# Dry stage anaerobic digestion of fine sieved solids from municipal wastewater


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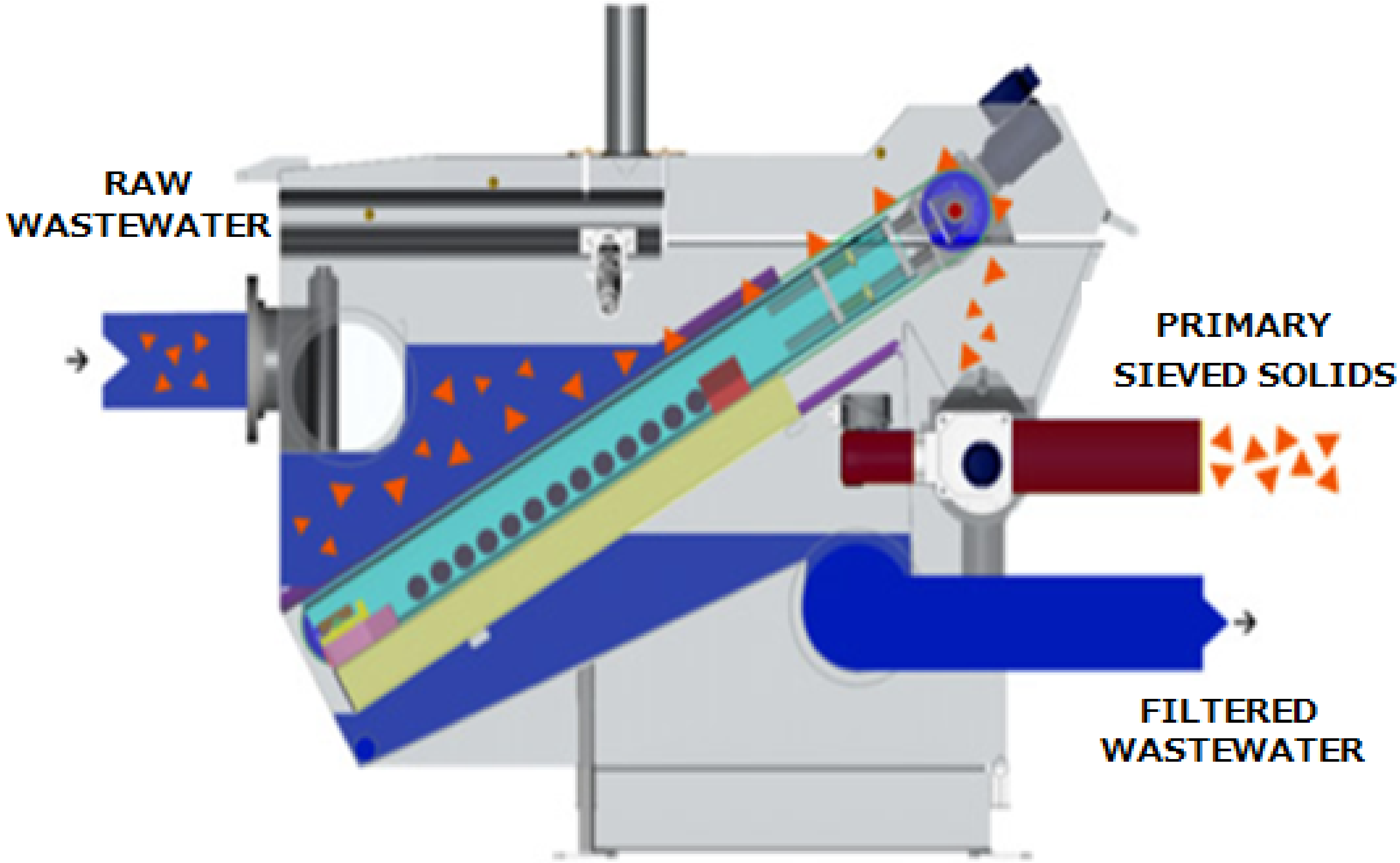
# Topics

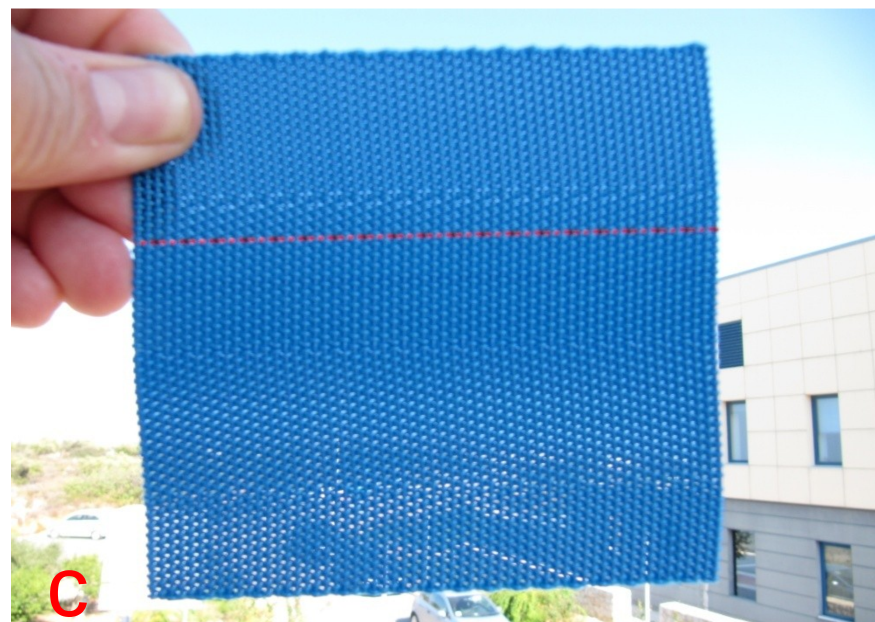
- The microsieving process
- Fine sieved solids characteristics
- Dry vs wet stage anaerobic digestion
- Experimental setup
- Experimental findings

# Microscreen - Operating principle



# Microscreen


a. Microscreen with open housing
b. Sludge removal (~45% TS)
c. Microscreen cloth (100-350µm openings)

# Microscreen (Patra, Greece)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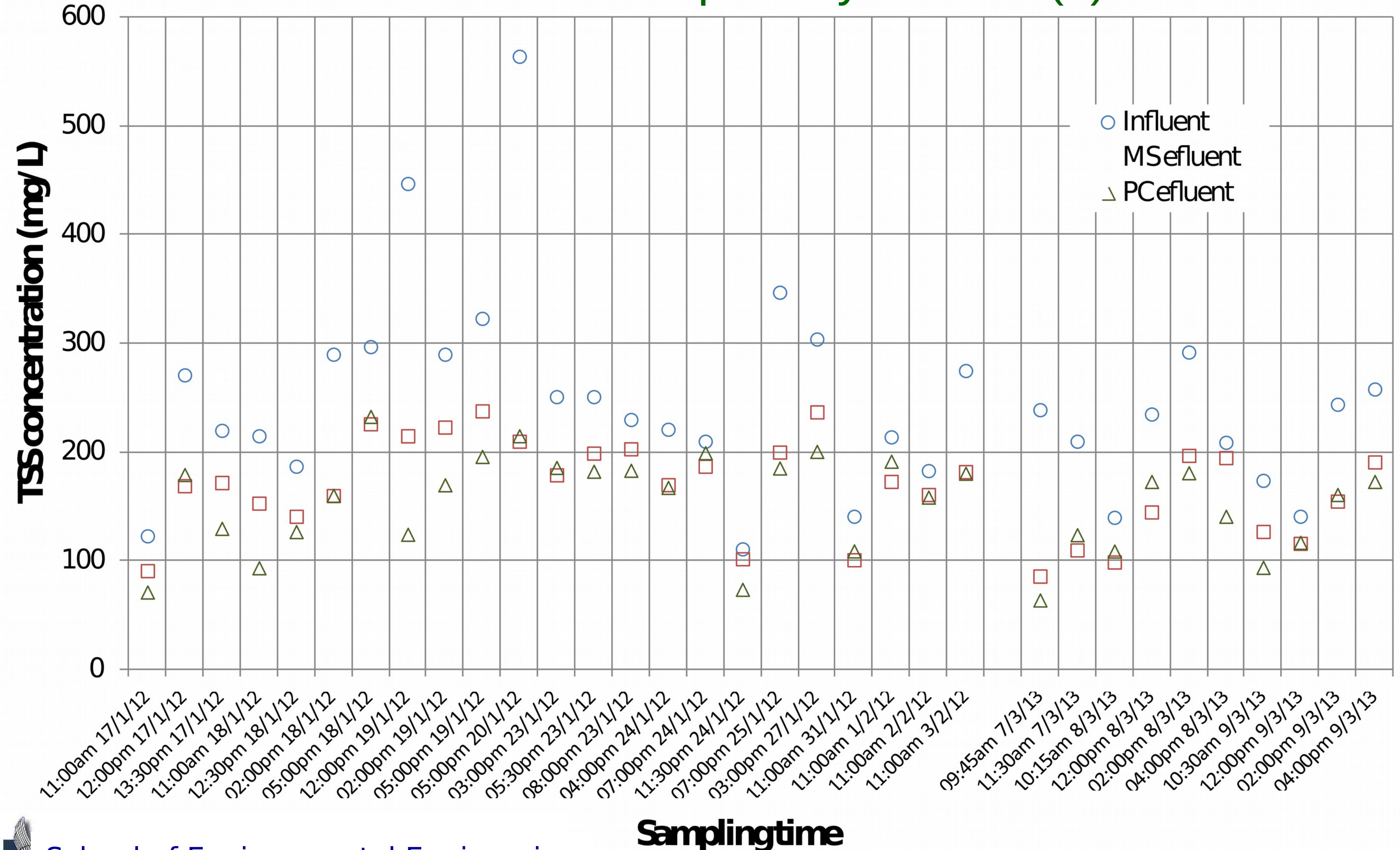
# Microsceen: Operation

Solids removal

Solids compaction

# Inlet TSS (○) and TSS at the outlet of microscreen (□) and at the outlet of primary clarifier (Δ)

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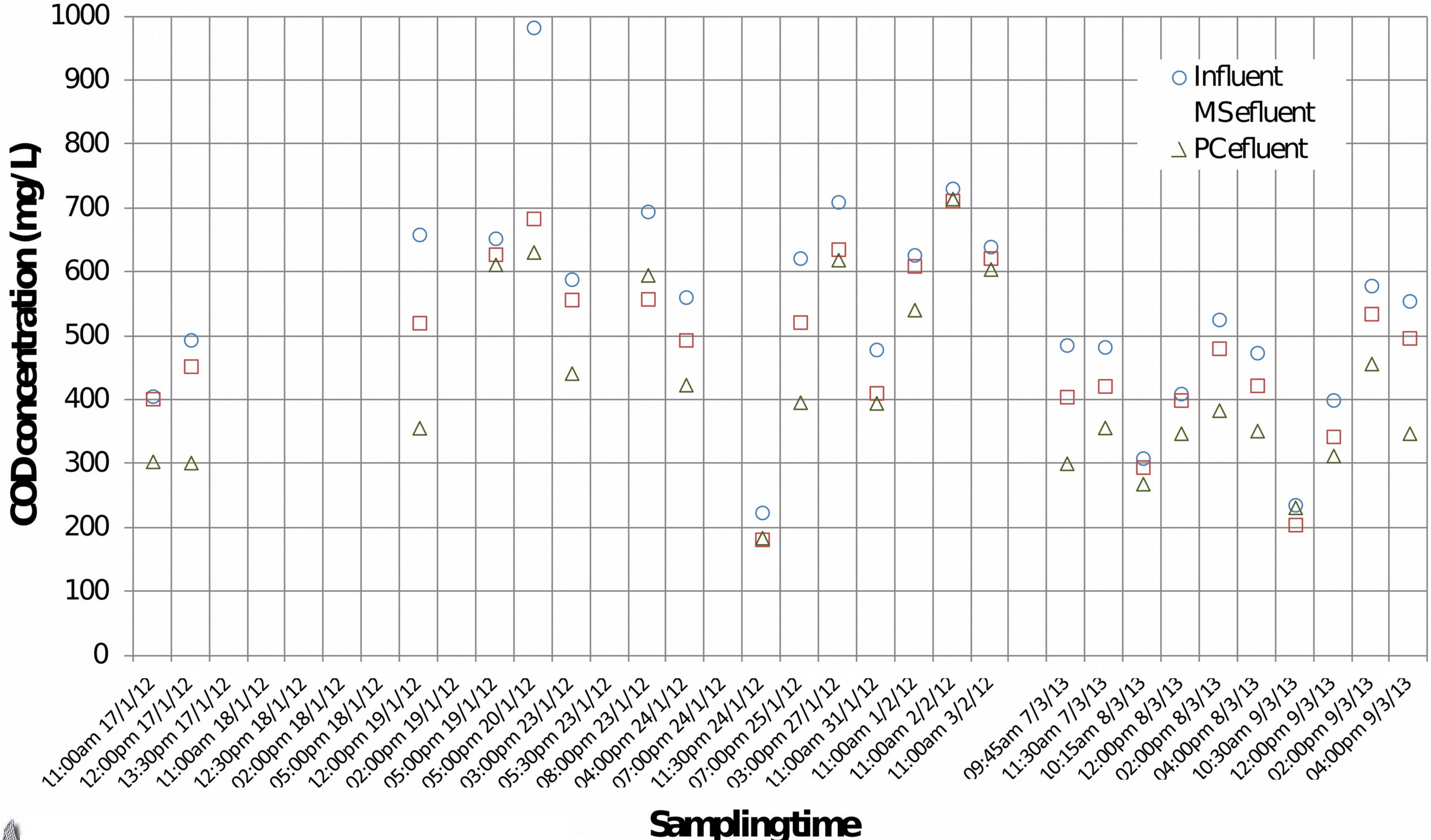
# Inlet COD (○) and COD at the outlet of microscreen (□) and at the outlet of primary clarifier (Δ)

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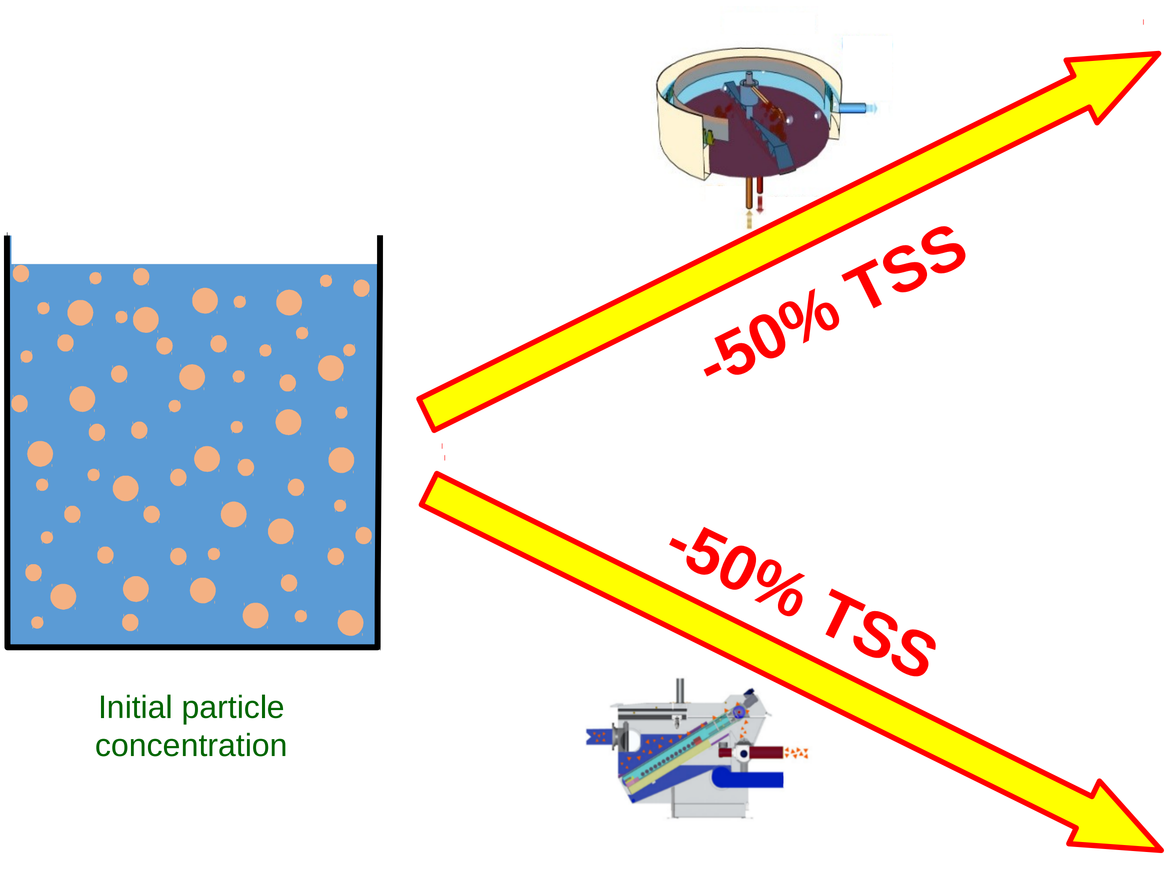
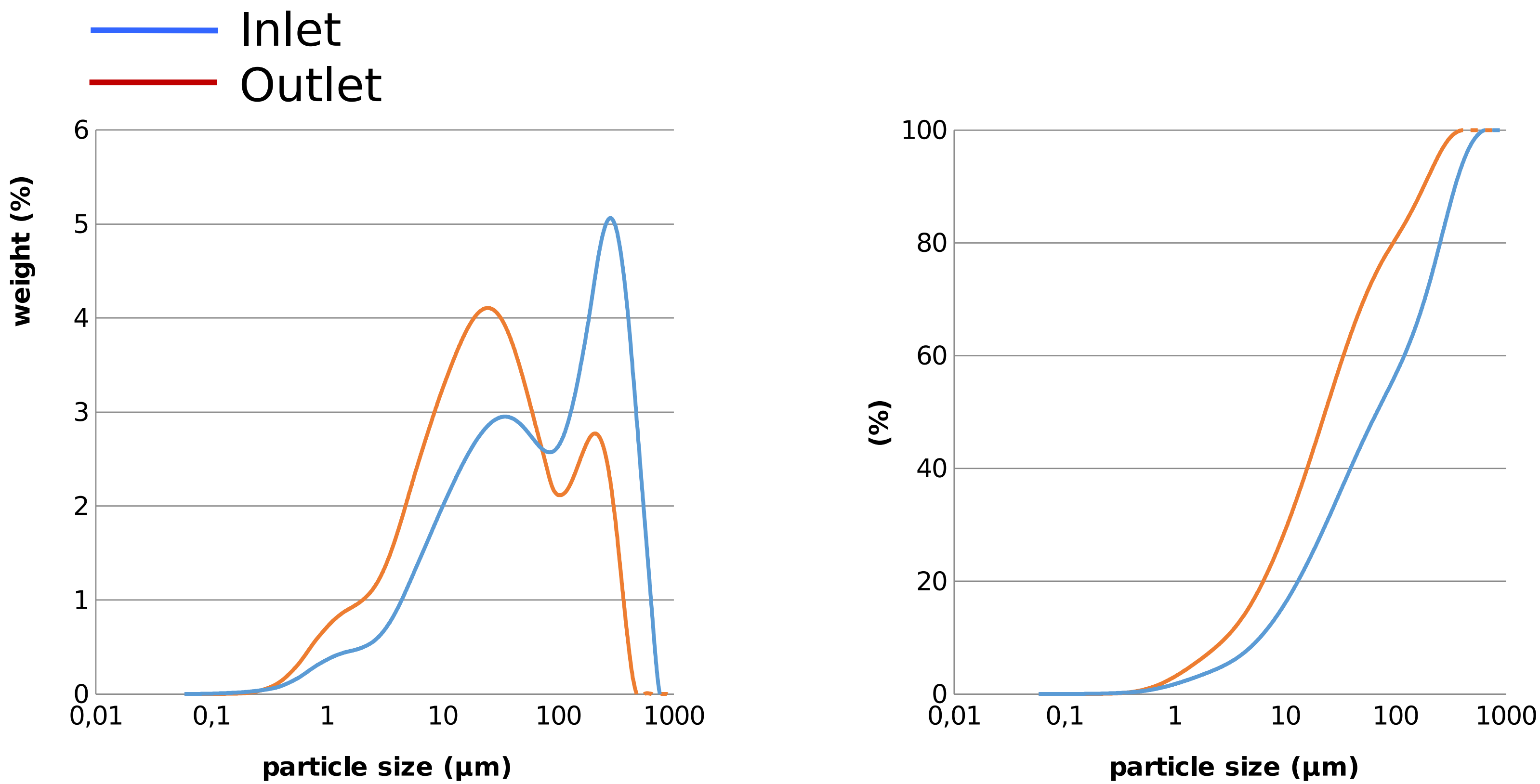
# Selected removal of large particles through microscreening



# Particle size distribution in municipal wastewater, prior and after microscrening

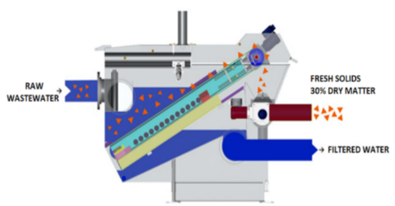


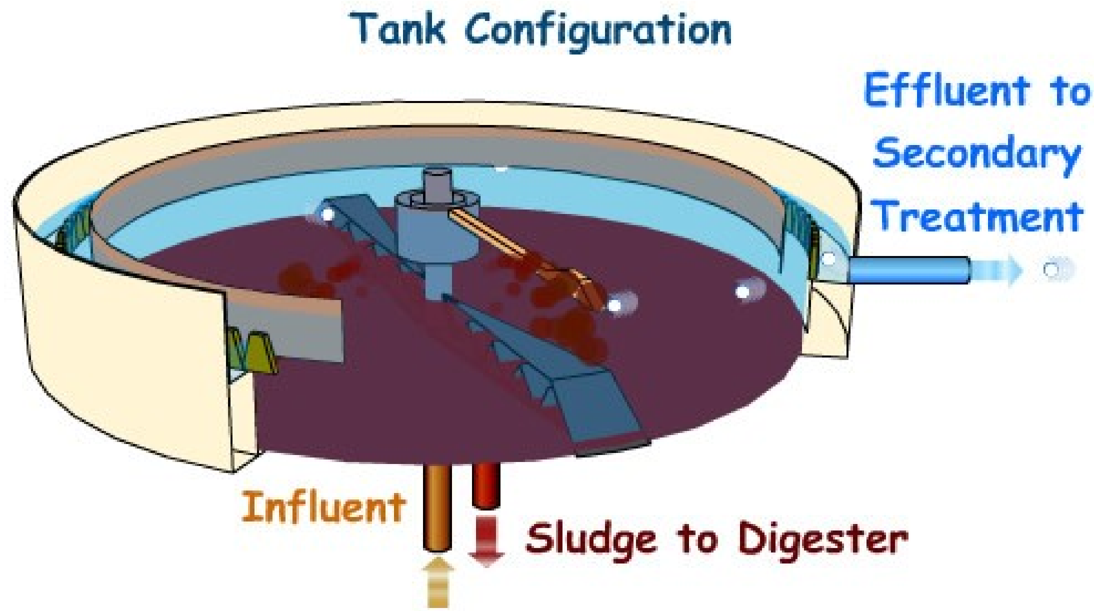

It is observed selective removal of the larger particles

Increase of wastewater biodegradability

# Footprint requirements

Wastewater flow: 4000m³/d:
Microscreen footprint: 4 m²
Clarifier footprint: 82 m²

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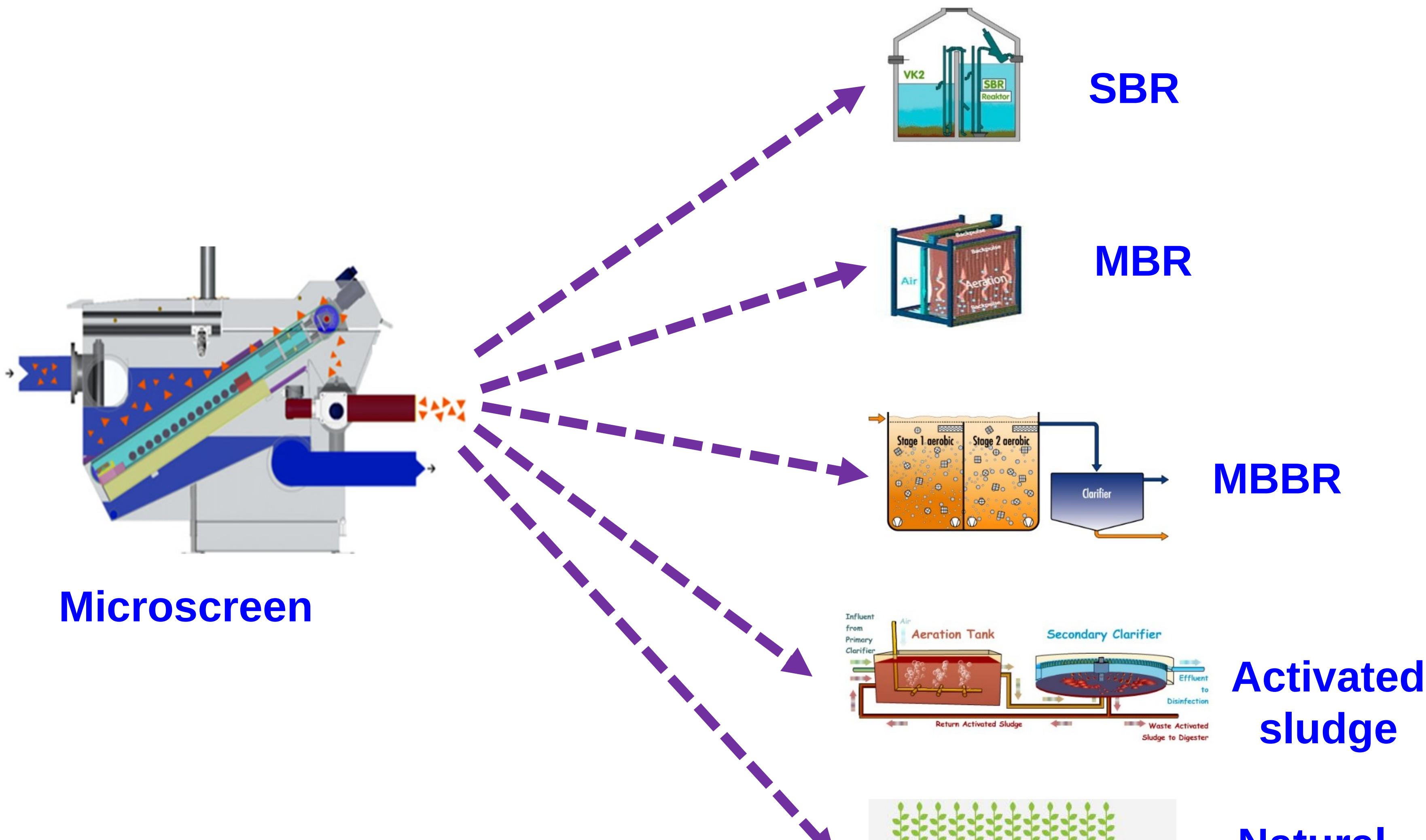
# Application of microscreening, upstream of various wastewater treatment processes



# Fine Sieved Solids (FSS) characteristics

- Managed as solids
- Total solids: 40-45%
- Volatile solids: 85-90%of TS
- C/N about: 20
- High Heating Value: 22-24MJ/kg

# Biosolids: Gasification versus anaerobic digestion*

Potential for net electrical energy production

Gasification — Anaerobic digestion

**2 : 1**

P. Gikas, 2014, Environmental Technology, 35(17), 2140-2146

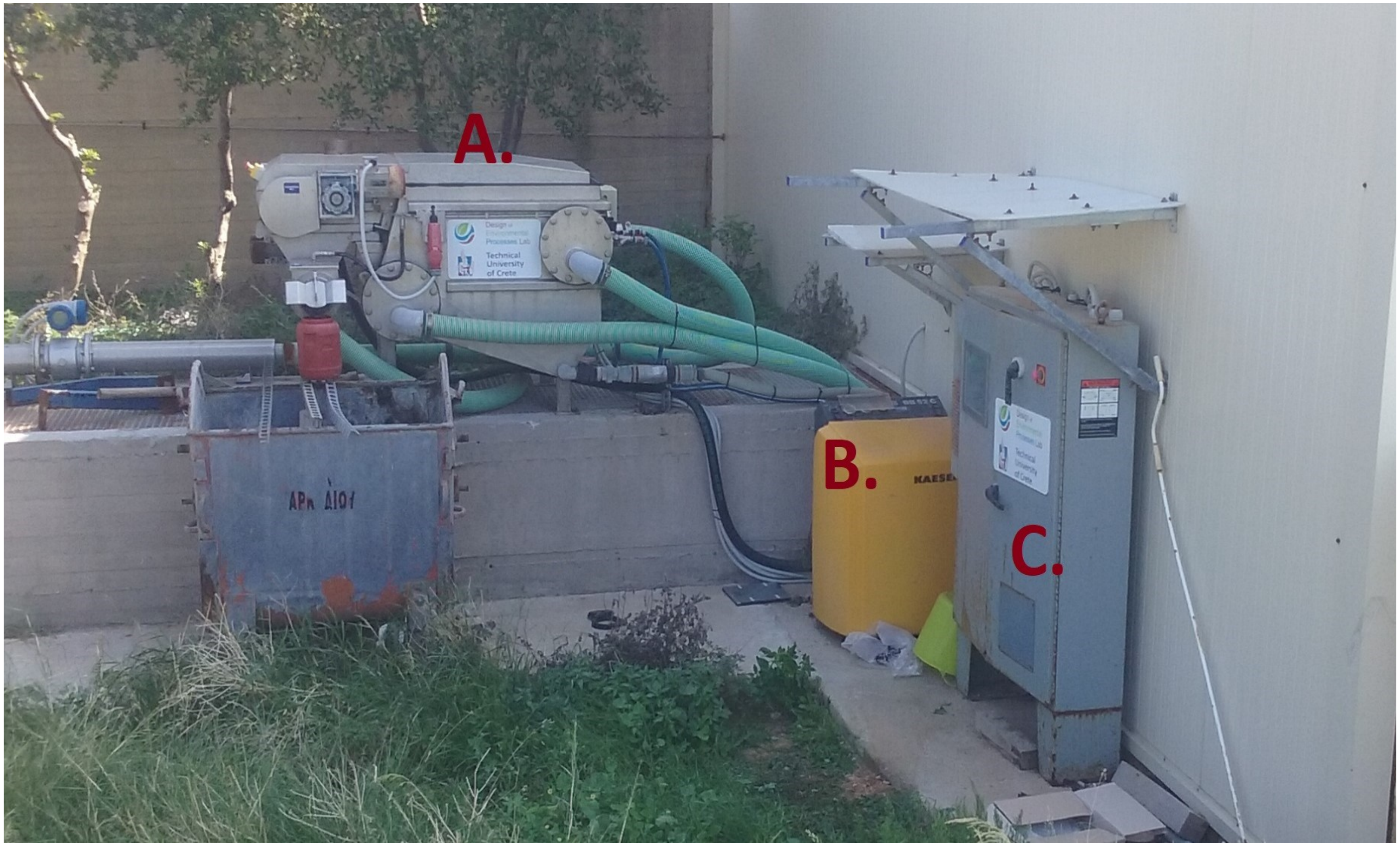
# Dry stage anaerobic digestion

## Advantages-Disadvantages (compared to wet stage)

- Requires smaller space compared to wet stage
- Tolerant to the presence of solid particles (e.g.: sand, fibers)
- Less complicated compared with wet stage
- Requires less maintenance
- Requires less electromechanical equipment (pumps, agitators, feeding equipment)
- Lower operational cost

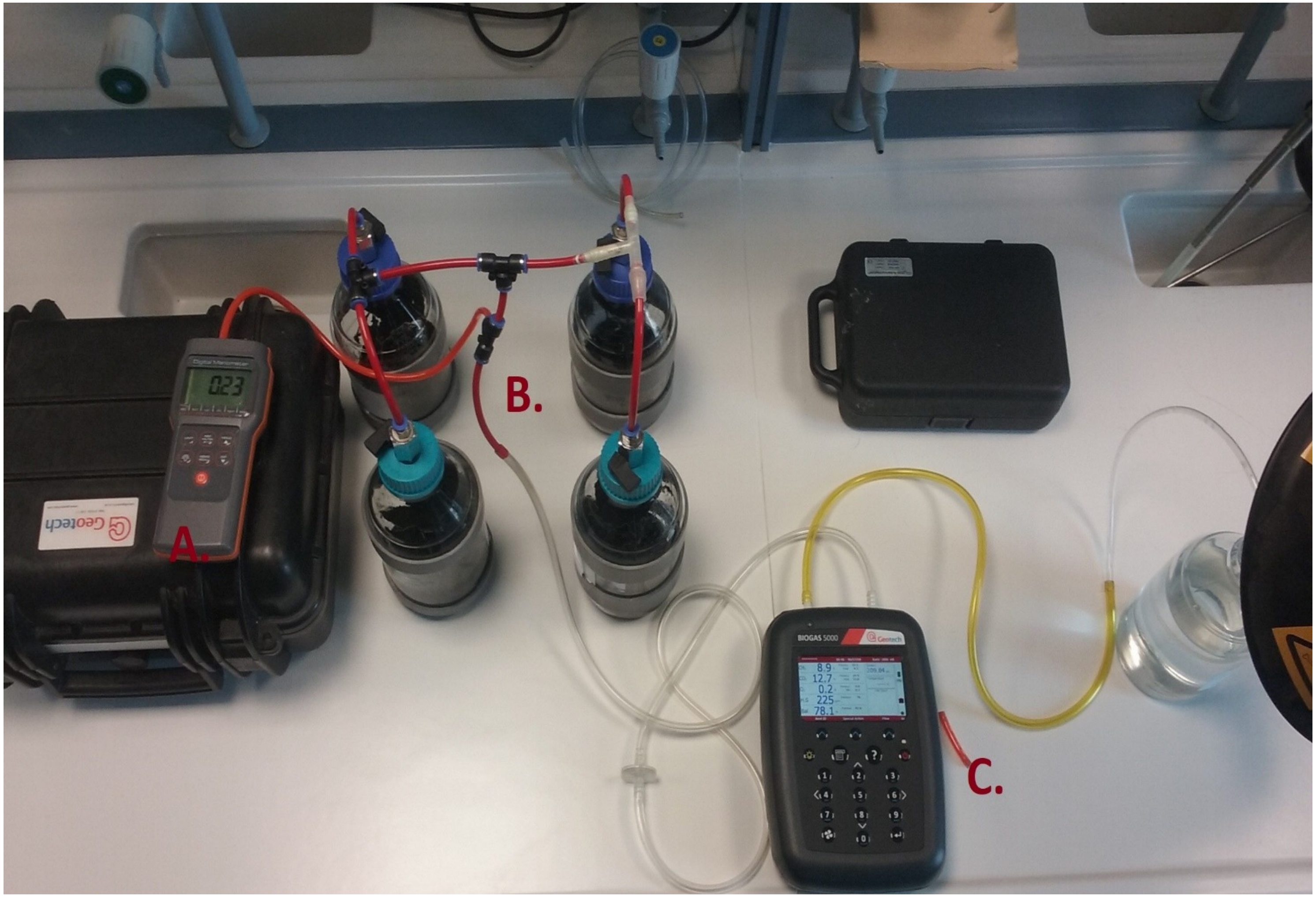
- A batch rather than a continuous process
- Requires advanced processes for loading-unloading
- Insufficient mixing
- Requires re-inoculation in every cycle
- Lower biogas yield
- Requires advanced design

# Experimental Set up




A. Microsieve (1000 $m^3$/d)
B. Blower (air knife for solids-screen separation, 5 bar)
C. Control Panel-PLC

# Experimental Set up




a) Digital manometer
b) Reaction bottles
c) Portable gas analyzer

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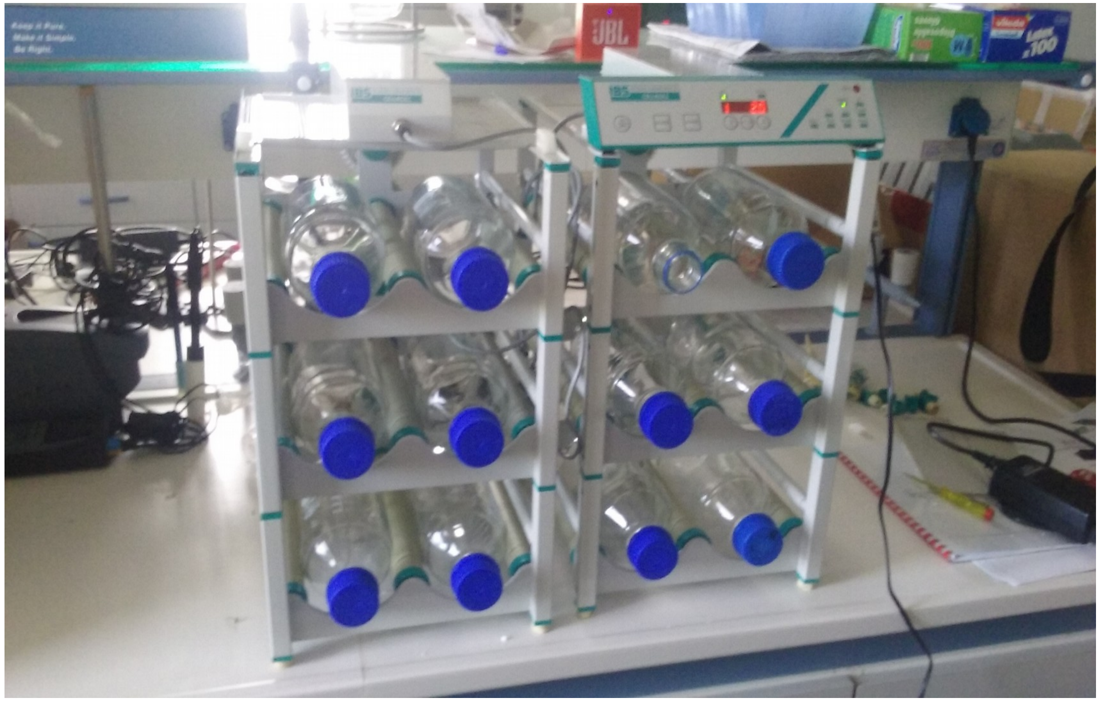
# Experimental Set up



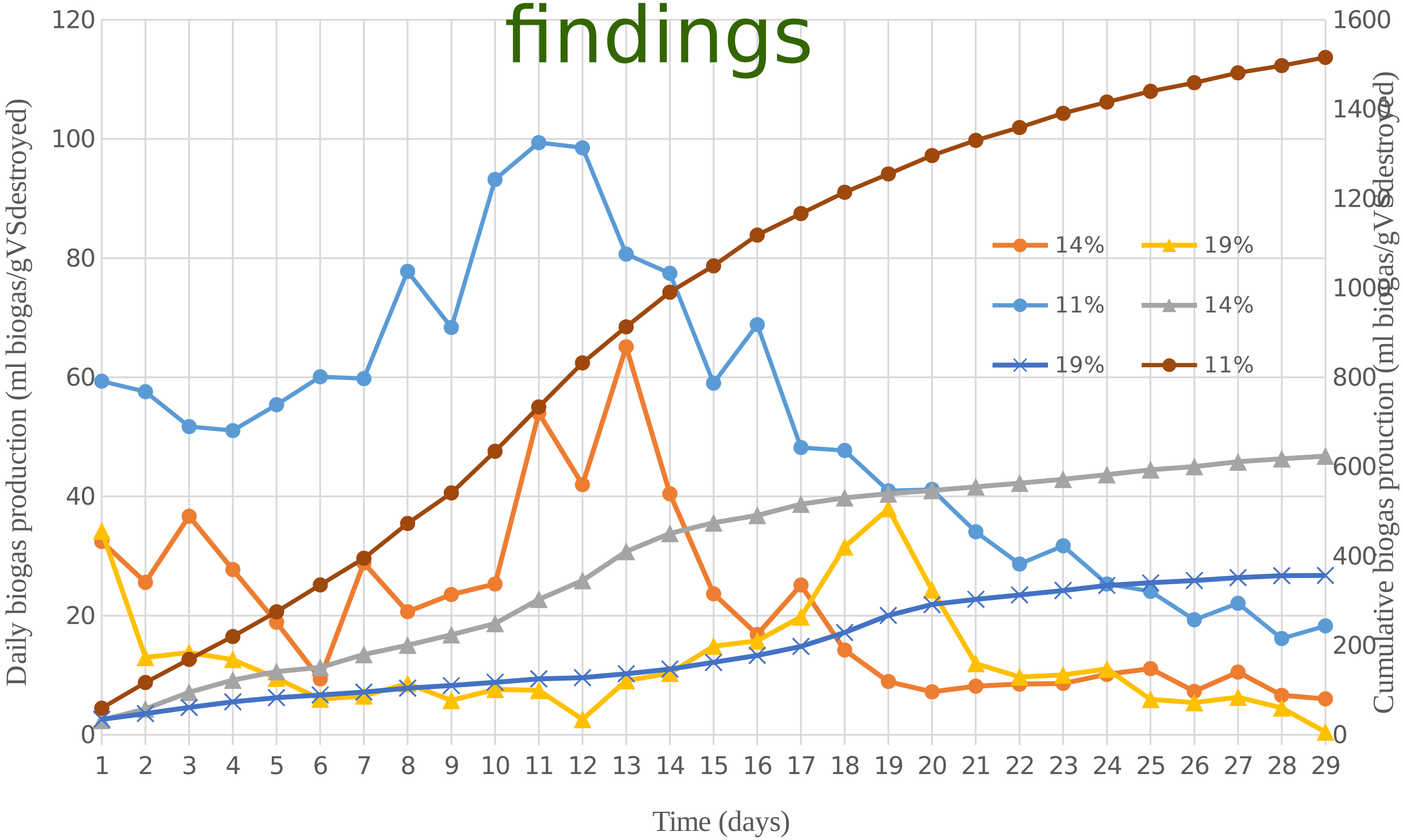

Mechanical stirring set-up

| Sample | Ratio Inoculum/sludge | TS(%) |
|---|---|---|
| 1 | 1 | 11% |
| 2 | 1/2 | 14% |
| 3 | 1/4 | 19% |
| 4 | 1/13 | 28% |

PSS sample:
From Rethymno, Greece, WWTP
Solids concentration: 40%
Volatile Solids: 89% (of TS)
C/N: 20

Inoculum:
From Chania, Greece, WWTP
Solids concentration: 40%
Volatile Solids: 89% (of TS)

# Experimental findings




- ✓ Optimum biogas production at 11% TS concentration
- ✓ The maximum daily biogas production (for 11%TS) achieved after 11 days
- ✓ At 19% TS concentration biogas yield was 30% of that produced by the 11% TS

# Conclusions

- Microsieving produces biosolids with high solids content (40-45%), high volatile content (85-90% of TS) and C/N of about 20
- Dry stage anaerobic digestion at 11% solids content exhibited the highest biogas production yield
- Maximum biogas production was achieved after 11 days from inoculation
- Agitation issues are to be resolved


# Thank you for your attention

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