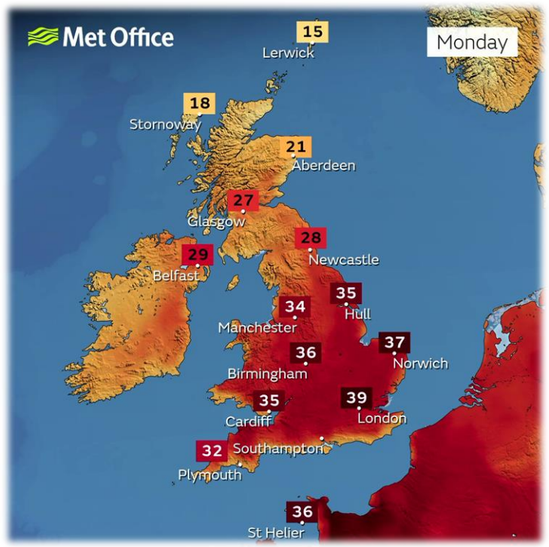
Development of high quality Lignin Based Carbon Fibres

Dr Anne Beaucamp Mc Loughlin ; Prof Maurice N Collins

Bio-based Industries Consortium -Jul-23

Horizon 2020 European Union Funding for Research & Innovation

Introduction



https://gulfnews.com/opinion/op-eds/worlds-climate-emergency-is-getting-harder-to-ignore-1.65546665

Sustainable materials

https://www.vox.com/2014/10/22/18093054/global-warming-explained

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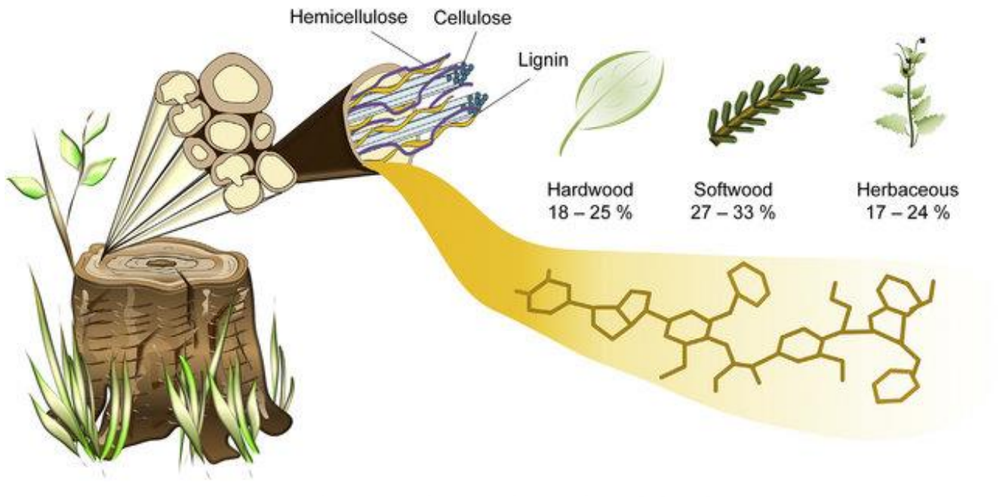
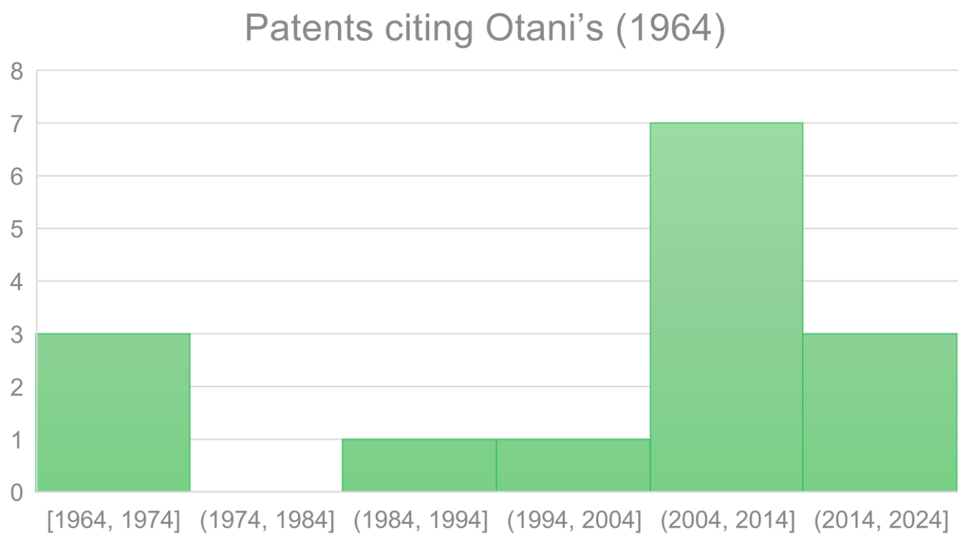
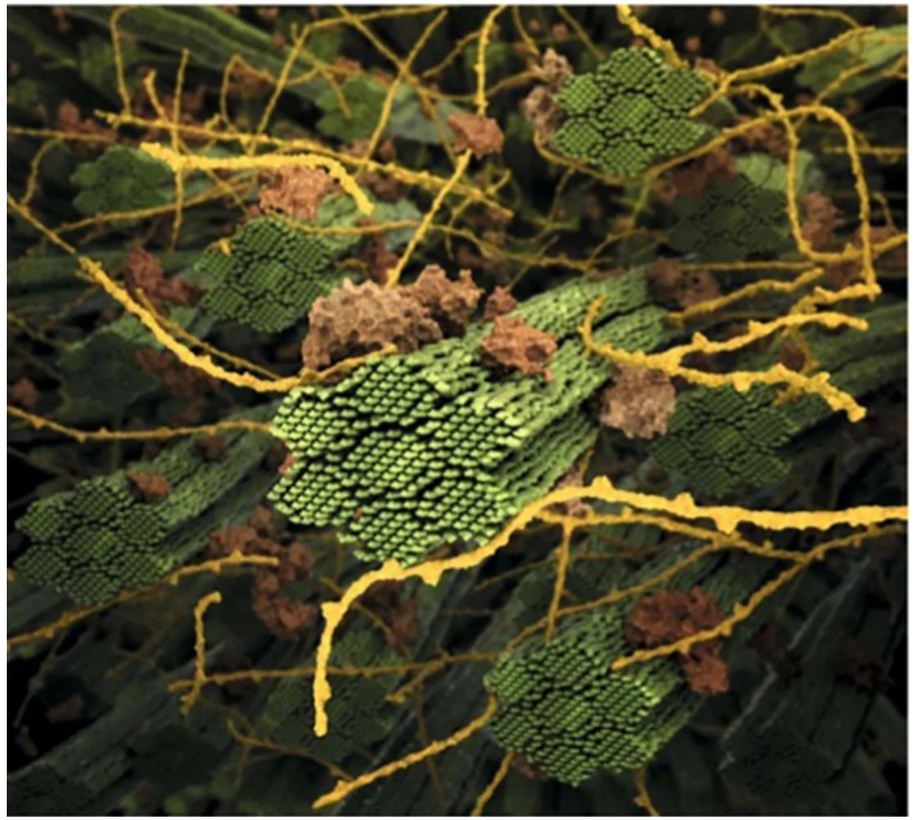
Introduction: Lignin



Becker, *Biotech Adv*, 2019





Yuan, *Biotechnol Biofuels* **14,** 205 (2021)

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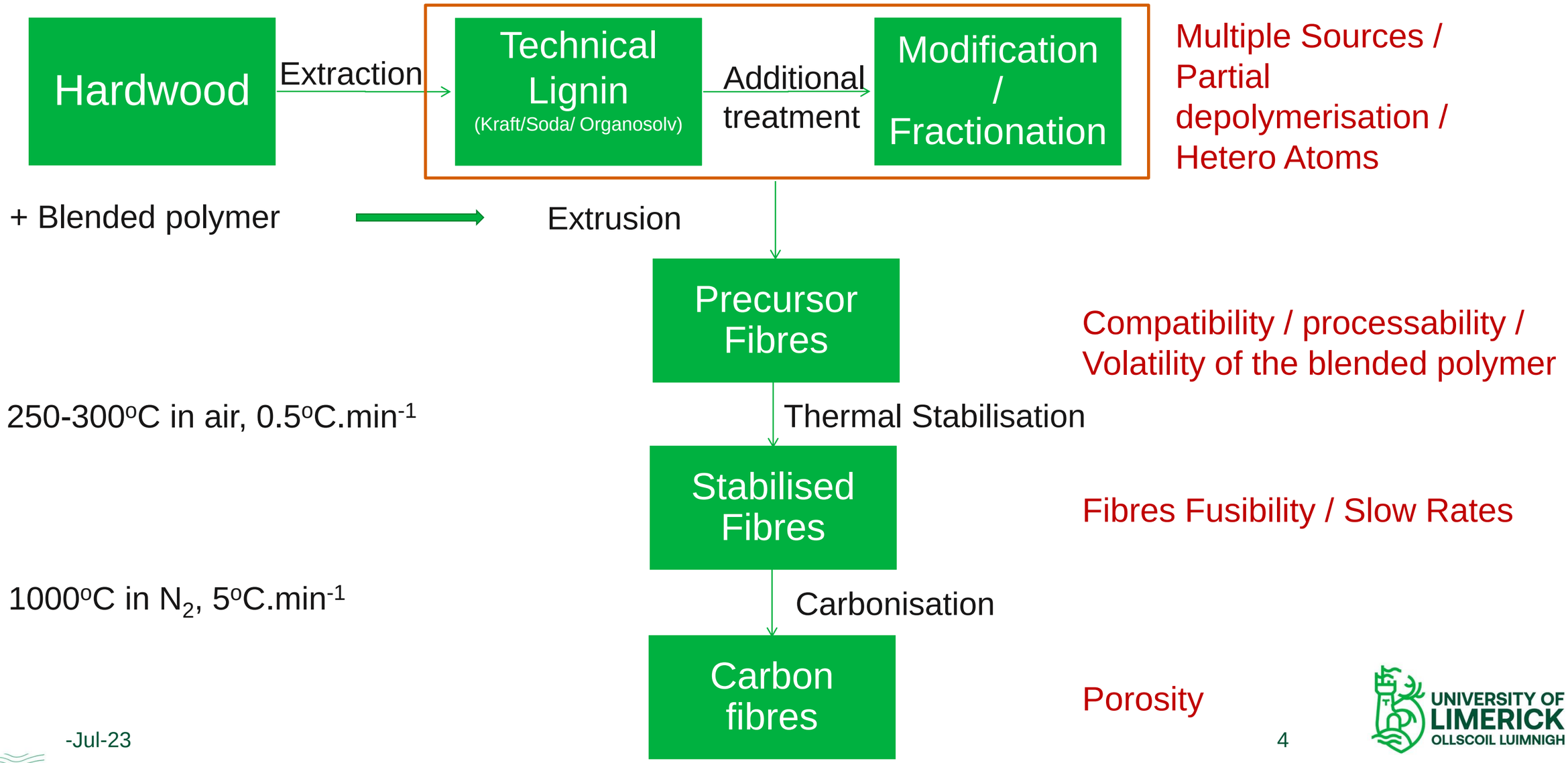
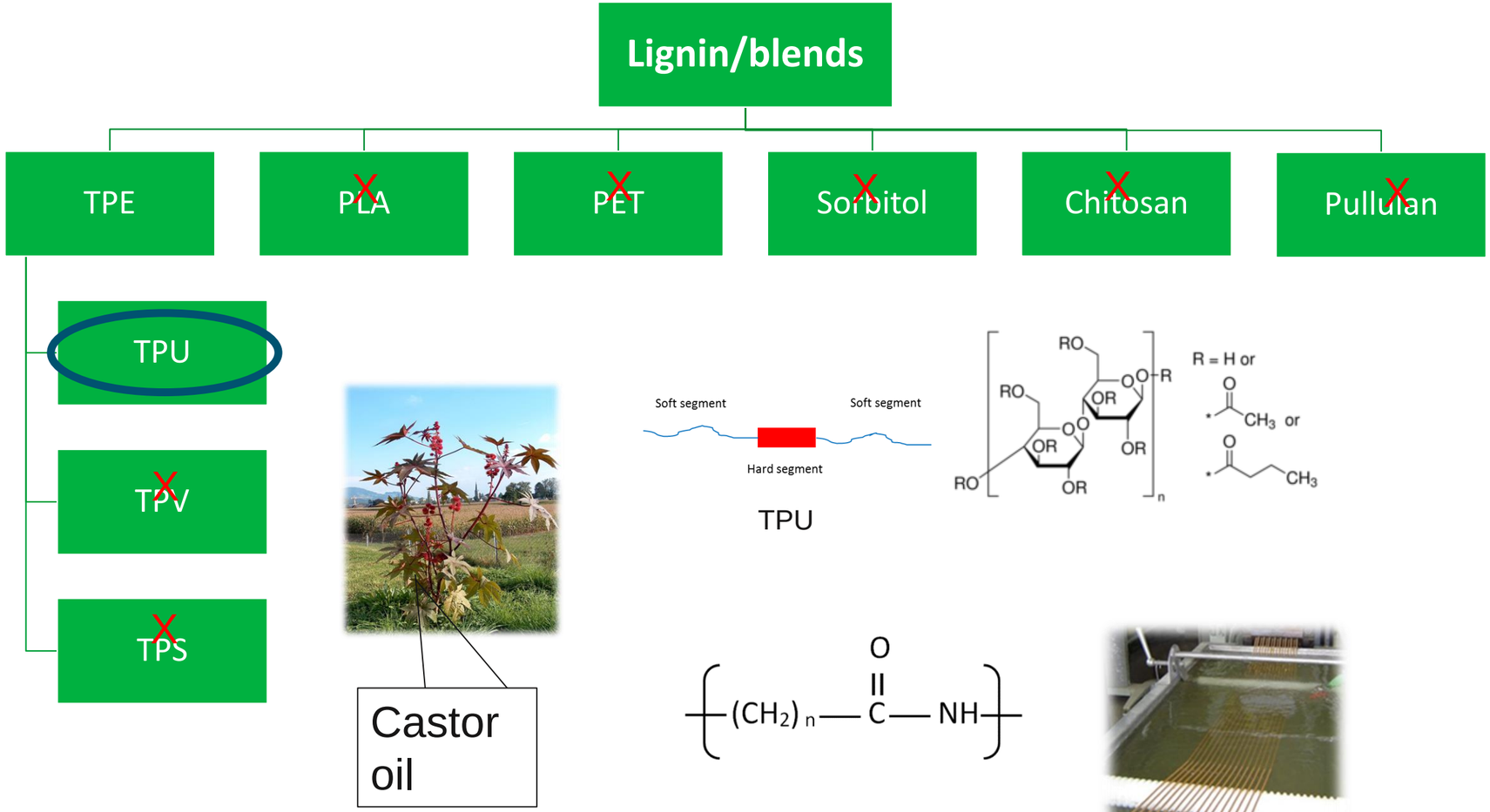
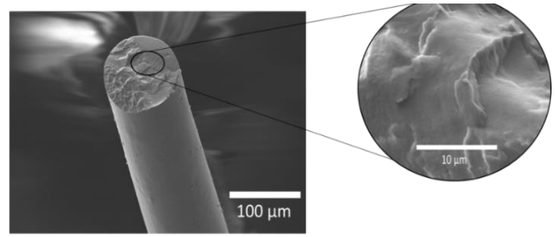
Lignin: Extraction And Challenges For Conversion Into Carbon Material



Successful development of lignin blends for CF precursors

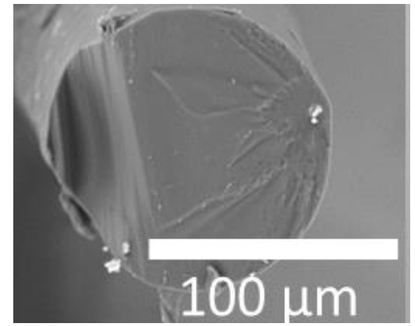


Precursor Fiber



Carbonisation

Carbon fiber



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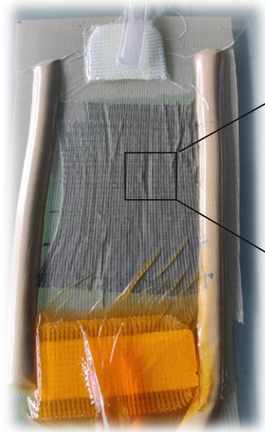
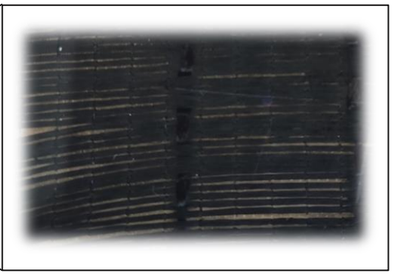
Successful development of lignin blends for CF precursors

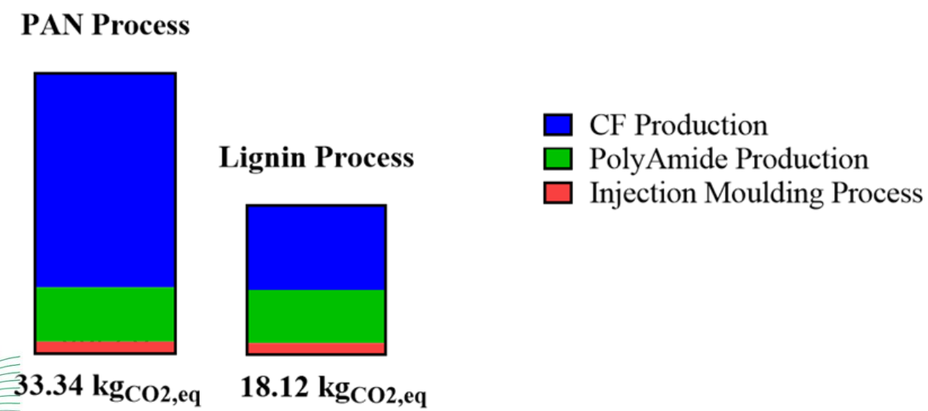




Direct PF Weave + carbonisation for VARI

Short PF fibres+ carbonisation for sCF + PA injection moulding

Composite car parts



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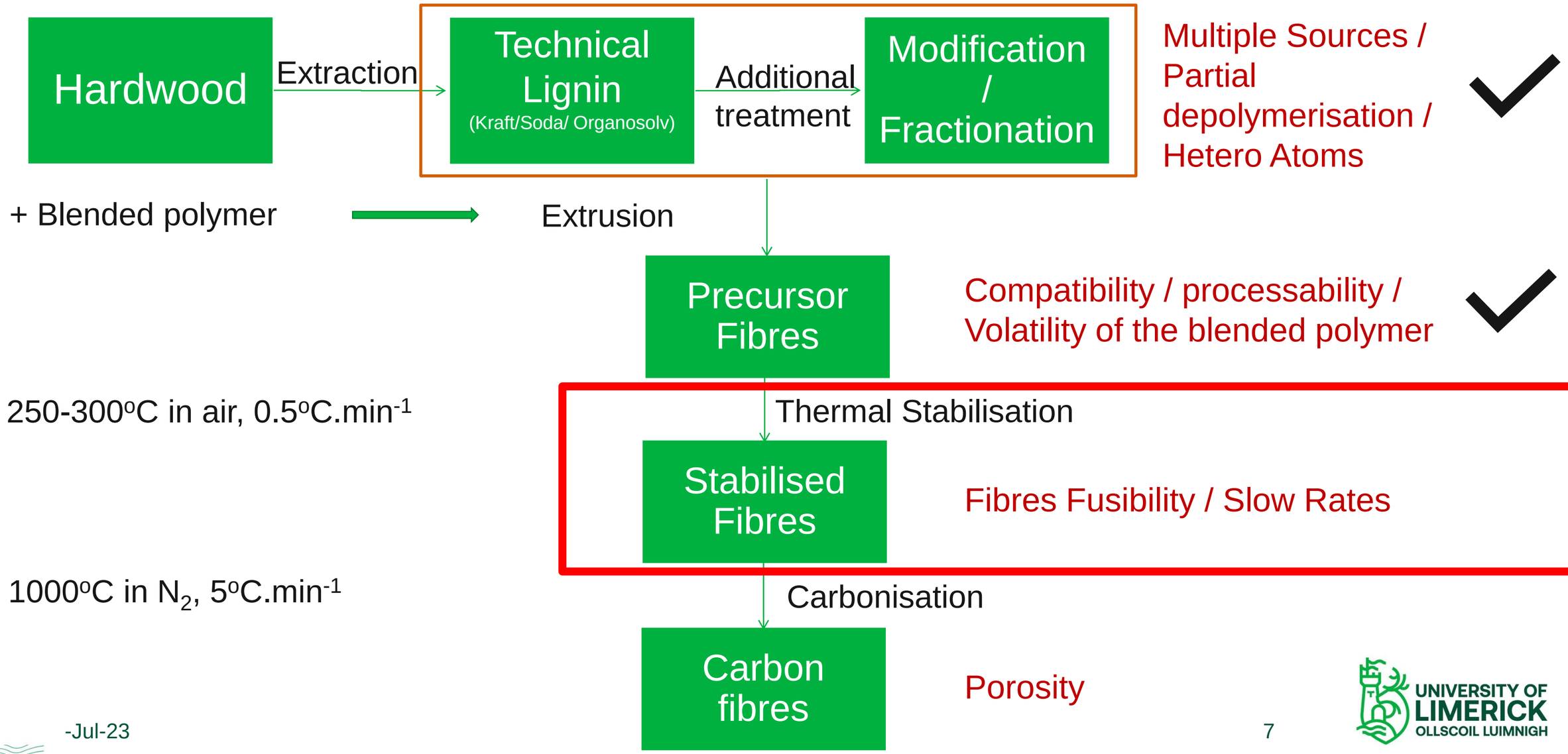
Lignin: Extraction And Challenges For Conversion Into Carbon Material



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Next Challenge = To produce continuous CF

Problem 1 :

The PF produced have a 80 µm diameter, leading to large CF.

Problem 2 :

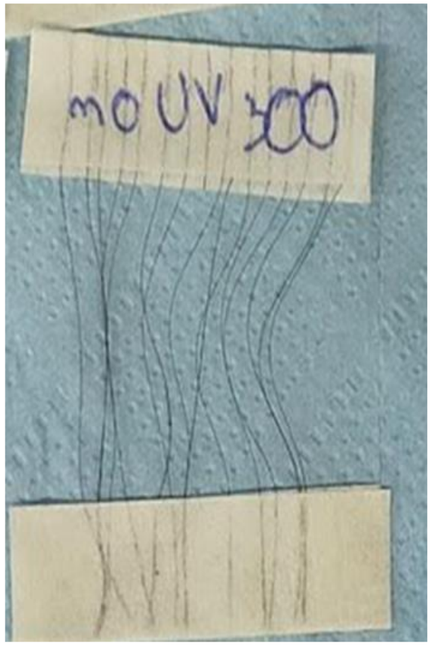
Stabilisation step is not efficient enough : Poor crosslinking of the lignin chains leads to fibres breaking at the stabilisation steps.

Solution?

Reactive coatings are used to improve the crosslinking of the lignin chains and reduce their fusibility. The coated fibres are stretched in the stabilisation process

Next Challenge = To produce continuous CF

Reactive coating



UV Treatment	Reactive coating in water bath	% Failure
-	0%	100%
-	1%	50 %
-	2%	17%
-	5%	No Failure
-	10%	No Failure
+	0%	No Failure
+	1%	No Failure
+	2%	No Failure
+	5%	No Failure
+	10%	No Failure

Concentration of RC (%)

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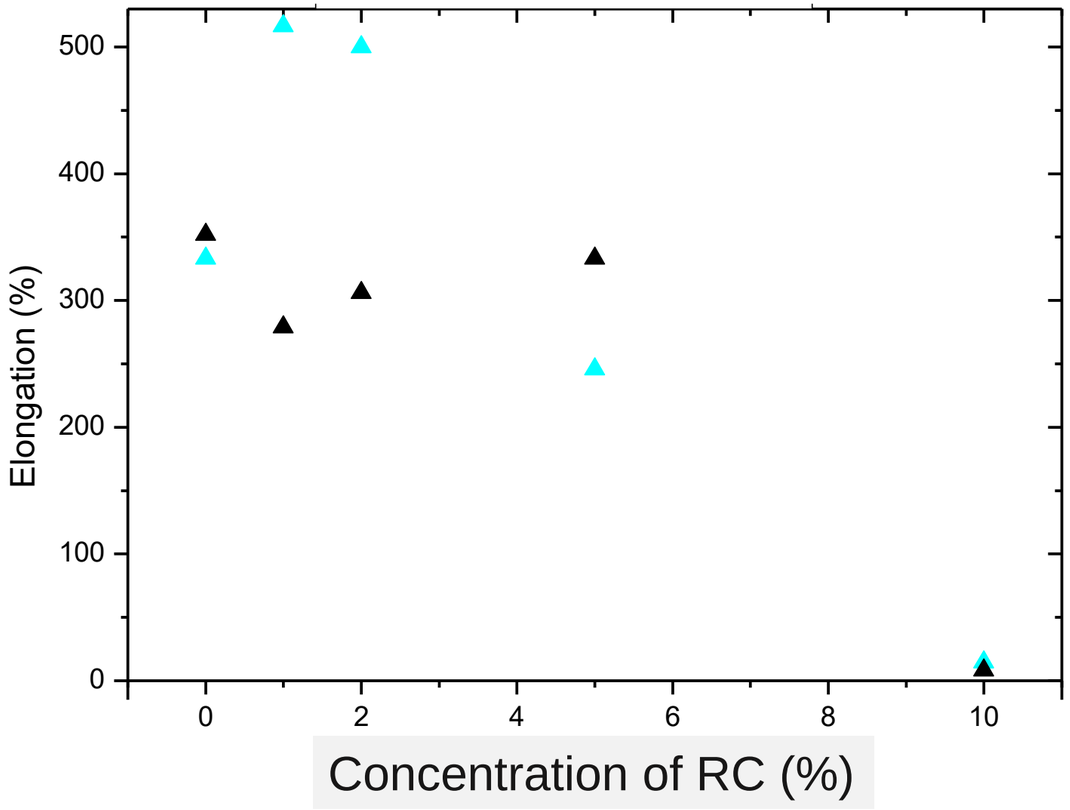
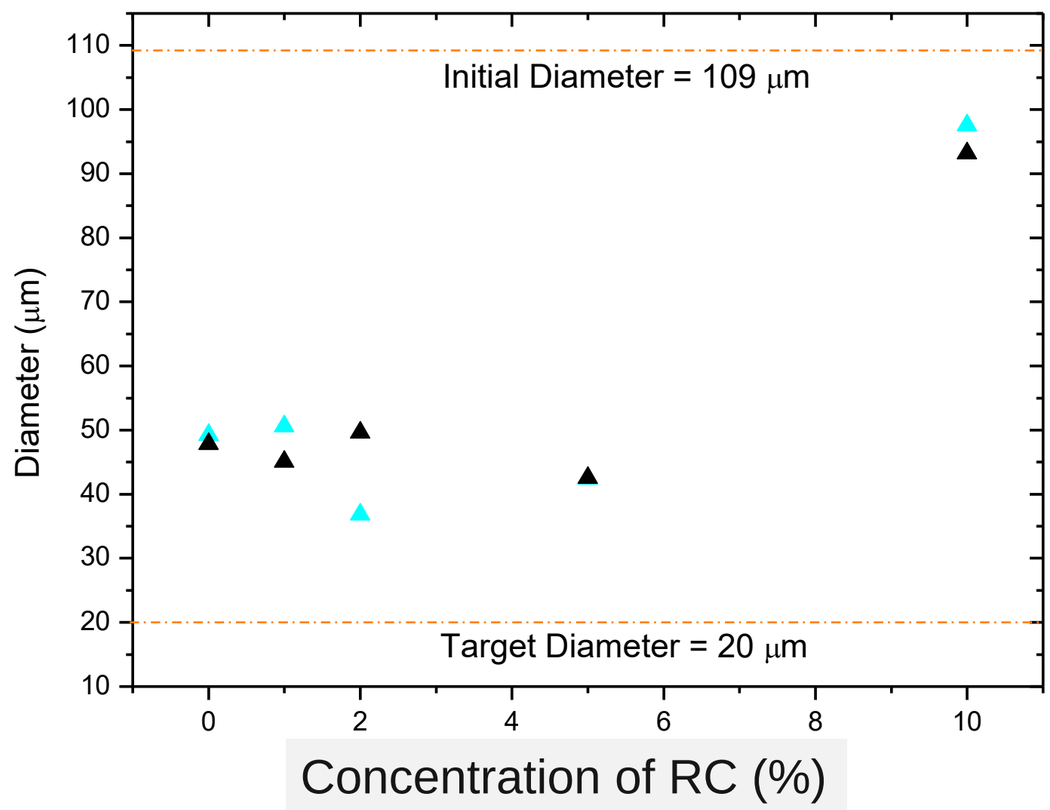
Next Challenge = To produce continuous CF

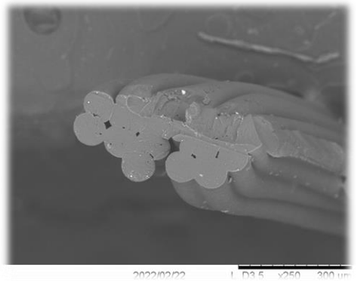
Reactive coating



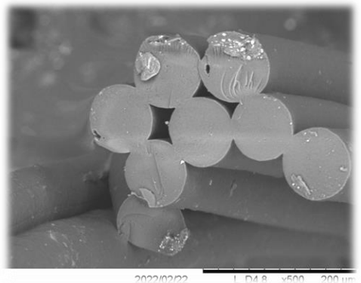


Next Challenge = To produce continuous CF

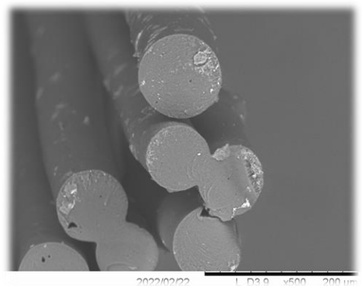
Improved crosslinking, Less fusing between the fibres and improved carbon yield



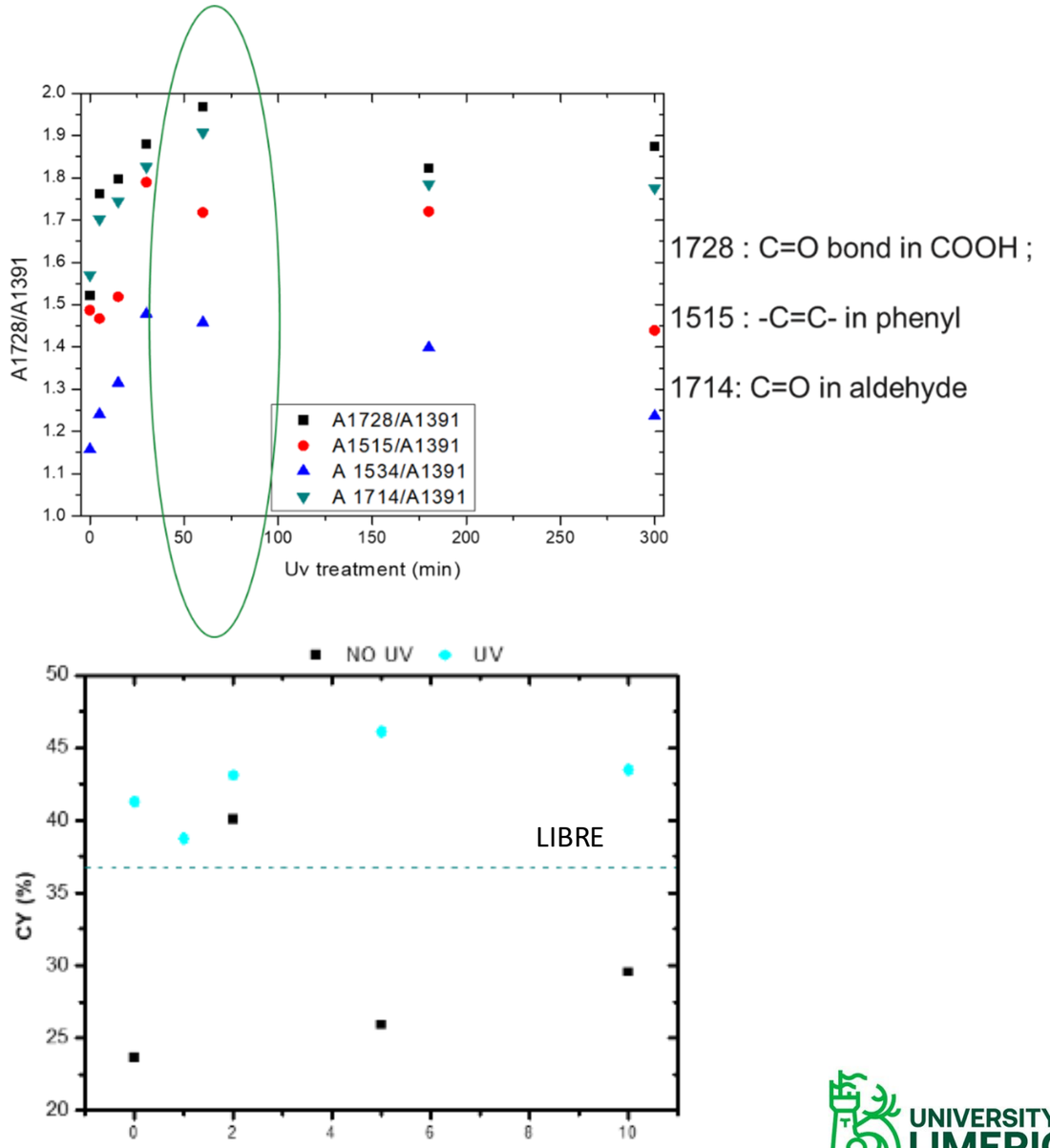
0% RC



5% RC

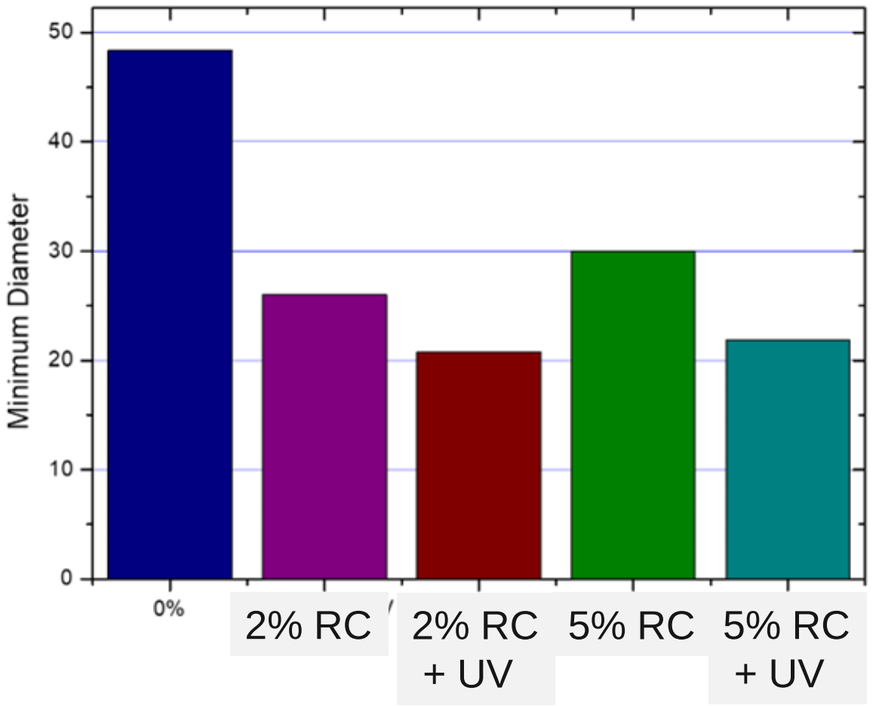


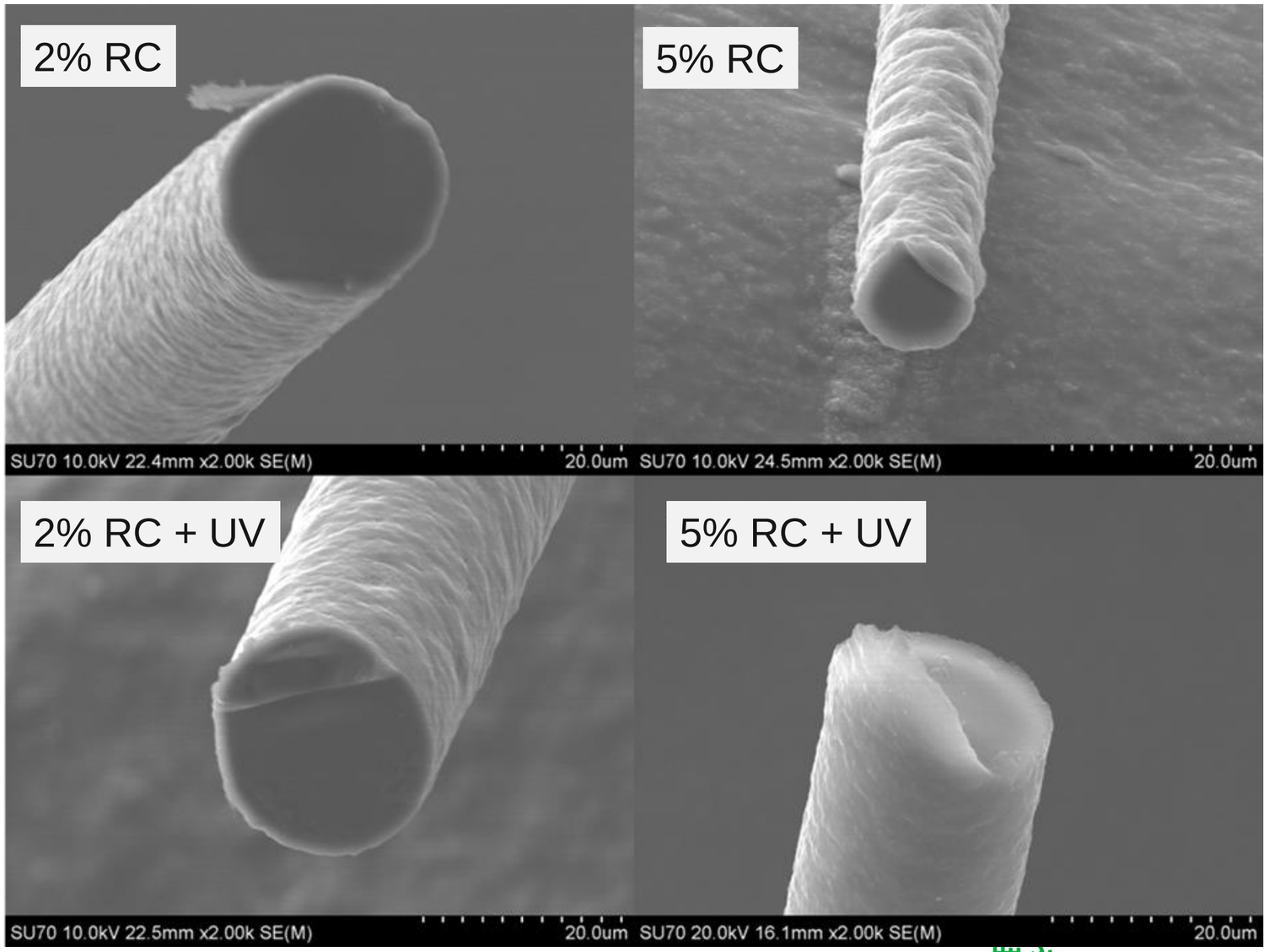
10% RC



Next Challenge = To produce continuous CF

Void less fibres

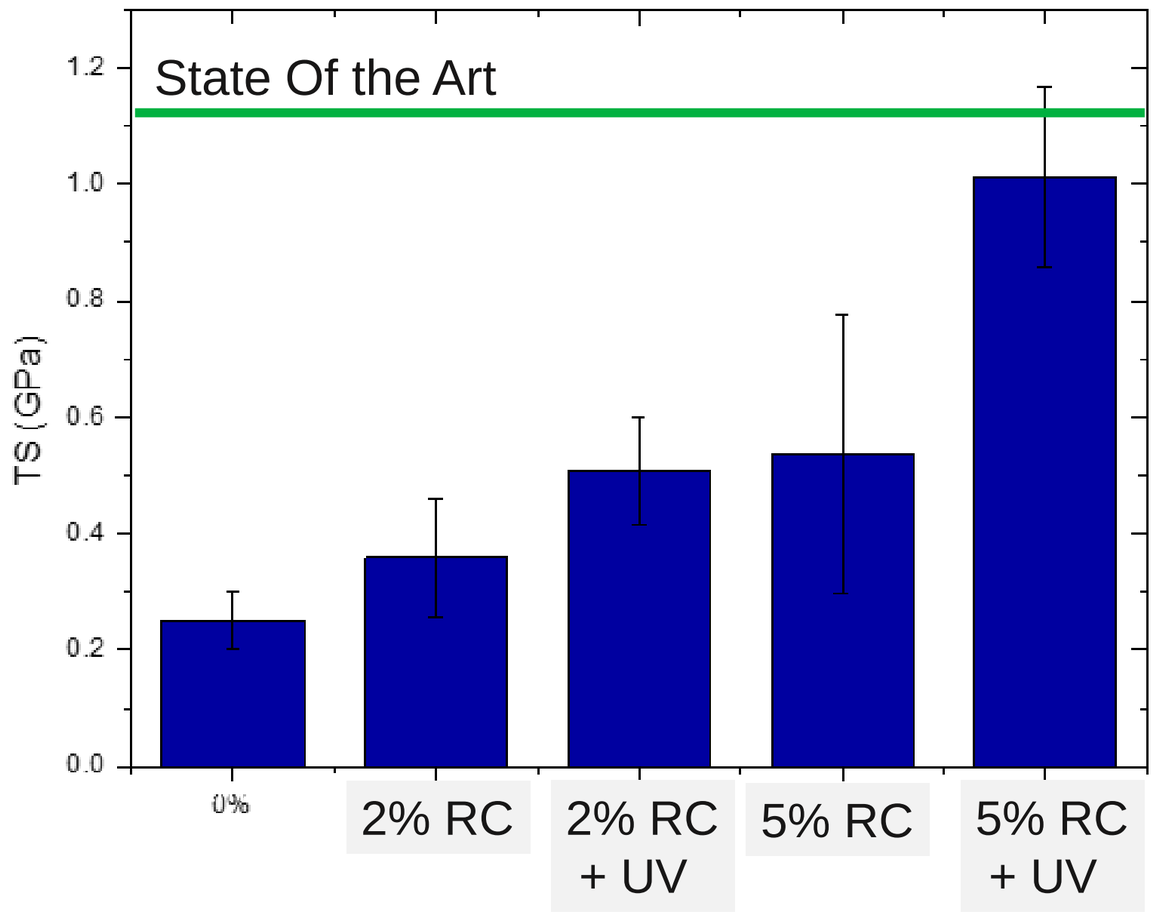




Concentration of RC (%)

Next Challenge = To produce continuous CF

Mechanical properties



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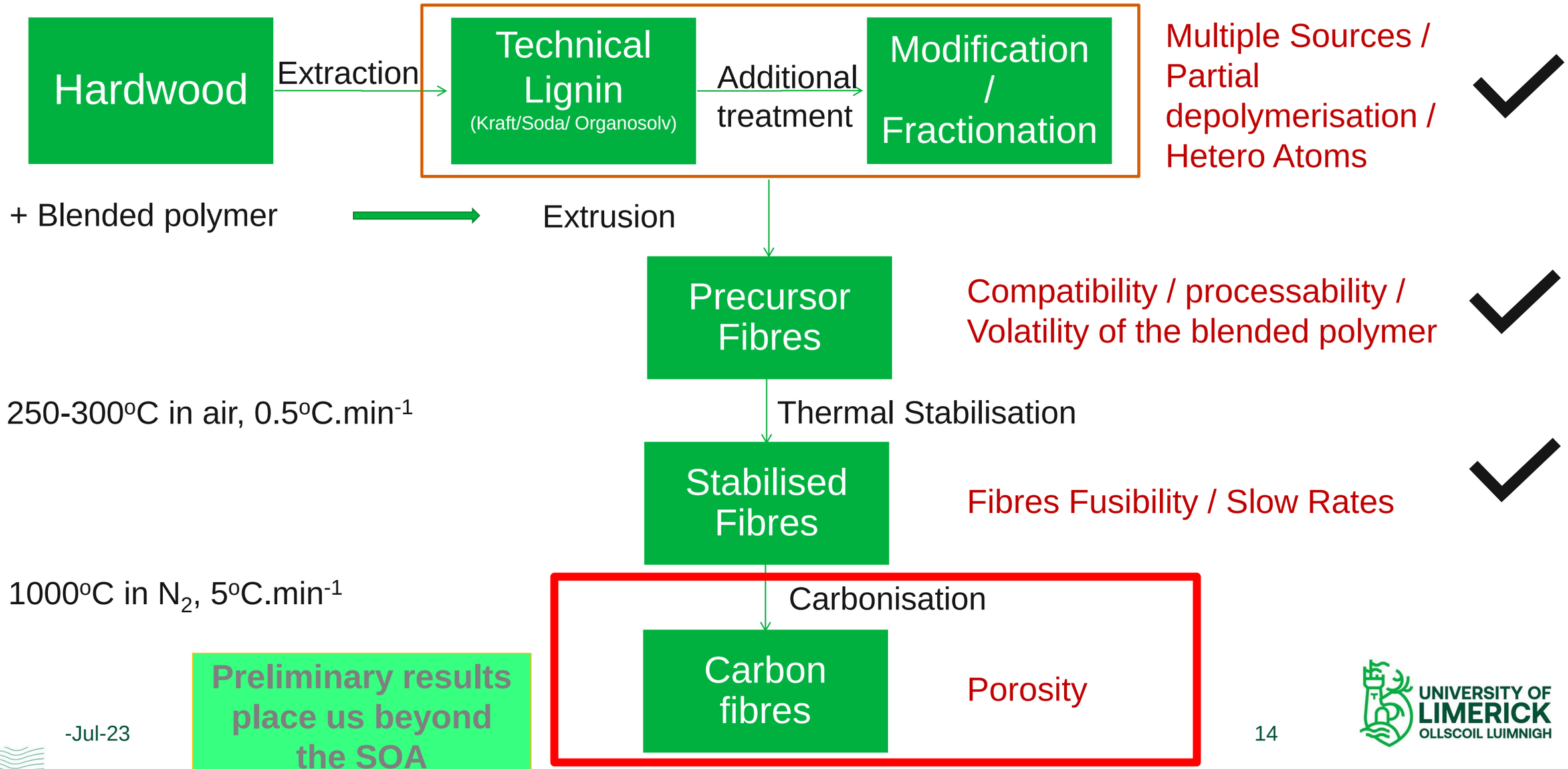
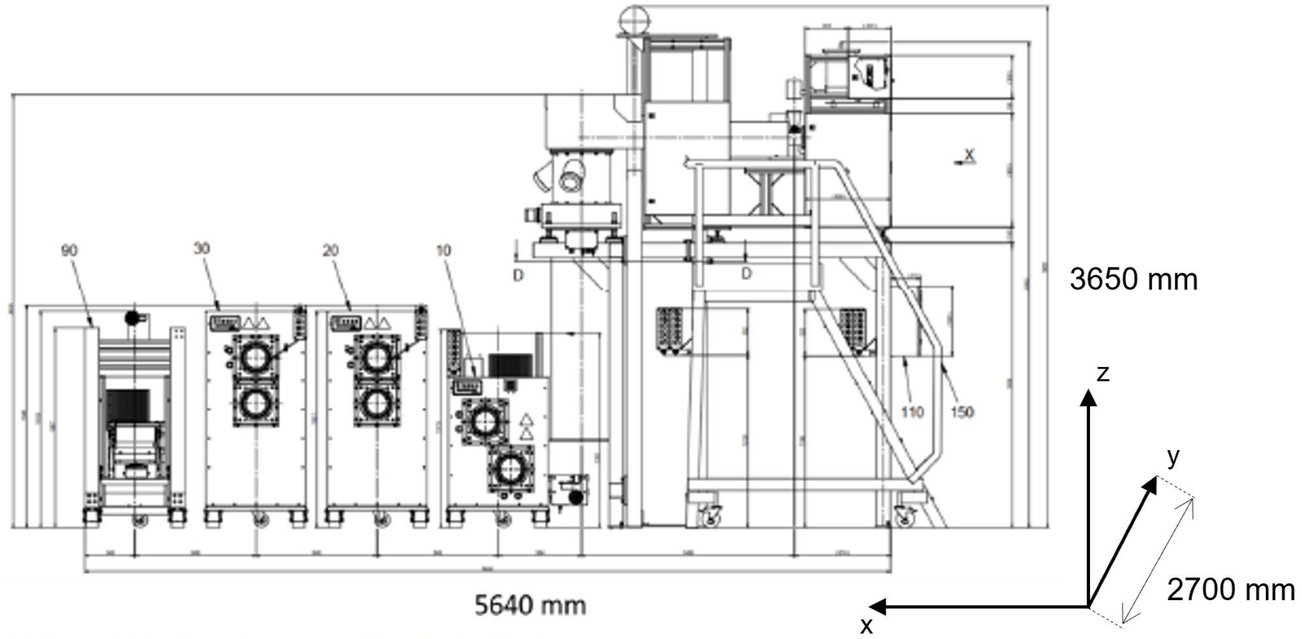
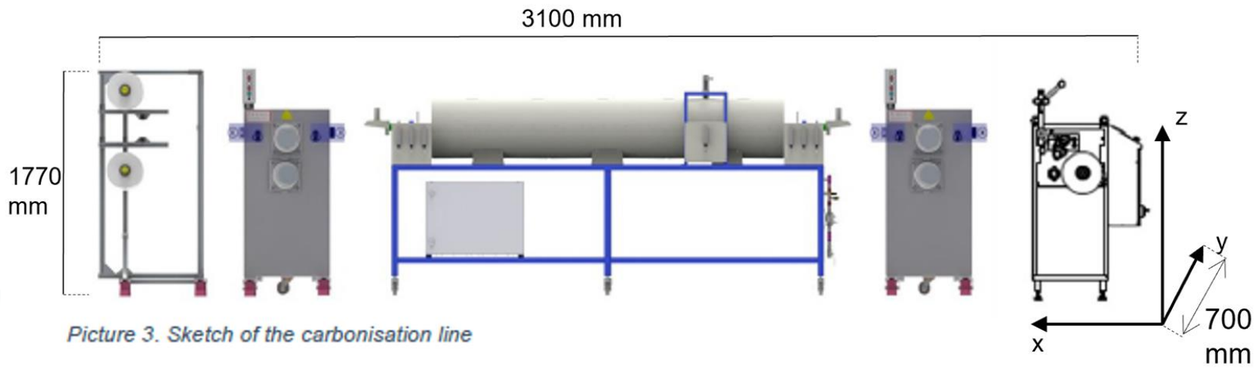


Preliminary results place us beyond the SOA

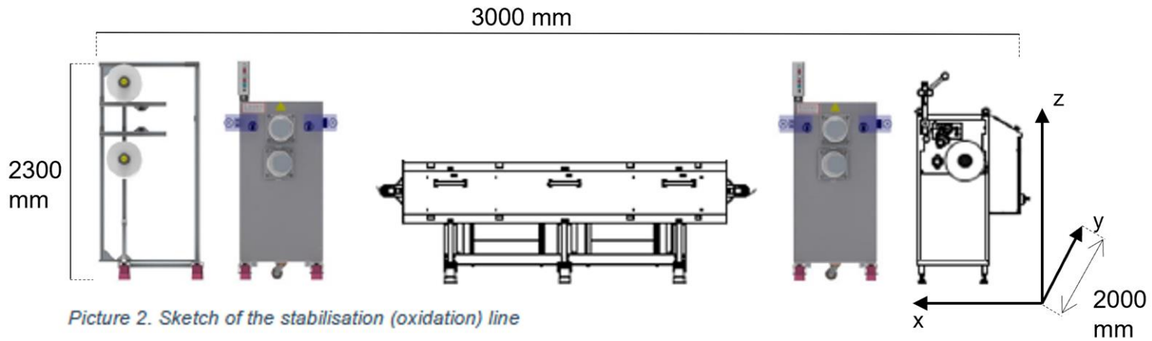
What is next ?



Picture 1. Side view of the complet melt spinning line



Picture 3. Sketch of the carbonisation line



Picture 2. Sketch of the stabilisation (oxidation) line

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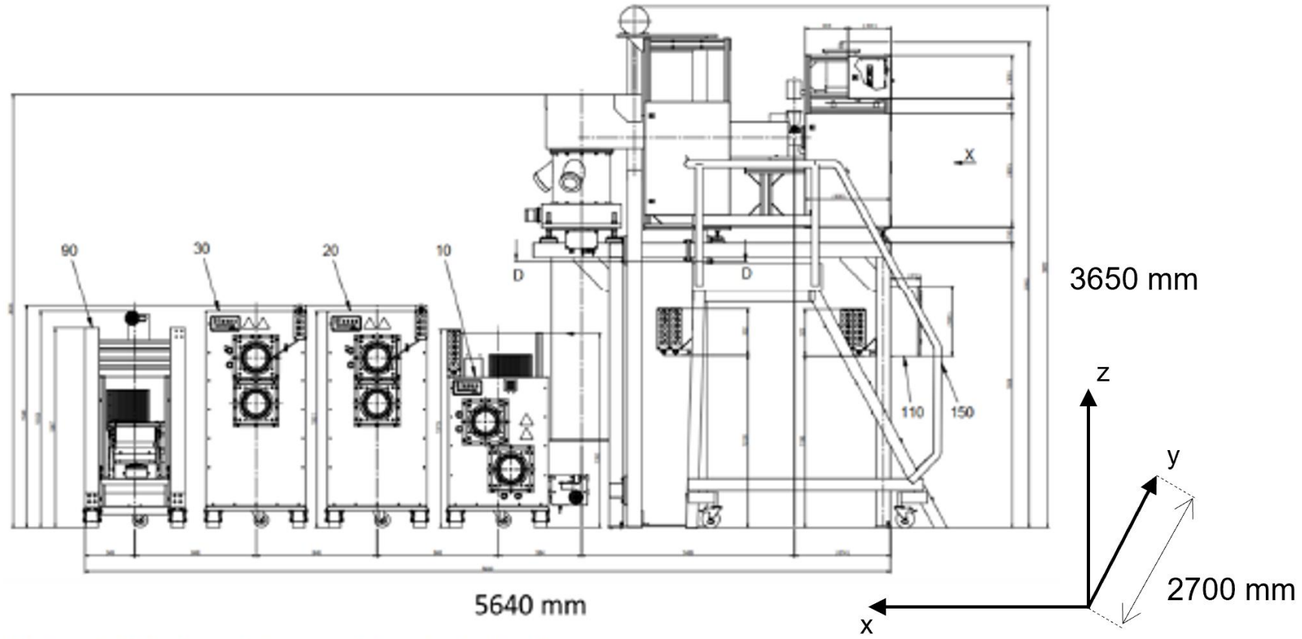
Acknowledgments

This research has received funding from the Bio Based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101023190.

Questions?

What is next ?



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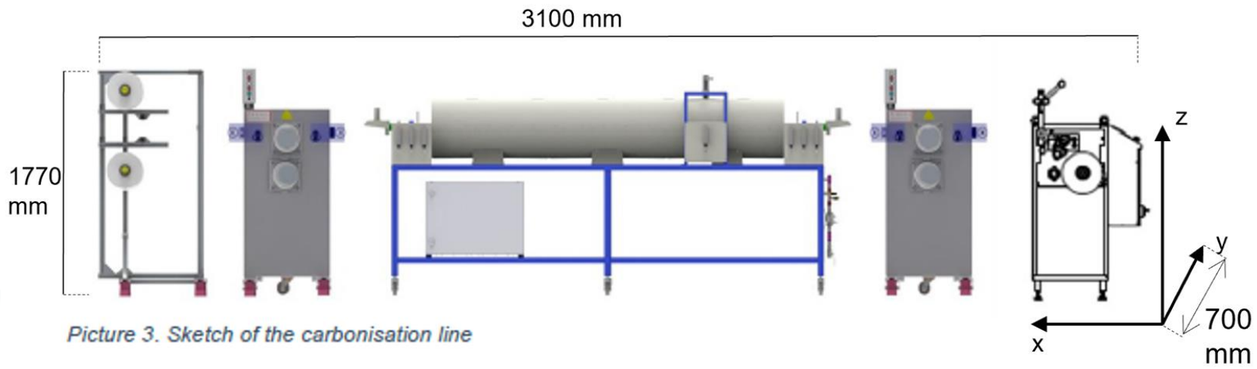

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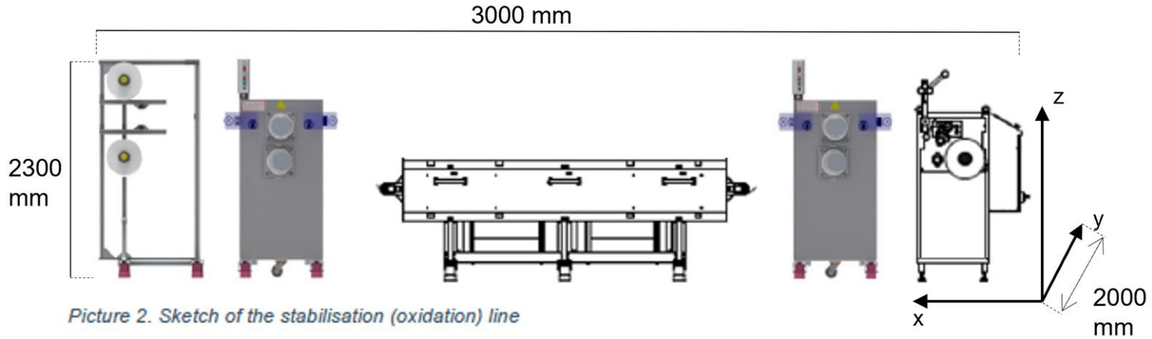

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Thank you

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