

ONLINE CONSOLIDATION OF FIBRE-FABRIC REINFORCED THERMOPLASTIC COMPOSITES

D. Thum¹, D. Bhattacharyya², F. Henninger¹ and K. Friedrich¹

¹ *Institute for Composite Materials (IVW GmbH), University of Kaiserslautern, 67663
Kaiserslautern, Germany: friedrich@ivw.uni-kl.de, henninger@ivw.uni-kl.de*

² *Centre for Composites Research, University of Auckland
Private Bag 92019, Auckland, New Zealand: d.bhattacharyya@auckland.ac.nz*

SUMMARY: This study deals with the development of a new consolidation method using the same process speed as roll forming. The online consolidation (OC) is carried out with roll forming equipment and uses an additional pair of steel rollers to create a proper consolidation. The variation of temperature, speed, pressure and number of plies allows tight control of the process and an evaluation of the performance in comparison to the classical method of vacuum consolidation (VC) - lower speeds and higher pressure - was made. The temperature affects only the two-layer sample significantly. Two-layer samples with two-stage consolidation produced the best quality test specimens. Especially in tensile tests, the OC samples give similar results as that of the VC samples. The investigation of the specimen under SEM showed a proper consolidation with good fibre wetting and only a few defects in the samples. This new online consolidation technology enables a practical application of roll forming in an industrial mass-production. The bottle-neck of a lot of high speed manufacturing process for composites might be avoided using this method of consolidation.

KEYWORDS: Thermoplastic Composites, Sheet Material, Processing, Consolidation, Commingled Yarn, Roll Forming

REFERENCES

1. B. T. Åström, *Manufacturing of Polymer Composites*, Chapman & Hall, London, UK, 1997.
2. F. N. Cogswell, *Thermoplastic Aromatic Composites, A Study of the Structure, Processing and Properties of Carbon Fibre Reinforced Polyetheretherketone and Related Materials*, Butterworth-Heinemann Ltd., Oxford, 1992.
3. P. K. Mallick, *Fibre-Reinforced Composites - Materials, Manufacturing and Design*, 2nd Edition, marcel Dekker Inc., New York, USA, 1993.

4. T. G. Gutowski, *Advanced Composites Manufacturing*, John Wiley & Sons Inc., New York, USA, 1997.
5. D. Bhattacharyya, *Composite Materials Series, 11 – Composite Sheet Forming*, Elsevier, Amsterdam, Lausanne, 1997.
6. R. Dykes, “Analysis of Roll Forming Continuous Fibre Reinforced Thermoplastic Composite Sheets”, PhD thesis, University of Auckland, 2000.
7. T. A. Martin and D. Bhattacharyya, “Rapid Manufacturing of Thermoplastic Composite Sections by Roll Forming”, Australasian Conference on Technology for Manufacturing, Massey University, Palmerston north, New Zealand, 1997.
8. F. Henniger, A. Wöginger, P. Mitschang, K. Friedrich and M. Neitzel, “New Process Technologies for Continuously Fibre-Reinforced Thermoplastic”, *Proc. Of 4th AVK-Tagung Baden-Baden*, Germany, 2001.
9. ASTM Designation D 638-98: *Standard Test Method for Tensile Properties of Plastics*.
10. ASTM Designation D 790-98: *Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials*.