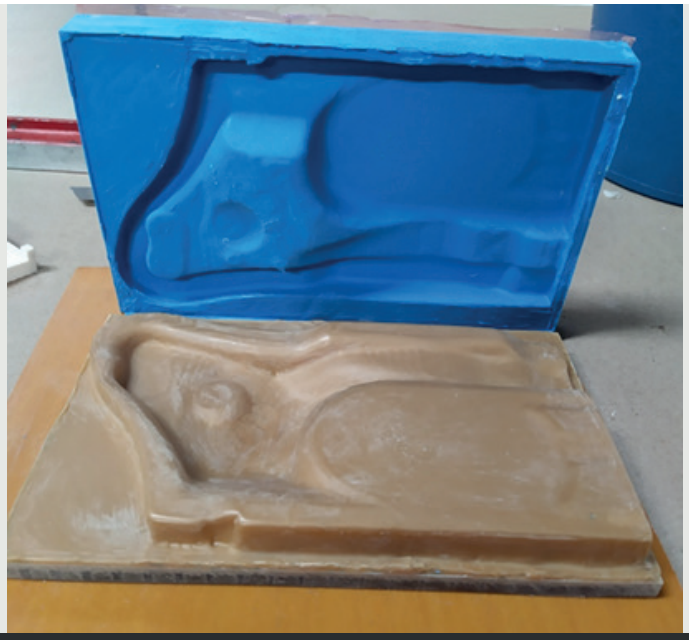
New alternatives for 3D printing, using extrusion technology, of tools for polymeric composites molding

Gaiker
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE



Email: direccion@gaiker.es | **Telf.**: +34 946 002 323 | **Web**: www.gaiker.es

Sector: Transformation of plastics and composites

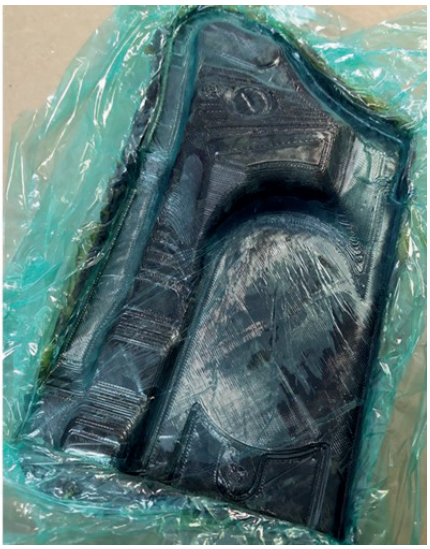
Challenge: Apply low-cost thermoplastics 3D extrusion printing to obtain molding polymeric composite tools.

Solution: Increase the printed parts functionality though optimizing the printed materials composition, the variables and applying post-treatments to obtain hybrid structures.

CHALLENGE

GAIKER works on the development of new functional materials and composites, and on the combination of 3D printing, with molding and forming technologies for plastics and composites.

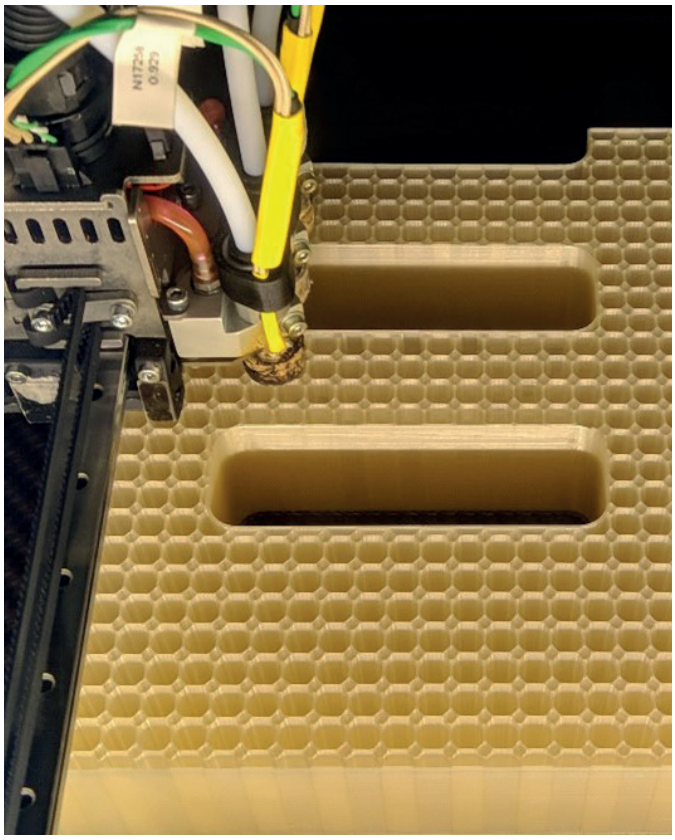
It is possible because GAIKER has got a wide catalog of pilot plants for the processing of plastics and composites, including technologies such as injection, compression molding, thermoforming, elastomeric membrane vacuum molding, RTM, infusion, Filament winding and pultrusion. GAIKER also has capabilities to apply finishing and functionalization post-treatments with paints and coatings and laboratories for the characterization of materials and products. GAIKER has set out to obtain low-cost thermoplastics for extrusion printing of tools that bear the temperatures and molding pressures of technologies such as thermosetting prepregs or conventional RTM.



Cured part of carbon fiber reinforced vinyl ester prepreg and release film.

SOLUTION

GAIKER has focused on the study of new 3D printing compounds based on polycarbonate and acrylonitro-butadiene-styrene, and the study of obtaining multimaterial products based on the hybridization of thermoplastic 3D printing with thermosetting resins. The modifications of the physical, mechanical, thermal resistance and processability properties of 3D printing materials mixed with reinforcements of glass and carbon fibers, and loads with laminar (mica) and spherical shapes (glass microspheres) have been analyzed. The analysis was carried out with a 223 mm side x 140 mm wide tool. The printed part of the mold was made in 14 hours and a 3NTR A2 printer was used. The thermal behavior of the 3D printing material is modulated based on the compositional relationship between the Polycarbonate and the ABS, into the PC ABS mixture. Working with the proportion 60/40% respectively of PC and ABS, and hybridizing the printed parts with thermosetting resin, the obtained tools can bear molding pressures of 20 bars at a temperature of 110ºC during a period of time greater than 20 minutes. Therefore, it is possible to mold thermoset prepregs without the use of advanced or high-performance printing materials.



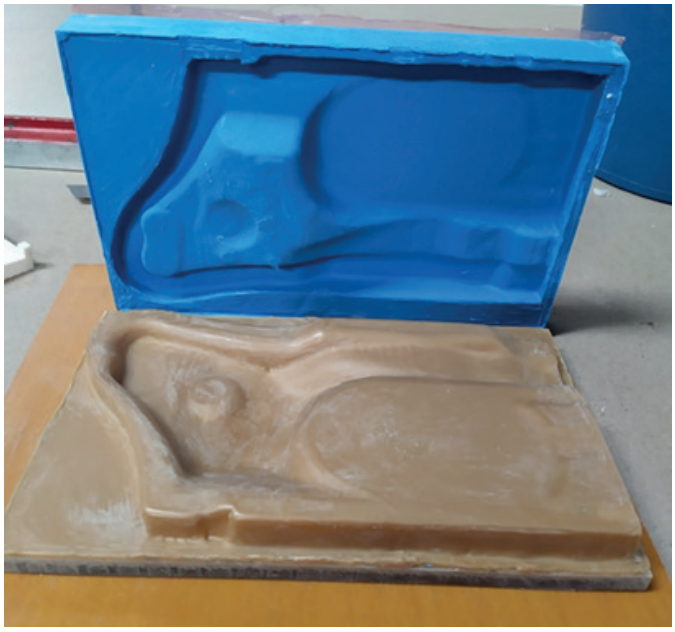
3D printing mold.

ADVANTAGES

With the 3D printing of tools and molds, companies can have a way to reduce costs and development time of product, and process improvement, thanks to quick access to molds for low series or single pieces.

Regarding advanced filaments, the cost/kg of the analyzed ABS PC-based filaments can be between 5 and 10 times lower than the cost of advanced filaments. It depends on the grade of the high-performance thermoplastic, furthermore the 3D printing process is also easier.

Hybridization of the printed parts, using thermosetting resin, is useful to increase their mechanical properties. For example, in the case of flexural strength and modulus values, an increase of 50% has been observed with respect to the unhybridized material. In addition, hybridization can be used as a way to provide additional functionalities to the printed parts, such as providing them with thermal conductivity.



Multimaterial tooling for forming prepregs.