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THE JOURNAL OF THE BIOFOREST PRODUCTS SECTOR



PITA PAPER *matters!* 2018 Conference & Exhibition at Lancaster University

Nanocellulose for enhanced packaging papers

Hassan Ahmad (Brunel University)

PAPERmatters 2018!

The Presentations

Hassan Ahmad
Brunel University



Hassan Ahmad is a Ph.D. student at Brunel University London. His research interests focus on innovative approaches to excite cellulose capabilities for high-end applications, with specific emphasis on chemical interactions between nanomaterials and polymers. Interests include Construction and Aerospace as well as Paper & Packaging sectors.



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Presenters:

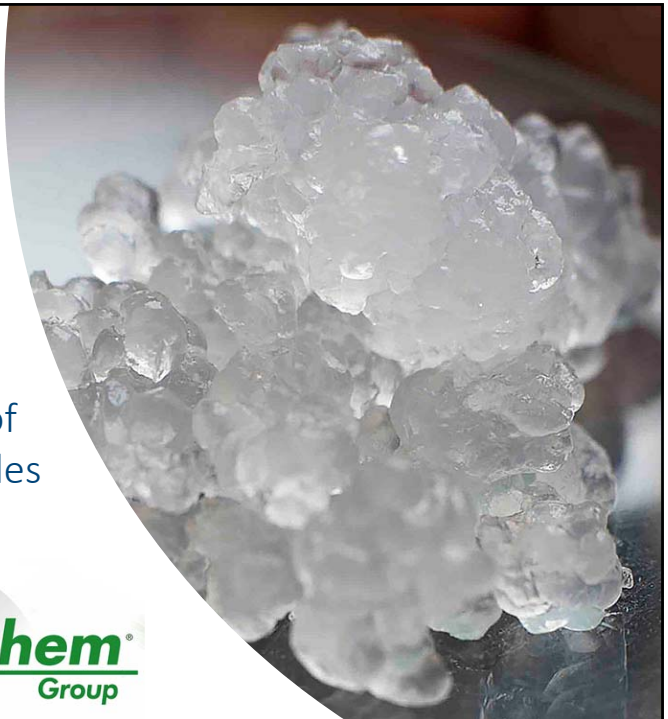
Brunel: Hassan Ahmad

Axchem UK: Aimée Hutton

Nanocellulose for enhanced packaging papers – A dynamic study of the potential benefits of Nanocellulose in packaging grades



Brunel
University
London



Outline

- **Brunel Nano-Research**
- Nanocellulose Patent technologies
 - Trial 1: Smithers Pira
- ICURe Venture – *Intensive Market Validation*
- Nanocellulose in Paper Industry
 - Trial 2: Millivision
 - Trial 3: Brunel
 - Trial 4: Axchem UK



State-of-the-art Facilities & Equipment

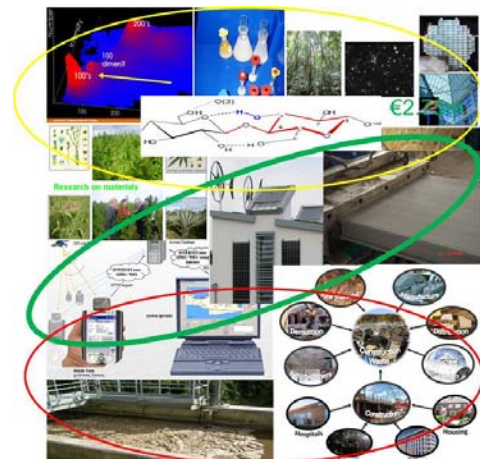
- Pilot micro/nanocellulose manufacturing plant
- Pilot scale composite manufacturing plant
- Scale-up plant for bioprocessing
- Pilot (3D) additive manufacturing
- Full range of characterisation and testing facilities



Address real-life problems in a way that advances fundamental scientific knowledge and understanding, and improves efficiency in industry and built environment

Current Research Focus:

- Development of the science and technology of engineering materials (Nanocellulose)
- New materials development and engineering materials optimisation through control of composition and design of microstructure
- Advanced bioengineering and 3-D printing composites
- Circular Economy-Innovation in wastes as resources, C2C manufacturing;
- Bio-engineering in wastes (Plastics), bio-polymer



Internationally Leading Research: Some recent EU projects



Laminated Strong Eco-Materials for Building Construction
Made of Cellulose-Strengthened Wood





Highly efficient production of ultra-lightweight clay-aerogel materials and their integrated composites for building insulation





Highly Sustainable and Effective Production of Innovative Low Cost Vacuum Insulation Panels for Zero Carbon Building Construction





Highly efficient cladding eco-panels with improved Nano insulation properties





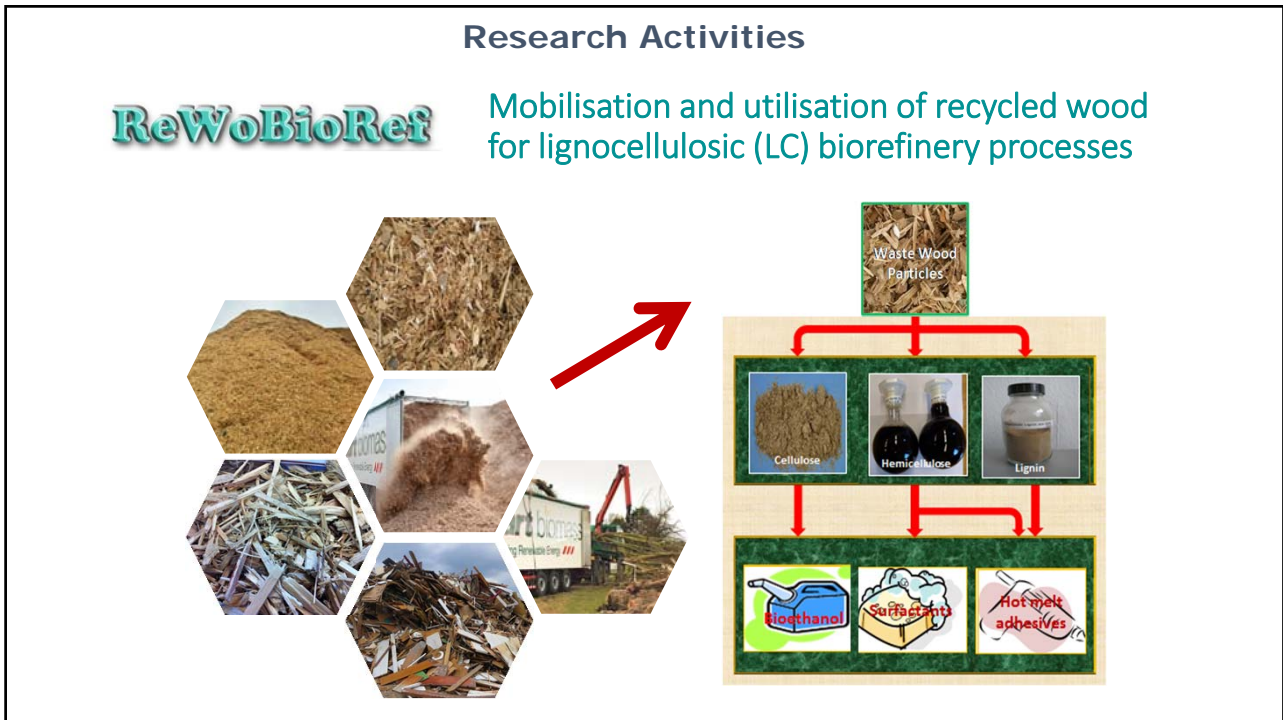
Rubber Fusion of Wood Plastic Composite to Make Functional Composites for Building Applications





Developing sustainable transitional business models





Research Activities



WoodRUB

Utilisation of recovered wood and rubber for alternative composite products



↓









Research Activities



SMART-Plant

Scale-up of low-carbon footprint Material Recovery Techniques in existing wastewater treatment PLANTS

Circular economy in the water sector



-  Water
-  Biogas & Heat
-  Nutrients
-  Biopolymers
-  Cellulose
-  Others

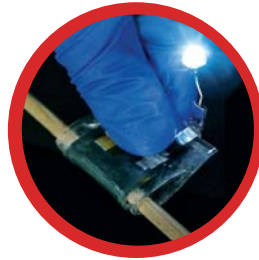
Sludge

↑

Anaerobic Digestion

In England and Wales, 80% of sewage sludge is currently treated through AD.

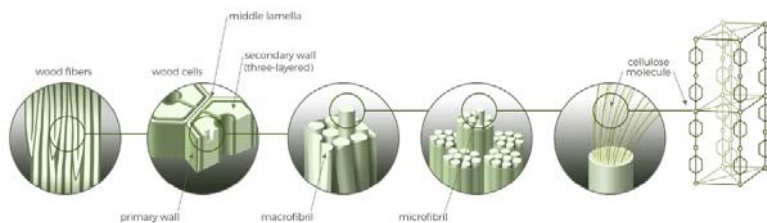
Micro (MFC)/ Nano (NCF) Cellulose & Graphene (GO) research for Insulation, Energy Storage, Filtration & Industrial Applications

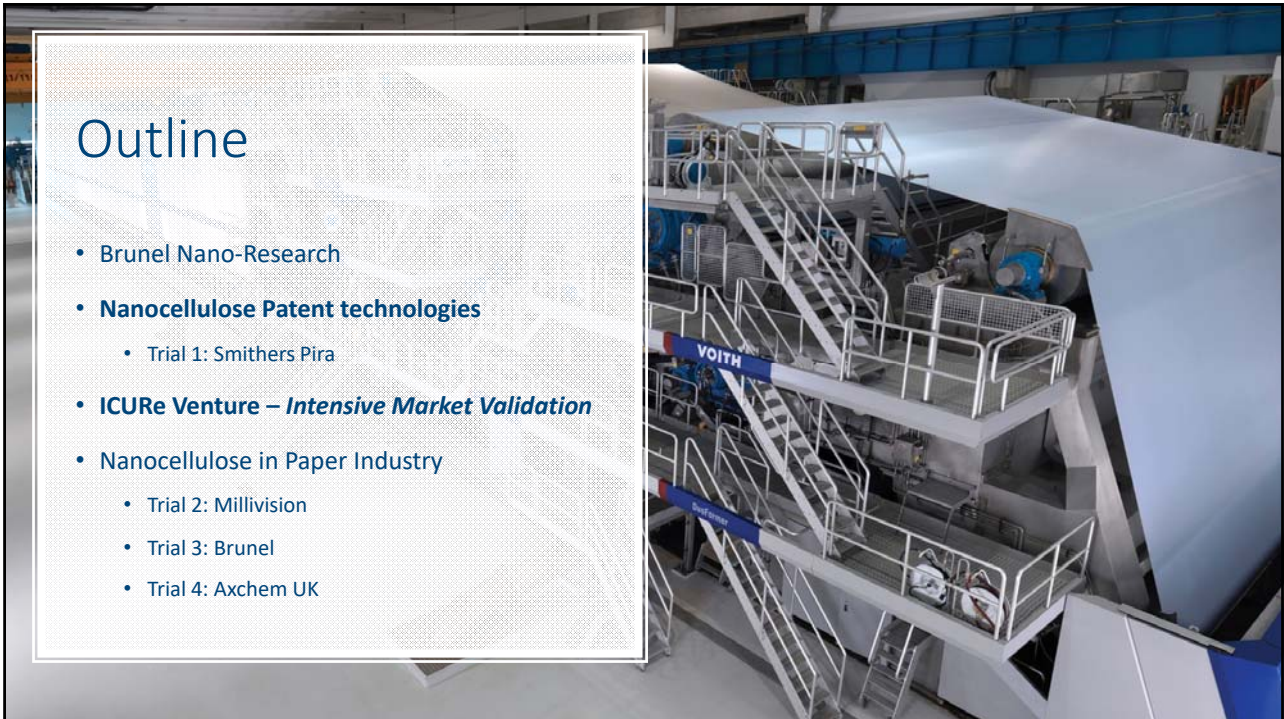


Micro/Nanocellulose – what is it?



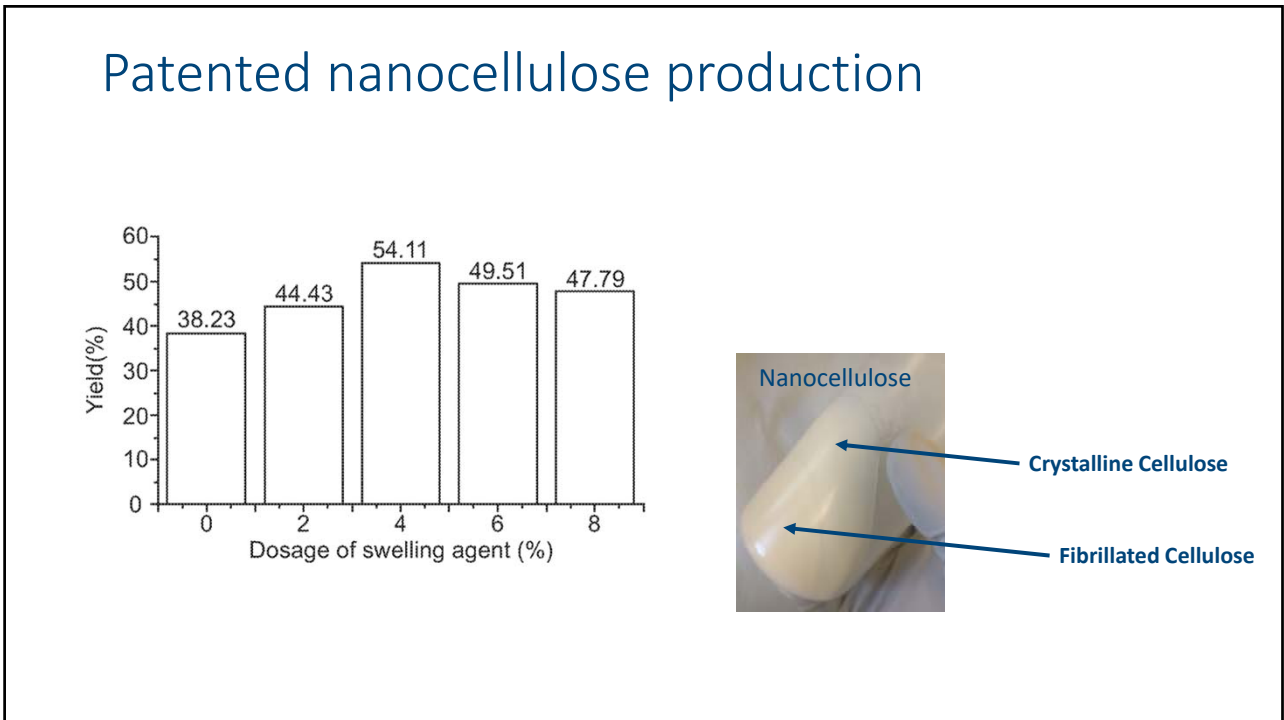
Natural Sources



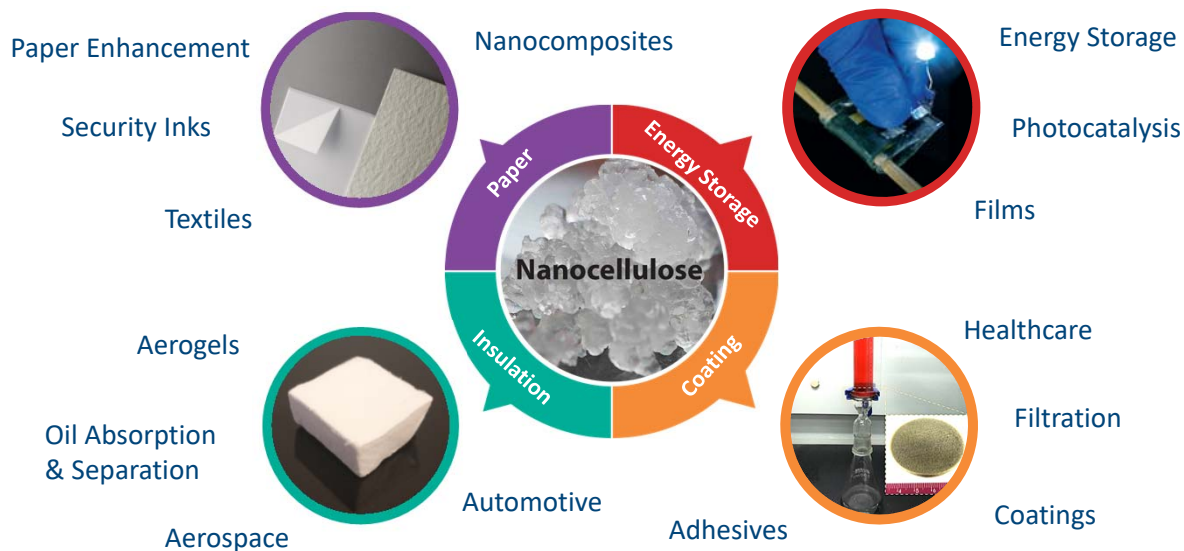


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Nanocellulose – Potential Applications



Preliminary lab trial results –



Property	Office W	ONP	OCC	UBSK	BHK
Bulk	/	/	/	NSC	7% loss
Tensile strength	25.55% increase	19.05% increase	11.11% increase	19.51% increase	15.11% increase
TEA	110.69% increase	40.93% increase	27.72% increase	NSC	NSC
SCT 23/50	/	/	/	38% increase	NSC
SCT 30/98	/	/	/	NSC	NSC
% Stretch	41.18% increase	25% increase	NSC	NSC	NSC

Office W – Office waste
 ONP – Old News Print
 OCC – Old corrugated case
 USBK – Unbleached softwood kraft pulp
 BHK – Bleach hardwood kraft pulp

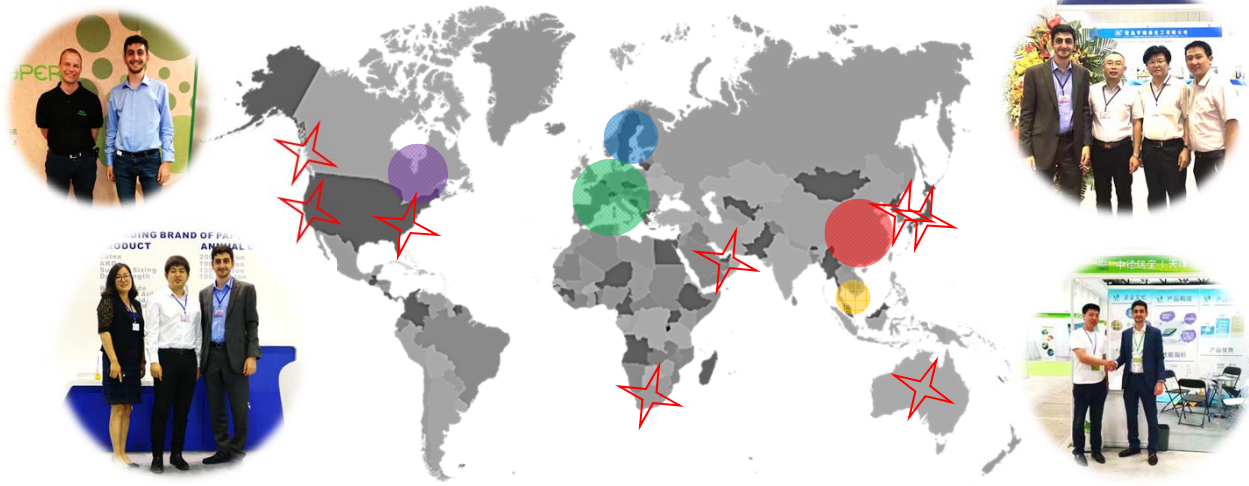
'NSC'=No significant change

'TEA'=Tensile Energy Absorption

'SCT 23/50'=Short Span Compressive Strength was measured at 23 °C, 50% RH

'SCT 30/98'=Short Span Compressive Strength was measured at 30 °C, 98% RH

Experience so far – the journey



- >10 countries
- >100 customers

- 5 trade shows
- 5 conferences

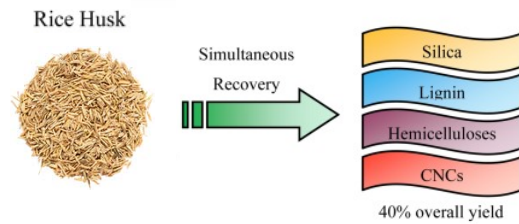
- 4 Industry visits
- 2 training courses

Journey – What I have learnt

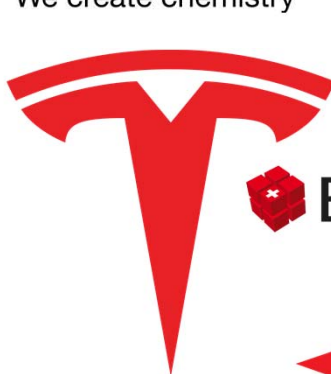
- **Industrial interest** – trials underway
- **Energy storage** – Innovation development
- **Reducing energy consumption** → e.g. **30 to 2 MW/tonne of NC production**
- **Other industries** → Chemical/Coating/Cosmetic



Journey – What I know now



Potential end users



Jet Propulsion Laboratory
California Institute of Technology



Empa
Materials Science and Technology



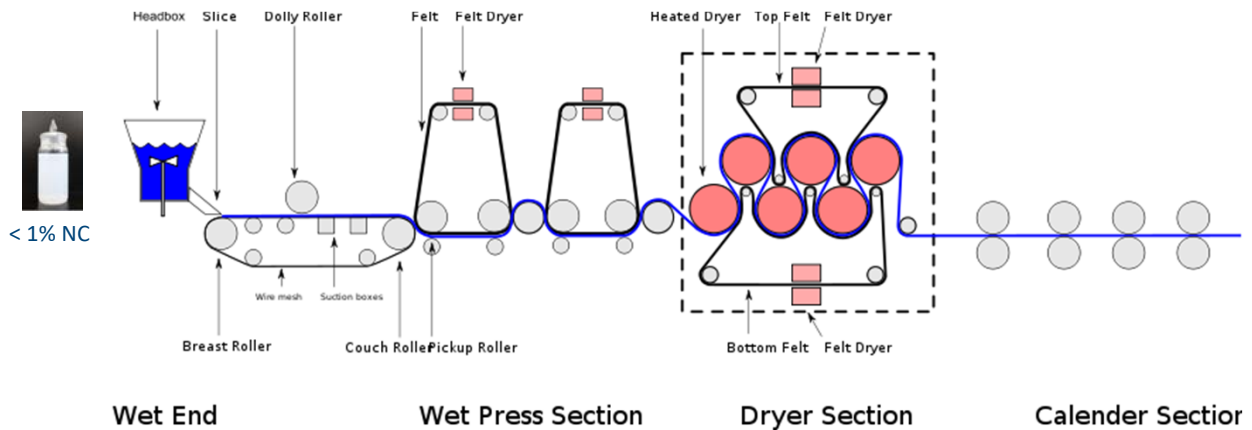
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Outline

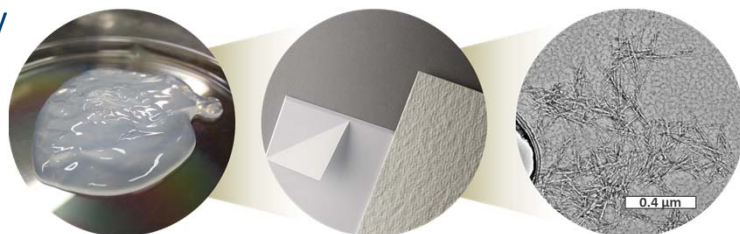
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Nanocellulose addition – Typical paper machine



Recycled Paper & Packaging Enhancement

- Enhanced Wet Strength
- Improved Retention – better material utilisation
- Improved Machine Runnability → Reduced effluent cost
- Improved Dry Strength
- Enhanced Functionality



1. NC Treatment

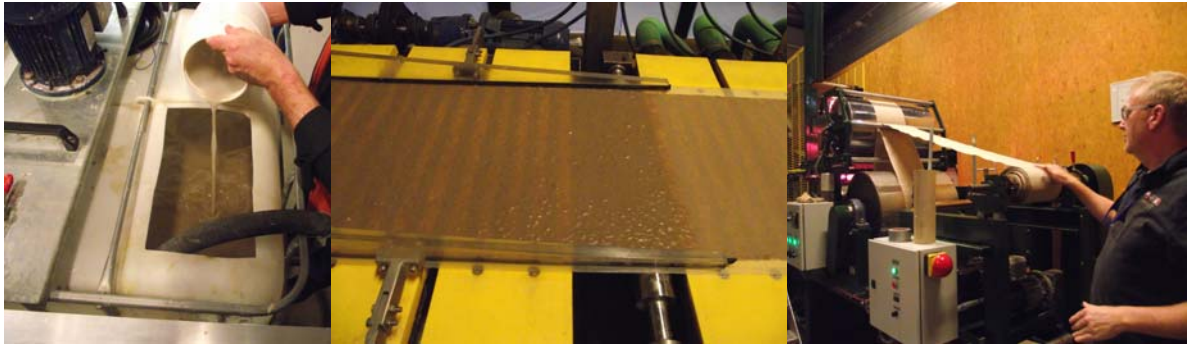
2. Recycled Paper

3. Nanostructure

Pilot trial in Netherlands –



- Pilot papermachine

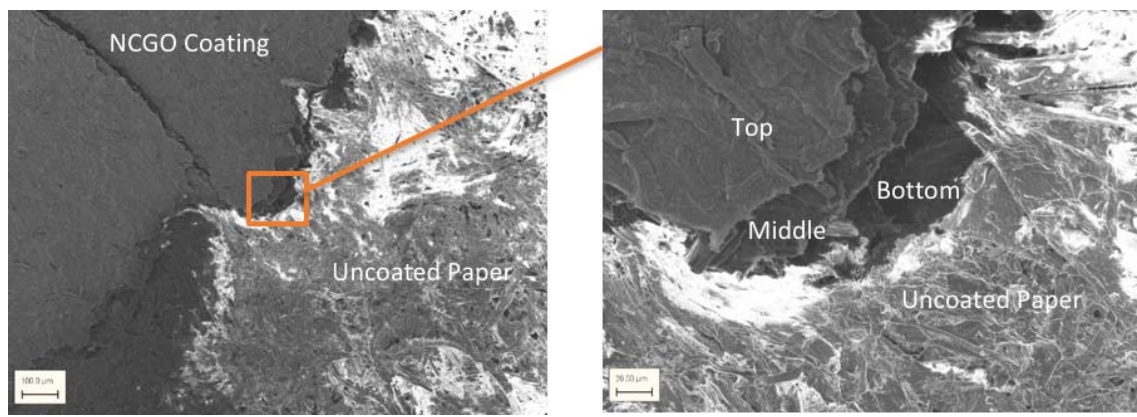


In-house testing at Brunel

- Incorporation of Nanocellulose, Starch, Graphene, and NanoClay
- Forms of incorporation: Spray and dip coating



In-house testing at Brunel



The team



Hassan
Researcher at Brunel



Aimée
Lab Technician at Axchem UK



Chris
Lab Assistant at Axchem UK



Stuart
General Manager at Axchem UK



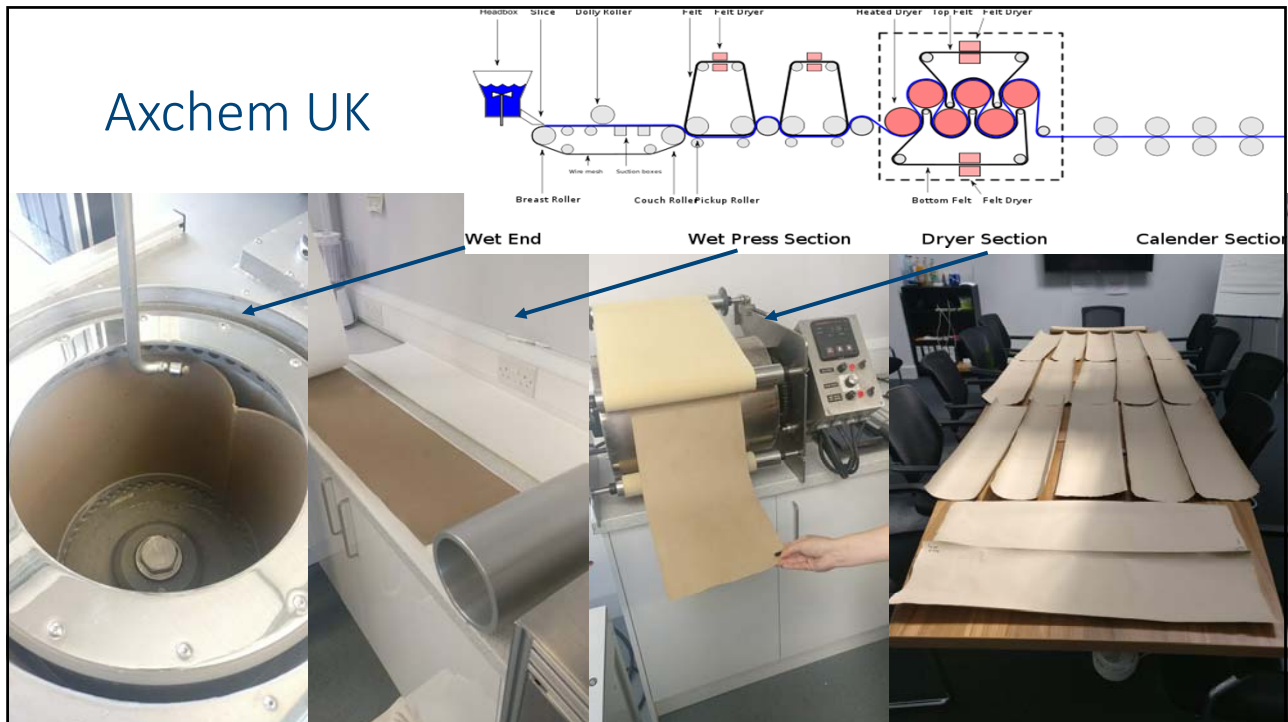
Averil
TTO at Brunel



Barry
CEO of PITA



Mizi
Head of Research at Brunel



What next for Nanocellulose...?

- Production of nanocellulose in the UK utilising novel fibre sources
- Bespoke tailoring of nanocellulose properties to optimise on paper machine performance
- Improved runnability
- Enhanced packaging products

We are still discovering exciting new opportunities for these novel cellulose-based materials



