

Press Forming and Consolidation of Thermoplastics Composites

by Rick Fingerhut

**International Composites Technologies, Inc.
(worked performed at Century Plastics, Inc.)**



ABSTRACT

The current cost of processing complex composite structures can be reduced in order to improve their affordability and ensure a greater use in production applications. The combination of a rapid forming process in conjunction with a thermoplastic or thermoset composite material increases the potential for low cost manufacturing. This process was demonstrated on the Air Force and Commercial development programs.

During 1988-1991, Century Plastics, Inc. (CPI) has demonstrated a novel rapid cycle, low recurring cost press consolidation and forming process on complex-shape APC-2 PEEK thermoplastic structures. This process successfully heated, consolidated, transferred, and formed parts in less than five minutes. Lower cost resin and fiber materials were also evaluated. The potential exists for fully automating this process using thermoplastics or thermoset composite materials for low, medium, and high volume production runs. Lower forming trials were also performed with metal machine composites.

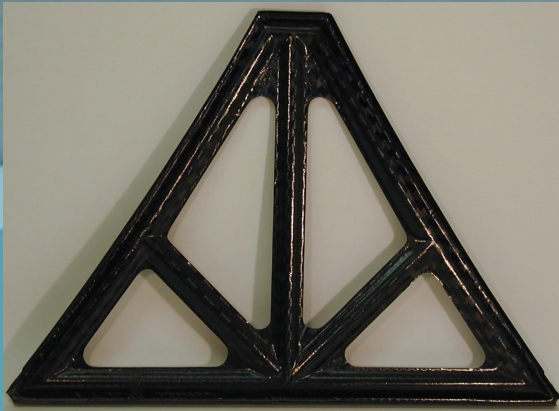
In a production environment, this process could significantly reduce unit costs as well as lead times for final assembly and just-in-time delivery of parts.

Currently International Composites Technologies, Inc. (ICT) is evaluating novel thermoplastic forming and consolidation processes for security and industrial applications.



Program Objectives

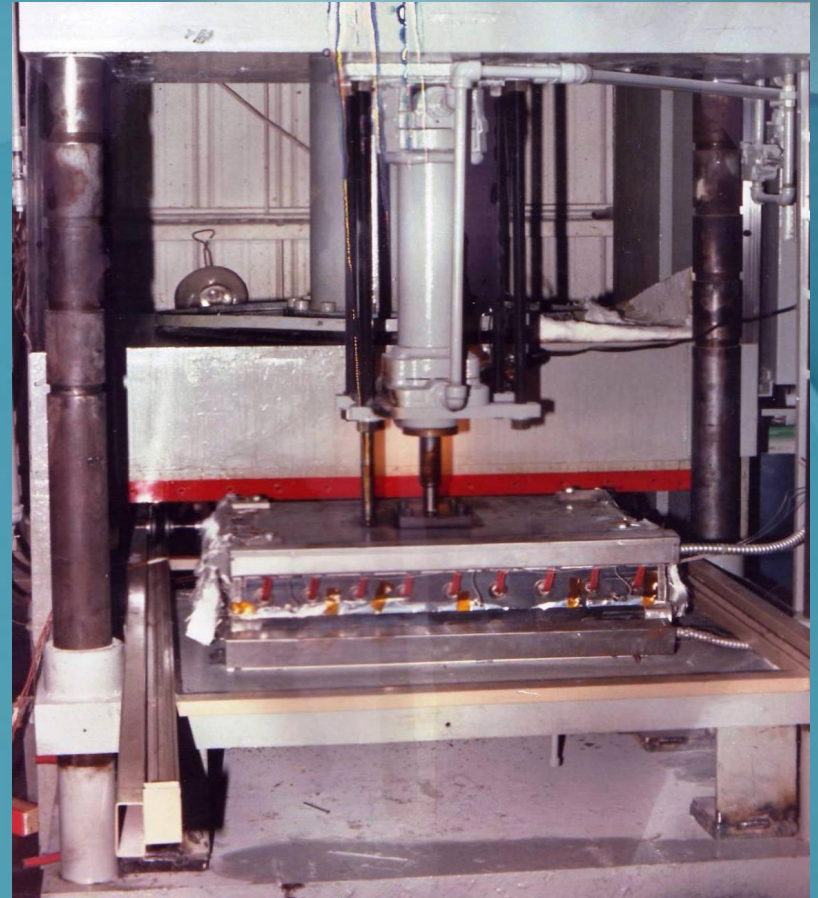
- ❑ Define, develop, and validate science based thermoplastic processing methods for complex shape parts.
- ❑ Demonstrate the low-cost processing potential of thermoplastics parts



**Full-Scale Frame
Segment**



TP Radome



Forming & Consolidation Press

Process Attributes

- ❑ Rapid Cycle semi-automated process
- ❑ Single-step heating and consolidation in 2 ½ to 5 minutes for these part
- ❑ Heating temperature uniformity
- ❑ Low cost compliant tooling
- ❑ Thermal process monitoring (data Acquisition)
- ❑ Accurate material positioning capability
- ❑ Repeatability of critical part dimensions
- ❑ Process simulation model can predict process parameters in advance of run

The Process is Capable of Forming a Wide Variety of Material Types and Forms

Material Types:

- ❑ APC-2 Peek, PEI, PPS, PAS-2, Radel 8320, HTA, Azdel, Acrylic prepreg, epoxy and polyester prepreg, nylon, polypropylene, SiCp/Aluminum MMC, Dyneema and thermoplastics aramid composite materials

Material Forms:

- ❑ Uni-tape, bidirectional fabrics, braided-slit tape, interlaced fabric, powdered towpreg, woven commingled fabric, thermoset prepreg

Material Thicknesses:

- ❑ 3 ply, 6 ply, 16 ply, 24 ply (with flanges) and 100 ply laminates (without flanges) demonstrated



Other Material Applications

Metal Matrix Composites (MMC'S)

- ❑ Rapid five minute heating and forming C-Channel shape using 25% SiCp / 6090H alloy demonstrated
- ❑ Successful forming of .040 inch thick panel with flange radius of 0.25"
- ❑ Low cost tooling approaches have been successfully applied to thin MMC's
- ❑ Same molds used for thermoplastic forming can be used for MMC'S
- ❑ Use for lightweight bulkheads, frames, tee's, & thermal management applications

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