



Comprehensive Review and Compilation of Pre-treatments for Anaerobic Digestion in Municipal Wastewater Treatment Plants

Presented by: Étienne Bordeleau

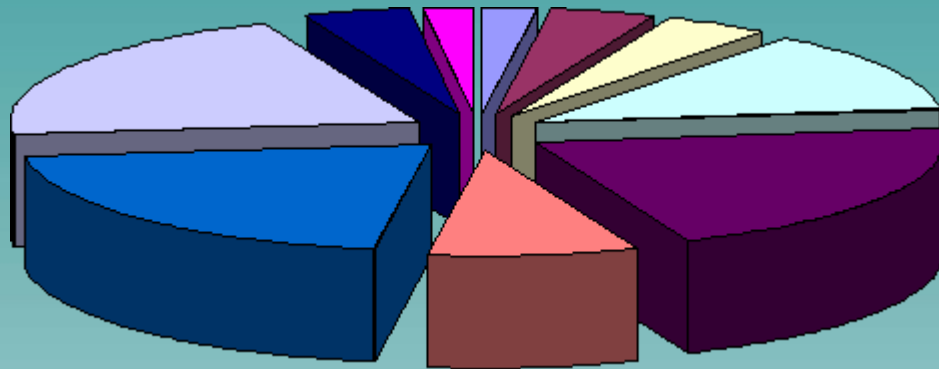


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OUTLINE

The Presentation



- Authors
- Problem ...
- Solution ?
- Review - Qualitative Results
- Review - Quantitative Results
- Approach
- Big Picture Analysis
- Model Simulation Walkthrough
- Summary
- Questions & Answers

AUTHORS

Who's Involved?

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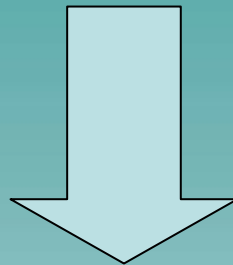
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PROBLEM . . .

What's Wrong?

Populations – INCREASING

Sludge land-use policies – MORE STRINGENT



Wastewater treatment plants can experience difficulties performing within *constraints* (*environmental and financial*)

SOLUTION . . .

Can Pre-treatments Help?

- Hydrolysis considered as rate-limiting step
- Pre-treatments (P-Ts) improve degradation of secondary sludge (WAS) and can improve digestion
- Such P-Ts include mechanical, thermal, chemical, biological, and combinations of these

Where treatment plants have disproportionately high sludge handling/disposal costs, treat wastes of low biodegradability, and/or generate minimal daily biogas, P-Ts might be a sustainable improvement.

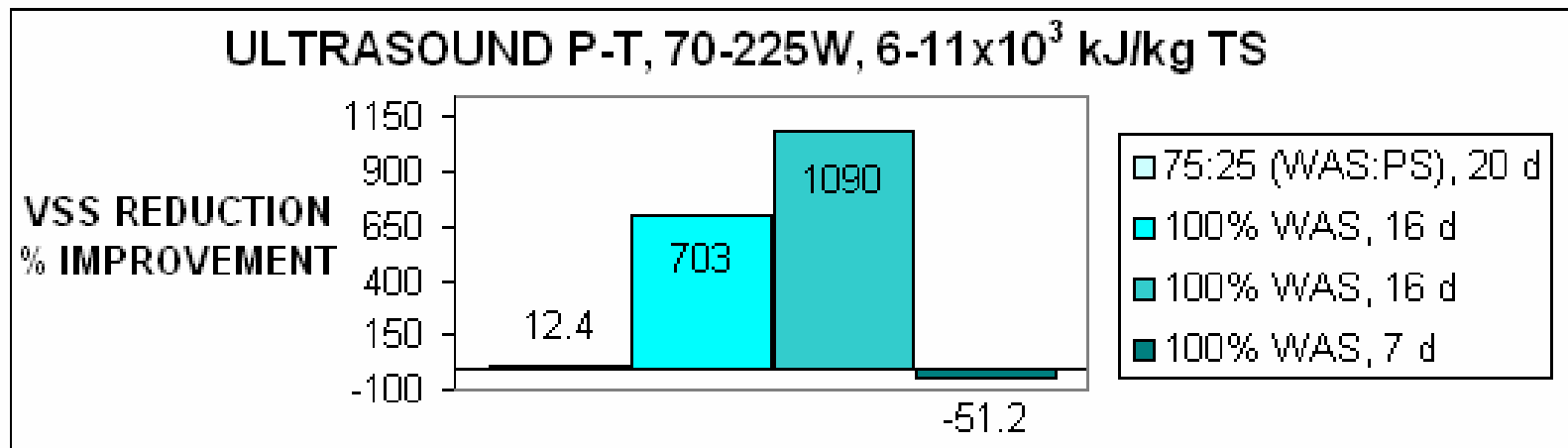
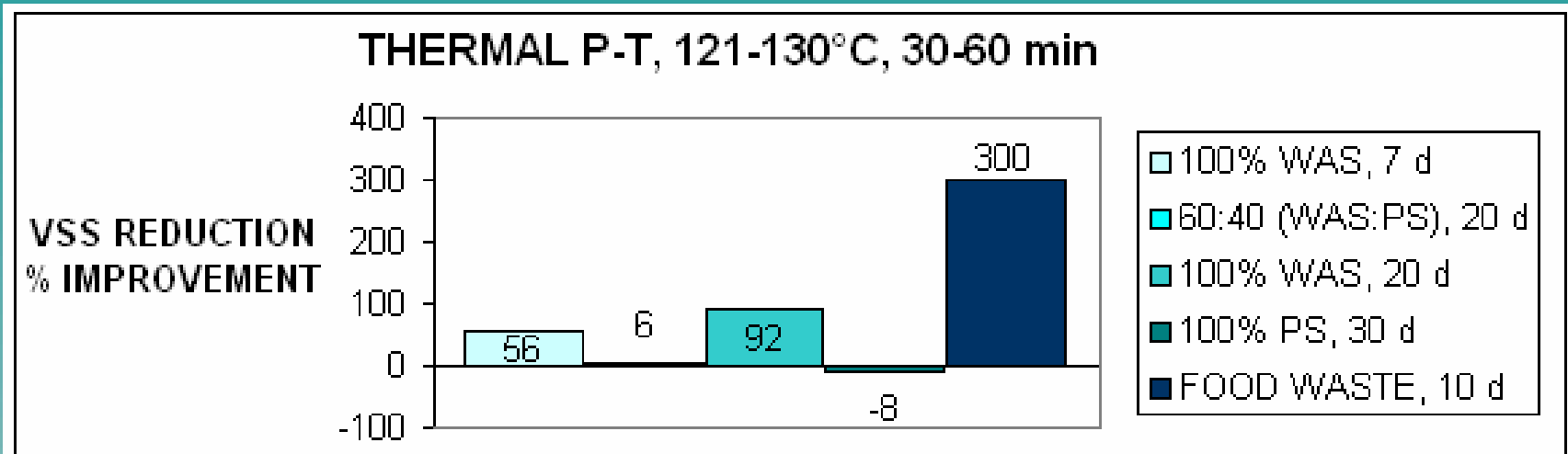
LITERATURE REVIEW

Qualitative Results

				Nitrogen removal
				Phosphate generation
x	x		x	Odour generation
	x			Improved dewaterability
	x		x	Corrosion/Fouling problems
x		x	x	Operation and maintenance
x		x		Energy consumption
				Reliability of operation
				Easy implementation
THERMAL	CHEMICAL	ULTRASOUND	CHEMICAL & THERMAL	

LITERATURE REVIEW

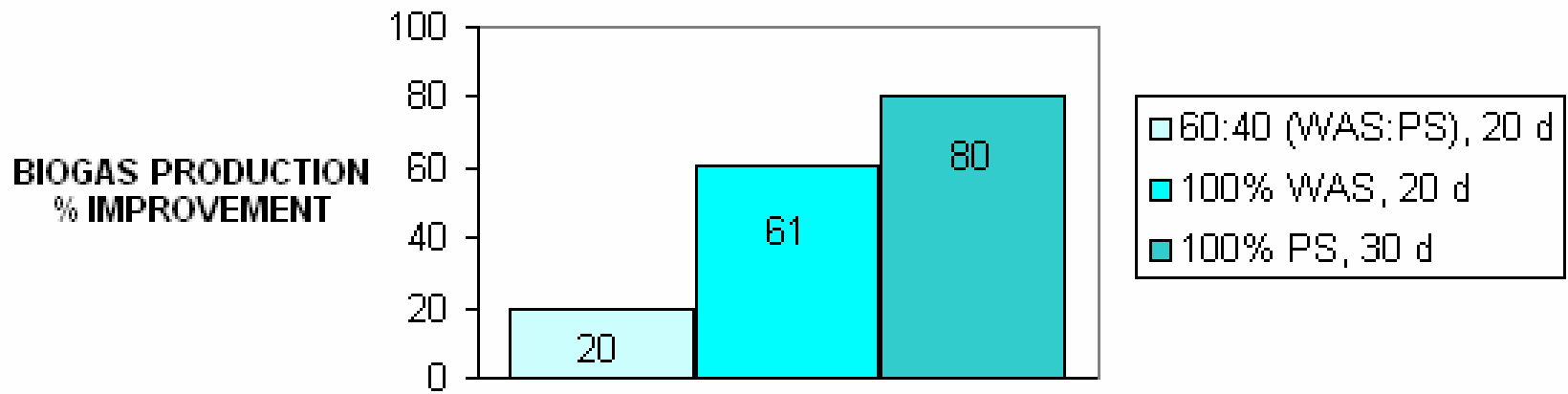
Quantitative Results: VSS



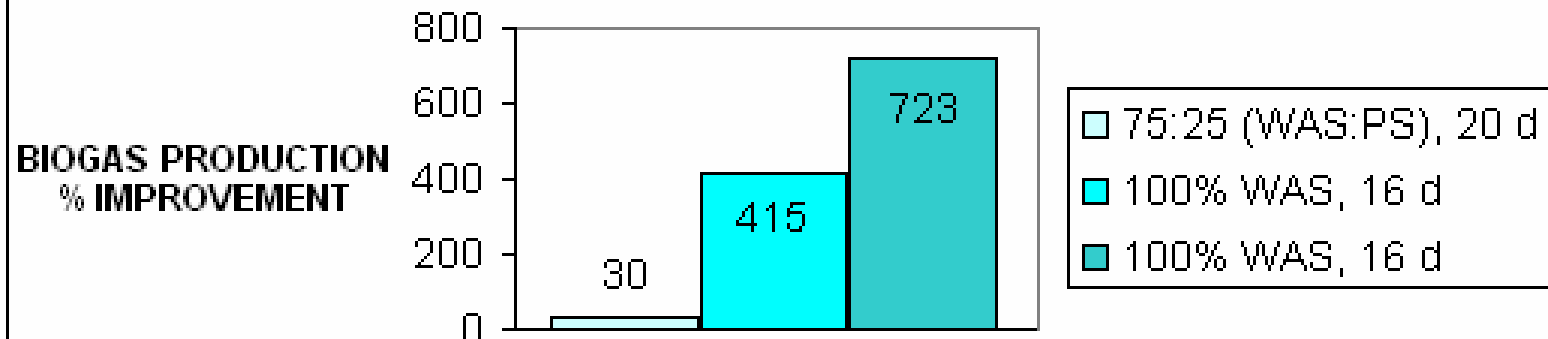
LITERATURE REVIEW

Quantitative Results: Biogas

THERMAL P-T, 121-130°C, 30-60 min



ULTRASOUND P-T, 70-225W, 6-11x10³ kJ/kg TS



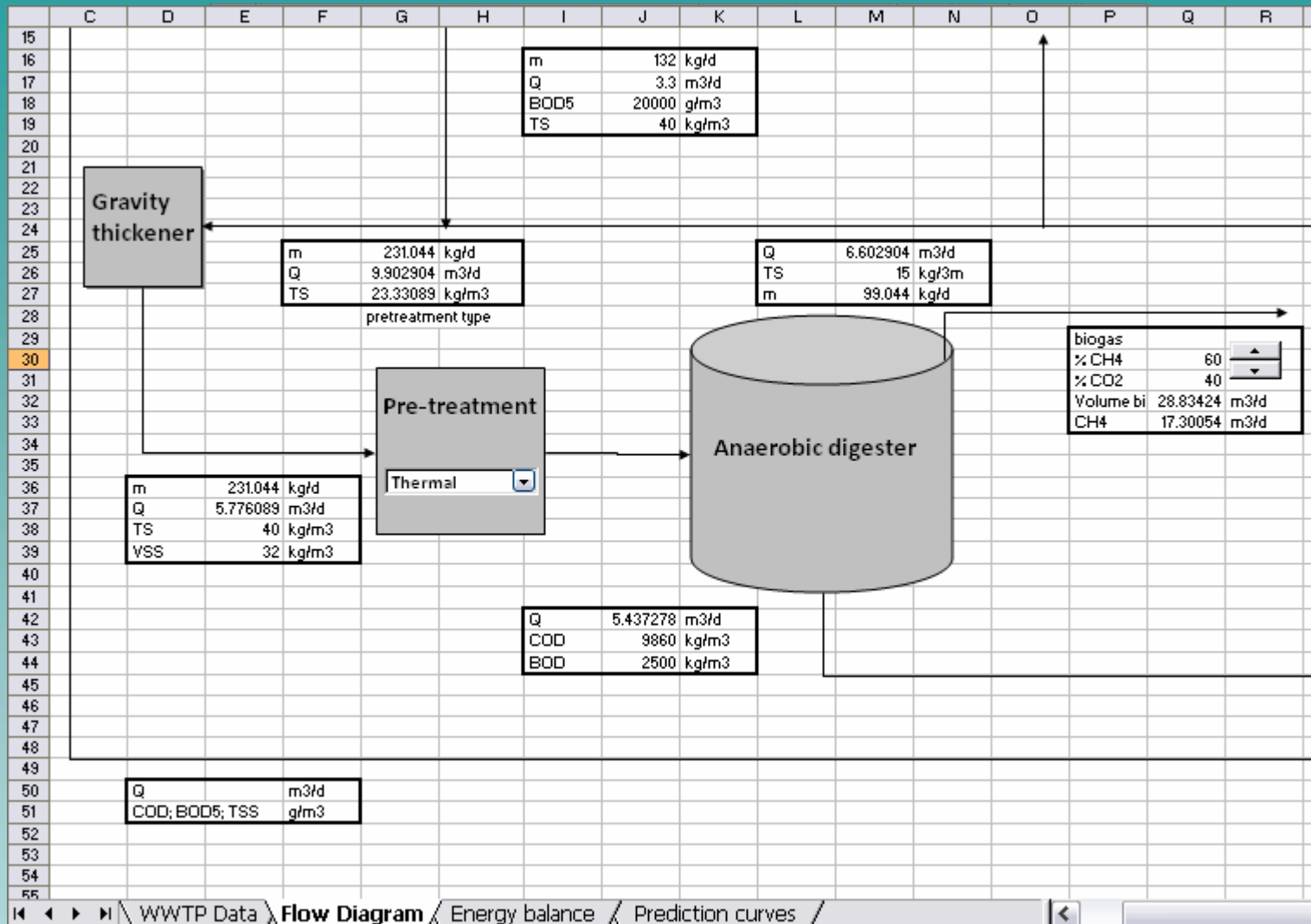
APPROACH

Our Methodology

- **Audit literature concerning bench-/pilot-/full-scale P-Ts**
- **Build database of reproducible and comparable data**
- **Contact industry to obtain unit capabilities/costs**
- **Develop a model that can prescribe a preferred P-T**
- **Evaluate the validity of the model's output**

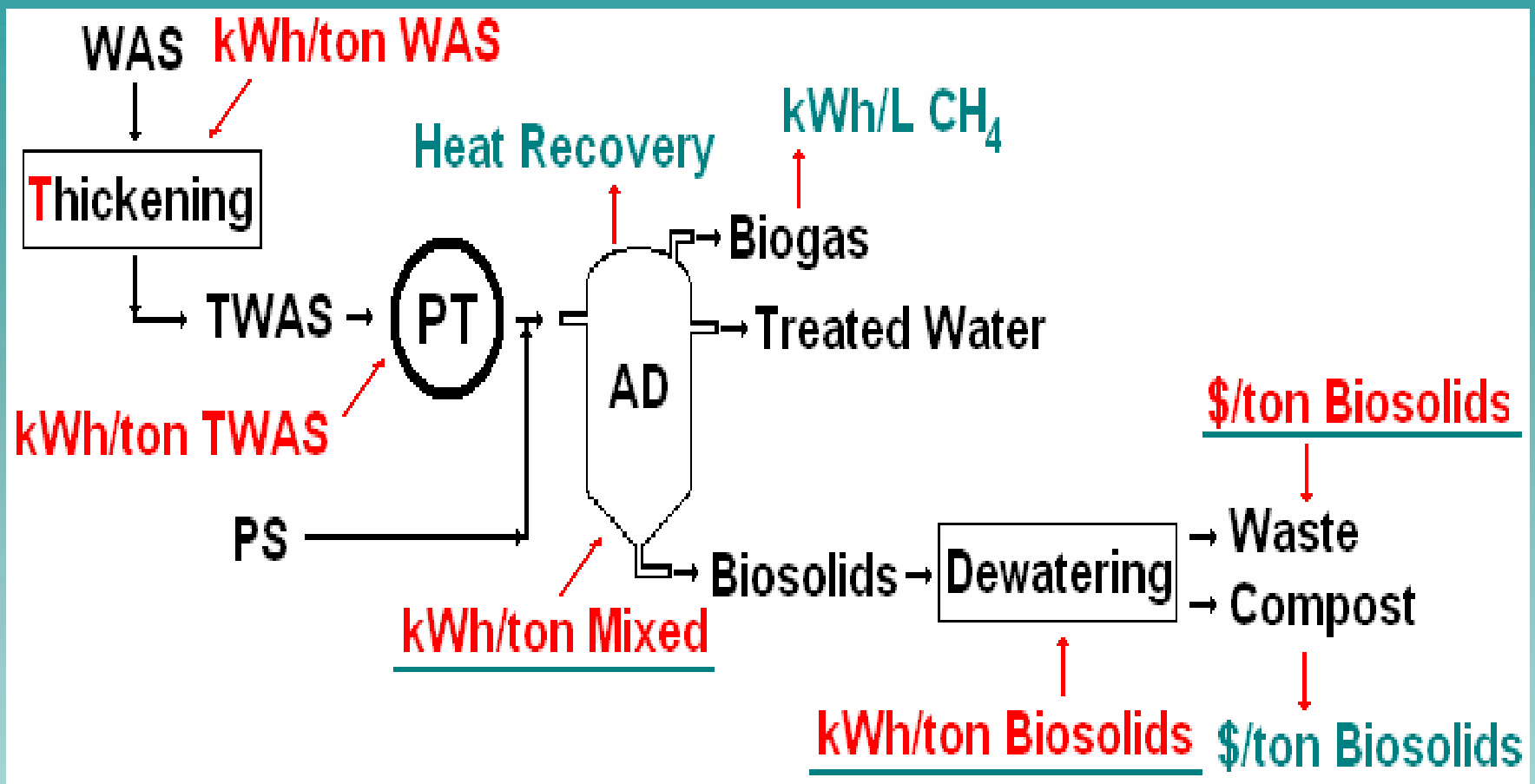
APPROACH

Visualization



BIG PICTURE

Energy Visualization



BIG PICTURE

Energy & Cost Analysis

Pérez, et. al., 2008

Kilowatt-hour Per Day (Integration 1)	8,126.83	kWh/d
Kilowatt-hour Per Day (Integration 2)	2,611.24	kWh/d
Electricity Demand Per Year (Integration 1)	118,651.72	\$/yr
Electricity Demand Per Year (Integration 2)	38,124.16	\$/yr

Our Analysis

Kilowatt-hour Per Day P-T 70°C	36,169.56	kWh/d
Kilowatt-hour Per Day P-T 170°C	96,452.16	kWh/d
Electricity Demand Per Year (low)	528,075.58	\$/yr
Electricity Demand Per Year (high)	1,408,201.54	\$/yr

MODEL SIMULATION

Walkthrough

USER - FRANK

Results:

[View Qualitative Benefits & Drawbacks](#)

	Control	Pre-treatment	Change
COD removed			
VSS removed			
Biogas Production			
Energy Required			
- Thickener			
- Pre-treatment			
- Dewatering			
Total Energy			
Biosolids			
Haulage Cost			

Q m³/d
COD; BOD₅; TSS g/m³

WWTP Data | **Flow Diagram** | Energy balance | Prediction curves

SUMMARY

Quite Briefly:

We aim to provide a quantitative sustainability analysis that clearly delineates benefits and drawbacks to P-T incorporation.

“...we must acknowledge the link between technical problem solving and economic/social/environmental elements to create appropriate solutions...” – EWB



Thank You!
Questions & Comments?



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