Enhancing latex-based coatings with carboxylated cellulose nanocrystals

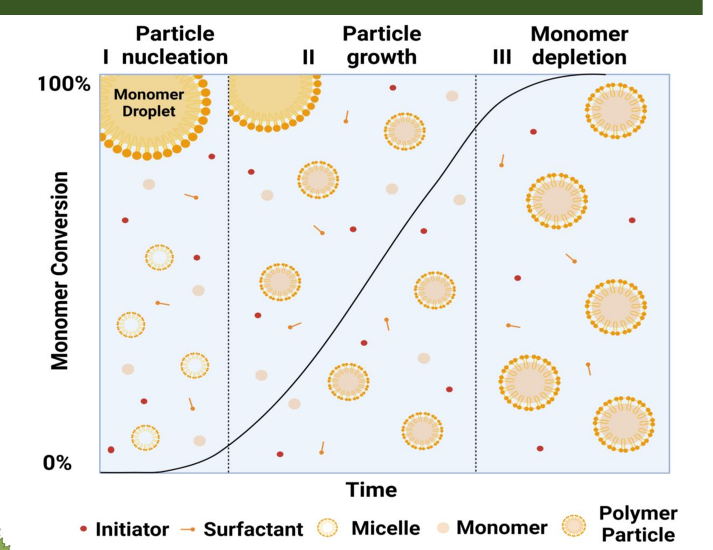
Carolina Ordóñez[1], Marc A. Dubé[2], Emily D. Cranston[3], Marianna Kontopoulou[1], Timothy Morse[4], Gary A. Deeter[5], Pascale Champagne[6] and Michael F. Cunningham[1]

[1] Department of Chemical Engineering, Queen's University, Kingston, ON, Canada
[2] Department of Chemical and Biological Engineering, University of Ottawa, Ottawa, ON, Canada
[3] Department of Wood Science and Department of Chemical and Biological Engineering, University of British Columbia, Vancouver, BC, Canada
[4] Anomera Inc., Montreal, Quebec, Canada
[5] BASF Corporation, Charlotte, North Carolina, United States
[6] Energy Mining & Environment Research Centre, National Research Council, Montreal, QC, Canada

BACKGROUND

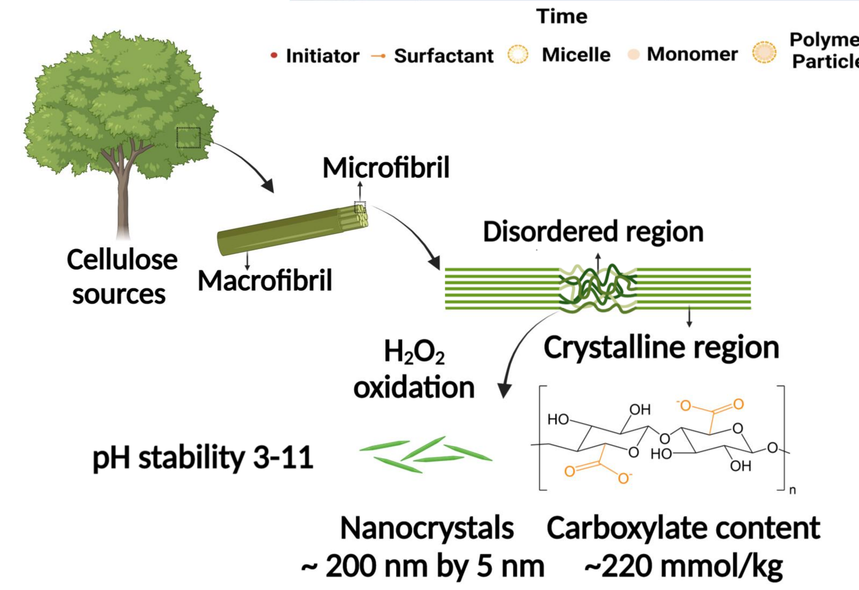
Emulsion Polymerization

- Improves sustainability by reducing volatile organic compound use [1-2]
- Emulsion polymer market has shown yearly increase in its demand [3]
- Provides facile route to polymer colloid preparation



Carboxylated Cellulose Nanocrystals (cCNC)

- Reinforcing agents and rheological modifiers
- High aspect ratio, tunable surface chemistry and high mechanical strength
- Lower cost than other nanoparticles and very low loadings can improve existing products [4]



OBJECTIVE

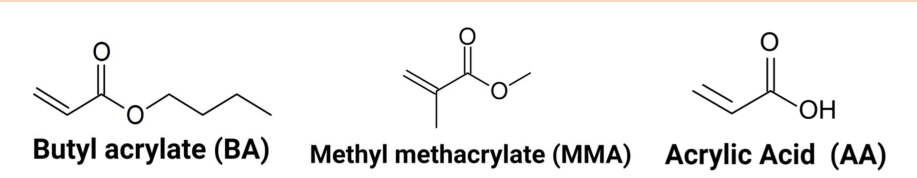
Use cCNCs to tailor polymer properties and make more sustainable latex-based coatings

METHODS

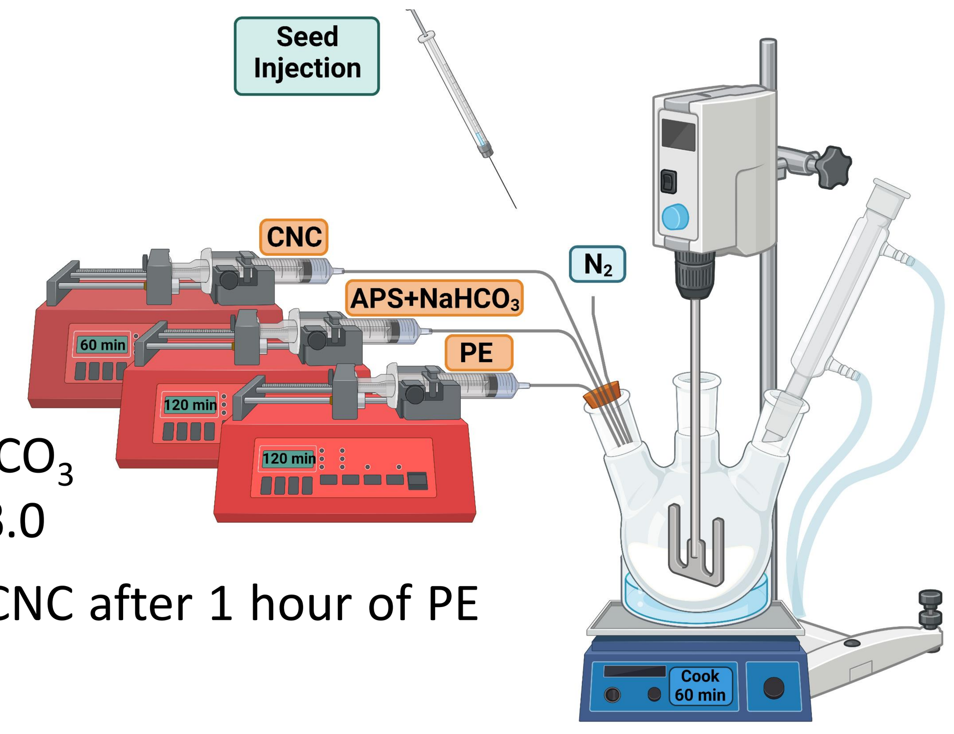
Formulation

COMPONENT	SEED	FEED	TOTAL
Dowfax 2A1	0.53 phm	0.38 phm	0.9 phm
APS	0.25 phm	0.25 phm	0.5 phm
$NaHCO_3$	0.65 phm	0.65 phm	1.30 phm
cCNC	0 phm	0.3 – 1.0 phm	0.3 – 1.0 phm
Water*	72.9%	27.1%	55%
Monomer (PE)	5%	95%	45%
Monomers	BA 51% - MMA 48% - AA 1%		
[cCNC]	0.3, 0.6 and 1.0 wt.%		

*Water percentages varies with the cCNC addition
phm: parts per hundred parts monomer
PE: pre-emulsion



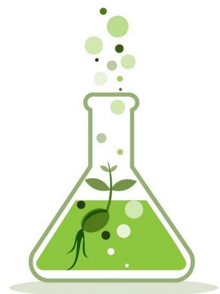
Set-up



- Use of $NaHCO_3$ to keep pH ~8.0
- Addition of cCNC after 1 hour of PE feeding

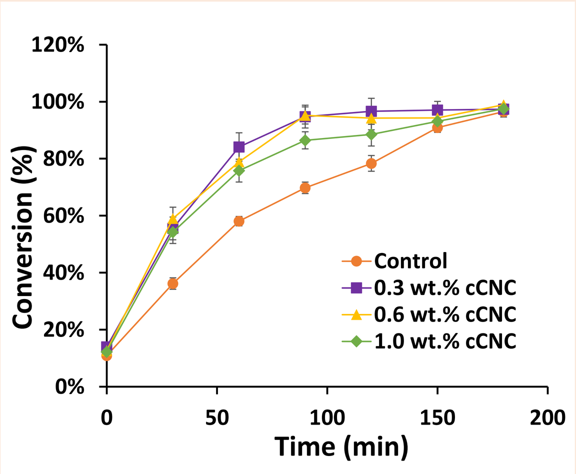
Relation to Green Chemistry

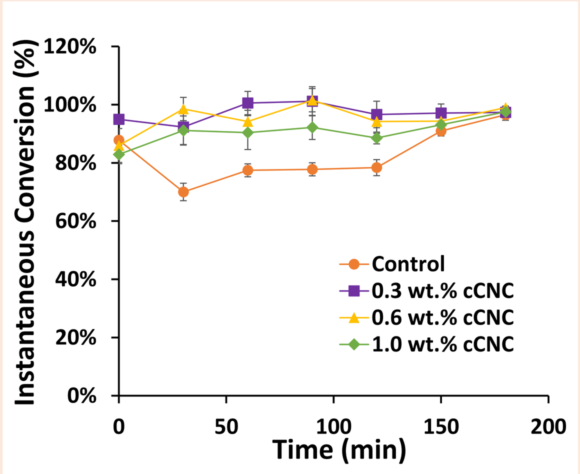
Water-based polymerization methods provide a more sustainable alternative to traditional solvent-based coatings. Furthermore, cCNC serves as an eco-friendly substitute for petroleum-derived fillers.



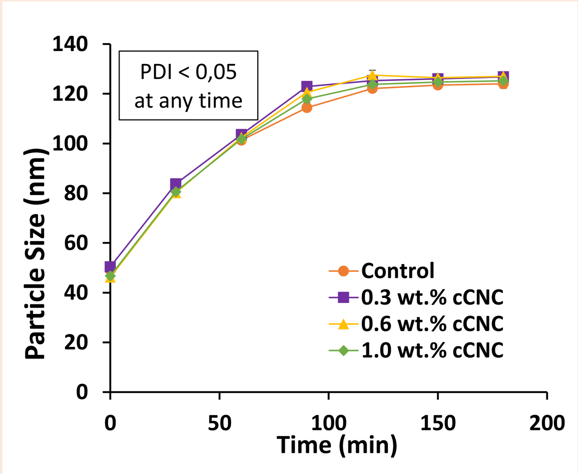
RESULTS

Monomer Conversion

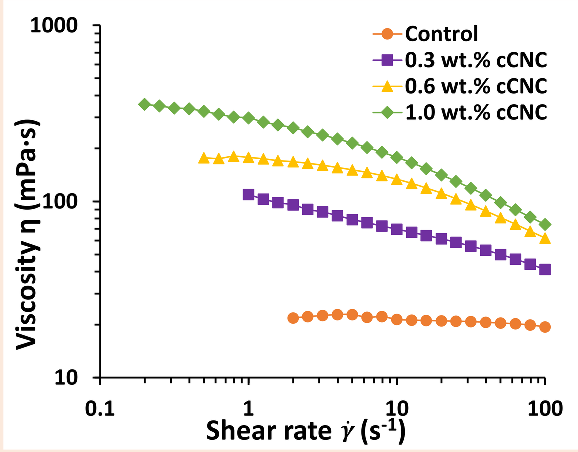




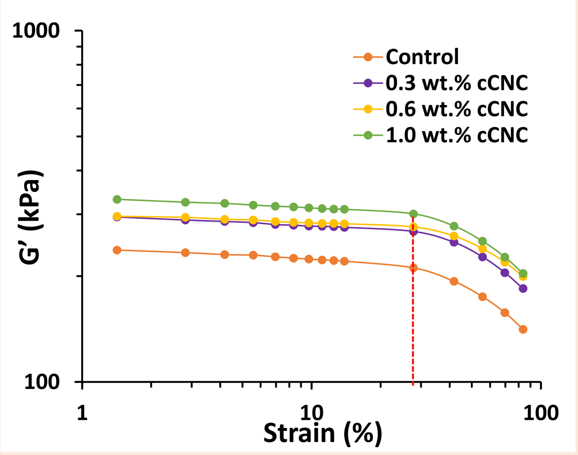
Particle Size Evolution

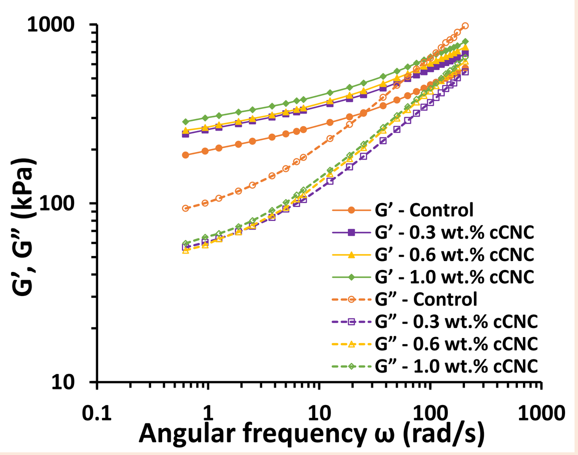


Viscosity → Latex

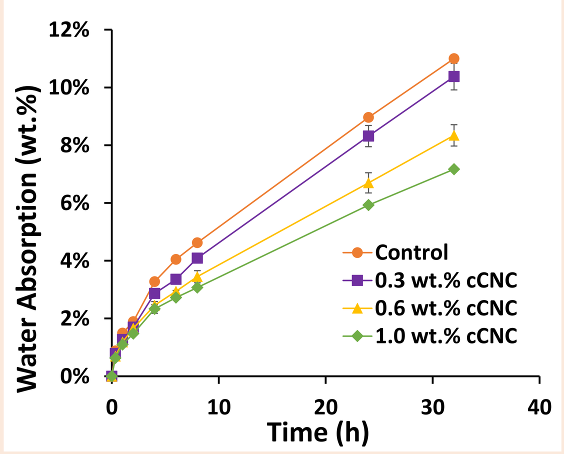


Mechanical Test → Dried Films





Water Absorption → Dried Films



CONCLUSIONS

- The incorporation method maintains constant latex particle size
- Addition of cCNC after one hour of reaction avoids influencing the nucleation phase, and reduces/eliminates coagulum
- Latex viscosity increases without evidence of filler network
- Enhanced stiffness and increased elastic behaviour, suggesting polymer-cCNC interactions
- Increase in cCNC concentration decreased water absorption of the films
- cCNC enhances the mechanical properties of a commercial latex formulation with loadings as low as 0.3 phm

REFERENCES AND ACKNOLEDGMENTS

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Contact
21mcof@queensu.ca

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