Development of Optical Fiber Sensor to monitor Liquid Composite Molding Process (LCM)

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An instrumentation system based on specific optical fiber sensor (OFS) was developed during the LCM Smart project in order to improve the reliability of LCM processes. First applications of this instrumentation were developed and adapted to a semi-industrial LCM system for the monitoring of the resin transfer molding process (RTM). The main challenges were the integration of the sensors to the process and the analysis of the OFS's responses. Specifically, these sensors require a special caution to be embedded into the materials, to ensure reliable information about the process.

In this project the instrumentation was applied to the case of the manufacturing of flat part. We have demonstrated the capacity of OFS to monitor temperature, flow front, degree of cure and internal strain in various geometries including thickness variations and ply-drops. A first comparison was carried out with some results from manufacturing simulations, in order to evaluate the reliability of both measurements methodology and numerical models. The instrumentation has highlighted the limits of the modeling, particularly for the prediction of the residual stresses. We have noticed an additional major source of residual stress coming from the Part/Tool interaction during the cooling stage. A first prototype of RTM composite Tool made up with HexTool material has been developed and proved to reduce this interaction. Finally this instrumentation was extended to the development of two industrial parts processing made by Issoire Aviation and SKF Aerospace.