CHARACTERIZATION AND MODELLING OF WELDED SHORT FIBER REINFORCED POLYMER MECHANICAL STRENGTH

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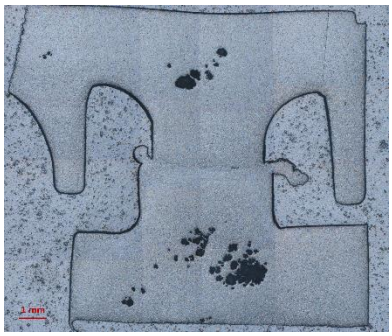

- Microstructure observation (Optical Microscope, MEB, X-Ray Tomography)
- Characterization of matrix crystallinity (DSC, FTIR, SAXS/WAXS)
- Monotonic and creep tensile tests of welded samples
- Modelling of mechanical properties

Abstract:

In automotive industry, more and more pieces traditionally made from metal are now made with short fiber reinforced polymers in order to diminish weight and cost. However some pieces have hollow and complex shapes which prevent them to be injected in one operation. Those pieces must be injected in several parts that are then joined together by welding. Although, welding operations are efficient for pristine polymers, it is not the case for glass fiber reinforced polymers. In fact, when fibers are added to the polymer, failure of the pieces generally occurs in the welded zone. Thus, the aim of this PhD project is to better understand the mechanisms governing the weld strength of these materials in order to reduce safety factors in the development of new products.

First part of this work consists in studying the microstructure of several materials samples welded with different parameters. For this purpose, microscopic and X-Ray tomography analyzes will be performed on samples to determine if fibers reorientation or cavities growth in the matrix occur during the welding operation. The evolution of matrix crystallinity in the thermally affected zone of the weld will also be studied. This can be done by DSC and FTIR measurement or SAXS/WAXS analysis. Then, the mechanical strength of welded samples in monotonic and creep tensile tests will be performed in order to link microstructure observations with mechanical performances. The aim is to understand why, as read in literature, it is not possible to achieve very high strength value with reinforced polymer while pristine polymer can be welded without any loss of mechanical properties. Finally, after having determined the most influencing factors, modelling of the mechanical strength of welded materials will be proposed.