Bioslurry Quality for Low-Solids Digestion

CBA Session:
Quality - Removing Contaminants

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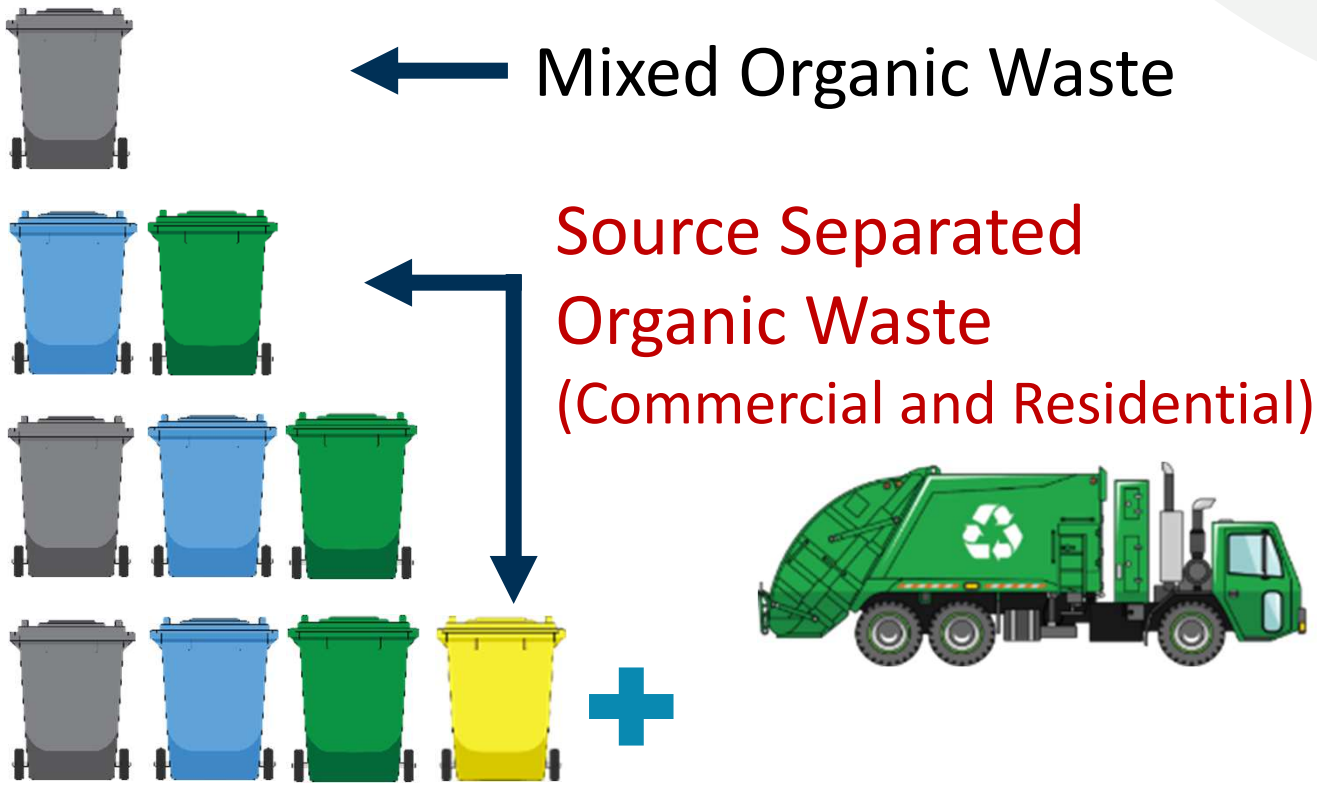
Photo Credit: Mavitec

Overview

- Municipal Organics to Bioslurry
  - Drivers
  - Characteristics, Physical Debris and Standards
- Pretreatment Technologies and Systems for Low-Solids AD
  - Core Equipment – Sufficient?
  - Other Issues/Concerns
- Conclusions and Way Ahead

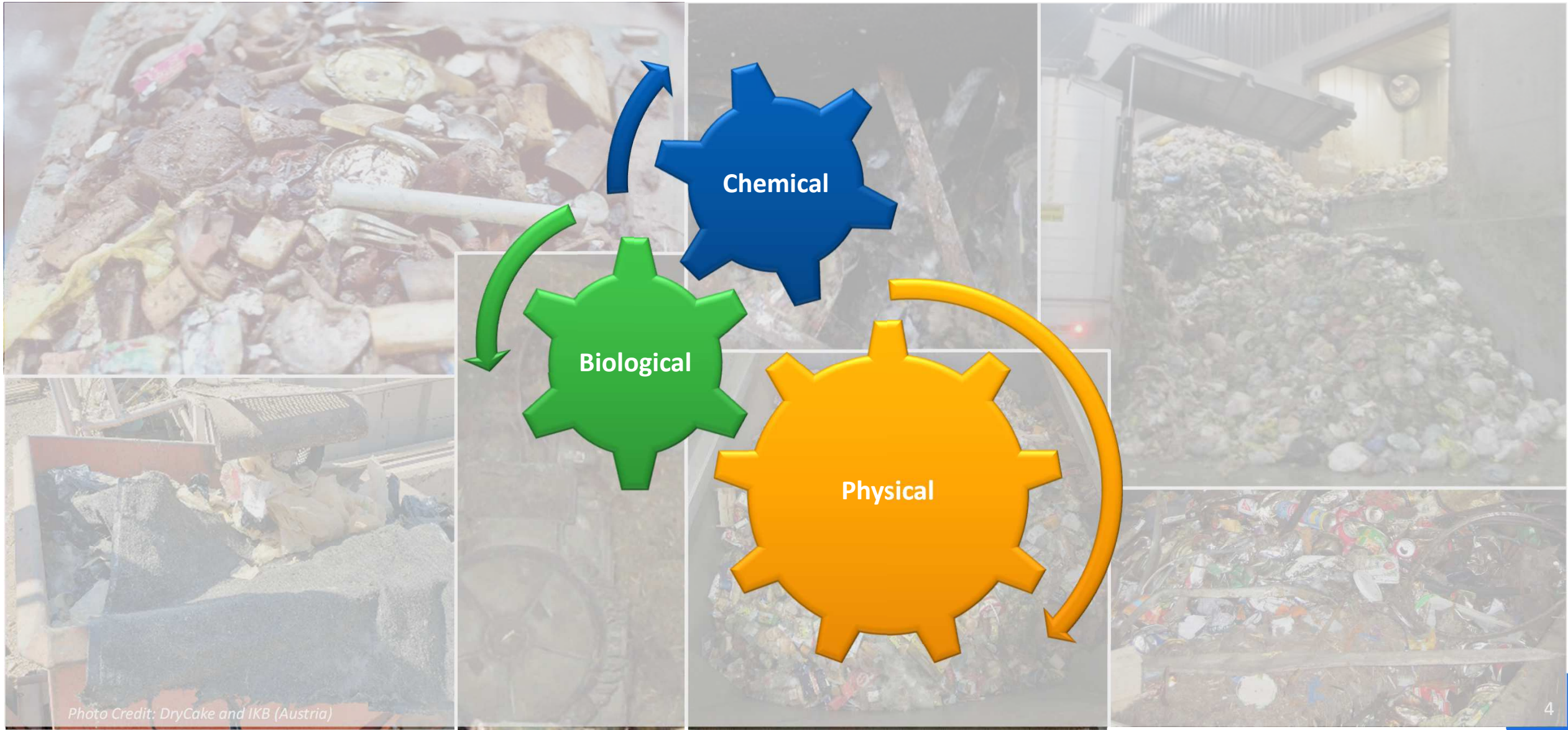
Photo Credit: Marabex

SB1383 – Municipal Organic Waste Collection Allows a Menu of Options



Source: CalRecycle

Contamination



Contamination

Photo Credit: DryCake and IKB (Austria)

Organic Solid Waste for Low-Solids AD

WHAT IS NEEDED

Pre-treatment for effective removal of physical contaminants and homogenization

Photo Credit: Witzenhausen Institut and Waste Management

Physical Contamination, Product Standards - Examples

Standard for Physical Contamination	CalRecycle Compost Regulation (2018)					
Foreign Debris	>4 mm: ≤0.5% dry weight					
Film/formable Plastics	>4 mm: ≤20% of foreign debris = 0.1% dry weight					
Surface Area Comparison						

Physical Contamination, Product Standards - Examples

Standard for Physical Contamination	CalRecycle Compost Regulation (2018)	Ontario, CAN Compost, Category AA	European Union Ordinance 2019/1009 Fertilizer Products	German Fertilizer Ordinance (DüMV)		
Foreign Debris	>4 mm: ≤0.5% dry weight	>3 mm: not exceed ≤1.0% dry weight Plastics: 0.5%; and no objects ≥ 25 mm per 500 ml Sharps: no material of a size or shape that can reasonably cause injury.	>2 mm: ≤0.5% dry weight, combined ≤0.3% dry weight, glass, metal, plastics	>1 mm*: ≤0.4% dry weight (other than formable plastics)		
Film/formable Plastics	>4 mm: ≤20% of foreign debris = 0.1% dry weight			>1 mm*: 0.1% dry weight		
Surface Area Comparison						

*was >2mm

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Film/formable Plastics	>4 mm: ≤20% of foreign debris = 0.1% dry weight			>1 mm*: 0.1% dry weight	
Surface Area Comparison					~3 US Quarters

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Surface Area Comparison					~3 US Quarters 	~1/2 Dime

*was >2mm

Coarse and Fine Debris Removal – Why it Matters

O&M and :

Prevent damage of pumps, clogging of pipes

Prevent loss of the active digester volume caused by sediments

Prevent digester floating blankets

Prevent environmental pollution => Soil/Ag-land, water bodies, drinking water

What Mechanical Tools Do We Have?

Mechanical Pre-Treatment of Organics

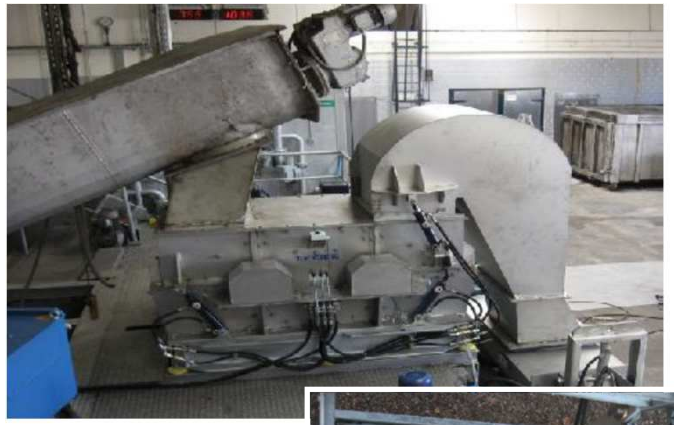
Core Equipment: *Paddle/Hammer Mill Principal*

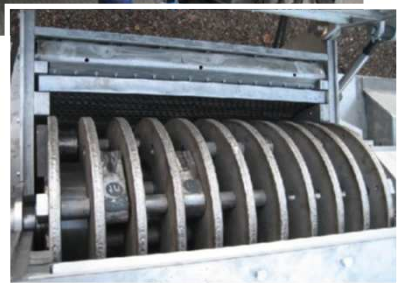
Continuous Process

Suppliers: >10

Horizontal Single Shaft Drum Assemblies

Horizontal Double Drum Assembly





Vertical Single Shaft Assembly

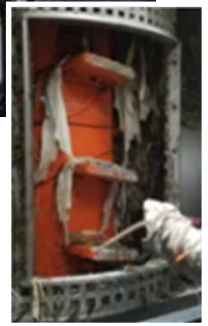


Photo Credit: Mavitec, Haarslev, Tietjen, and Drycake

Mechanical Pre-Treatment of Organics

Core Equipment:

Waste Separation Press

Continuous Process

Suppliers: >5

Semi-continuous Process

Suppliers: <5

Pulper

Discontinuous/Batch Process

Suppliers: <5

Photo Credit: Anaergia and Cellwood

Are These Sufficient?

Performance Test Bioslurry Analysis

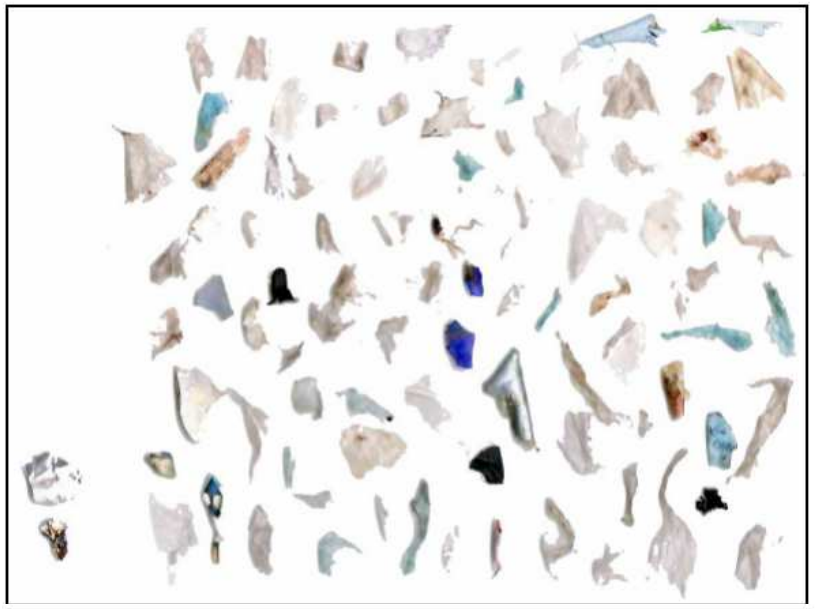
Core Equipment 1

Feedstock:
Commercial Organics

12mm Screen Size

Parameter		Result
Sample (TS)		18.04%
Debris > 2mm	Glass	0.45 w/w % TS
	Plastics	3.48 w/w % TS
	Metal	0.13 w/w % TS
Debris Total >2mm		**4.06 w/w % TS**
Surface Area Total		**527 cm^2/l**

Courtesy of Witzenhausen Institut



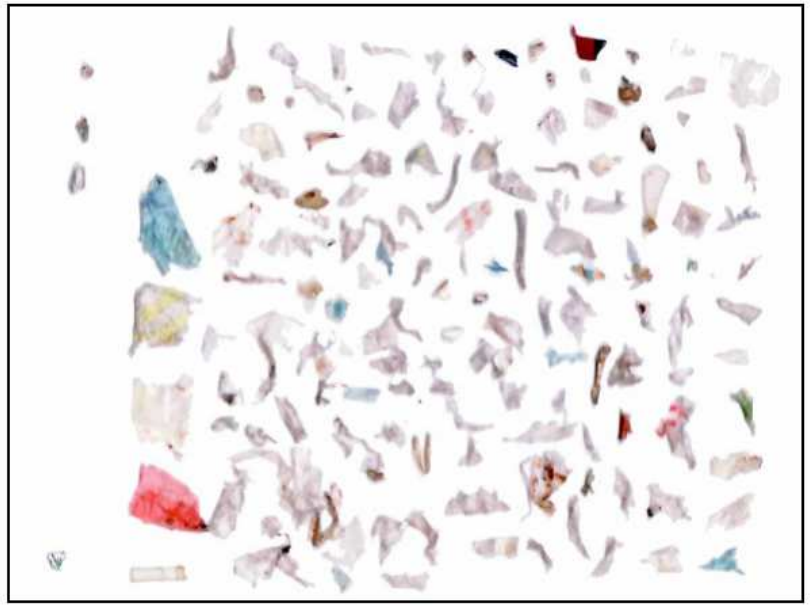


Illustration of fine debris covered surface area, 0.25 Liter bioslurry sample

Performance Test Bioslurry Analysis
Core Equipment 2

Feedstock:
Commercial Organics (Grocery stores & mixed dairy waste)

15mm Screen Size

Parameter		Result
Sample (TS)		12.4%
Debris > 2mm	Glass	0.11 w/w % TS
	Plastics	0.37 w/w % TS
	Metal	0.08 w/w % TS
Debris Total		**0.56 w/w % TS**
Surface Area		**14 cm^2/l**

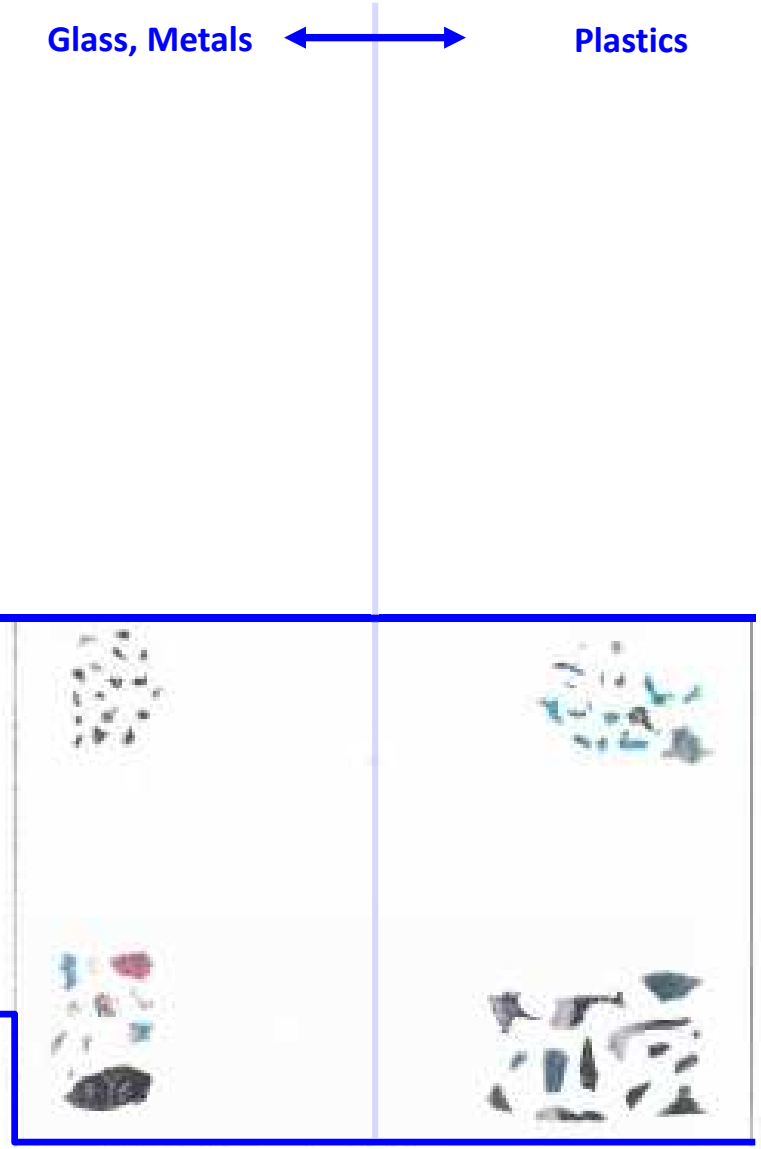


Illustration of fine debris covered surface area, bioslurry sample

Courtesy of Mavitec

Performance Test Bioslurry Analysis

Core Equipment 2

Feedstock:
Commercial Organics (Grocery stores & mixed dairy waste)

15mm Screen Size

Parameter		Result
Sample (TS)		12.4%
Debris 1-2mm	Glass	0.14 w/w % TS
	Plastics	0.01 w/w % TS
	Metal	0.0 w/w % TS
Debris Total		0.15 w/w % TS
Surface Area		2 cm^2/l
Debris > 2mm	Glass	0.11 w/w % TS
	Plastics	0.37 w/w % TS
	Metal	0.08 w/w % TS
Debris Total		0.56 w/w % TS
Surface Area		14 cm^2/l
Debris Total >1mm		**0.71 w/w % TS**
Surface Area Total		**16 cm^2/l**

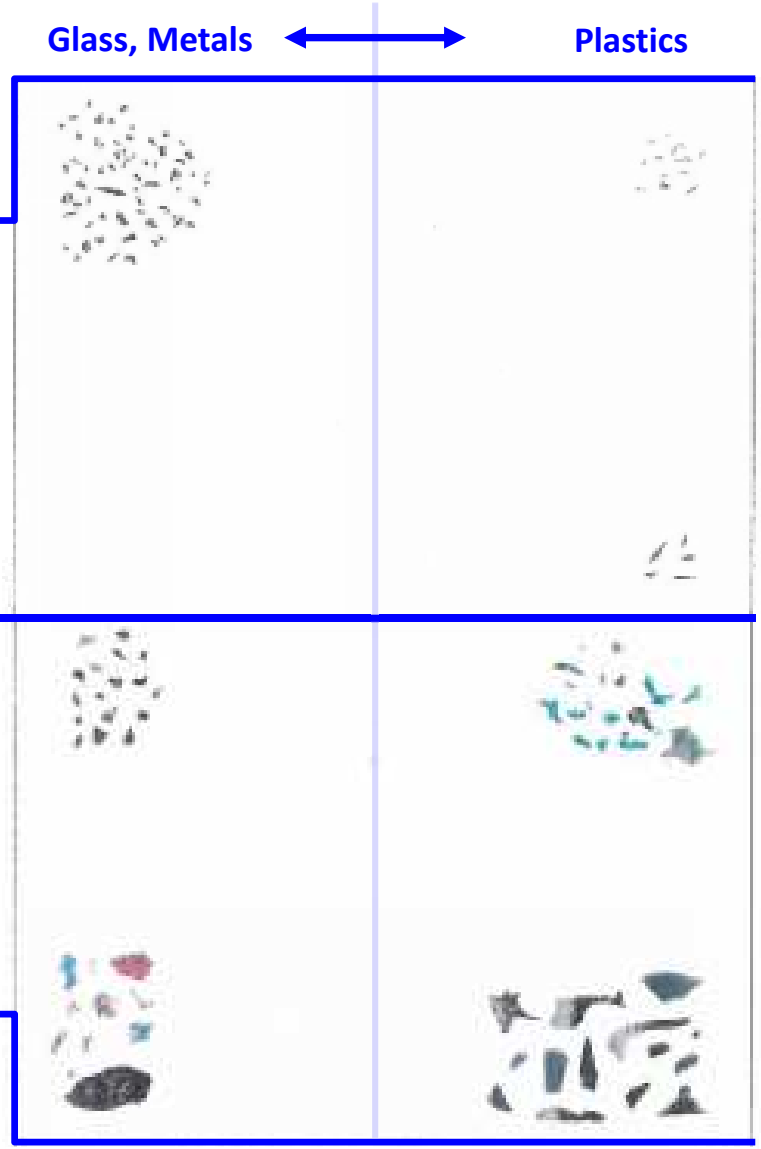


Illustration of fine debris covered surface area, bioslurry sample

Courtesy of Mavitec

What About Smaller Debris, e.g. <12mm (~1/2”)?

Photo Credit: Wackerbauer

Research on Digester Sediments at WRRFs w/Co-Digestion, University of Innsbruck, Austria

WRRF Zirl – Sampling w/Diver

WRRF Innsbruck – Sampling after Emptying of Digester

Courtesy of University of Innsbruck

Research on Digester Sediments at WRRFs w/Co-Digestion

Sediment Samples by Category

Debris >4mm

Plastics

Struvite

Stones

Egg & Seafood Shells

Glass

Wood

Bones

Pits, Plant Shells

Metal

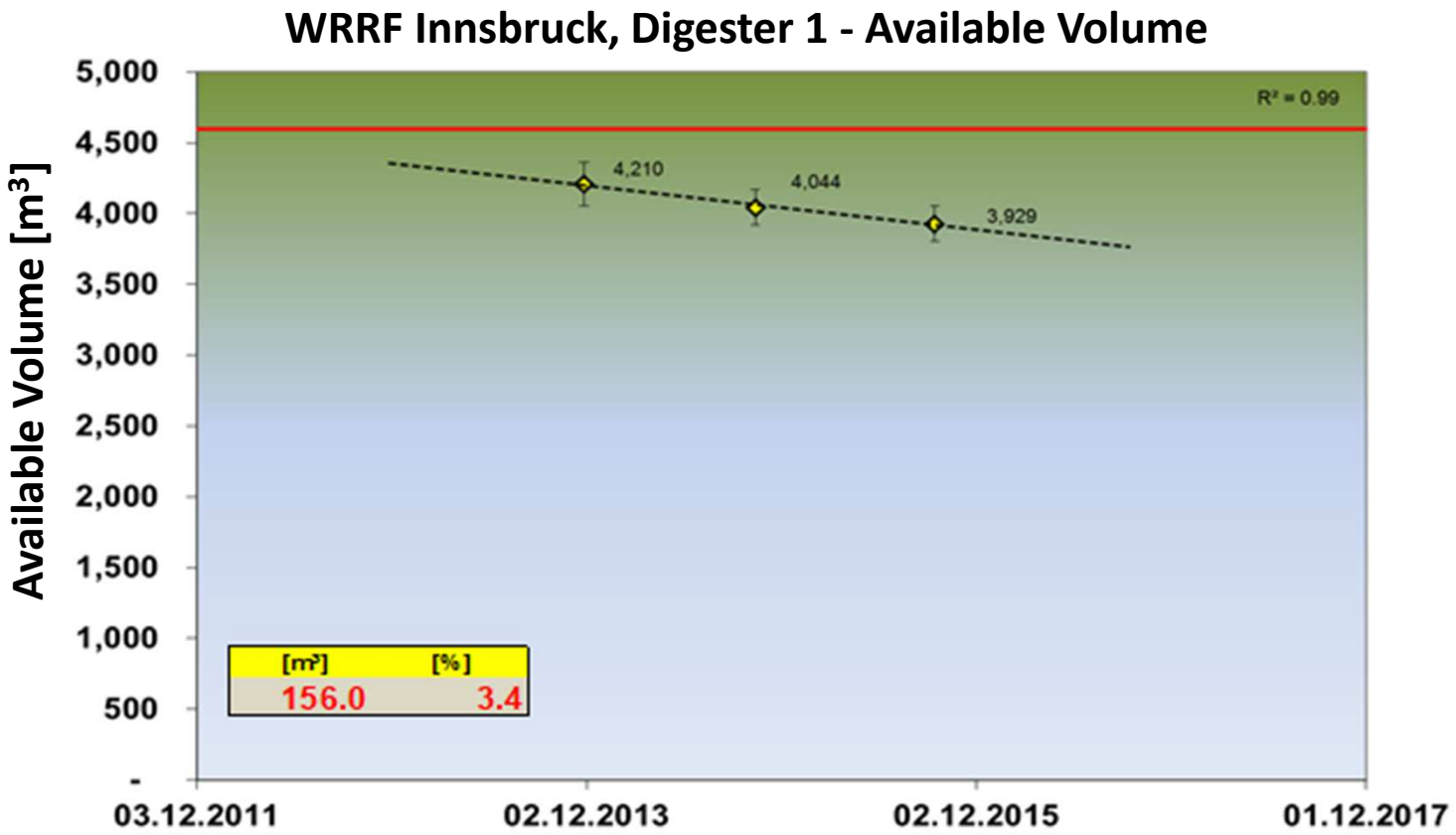
Hair, Twines

½ Inch

[Scale in Centimeter]

Courtesy of University of Innsbruck

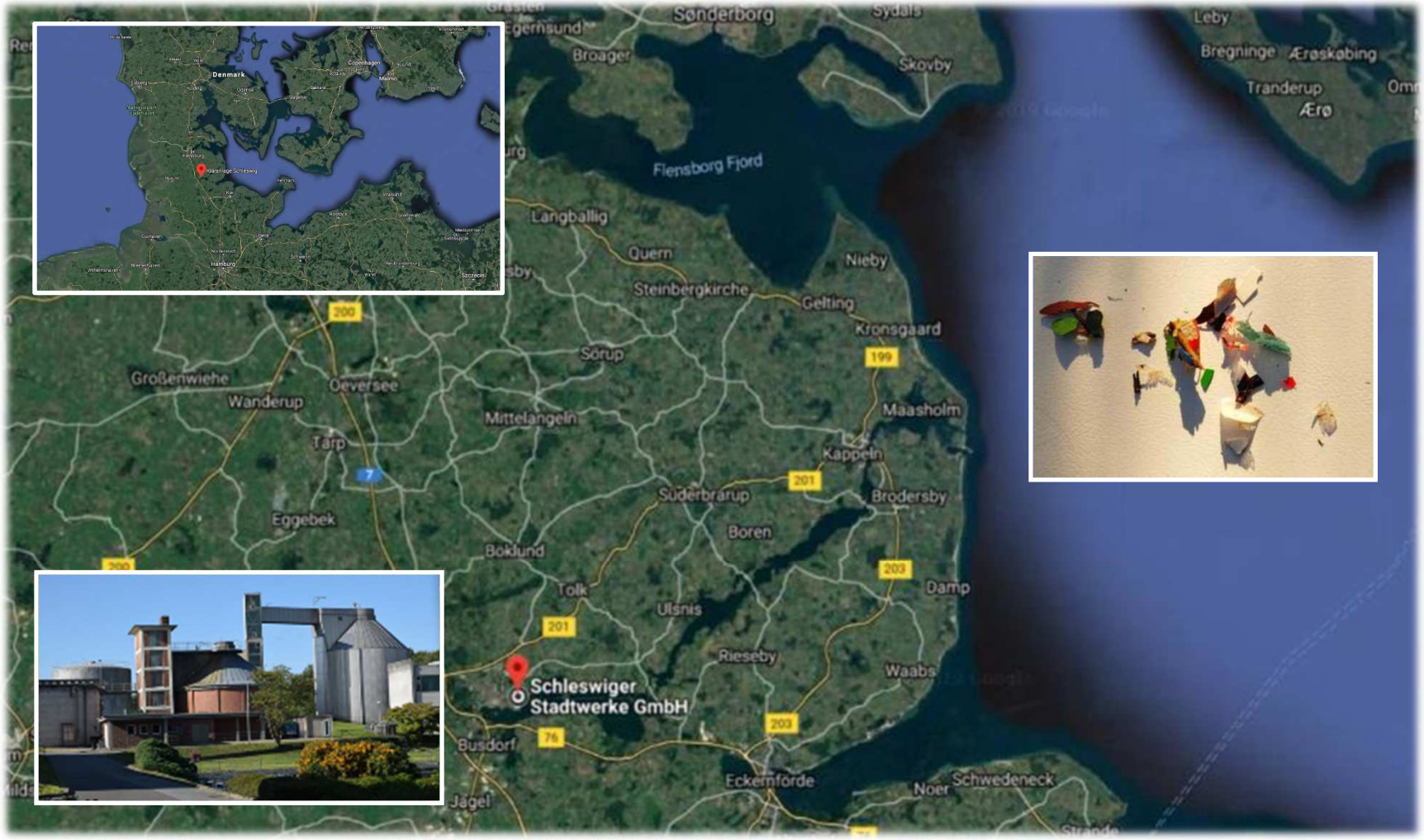
Research on Digester Sediments at WRRFs w/Co-Digestion, University of Innsbruck, Austria; Loss in Digester Capacity



Decline Rate of Active Digester Volume: 3.4% per year liner decline, measurement with tracer method

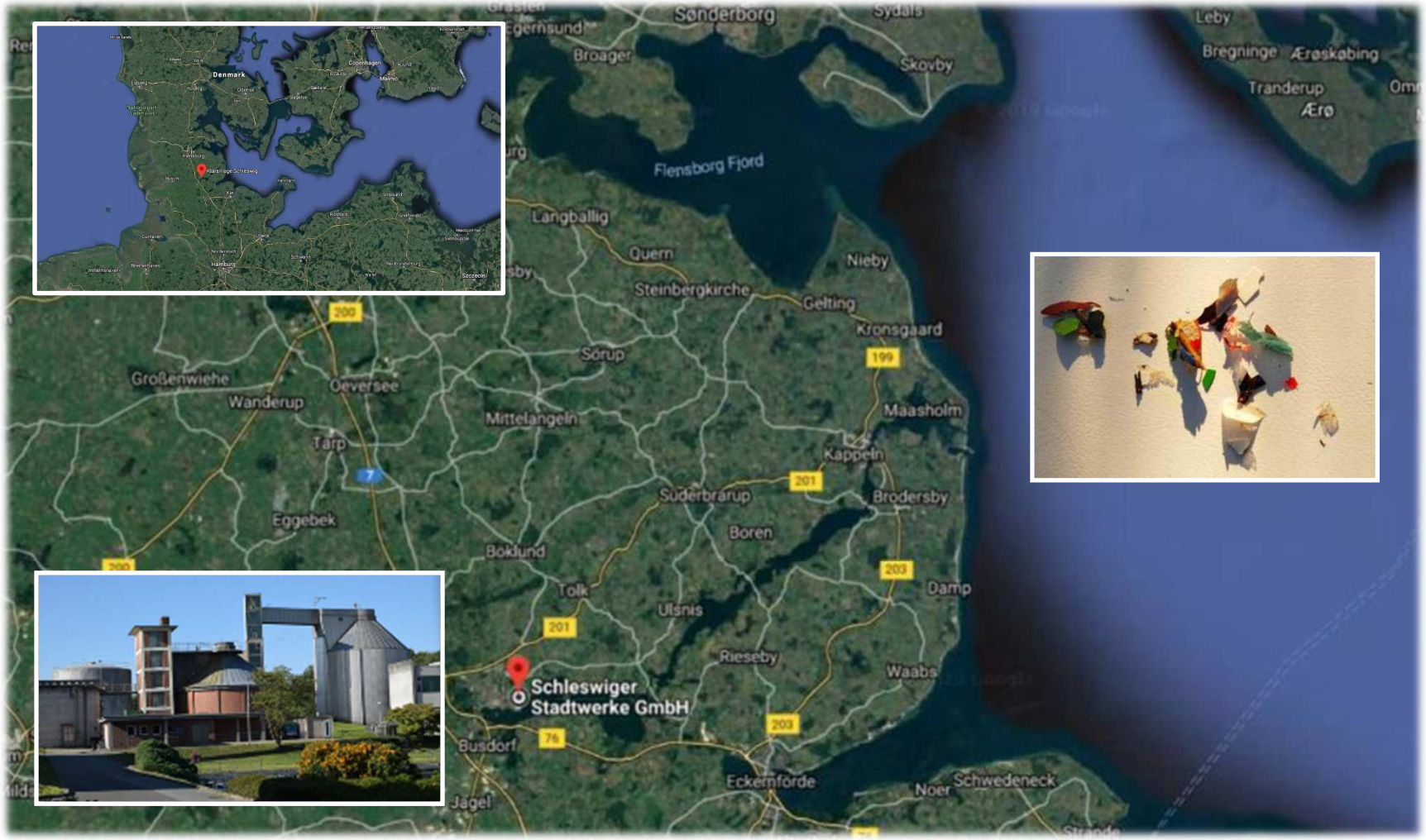
Courtesy of University of Innsbruck

Fine Debris in Filtrate and Effluent



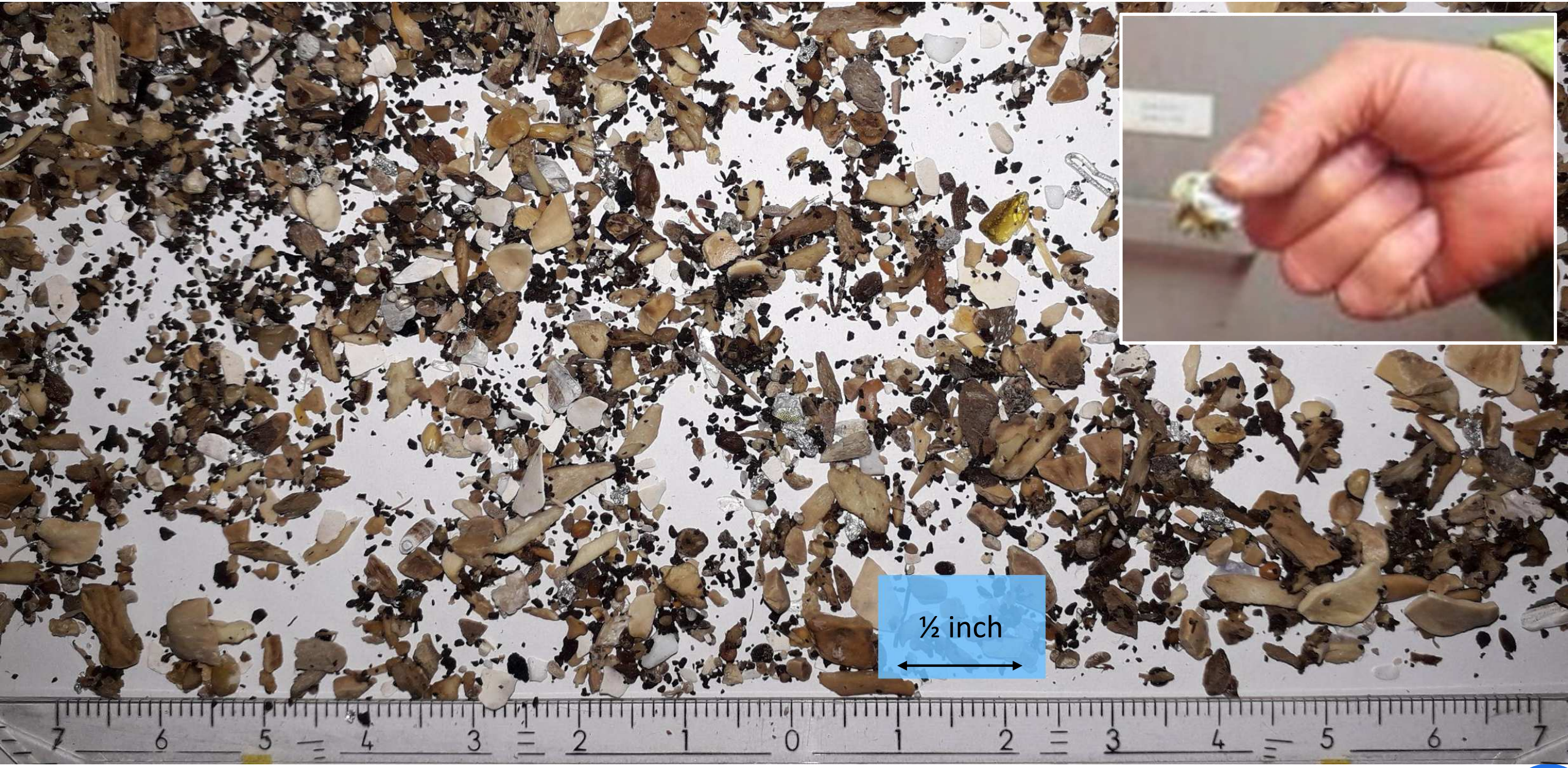
Sources: NDR and Google Map

Fine Debris in Filtrate and Effluent



Fine Debris on Filtrate Screen

Sources: NDR and Google Map



[Scale in Centimeter]

Photo Credit: University of Innsbruck in cooperation with MCI – The Entrepreneurial School®

Mechanical Pre-Treatment of Organics

Polishing Equipment

Hydrogritter (Hydrocyclone)

Grit Removal System (Hydrocyclone)

Grit Settling System

Photo Credit: BTA International and Kajima

Mechanical Pre-Treatment of Organics

Polishing Equipment

Longitudinal Grit Channel w/aeration plus grit washer

Dynamic Cyclone for light/fine debris removal

Photo Credit: Huber and Anaergia

Other Issues/Concerns

What about Microplastics?

Size-Based Classification

- Nanoplastics 1-100nm
- Sub-micro Plastics 100-1,000nm
- Small Microplastics 1-100µm
- Large Microplastics 100-5,000µm (0.1-5mm)
- Mesoplastics 5-25mm
- Macroplastics >2.5cm

Bioslurry Quality – Conclusions and Way Ahead

- Need for Bioslurry Standard for Physical Contamination
- Understand Performance of Pretreatment Equipment/System
  - Matching Feedstock with Pretreatment?
- Microplastics – What Role Do They Play?

Questions?

Photo Credit: University of Innsbruck in cooperation with MCI – The Entrepreneurial School®

Contact Us

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