

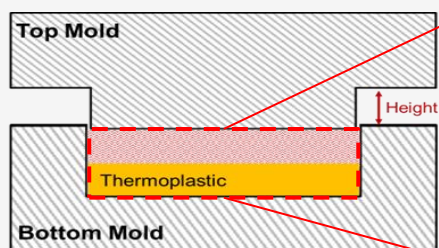
Multi-modal Imaging for Porosity Quantification in Partially-impregnated UD Woven Glass Fiber/ Polypropylene Composites

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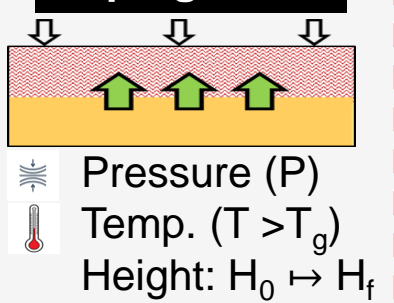
CONTEXT

Compression Flow Molding

Processing conditions

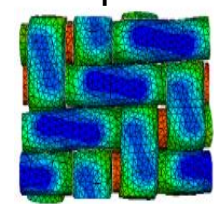


Impregnation



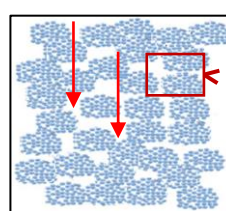
Fiber-bed Deformation + Flow Resistance

Compaction

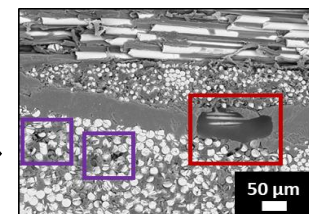
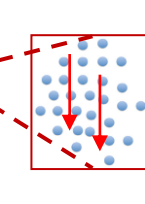


(TexGen -MICRA); (Binetruy et al., 2015)

Inter-bundle

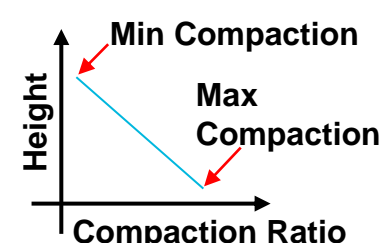


Inter-fiber



- Inter-bundle Porosity
- Inter-fiber Porosity

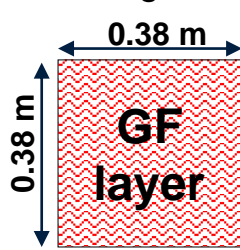
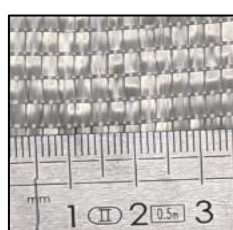
Objective: To identify a correlation between localization of residual porosity with the compaction ratio as a processing control parameter?



EXPERIMENTAL WORK

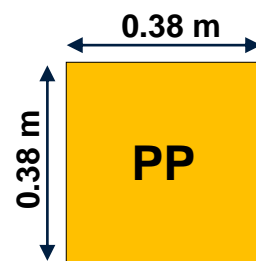
Reinforcement

- UD Woven GF
- 6 GF plies; [0/90]₃
- Areal weight – 1054 g.m⁻²

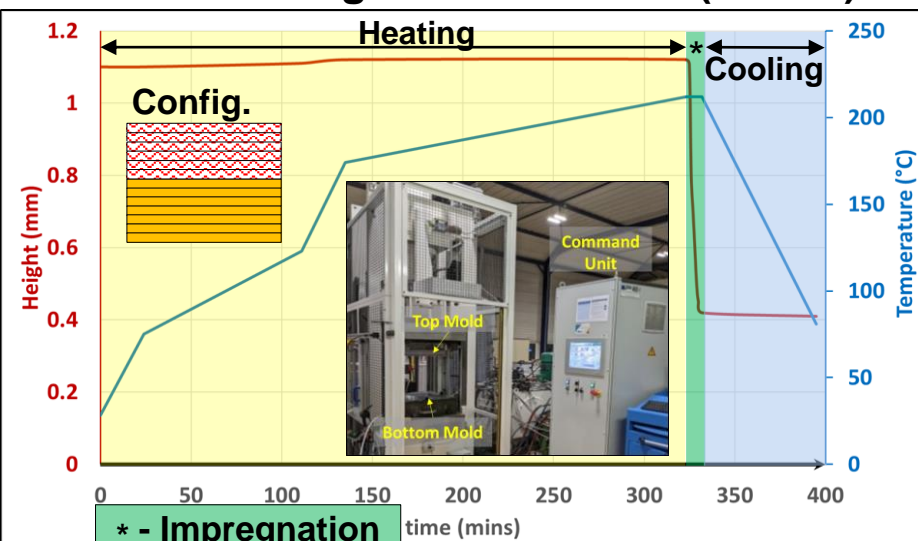


Thermoplastic Film

- PP (Total, PPC13442)
- 7 PP films; 0,53 mm thick/ film
- MFI (100 g/ 10 min)

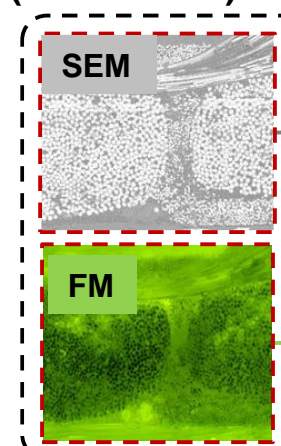


Manufacturing – Pinette Press (120KN)

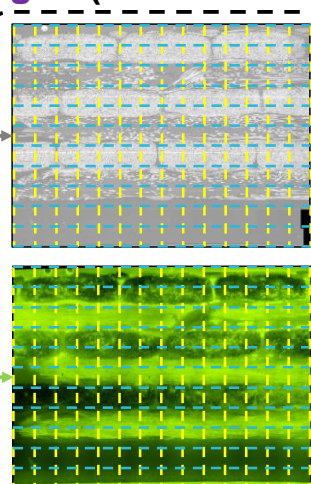


CORRELATIVE IMAGING TECHNIQUE

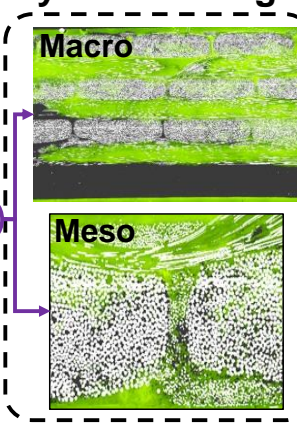
Raw images (meso-scale)



Extended field images (macro-scale)



Synthetic images

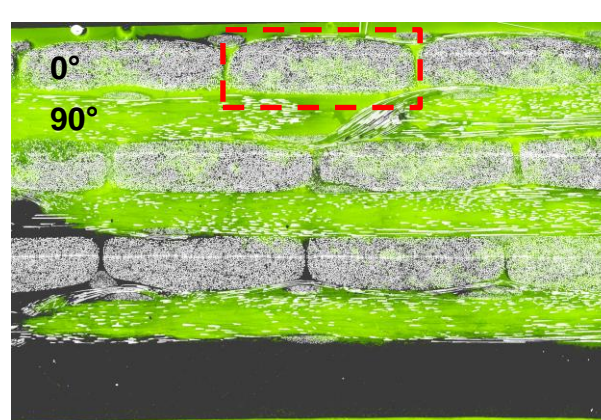


Artefact filtering
Intensity correction

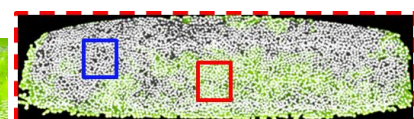
Registration

QUALITATIVE RESULTS

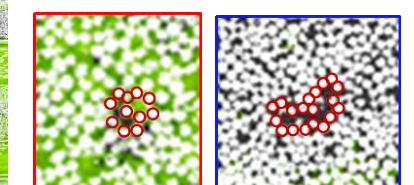
0° oriented fiber bundles - Macro Scale



- Meso Scale



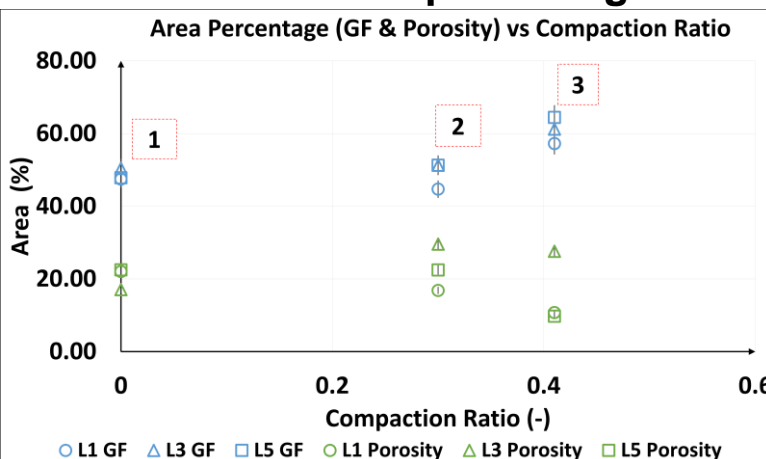
- Micro Scale



Single GF PP
Porosity

QUANTITATIVE RESULTS

Intra bundle area percentages



GF 64.17%
Void 19.03%

CONCLUSIONS

- Multi-modal imaging helps in the localization of residual porosity and PP within partially-impregnated fiber bundles.
- Correlative imaging enhances the accuracy of quantification of impregnation quality.

PERSPECTIVES

- Extending the approach to μ -CT data.
- Validation of correlative imaging approach for impregnation analysis in the context of CRTM process.