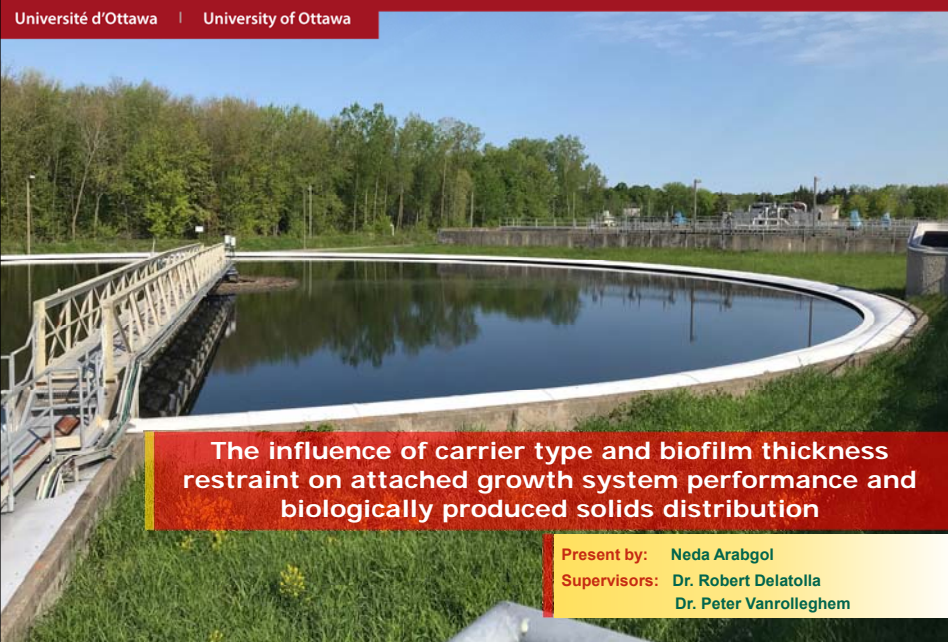


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The influence of carrier type and biofilm thickness restraint on attached growth system performance and biologically produced solids distribution

Present by: **Neda Arabgol**
Supervisors: **Dr. Robert Delatolla**
Dr. Peter Vanrolleghem

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Background

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Biological Treatment System

- Suspended growth**

Lagoon

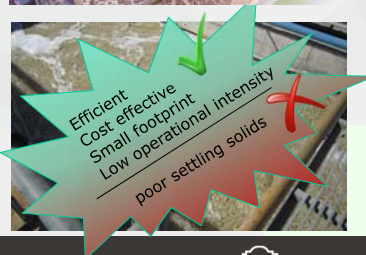
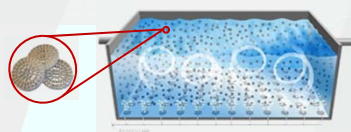


Activated sludge

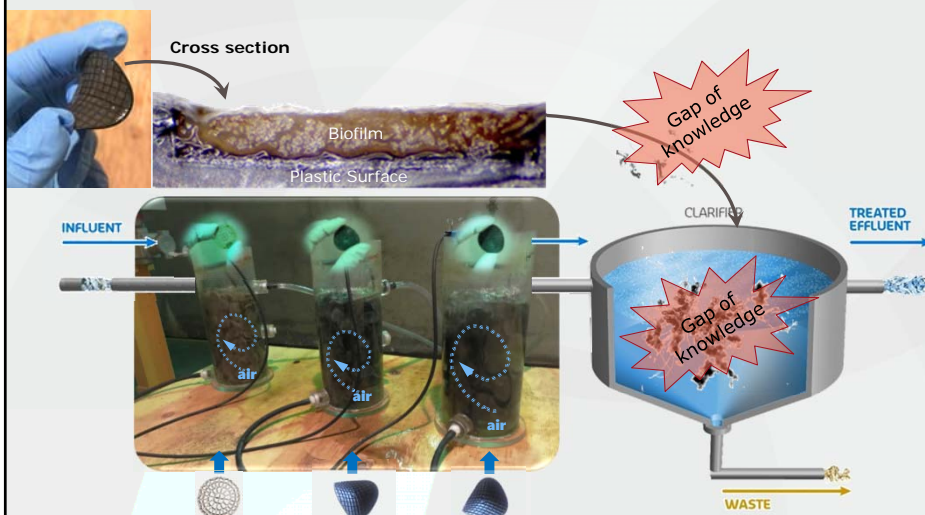


- Attached growth**

Moving Bed Biofilm Reactor (MBBR)



Moving Bed Biofilm Reactor (MBBR)



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Objective

Optimization of the MBBR attached growth treatment technology by enhancing current fundamental knowledge of relation between the bio-carrier design and the resulting biofilm characteristics, detachment of particles and settling response of the particles.

- Effect of "**carrier type**" (K5 vs Z-carriers)
- Effect of "**thickness-restrained**" carrier (Z200 vs Z400)

On:

- System performance
- Biofilm thickness
- Particle characteristics

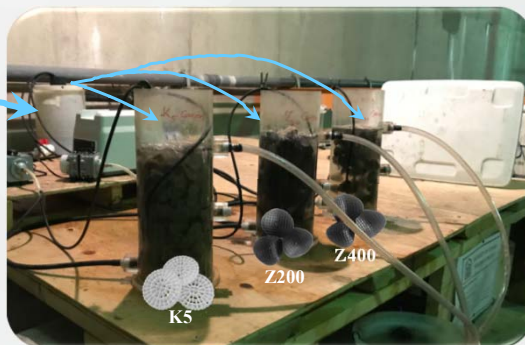
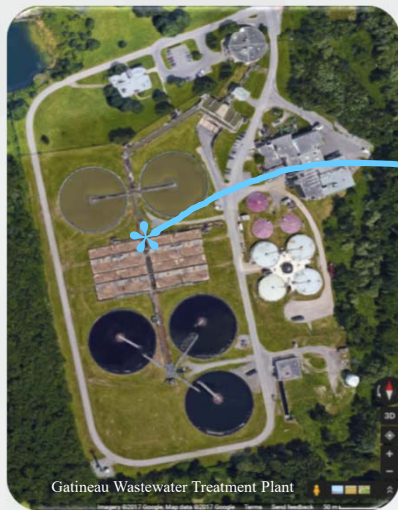
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Experimental Plan

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Experimental Plan



$$\text{SALR} \approx 6 \frac{\text{g BOD}}{\text{m}^2 \cdot \text{d}}$$

$$\text{HRT} \approx 1 \text{ hr}$$

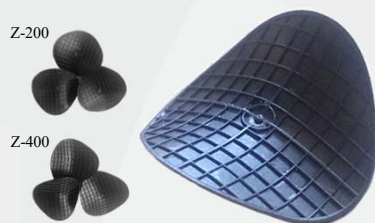
Experimental Plan

Effect of:

➤ **Carrier type**



➤ **Thickness restraint**



<p>1-Characterisation of the particle</p>	<p>2- characterization of biofilm</p>	
		<p>3- Modelling</p>


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Experimental Plan

Effect of:

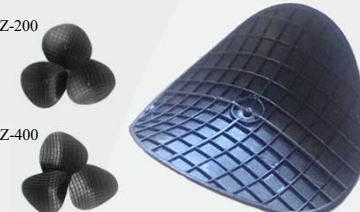
- **Carrier type**

K5 Z- Carriers

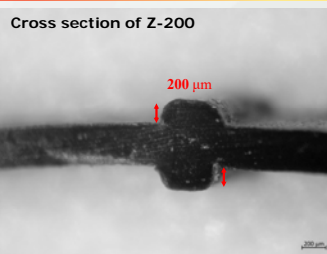


- **Thickness restraint**

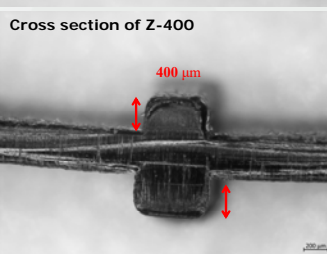
Z-200 Z-400



Cross section of Z-200



Cross section of Z-400



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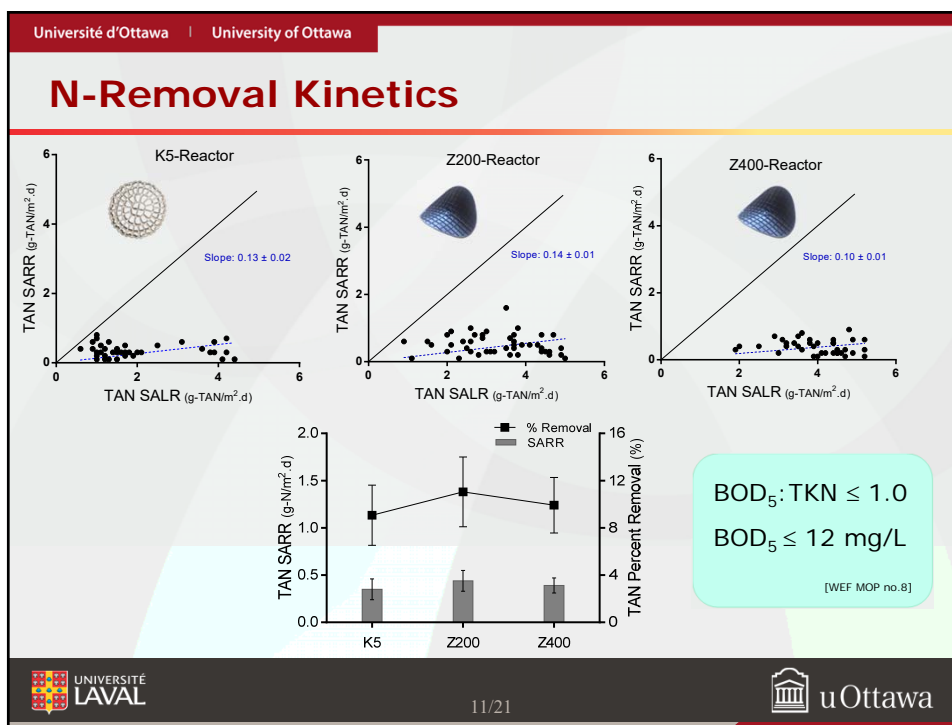
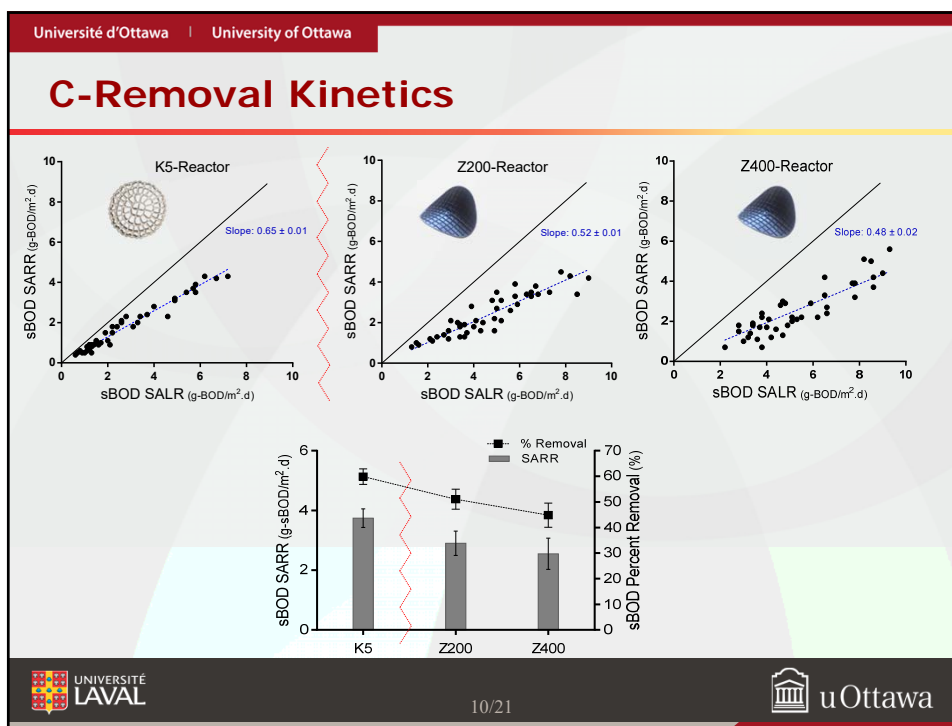
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Carrier Effects

(Carrier Type & Thickness Restraint)

- **System Performance**
- Biofilm Thickness
- Particle Characteristics

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Carrier Effects

(Carrier Type & Thickness Restraint)

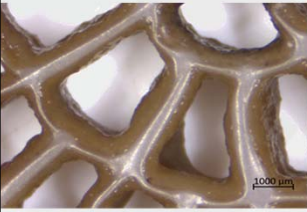
- System Performance
- **Biofilm Thickness**
- Particle Characteristics

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Biofilm Thickness


K5

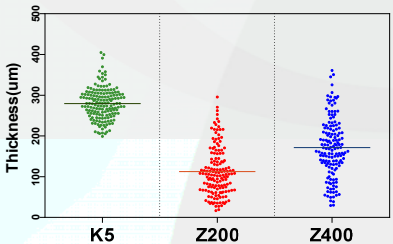


Z-200



Z-400





Carrier Type	Mean Thickness (µm)	Range (µm)
K5	~280	~200 - 450
Z200	~100	~50 - 300
Z400	~150	~50 - 400

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Carrier Effects

(Carrier Type & Thickness Restraint)

- System Performance
- Biofilm Thickness
- Particle Characteristics

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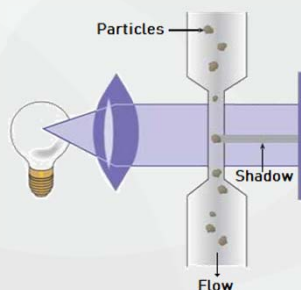
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Solids Concentration & Production

	TSS (mg/L)	VSS (mg/L)	Production (mg-TSS/L)	Detachment rate (g-TSS/m ² .d)
K5	53.4 ± 4.7	42.2 ± 2.3	7.7 ± 3.2	1.7 ± 0.7
Z-200	67.2 ± 11.9	51.2 ± 6.4	19.4 ± 7.6	5.0 ± 2.0
Z-400	58.1 ± 7.5	44.0 ± 4.5	15.1 ± 3.9	3.7 ± 1.0

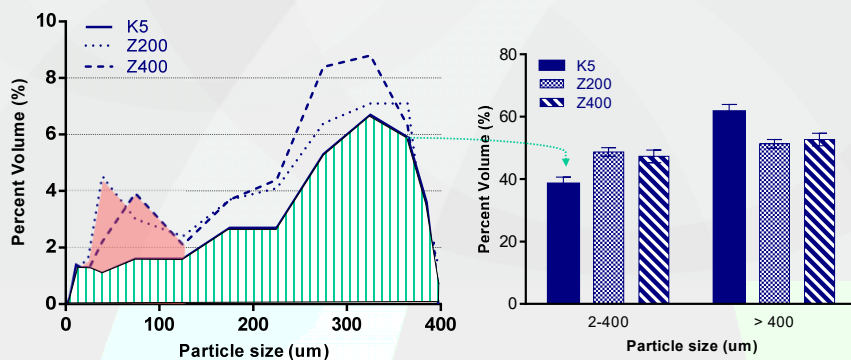
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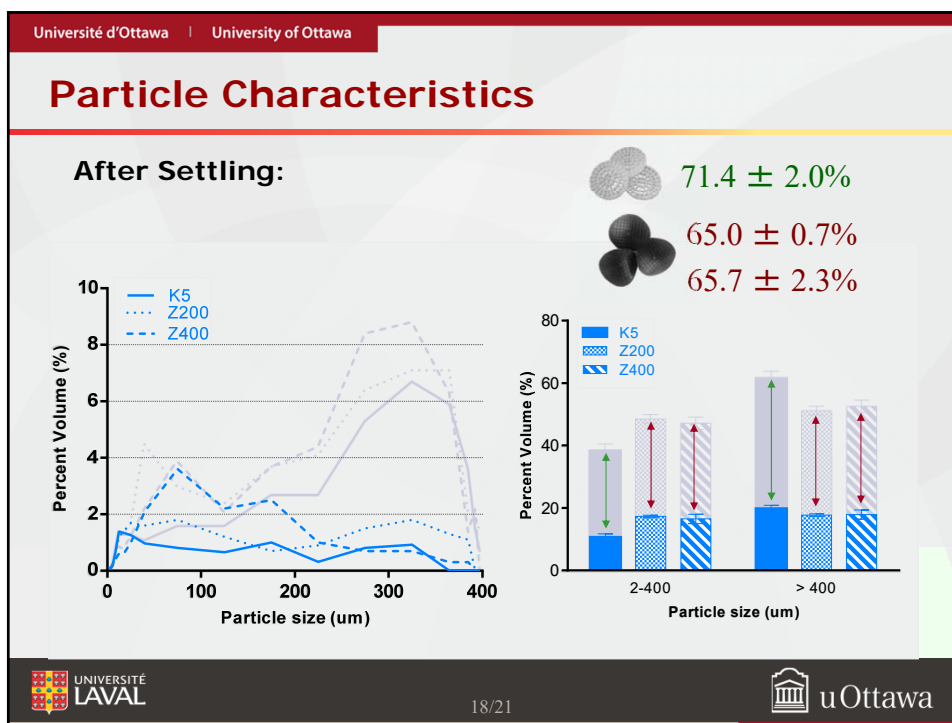
Dynamic Particle Analyzer (DPA)



Carrier Effects on Particle Characteristics

Before Settling:





Conclusion

- Effect of “**carrier type**”: (K5 vs Z-Carriers)
 - Increase in removal efficiency for K5.
 - K5 demonstrates a statistically significant thicker biofilm.
 - K5 showed statistically significant lower solids production and better settling behaviour.
- Effect of “**thickness-restraint**”: (Z-200 vs Z-400)
 - No difference in removal efficiency.
 - Constant thickness but less than designed thickness.
 - No statistically significant difference in solids production and settling behavior.



Thanks for your attention

Fall 2019