

The Influence of Processing Parameters on Tape Deconsolidation in Thermoplastic Composites

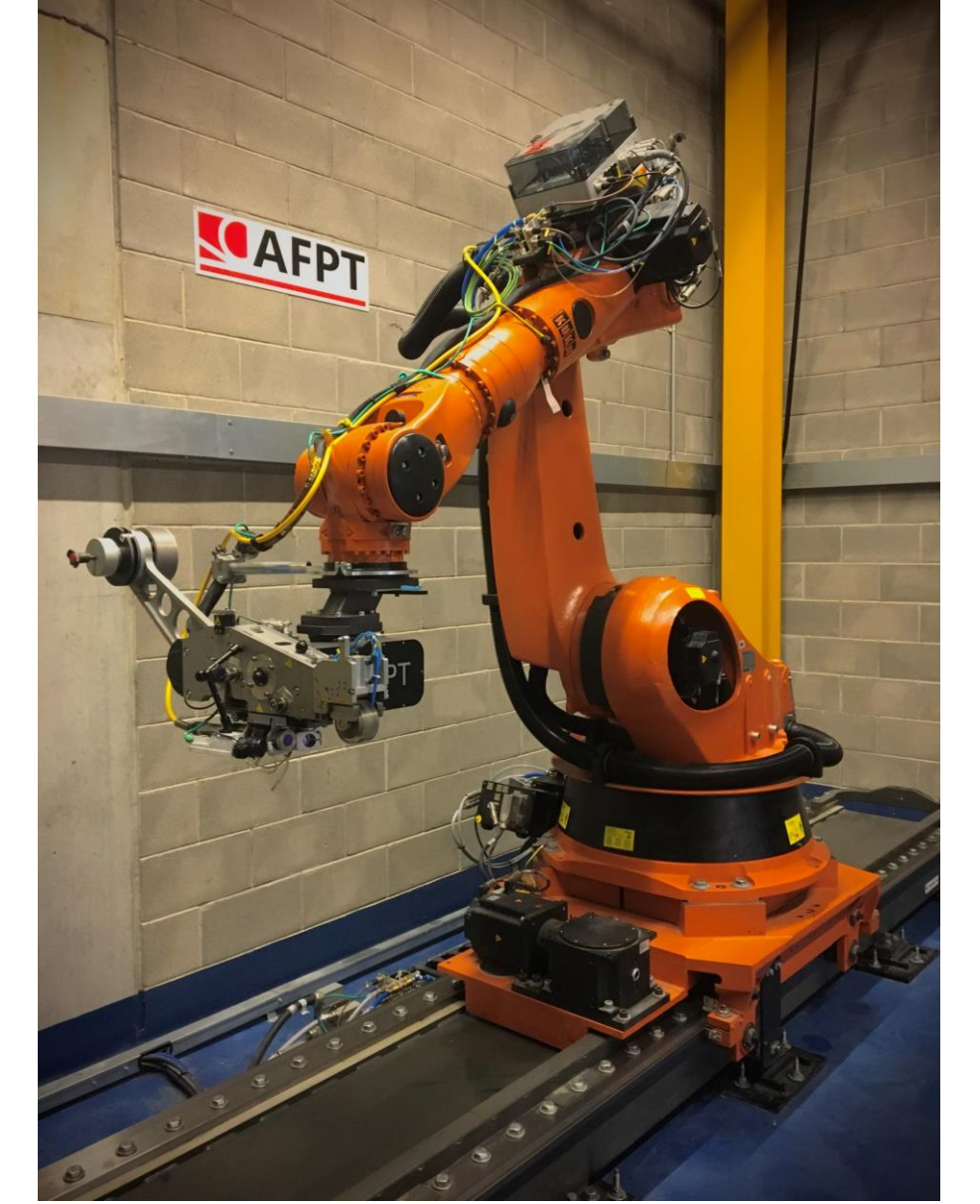
E. Tobin, R.M. O'Higgins and P.M. Weaver

Introduction and Question

- There is increasing interest in **Laser-assisted Automated Tape Placement (LATP)** as a fibre-reinforced thermoplastic composite structure manufacturing method
- Compared to other systems it offers low waste, low energy usage, high repeatability and reduced labour cost [1]
- However, the process is not yet widely adopted in industry due to:
 - Poorer component quality** compared to conventional consolidation methods (autoclave and hot-press)
 - Issues surrounding **bond quality, voids and tape deconsolidation** [2]

Tape deconsolidation is a change of mesostructure of the tape during processing

Can **optimised process parameters** improve bond quality, reduce void content and deconsolidation in thermoplastic composites?



Methodology

- Hoop** samples with various processing parameter combinations manufactured
- Performance assessed by **Interlaminar Shear Strength (ILSS)** tests conducted in accordance with **ASTM D-2344**

Manufacturing combinations used – number is sample indicator

Indicated Temperature* (°C)	Placement Rate (m/min)		
	3	9	15
400	1	4	7
450	2	5	8
500	3	6	9

* IR Camera indicated nip-point temperature – the actual temperature may be lower

Results

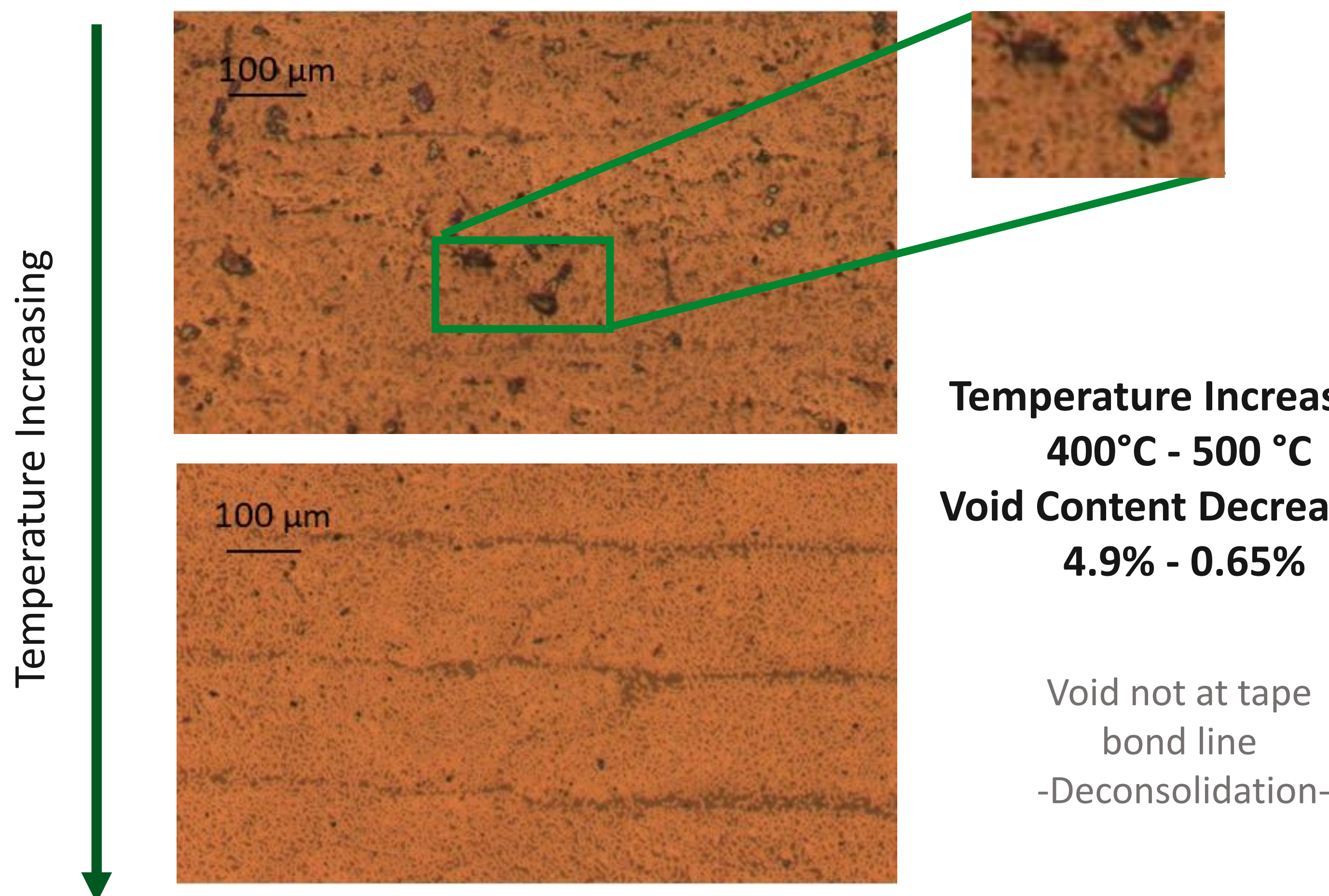
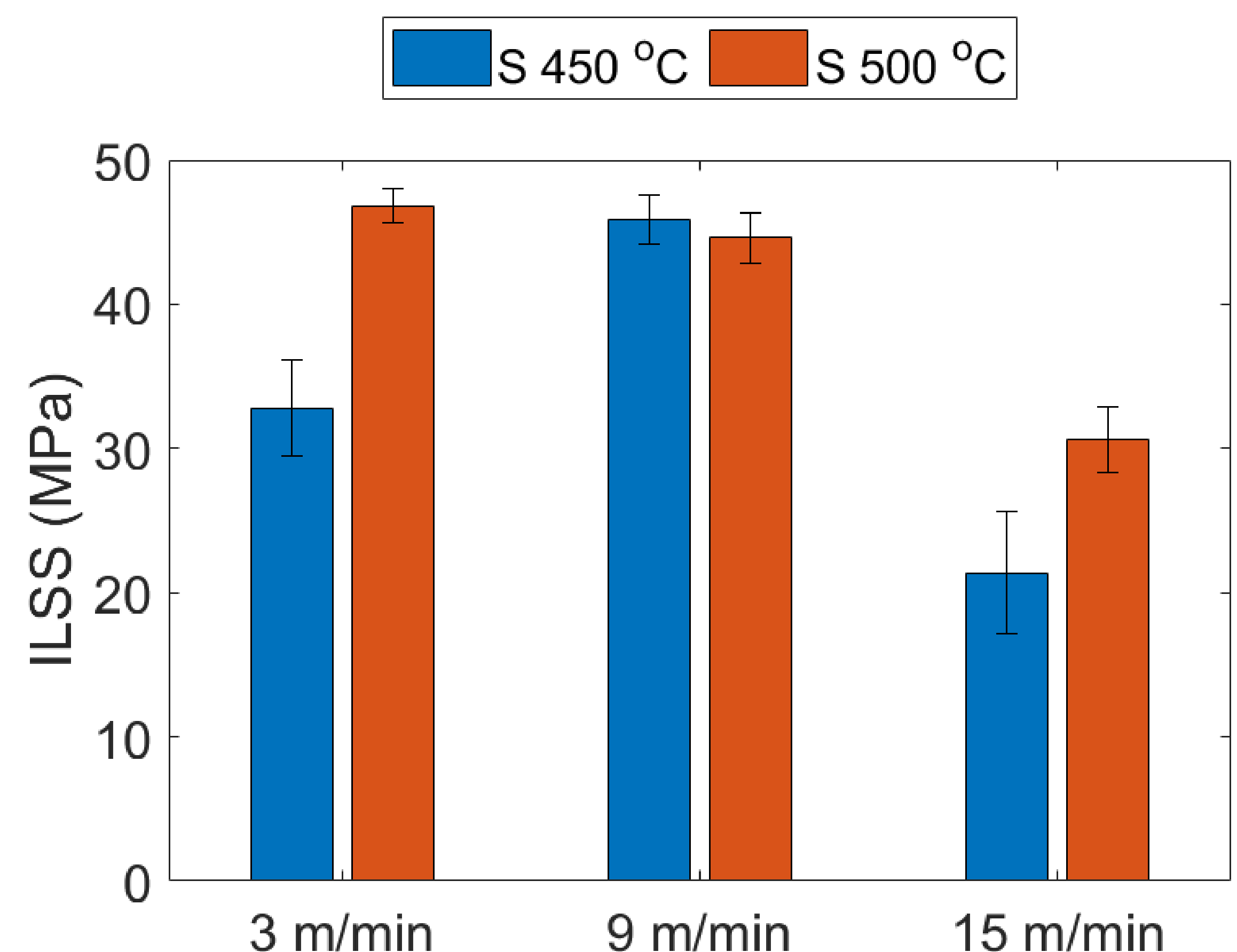
- Sample **thickness increased** as a result of **processing**
- Increasing placement rate at constant temperature reduced sample thickness
- No direct correlation between constant placement rate and increasing temperature

Thickness change as a result of deconsolidation

Above 400°C crystallinity had low variation, regardless of placement rate

28% - 32%

Poor bonding at 400 °C indicated temperature resulted in no ILSS data above 3 m/min placement rate



Conclusion

- Voids developed within the tape as a result of deconsolidation
- Increasing placement rate with constant temperature reduced ILSS
- Increasing temperature with increasing placement rate increases ILSS
- Correlation observed between higher void content and lower ILSS

References

- [1] Comer AJ, Ray D, Obando WO, Jones D, Lyons J, Rosca I, et al. Mechanical characterisation of carbon fibre-PEEK manufactured by laser-assisted automated-tape-placement and autoclave. Composites Part A: Applied Science and Manufacturing. 2015;69:10-20.
- [2] Grouve WJB, Warnet L, Akkerman R, Wijskamp S, Kok JSM. Weld Strength Assessment for Tape Placement. International Journal of Material Forming. 2010;3(S1):707-10.