cured foam blocks - are usually made from polyurethane and are often inexpensive. However, when you factor in the capital expenditure and operational expenditure of buying or renting CNC machines - and accessing the skilled labour to operate them - you've got an expensive pre-production phase on your hands. Plus, the process is inherently wasteful: parts of the foam blocks must be cut away to create the final form.

Vacuum moulding: With a split mould, the process of preparing and sealing the layup, dealing with air hoses and pumps, and completing the heat cycle can be cumbersome and time-consuming.

Bladder moulding: There's an extra preparation step to consider compared to vacuum moulding: The bladder must be designed to fit each mould and application, which may inflate preparation time and costs.

Liquid-resin layups: The preparation challenges of liquid-resin layups can be a heavy lift: the preform, mandrels, or honeycomb core for the layups must be prepared to size, which adds time and costs.

Hand-mixed core materials: For moulding applications in particular, off-the-shelf core materials often must be mixed by hand. This is usually a messy process that adds time and labour costs to the preparation stage.

Pain points: production stage - CNC-machined preforms and mandrels: Once the preform or mandrel is machined, the work is only beginning. Reinforcement layers must be added, typically with liquid resins or prepreg reinforcing surface layers. The part is then baked to cure the adhesive and bond materials together.

Vacuum moulding: There may be less waste involved with the vacuum-moulding production process, but it's still a concern. Vacuum-moulded parts often must be cut down or trimmed to size, introducing waste and additional production steps.

Bladder moulding: By nature, the bladder-moulding process creates parts with an empty core. That doesn't make it a bad solution for all applications, but it does limit its efficacy for other applications in terms of strength and rigidity. Having that hollow centre affects the integrity and durability of parts.

Liquid-resin layups: Creating composites by adding and finishing layers of wet resin is a painstaking process. It's messy, time-consuming, and challenging to create parts with consistent resin thickness and a perfectly smooth surface.

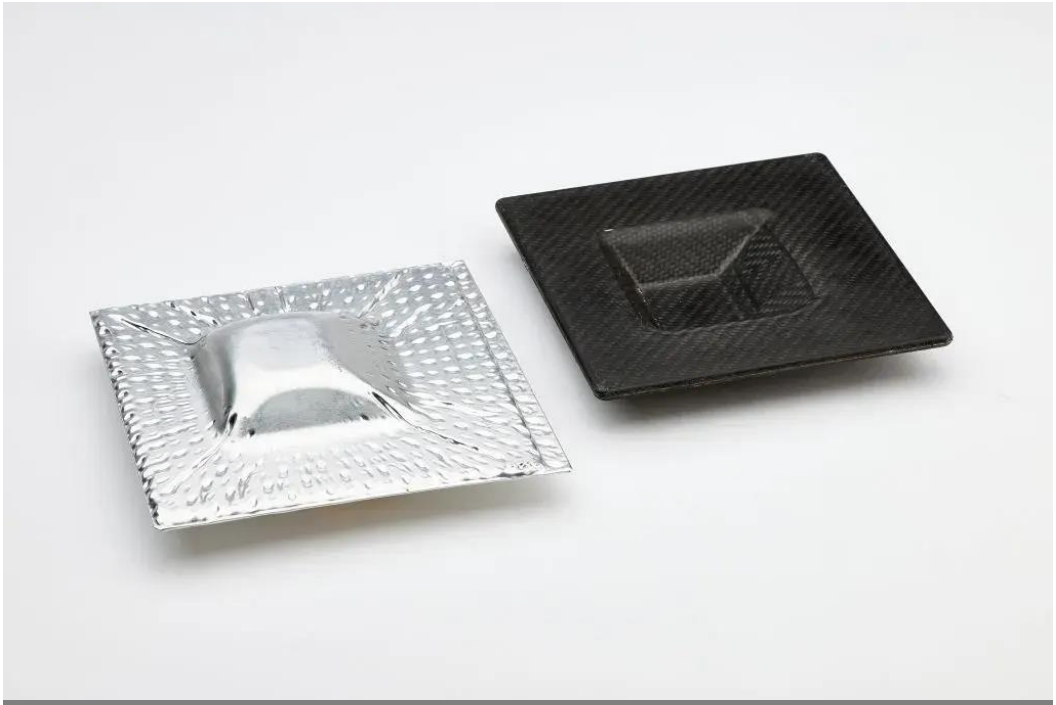
Pain points: post-production stage - Secondary finishing operations: Regardless of the manufacturing technique, there are usually post-processing tasks to consider. Many parts must be sanded, finished, and otherwise treated after initial production, which of course takes time and effort. For example, with the vacuum-moulding technique, you may have visible seams from the mould in your part, which is no-go for some applications. While additional processing can improve the surface quality of parts, it certainly adds time and labour costs.

Edge close out: Let's not forget about the edges. Mould parting lines and flash may need to be cleaned up. Additional protective or reinforcing layers may be required as well.

Insert bonding: If the desired part requires bushings and inserts, those components may need to be added during the post-processing phase by drilling holes and gluing the inserts in place.

A new approach

All of the challenges above led our research and development team at L&L Products to engineer a simpler solution for producing strong, lightweight composite parts. Our new approach to foam core composite manufacturing was designed around the wish list of most manufacturers: Simpler, faster, cleaner, free of the costs associated with complex machinery, and less wasteful than competing techniques. Not only that, but the solution would be potentially safer and more pleasant for workers, as it is typically free of pungent odours and isocyanates.



InsituCore thermosetting material with aluminium and carbon fibre facings

Our solution is InsituCore, an innovative family of one-component, heat-activated foam materials that address many of the process drawbacks we've outlined above. When you create a part with InsituCore, production can be easier, faster, cleaner, and -- in many cases – less expensive, all while meeting appropriate strength specifications.

Creating net-shape, foam core composites with InsituCore is simple. You place InsituCore thermoplastic or thermosetting material, in sheet or pellet form, into a two-part mould, heat the mould, and the material foams to form a net-shape part.

Traditionally, pressure would be generated by a vacuum, bladder, or autoclave. In our solution, the foam core material generates the pressure needed to consolidate the layers in the mould. The material offers up to 3,000% volumetric expansion, ensuring excellent consolidation and bonding of the layers without adding another adhesive to the layup.

With minimal pre- and post-production steps, you simply get lightweight and strong 3D parts with no waste. You can even add bushings and inserts directly into the mould, eliminating the need to cut and bond them in later.

To illustrate how InsituCore can help manufacturers save time, money, and waste at every stage of the workflow, here are the advantages it introduces at each stage.

Preparation stage: With InsituCore, there are no time-, money-, or labour-intensive pre-production processes. You don't need a machine to pre-form, and you don't need to hand-mix or cut down materials. You just add pellets or sheets to your mould, along with the reinforcement layers.

Production stage: With InsituCore, you just heat the mould. Once heat is applied, the material foams up, using internally generated pressure to create strong and light net-shape 3D parts. There are no messy liquid-resin layups, no bladders to fit, and no autoclaves or huge industrial machines needed. Dry reinforcement fabric layups are possible, and the adhesive properties of InsituCore bond core materials and reinforcing layers together without additional adhesives.

Post-processing stage: With InsituCore, post-processing simply involves letting the net-shape 3D part cool down. There's minimal sanding, finishing, and time-intensive post-production processes to worry about, and all bushings and inserts can be added during the production phase.

Shaping the future

As with any brand-new product, technique, material, or technology, the potential applications of InsituCore will come down to manufacturers' imaginations and use-cases.

InsituCore thermoplastic pellets and sheet

In addition to the time, cost, and waste-reduction benefits InsituCore brings to manufacturing processes, there are other traits that make it an exciting solution. It can produce pre-formed mandrels with specific target densities and strengths, which can be wrapped with prepreg reinforcing surface layers and placed into a net-shape mould. When subjected to a second heat cycle, the InsituCore mandrel will expand, providing the pressure required to consolidate the reinforcing layers and push them to the mould surface. The material also provides excellent acoustic and thermal insulation.

All of that can add up to incredible lightweighting benefits for many applications. We're excited to bring this new innovation into the market and partner with manufacturers that will use it to simplify and streamline their production processes.

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