Emissions Analysis of Changing the Aerobic Digestion of Excess Sludge from Wastewater Treatment Plants to Anaerobic Sludge Digestion in Chile

Christian E. Seal
Oriana Holzapfel

Florianópolis, Brazil
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Agenda

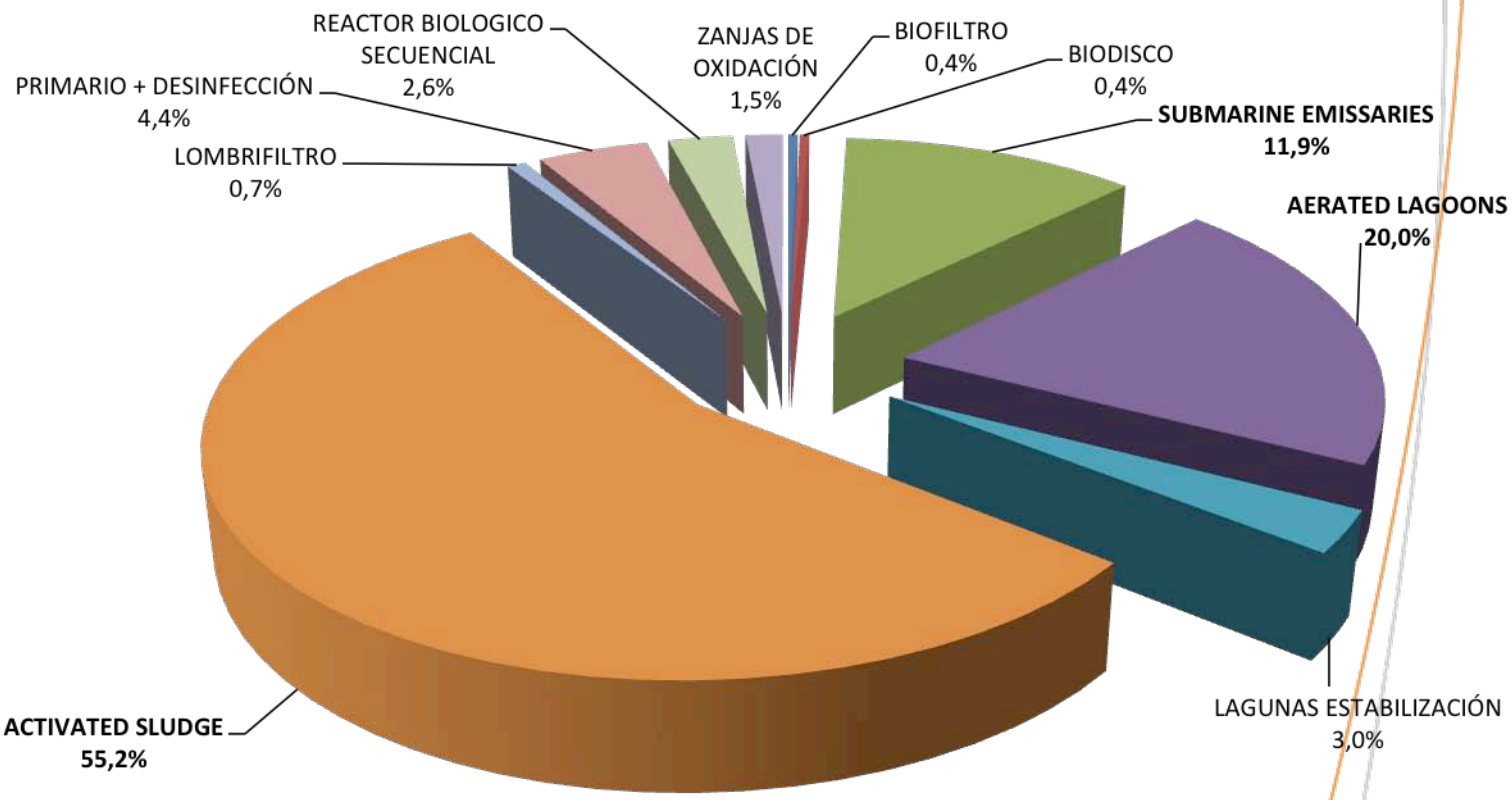
- Background
- Study Description
- Data Collection and Analysis
- Results
- Future Work

Background

Picture: http://es.wikipedia.org/wiki/Chile

- **Chile**
  - **Population: 16,634,603**
  - **Two different sector for water utilities (Urban vs. Rural)**
    - **Urban Wastewater Treatment Coverage: 99,8%**
    - **Urban Tap water Coverage: 100%**
    - **Rural Tap water coverage approximately 99% (SAPR)**
    - **Rural Wastewater over 87% for sewer and 60% for wastewater treatment.**

Urban Wastewater Treatment Technology



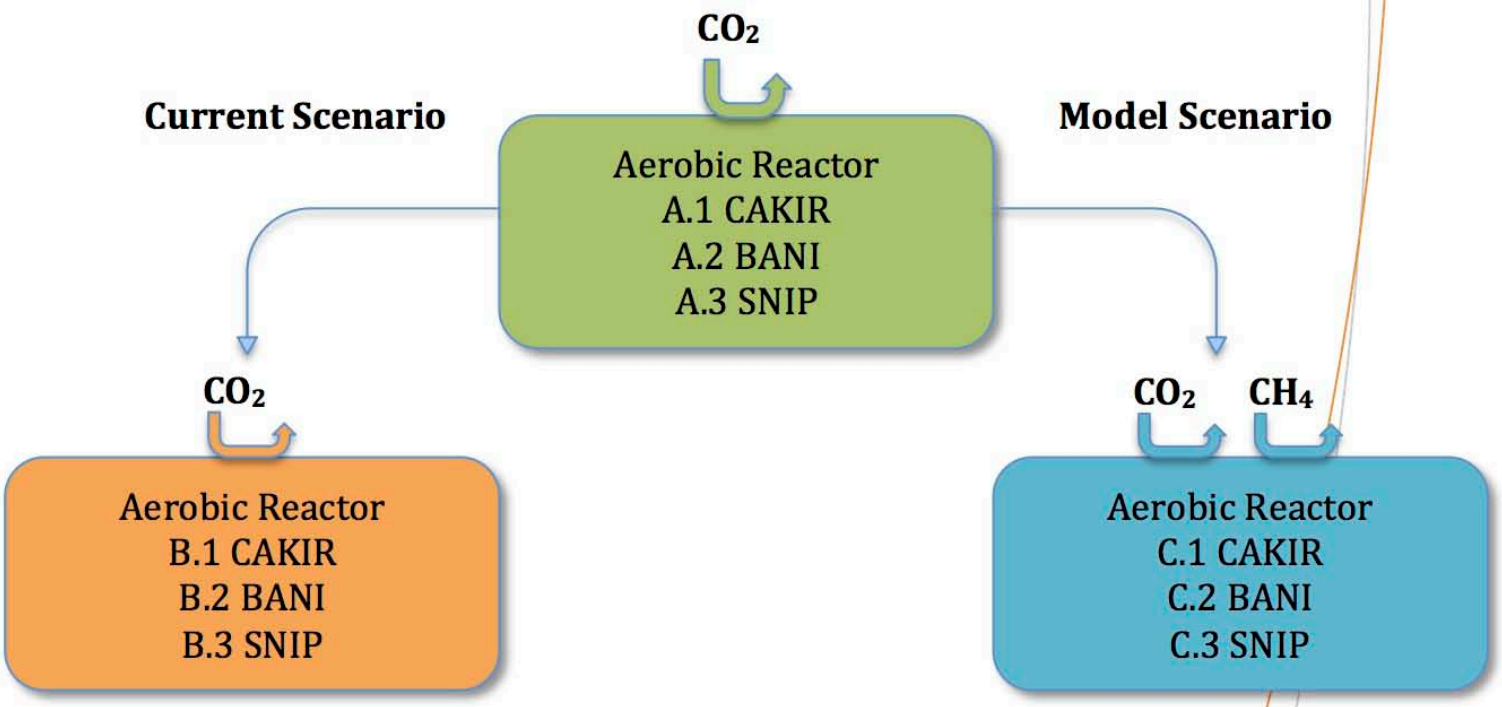
Study Description

- Objective: Evaluate the methane reduction of anaerobic sludge digestion as an alternative for the aerobic digestion of sludge.
  - Nine WWTP were study
    - Population between 57,679 to 333,271
    - Average flows between 80 to 930 L/sec
  - No economical analysis was performed

Data Collection and Analysis

	Region	Utility Name	WWTP Name	Communities Served	Population2012
North part of Chile	II	Tratacal S.A	Calama	Calama	165.337
	III	Aguas Chañar	Copiapó	Copiapó	158.479
	VI	ESSBIO S.A	Rancagua	Rancagua, Machalí & Graneros	333.271
	VI	ESSBIO S.A	San Fernando	San Fernando	57.679
South part of Chile	VII	NUEVO SUR S.A	Curicó	Curicó & Romeral	120.897
	VII	NUEVO SUR S.A	Linares	Linares	80.522
	VII	NUEVO SUR S.A	Talca	Talca	190.622
	VIII	ESSBIO S.A	Chillán	Chillán	200.315
	VIII	ESSBIO S.A	Los Ángeles	Los Ángeles	145.330

Study Description



Model Scenario for Methane:
Burn and Electricity Generation

- kg $CO_{2\ equivalent}$/d
- kg $CO_{2\ equivalent}$/m^3 wastewater treated (Inflow WWTP)
- kg $CO_{2\ equivalent}$/kg DBO_5 a treated (Inflow WWTP)

Data Collection and Analysis

PARAMETER	INFORMATION SOURCE
Wastewater Inflow	Statistical analysis of the average monthly flow (Linear regression)
Inflow BOD_5	Average BOD_5 (weekly, didn't have a tendency)
Outflow BOD_5	Average BOD_5 (weekly, didn't have a tendency)
Sludge Age	WWTP design value
Y, aerobic reactor	0,6 (Metcalf y Eddy, 2003)
kd, aerobic reactor	0,06 (Metcalf y Eddy, 2003)
MLVSS, aerobic reactor	WWTP design value
THR, aerobic reactor	WWTP design value
TSS in the Effluent	Average TSS (weekly, didn't have a tendency)
Sludge Age, Anaerobic Digester	10 (Metcalf y Eddy, 2003)
Y, anaerobic reactor	0,04 (Cakir F. y Stenstrom M., 2005).M. , 2005)
kd, anaerobic reactor	0,034 (Metcalf y Eddy, 2003)

Data Collection and Analysis

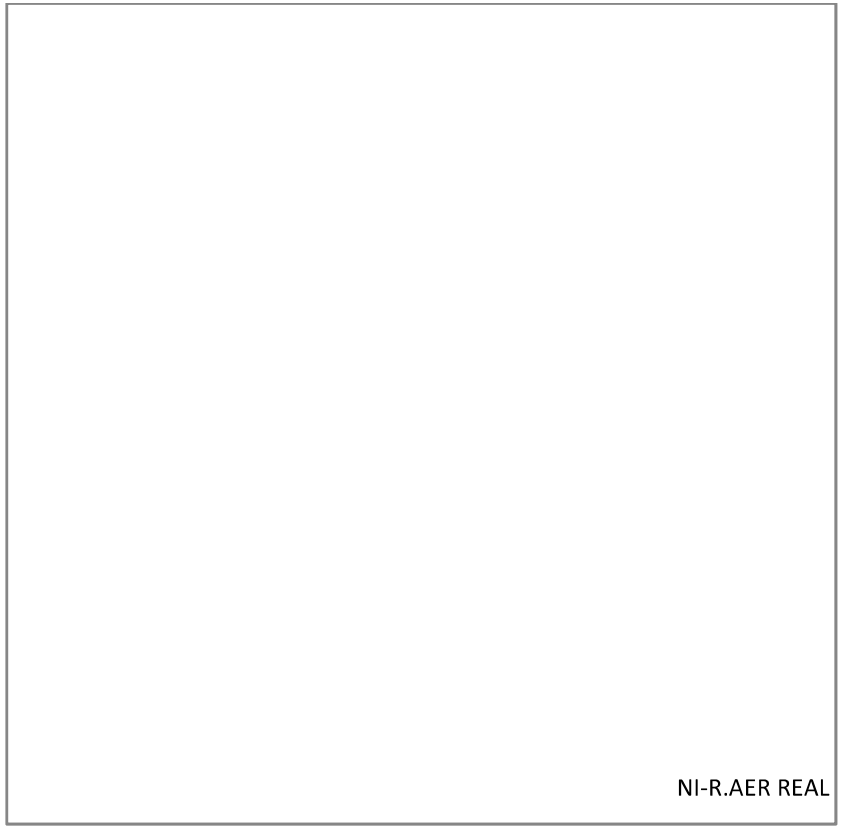
Emissions Reference

Source	WWTP	Kg CO_2/m^3 Treated	Note
			*
			*
		13	Industrial + CH4 Effluent

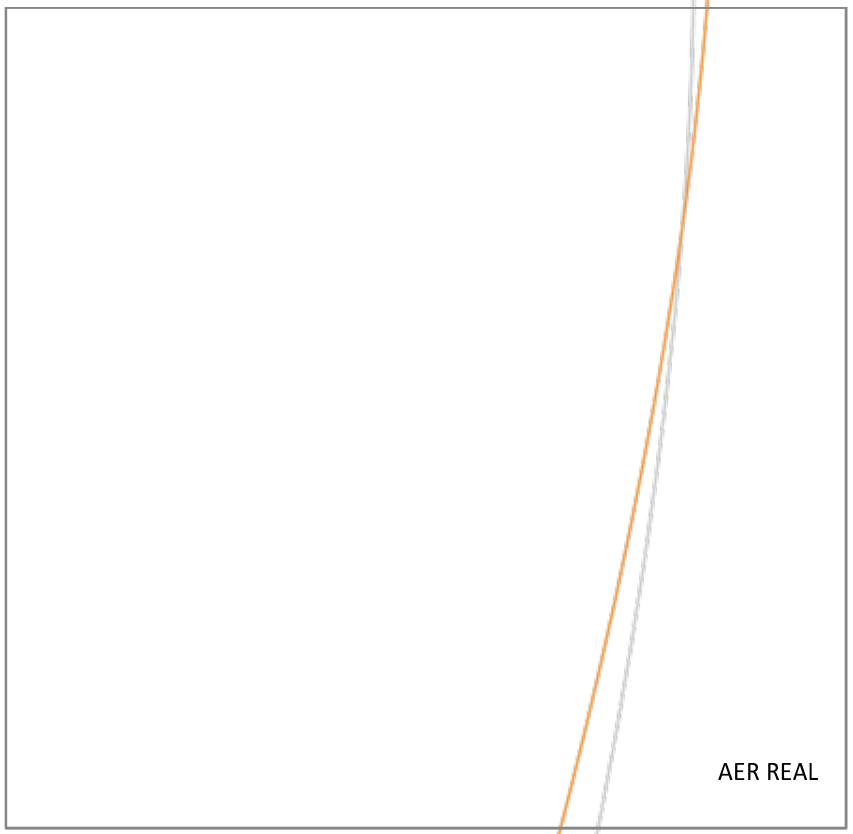
* Calama´s operational values are similar to the WWTP used in the Journal

Data Collection and Analysis

Aerobic Reactor Emissions (Kg CO_2/d)



Aerobic Reactor Emissions (Kg CO_2/m3)



Results

Total Emissions for WWTP (Ton CO_2/year)

WWTP	Calama	Copiapo	Rancagua	San Fernando	Curico	Talca	Linares	Chillan	Los Ángeles

nergy Source

Results

h Methane Burning									

Results

Emission Factor (Kg CO_2/m^3)

WWTP	Calama	Copiapo	Rancagua	San Fernando	Curico	Talca	Linares	Chillan	Los Ángeles

ethane as Energy Source

Results

- Aerobic Reactor + Energy Generation, can reduce greenhouse emissions and energy consumption for WWTP.
- **Infiltration:** The emission reduction by changing the digestion process was between 50 to 60 percent in the south part of Chile and 30 to 40 % in the north part of the country.
- Significant difference between the different models used (Snip doubles the other models)

Future Work

- Evaluate the Economical Impact
- Improve Kinetic Values for WWTP
- Consider Off-Road emissions (transport, sludge disposition…)
- Generate a National Greenhouse Gas Inventory for the Wastewater Treatment Sector for the different technologies.
- Estimate N_2O generated in the process or afterward

Thanks

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