WIHAH
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WATER INNOVATIONS FOR HEALTHY ARCTIC HOMES

ARCTIC TECHNOLOGY CENTRE DTU

Potentials and challenges of biogas from fish industry waste in the Arctic

Pernille Erland Jensen
Arctic Technology Center
Department of Civil Engineering
Technical University of Denmark.

Content

- Introduction
- Why make biogas in the Arctic?
- Why is it not done already?
- Biogas potential of fish residues and organic waste
- Perspective

Present challenges

Fish industry residuals

- Major part disposed off at sea
- Oxygen depletion at seafloor
- Methane emission

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General waste

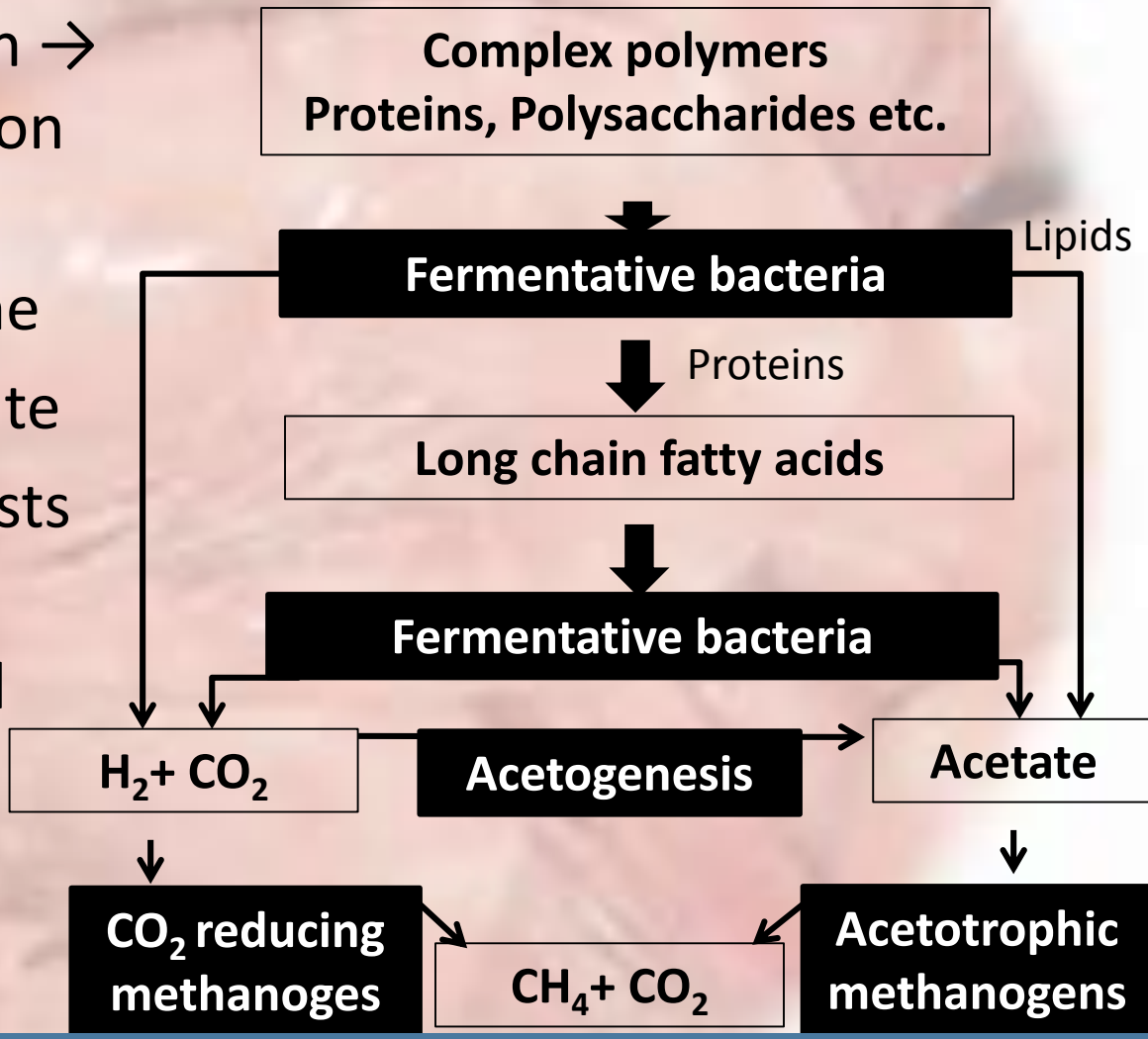
- Organic household waste
- Sludge from wastewater treatment
- Bag toilet and septic tank content

Can we make the anaerobic digestion happen under controlled conditions, collect biogas and utilize the energy?

Envisioned challenges

- Shrimp, crab: Protein → Ammonia → Inhibition
- Halibut: Lipids → Inhibition of methane
- Cold, changing climate
- Lack of local specialists
- Seasonal shift in loading material and rate

Simplified overview of anaerobic digestion process



Biogas plants

Can be very simple installation or highly industrialized optimized plant.

Biogas use

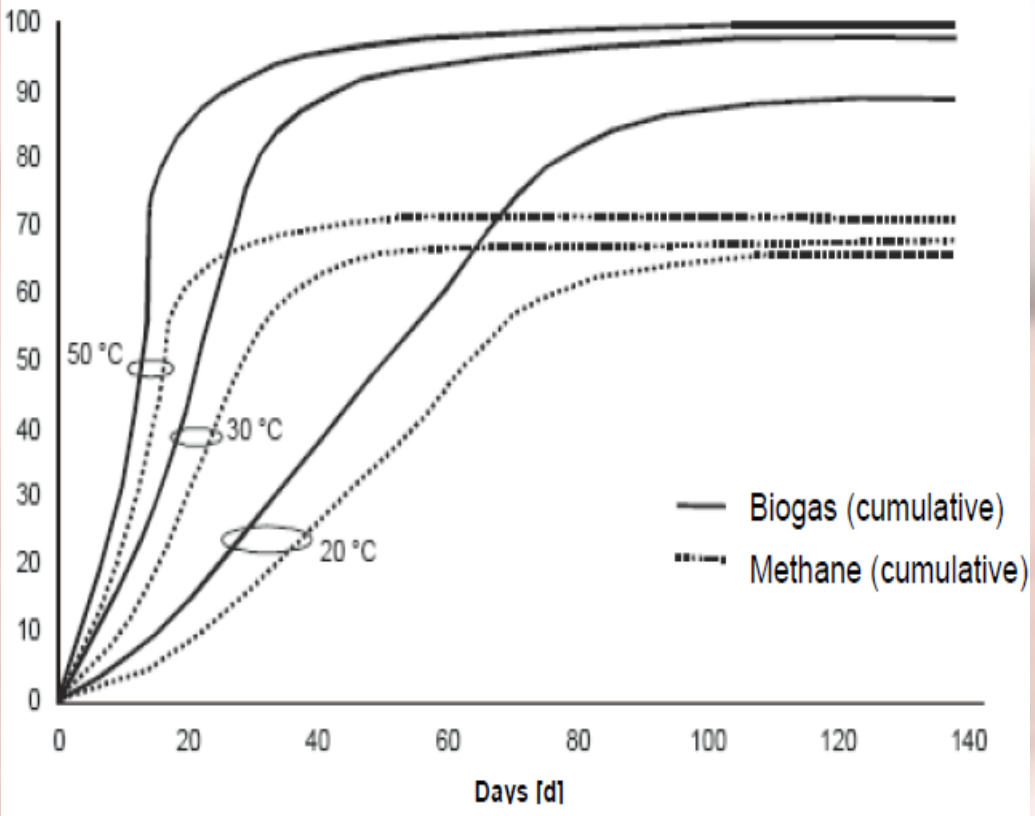
- Electricity – requires large scale plant + energy conversion
- Vehicles – biogas from vegetable products, requires upgrading of gas
- Heat or cooking – can be used directly

  - Simple technology for use of gas to e.g. heat water for boiling of shrimps or heating of buildings

Temperature

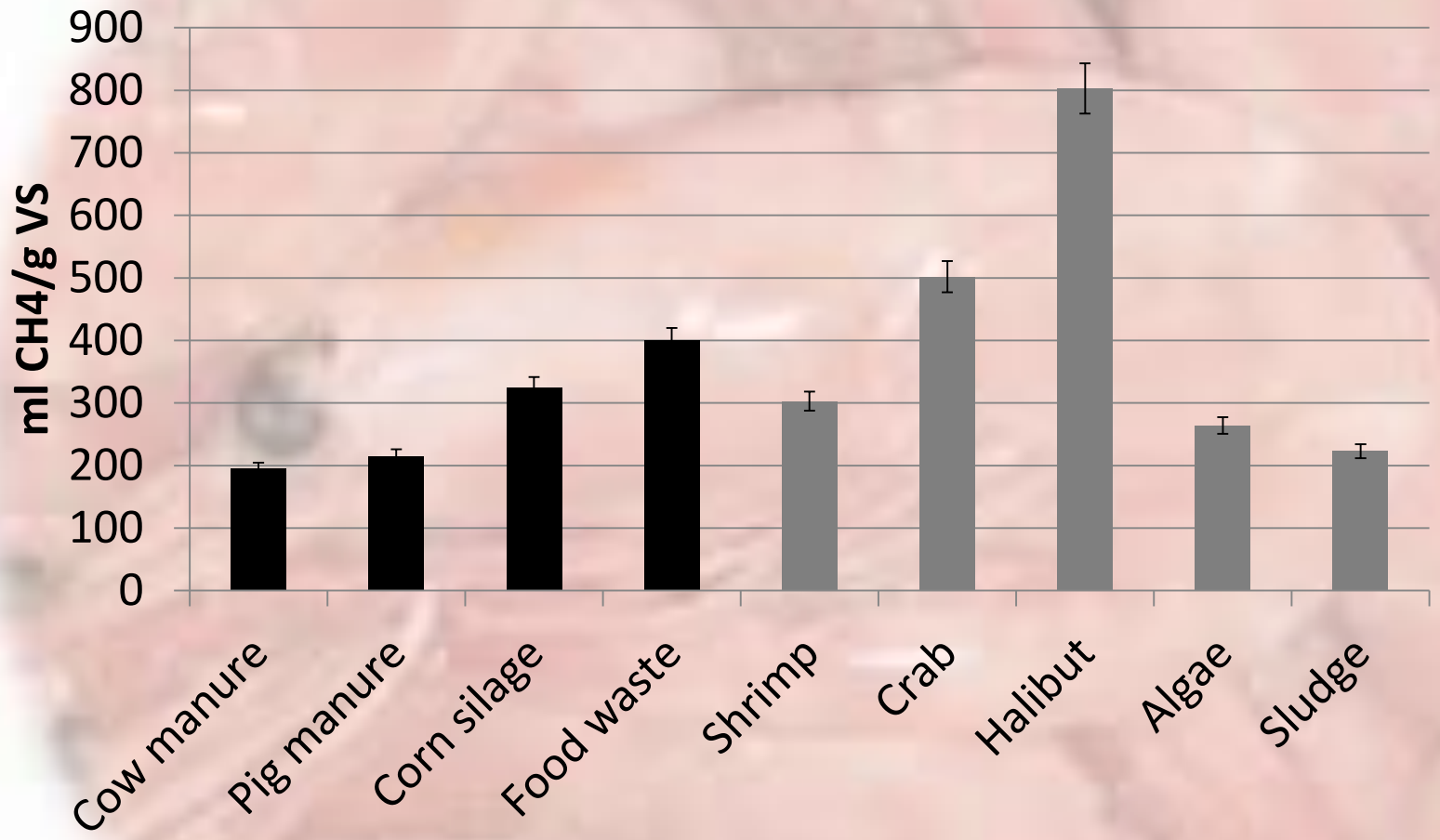
Low temperatures
Slower – higher retention time – larger tank

Lower risk of inhibition and instability at mesophilic conditions



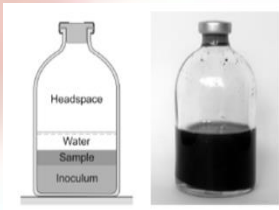
Thermal stage	Process temperatures	Retention time
Psychrophilic	< 20ºC	70 – 80 days
Mesophilic	30 – 42 ºC	30 – 40 days
Thermophilic	43 – 55 ºC	15 – 20 days

Methane potential

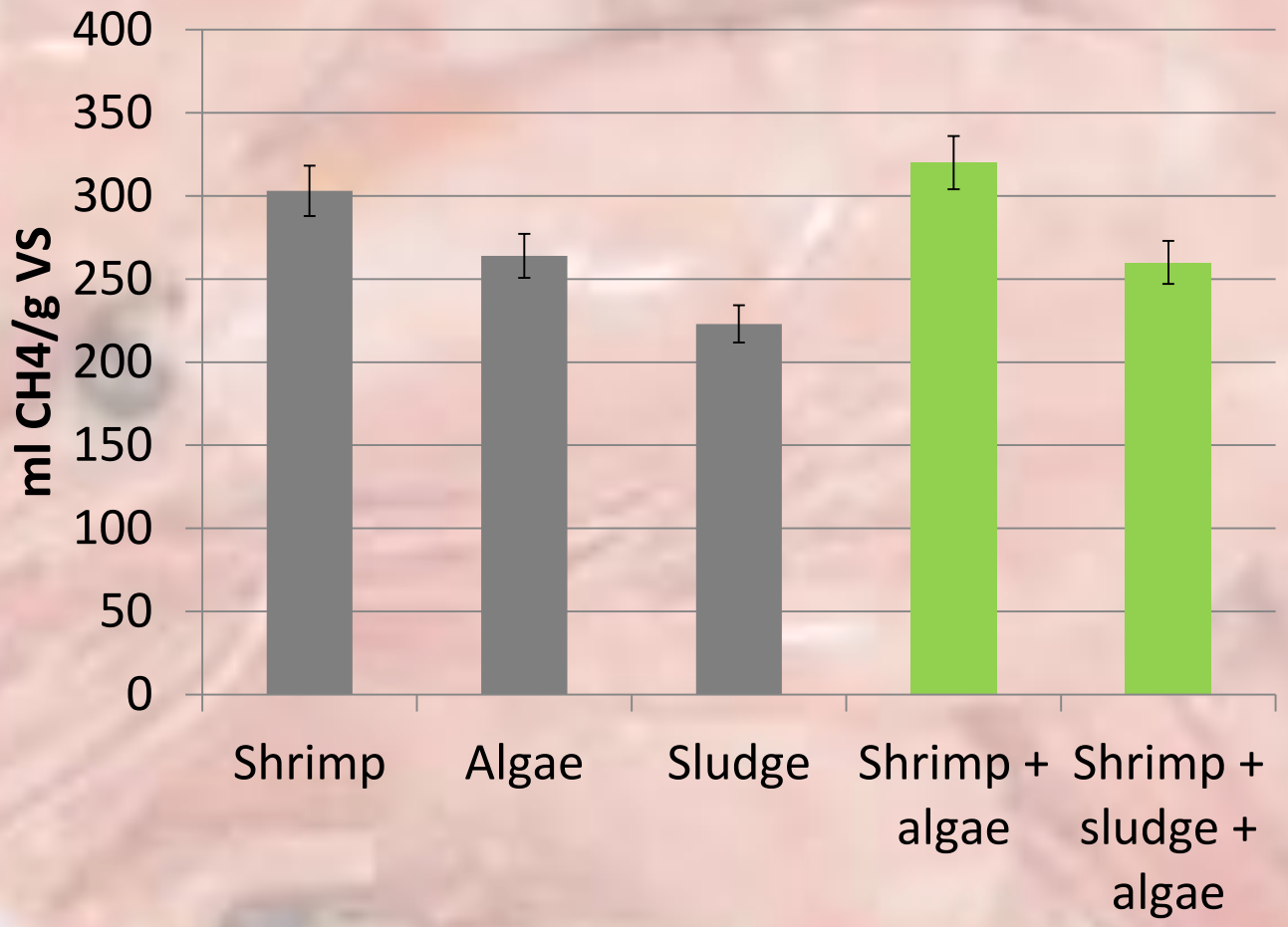


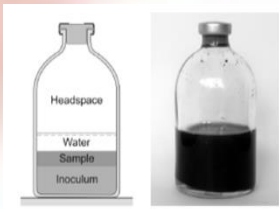
Literature values, thermophilic

Our measurements, mesophilic



Methane potential





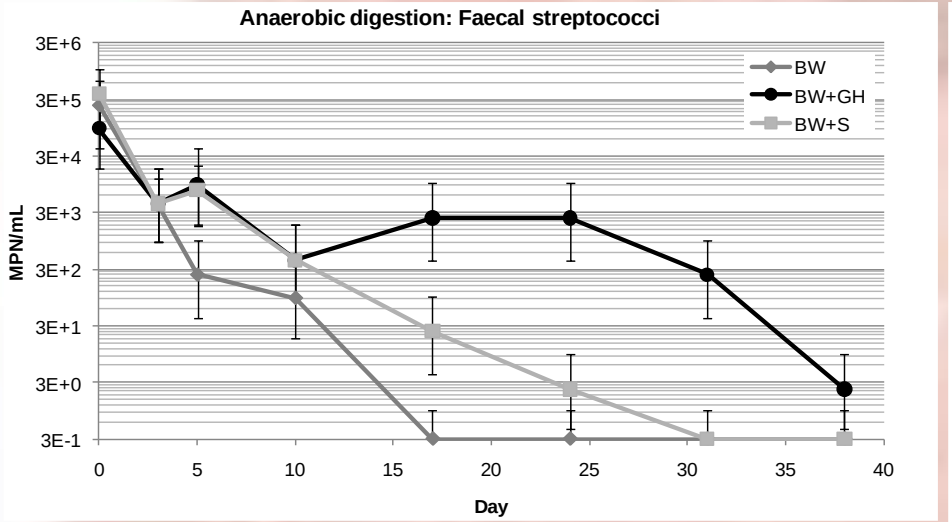
Potential

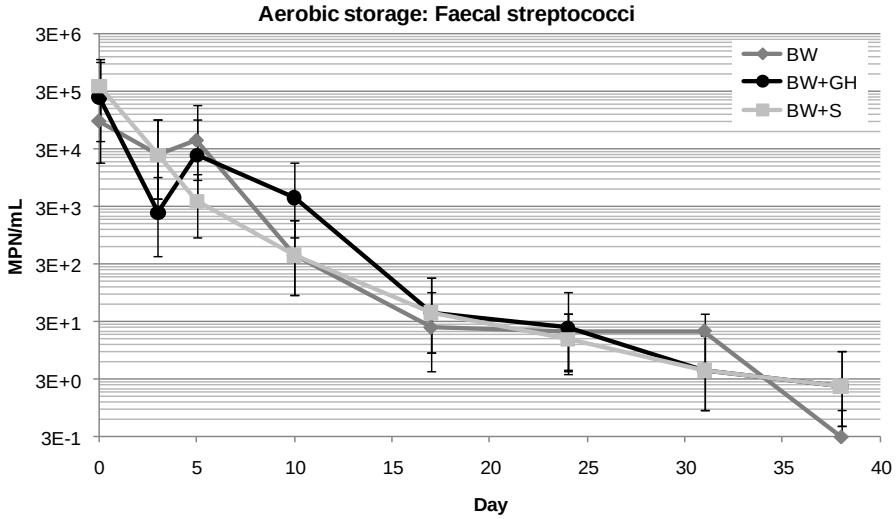
In Sisimiut

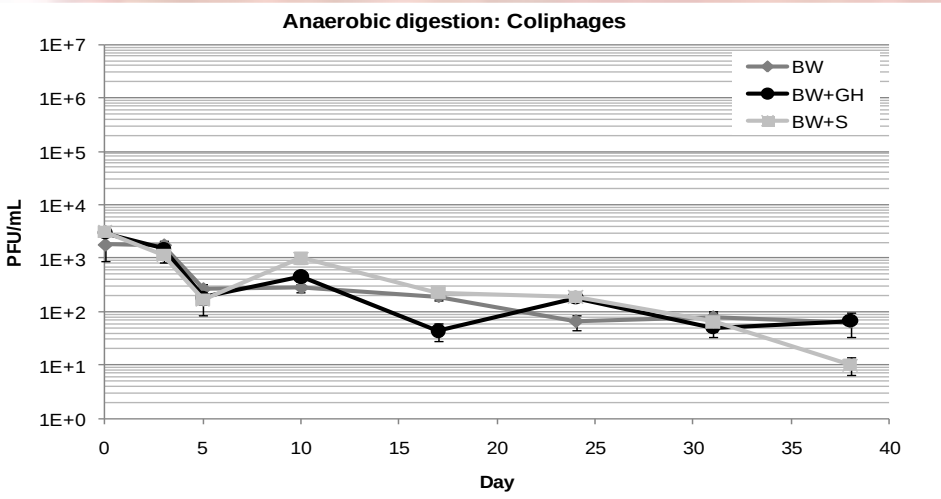
> 80% of energy used for heating at shrimp processing plant

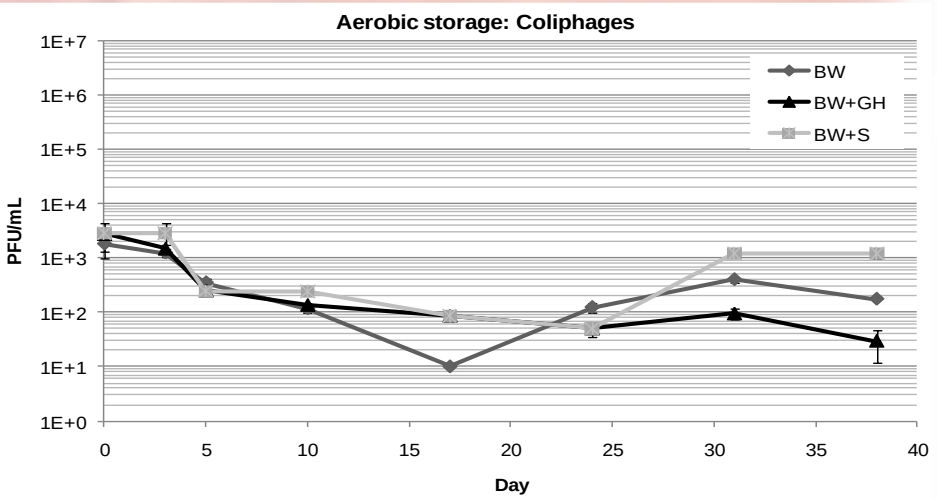
Hygienization of blackwater

Anaerobic Mesophilic incubation Aerobic









Gunnarsdóttir, R.; Heiske, S.; Jensen, P.E.; Schmidt, J.E.; Villumsen, A; Jenssen, P.D. Effect of anaerobiosis on indigenous microorganisms in blackwater with fish offal as co-substrate, *Water Research*, 63, 1-9, 2014.

Other options

- Shrimp flour
  - Local experience
  - Low price
  - Only shrimp residuals
- Bio oil
  - Only halibut
- Chitin
  - Advanced processing
- Food for fish farming?
- Food for dogs?

Conclusions and outlook

- Fish and seafood by-product do have significant biogas potential.
- Risk of instability of process due to high lipid and protein content, change in temperature, seasonal variations in loading, lacking of local experts.
- Mesophilic conditions may help stabilize process + reduce need of heating/insulation.
- Mixing with organic food waste, sludge and/or algae may help stabilize process + solve mutual waste challenges – needs to be investigated.
- Knowledge exists for operation, but innovation is needed prior to successful implementation.

Questions