

Improving the performance of starch film by engineering the interaction of nanocrystalline cellulose fillers with starch molecules

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WHY STARCH FILM?

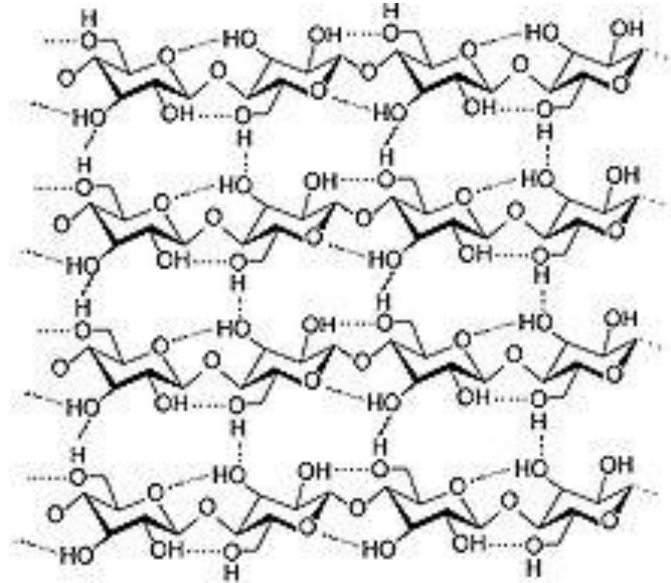
- ▶ Biopolymer
 - Renewable & Sustainable
 - Biodegradable & Compostable
 - Carbon-neutral
- ▶ Starch as a renewable and biodegradable polymer
- ▶ is an essential alternative to synthetic polymers in production of films for food packaging and agricultural mulching applications

MAJOR PROBLEMS...

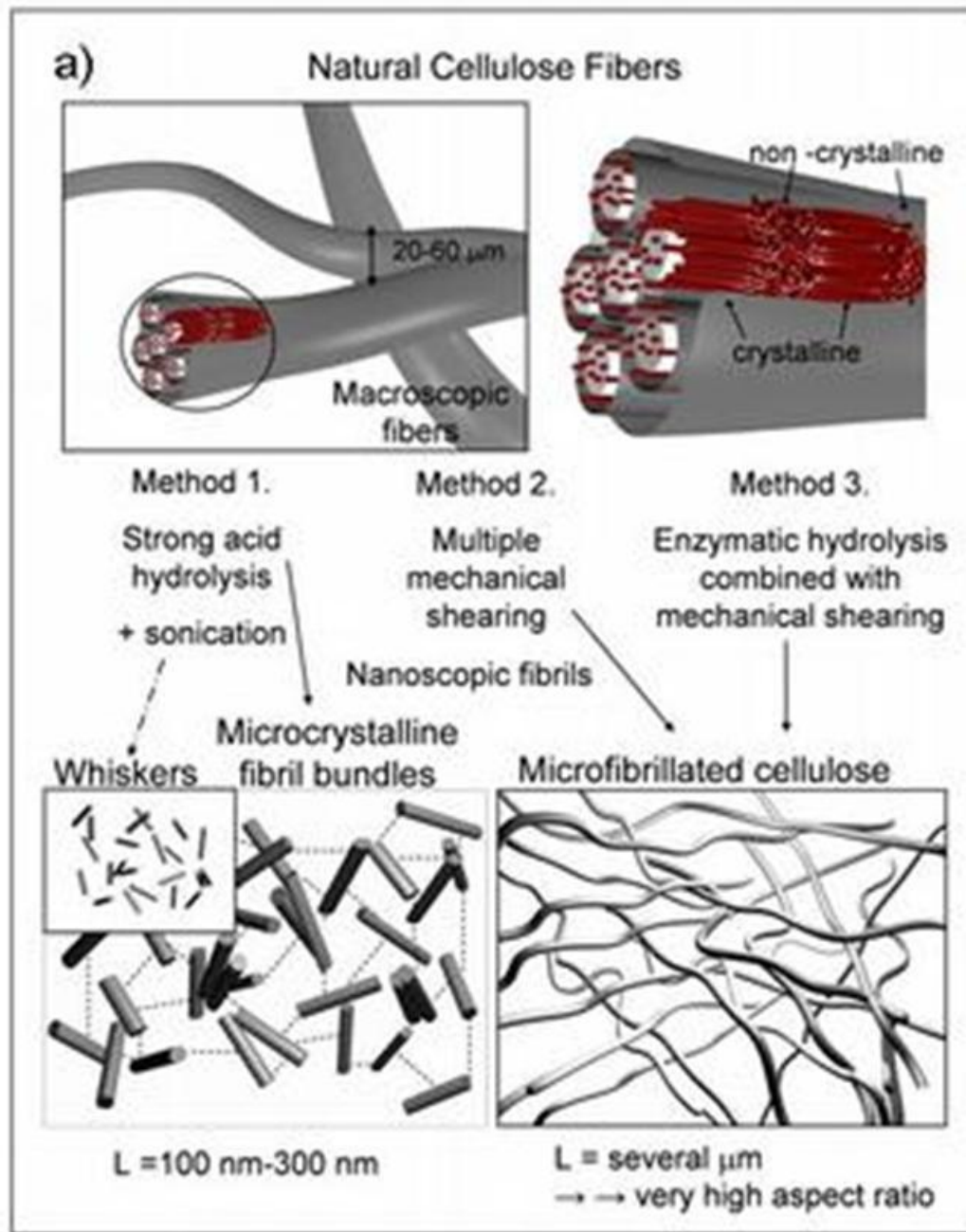
- ▶ High water vapour permeability
- ▶ High oxygen permeability
- ▶ Low strength

NANOFILLERS...

- ▶ Nanocellulose
- ▶ Highly crystalline
- ▶ Young's modulus as high as 134 GPa



NANO-CELLULOSE FROM CELLULOSE FIBERS...



NANOCELLULOSE PREPARATION...

- ▶ High pressure homogenization
- ▶ 20,000 psi pressure
- ▶ Repeated passes till it reaches nano size

HIGH PRESSURE HOMOGENIZER



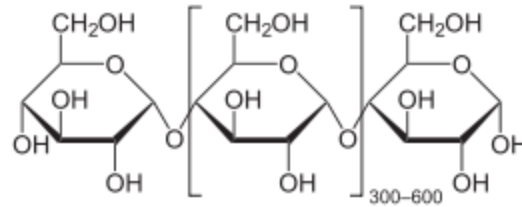
- ▶ EmulsiFlex-C3 (Avestin, Inc) is delivered with a pneumatically controlled, dynamic homogenizing valve
- ▶ Capacity: 3L / hr
- ▶ Maximum pressure up to 2,000 bar / 30,000 psi

STARCH NANOCELLULOSE COMPOSITE FILMS...

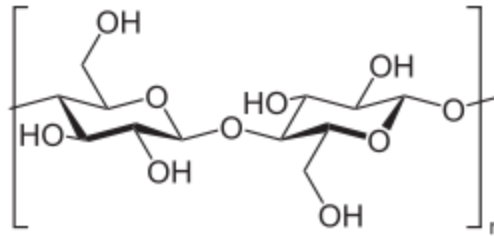
- ▶ Soluble starch from potato
- ▶ NCC prepared by homogenization process from Avicel
- ▶ Film by casting process in teflon dish, dried at 50 °C overnight
- ▶ Concentrations:
 - 4% starch
 - 0.02% sodium azide
 - 0.04% nanocellulose (1% of starch)
 - 0.04% gum arabic (1% of starch)

COMPONENTS

- ▶ Starch



- ▶ Cellulose



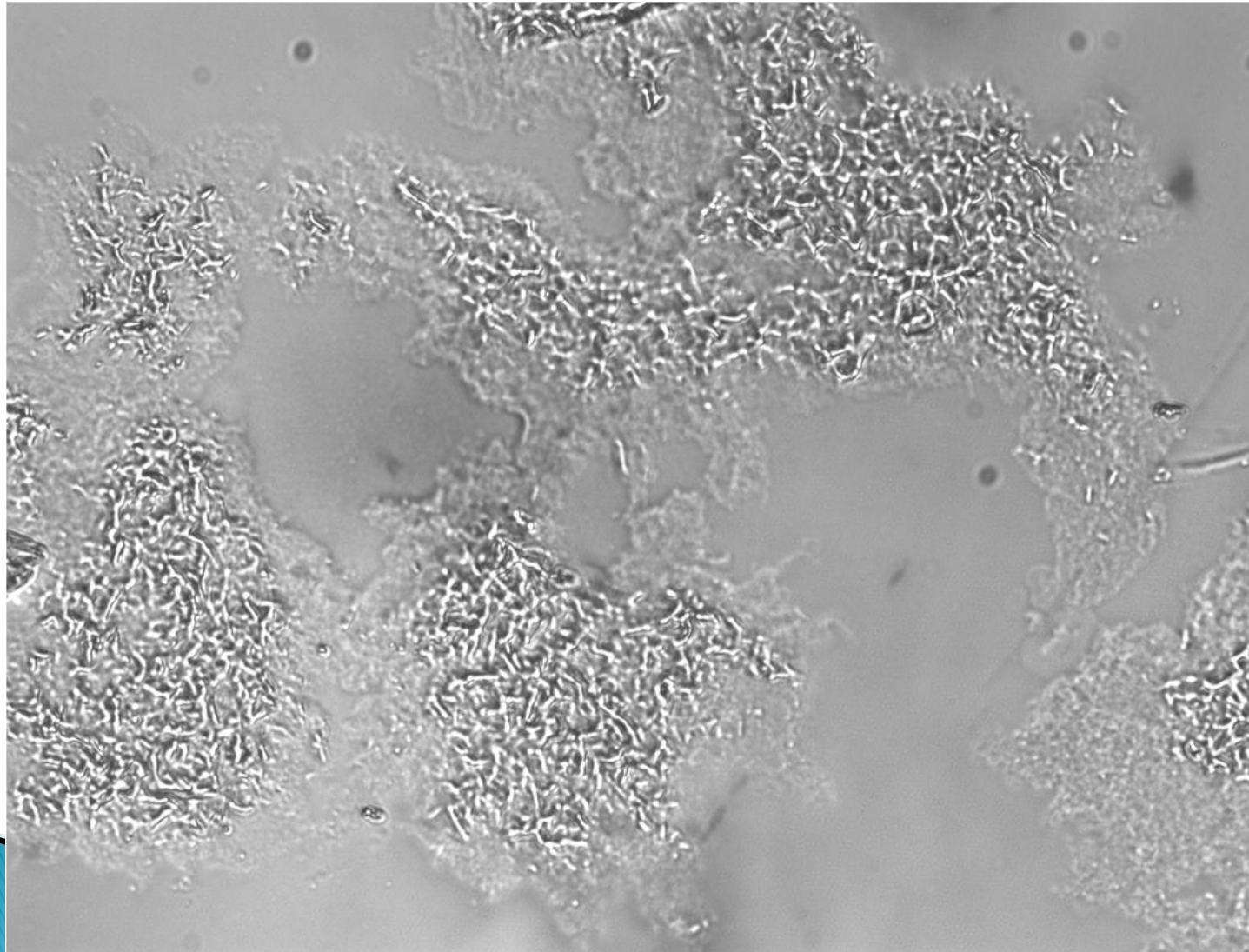
- ▶ Gum arabic (mixture of polysaccharides and glycoproteins)

STARCH FILM BY CASTING PROCESS IN TEFLON DISH...



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AGGREGATION OF NANOCCELLULOSE IN STARCH FILM



TO PREVENT AGGREGATION OF NANOCELLULOSE...

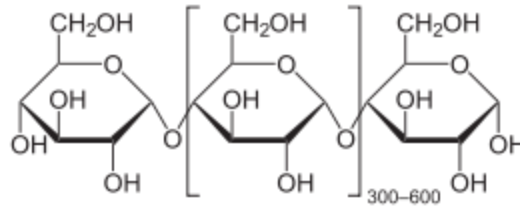
- ▶ Use of various stabilizing agents
 - Soluble starch
 - Gum arabic
 - Tween 80

DLS PARTICLE SIZE ANALYSIS...

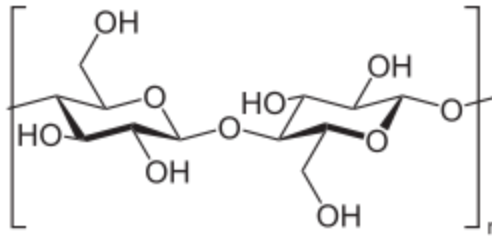
- ▶ Nanocellulose
 - 197.8 nm
- ▶ Nanocellulose stabilized by starch
 - 391.7 nm

COMPONENTS...

- ▶ Starch



- ▶ Cellulose



- ▶ Gum arabic (mixture of polysaccharides and glycoproteins)

Eco-Friendly

WORK IN PROGRESS...

- ▶ Permeability Characterization
 - Water vapor
 - Oxygen
- ▶ Mechanical properties
- ▶ Biodegradability

ACKNOWLEDGEMENTS...

- ▶ Rutgers University, New Brunswick, NJ, USA
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www.nanocellulose.in

Thank You...

