Cellulose Nanocrystals as Modifier for Oxidation Stability and Tribology in Hyaluronic Acid Suspensions

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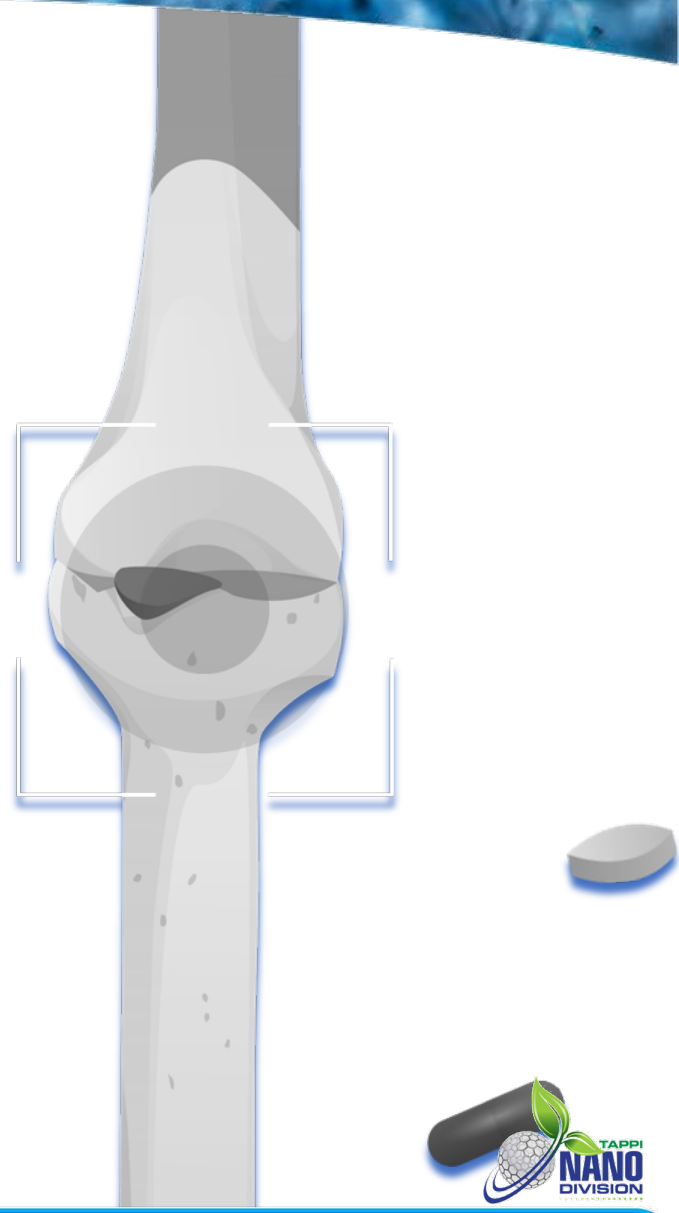
About Osteoarthritis (OA)

- Prevalence of OA in Canada

$\approx 10\%$

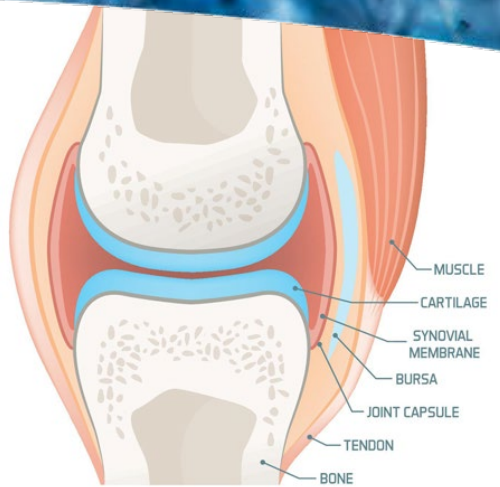
Aged 15 or older



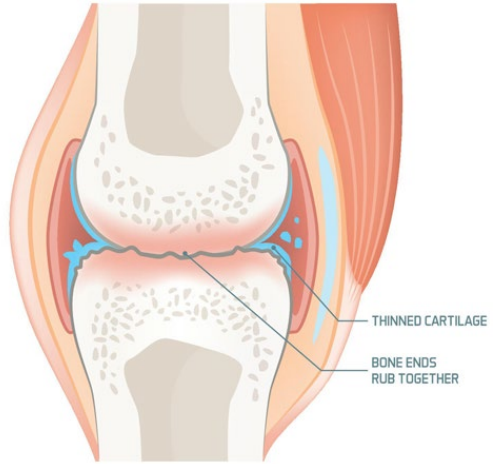
About Osteoarthritis (OA)

- Quality of life implications

- Importance of effective treatment options

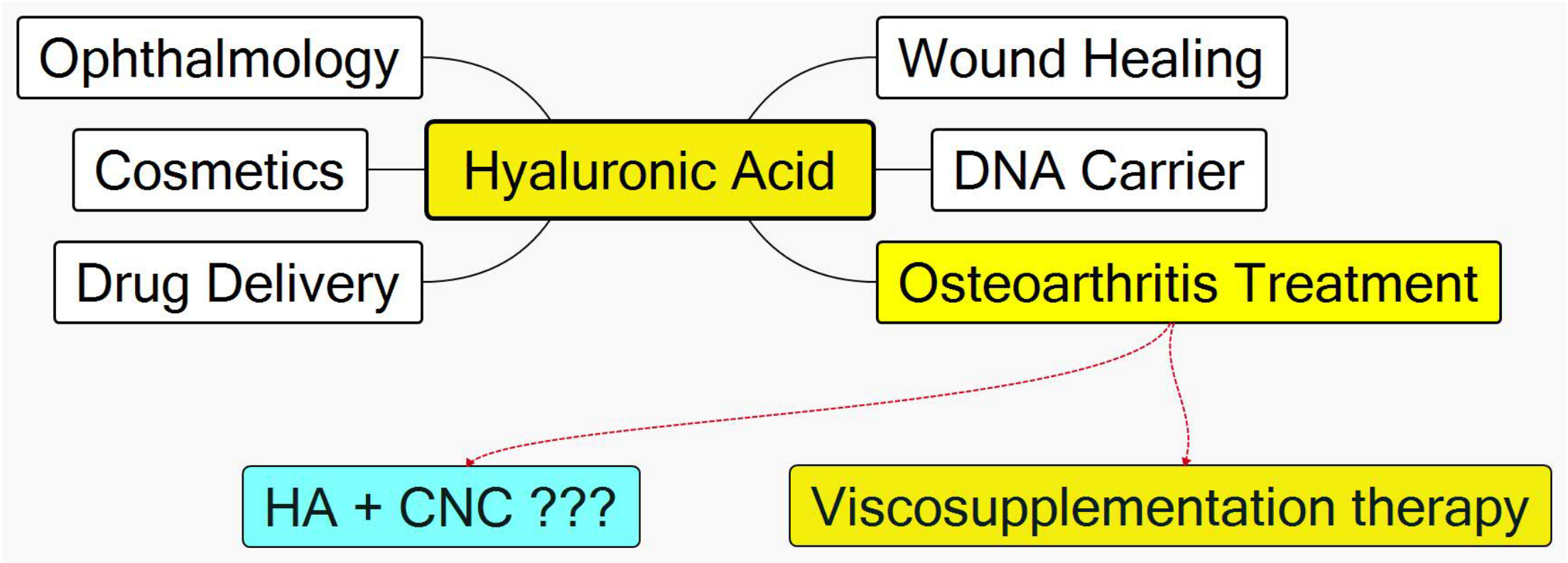


HEALTHY JOINT



OSTEOARTHRITIS

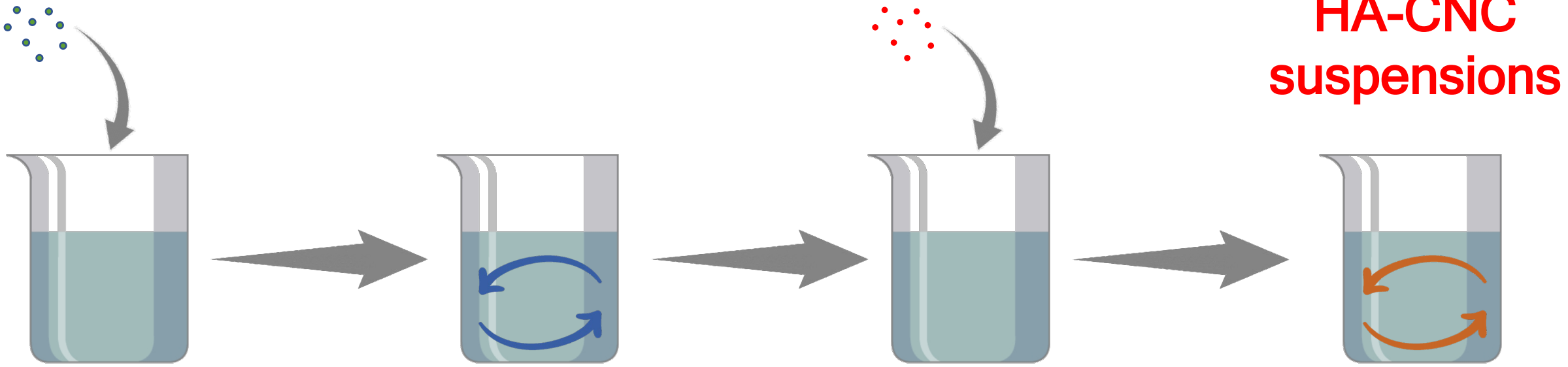
Introduction to Hyaluronic Acid (HA)



Objectives

- **Enhanced oxidative stability:** the addition of CNC / Viscosupplement (VS)
- **Enhanced tribological nature:** the addition of CNC / VS

Materials and Methods



Materials and Methods

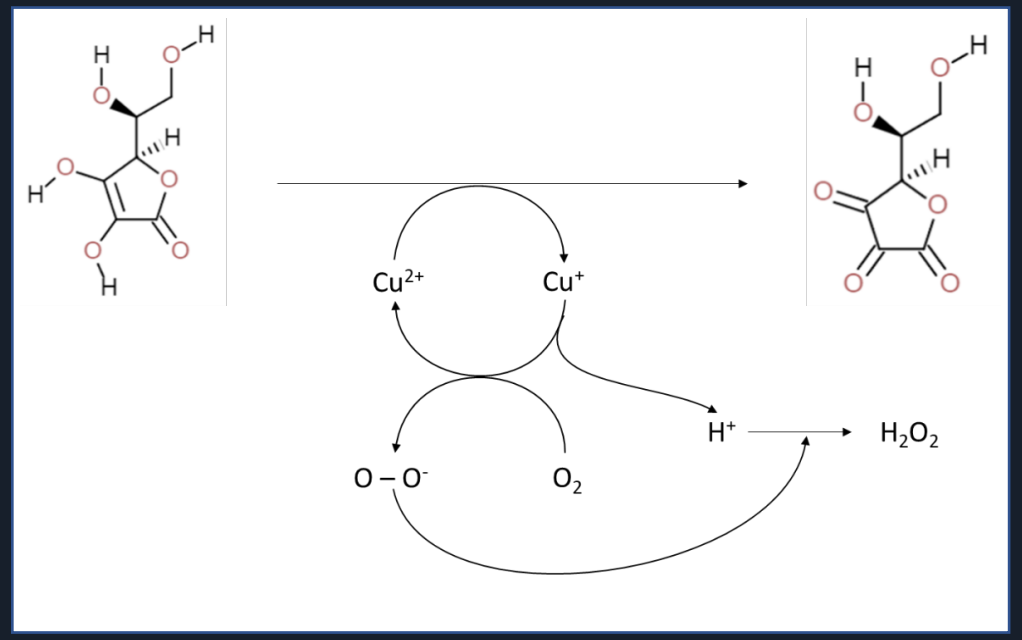
Investigation of varied HA and CNC fractions in suspensions

Nomenclature of samples

Sample No.	Sample name	HA concentration ($mg \cdot ml^{-1}$)	CNC percentage
1	0.5HA-2CNC	0.5	2%
2	2HA-2CNC	2	2%
3	3HA-2CNC	3	2%
4	4HA-2CNC	4	2%
5	0.5HA	0.5	0%
6	2HA	2	0%
7	3HA	3	0%
8	4HA	4	0%
9	VS+0.25CNC	--	0.25%
10	VS	--	0%

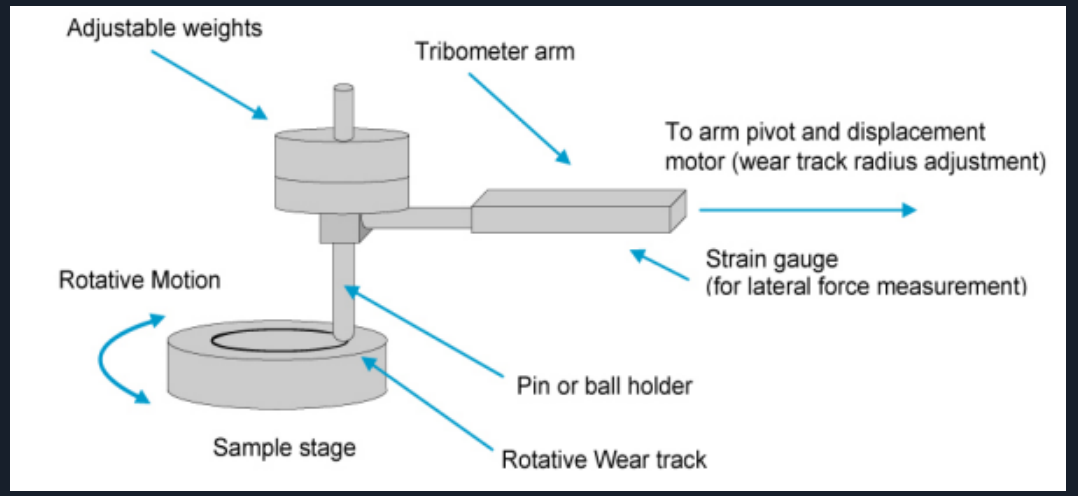
Materials and Methods

Oxidation test – Change in Viscosity



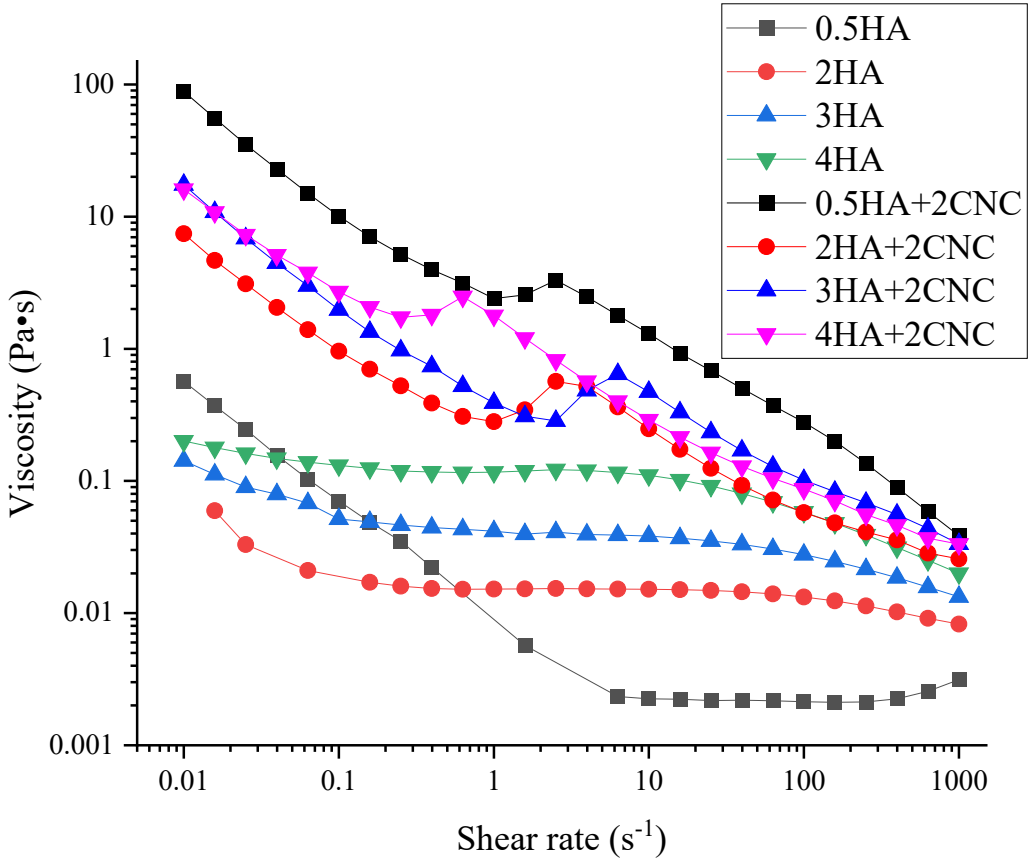
Weissberger's H_2O_2 generating system

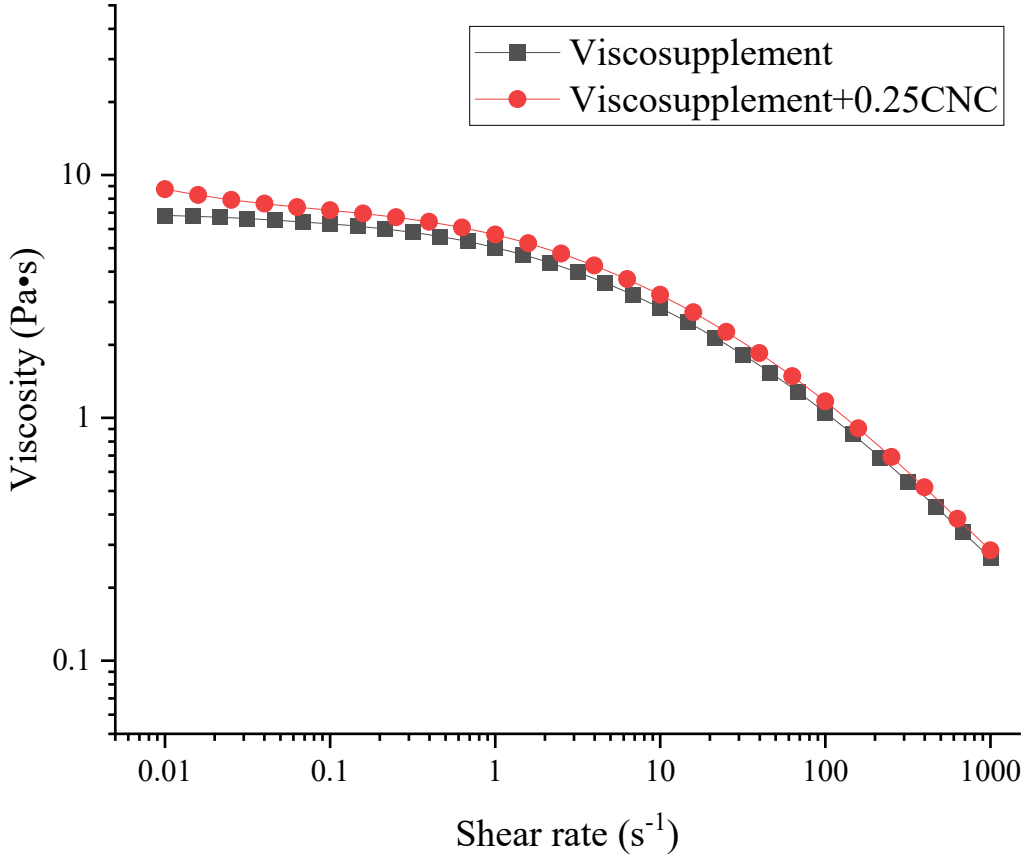
Tribology test – Pin on Disc



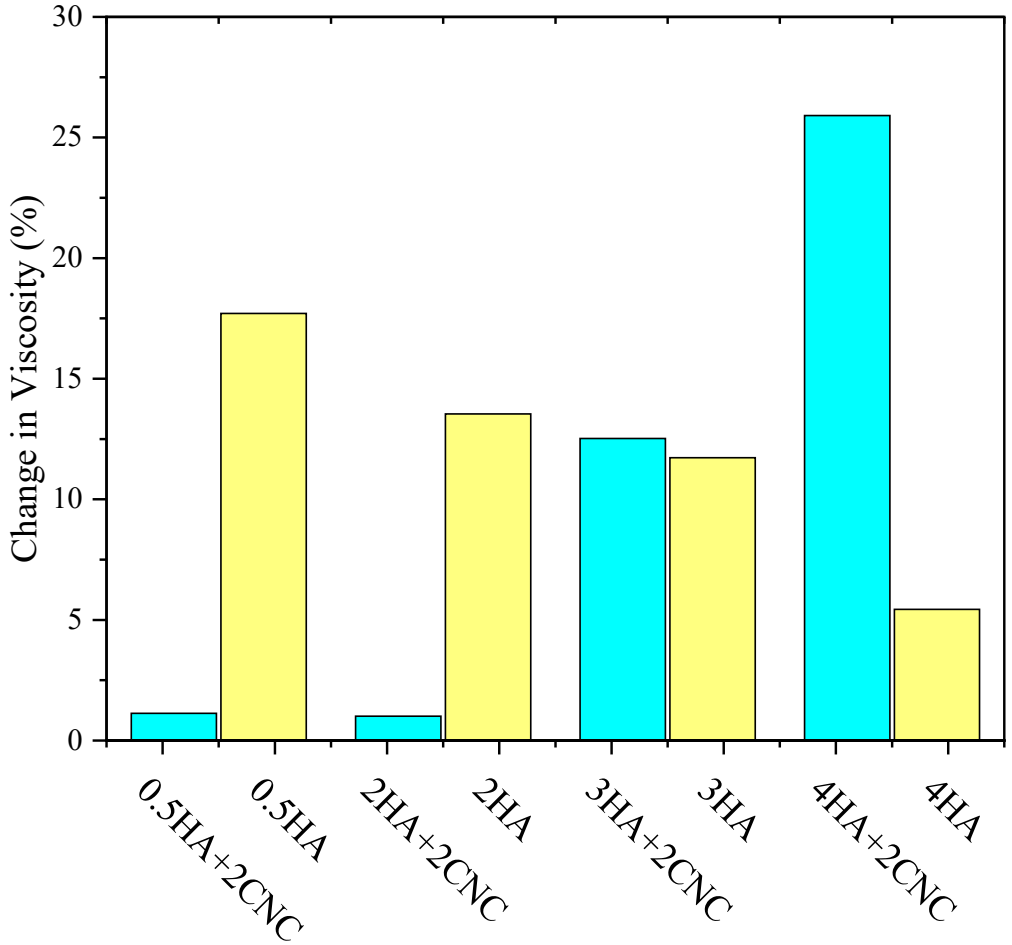
Coefficient of Friction (COF) is measured.

Steady Shear Viscometry





Oxidation Stability and Rheological Insights

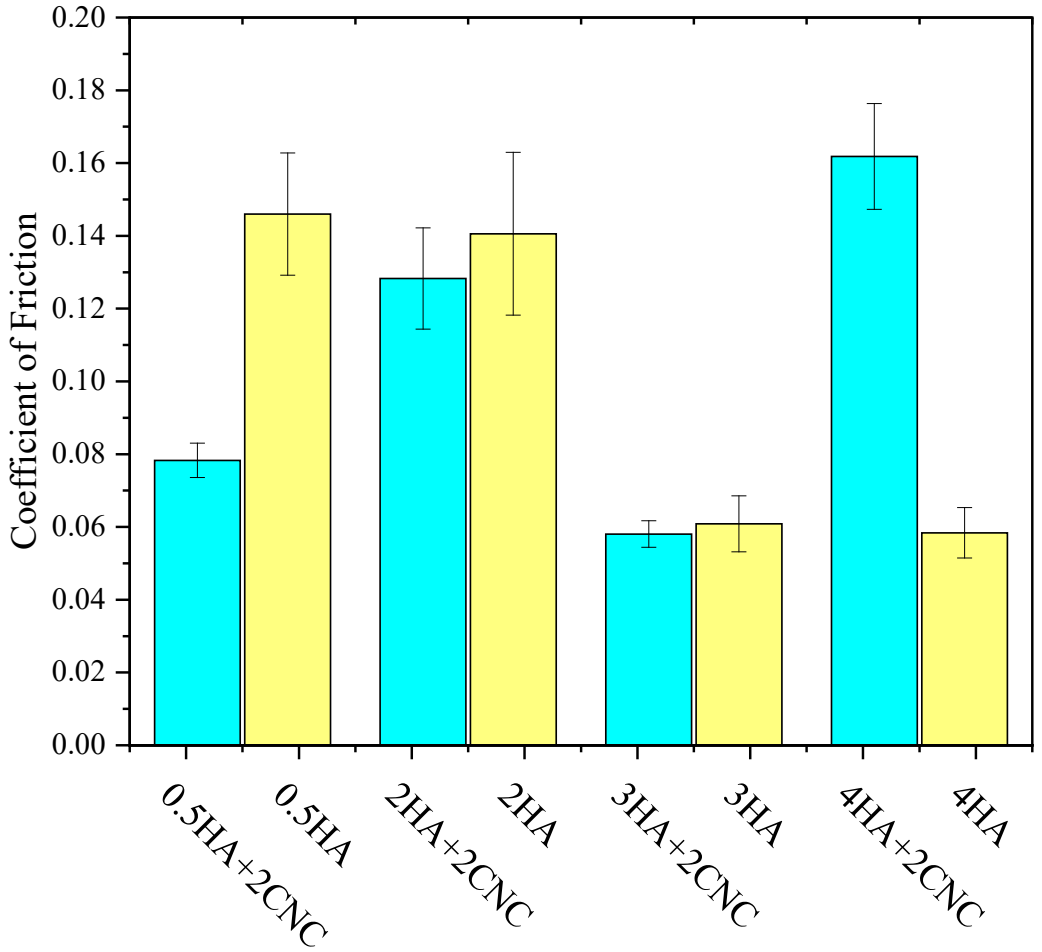


Enhanced stability:
0.5HA+2CNC, 2HA+2CNC

Deteriorated stability:
3HA+2CNC, 4HA+2CNC

Oxygen Scavenging Capability of CNC

Investigation of Tribology -- HA-CNC suspensions



COF of different samples with/without CNC for 5N, 150mm/min on PDMS

Compared to samples without CNC:

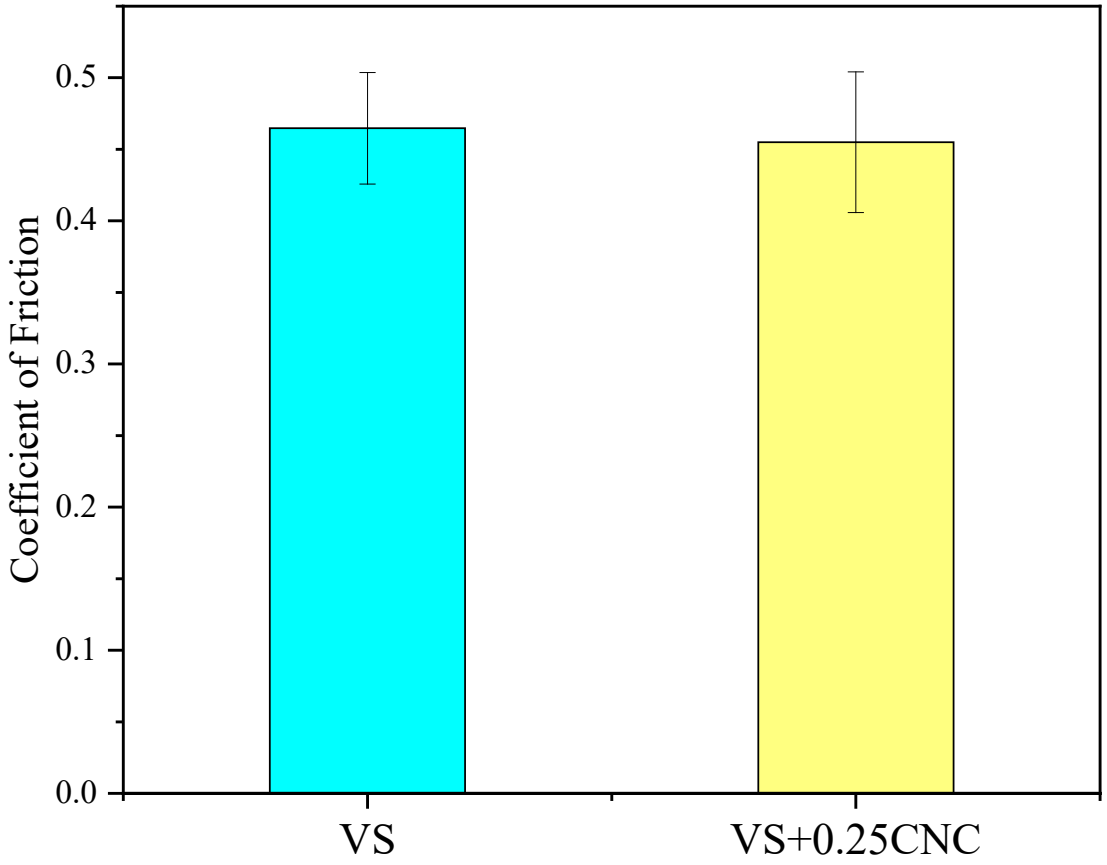
Low HA concentration

lubrication film formation (mending effect)

High HA concentration

Suspension agglomeration
Increased COF

Investigation of Tribology -- VS-CNC suspensions



COF of VS samples with/without CNC for 5N, 150mm/min on steel

Conclusions and Summary

- CNC addition in HA suspensions improves oxidation stability but deteriorates with increasing HA concentration, reaching a critical point at approximately 3 $mg \cdot ml^{-1}$.

- Low HA concentrations coupled with CNC reduce the coefficient of friction due to the mending effect of nanoparticles, whereas higher HA concentrations result in increased friction caused by suspension agglomeration. The addition of CNC to the viscosupplement sample does not result in a significant decrease in COF.

Future Work

- Experiment with a broader range of HA and CNC combinations
- Employ diverse loads and rotary speeds in these experiments
- A thorough investigation into cytotoxicity. Ultimately, aim to develop a viscosupplement

Acknowledgement

- Dr. Dana Grecov, Professor
- Akshai Bose, Ph.D. Student
- Lab members' contributions

- Research fundings from NSERC

THANK YOU

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