



THE NORTHERNMOST UNIVERSITY  
of Technology in Scandinavia

# Density based separation of heterogeneous CDW-mixtures

Erik Marklund

Luleå University of Technology

2016-11-17



LULEÅ  
UNIVERSITY  
OF TECHNOLOGY



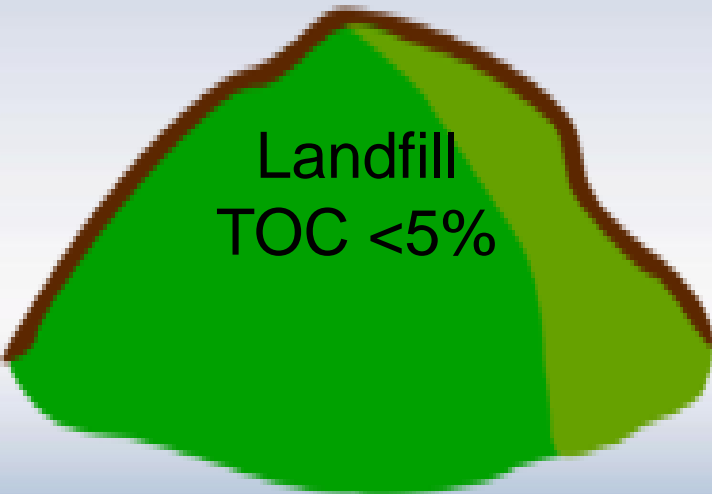
# Luleå University of Technology

- Distances
- Open spaces
- Forests

[Map of Sweden and Luleå.  
Removed due to copyright  
issues]

## Project intro

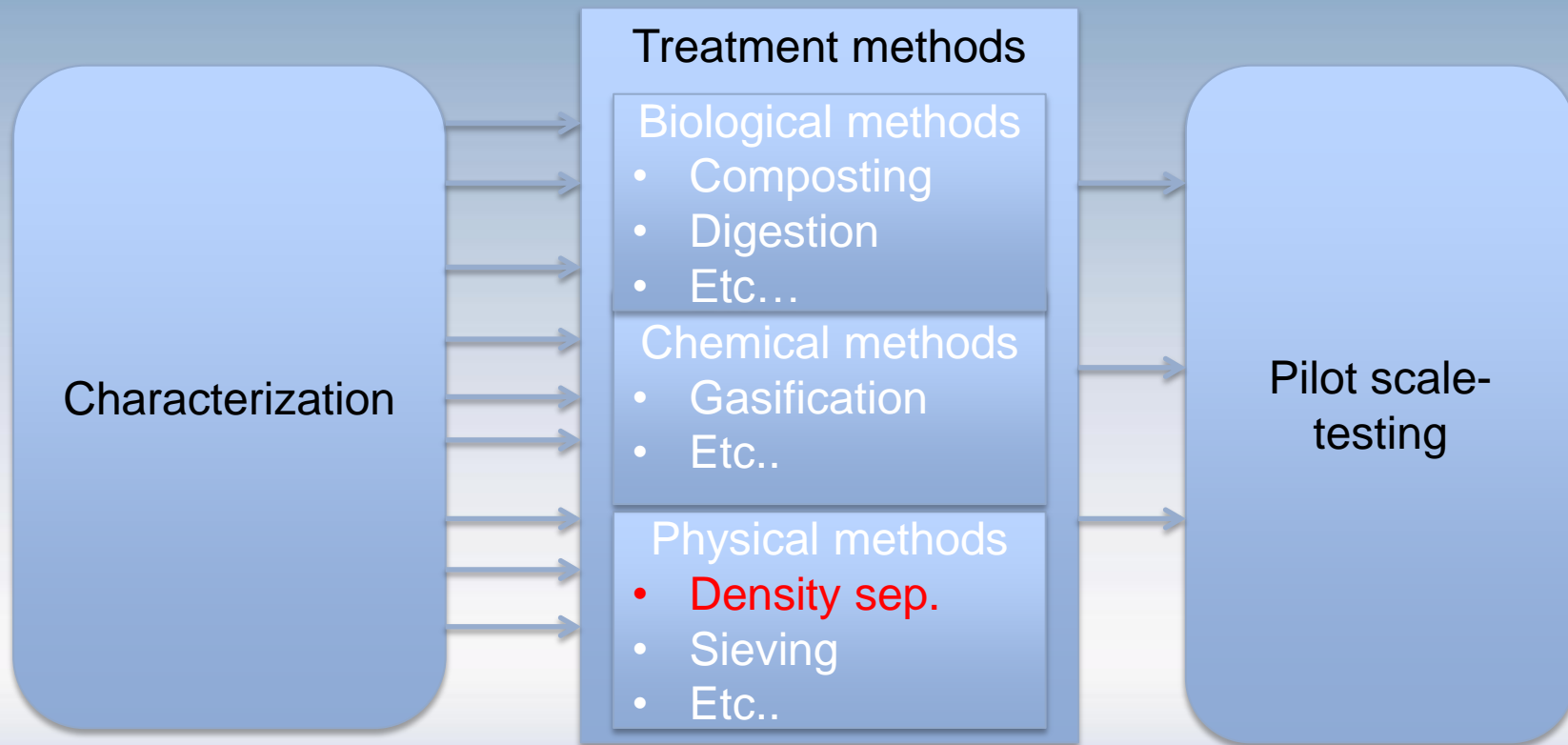
- A research collaboration between Luleå University of Technology (LTU) and a Swedish recycling company
- TOOLF – "Too Lean to Burn. too Fat to dump"



$5\% < \text{TOC} < \sim 30\%$   
?



# “Treatment oriented characterization”



- Increase recycling
- Decrease environmental impact







- 
- Currently crushed
  - RDF
  - Landfill exemption permit
  - 40000 tons/year



# Would it be possible to reduce the organic content by separation by density?

- Experimental setup
  - 80 liters of water
  - 20 kg's of waste
  - $>63\mu\text{m}$  separation
  - Using denser liquids

# Does sink/float separate any material?

Untreated waste



100%

Sink/float  
separation

8-14%

Float fraction



86-92%



Sink fraction

- ~90% of the mass is in the sink fraction



# Does sink/float reduce TOC?

9-17% TOC



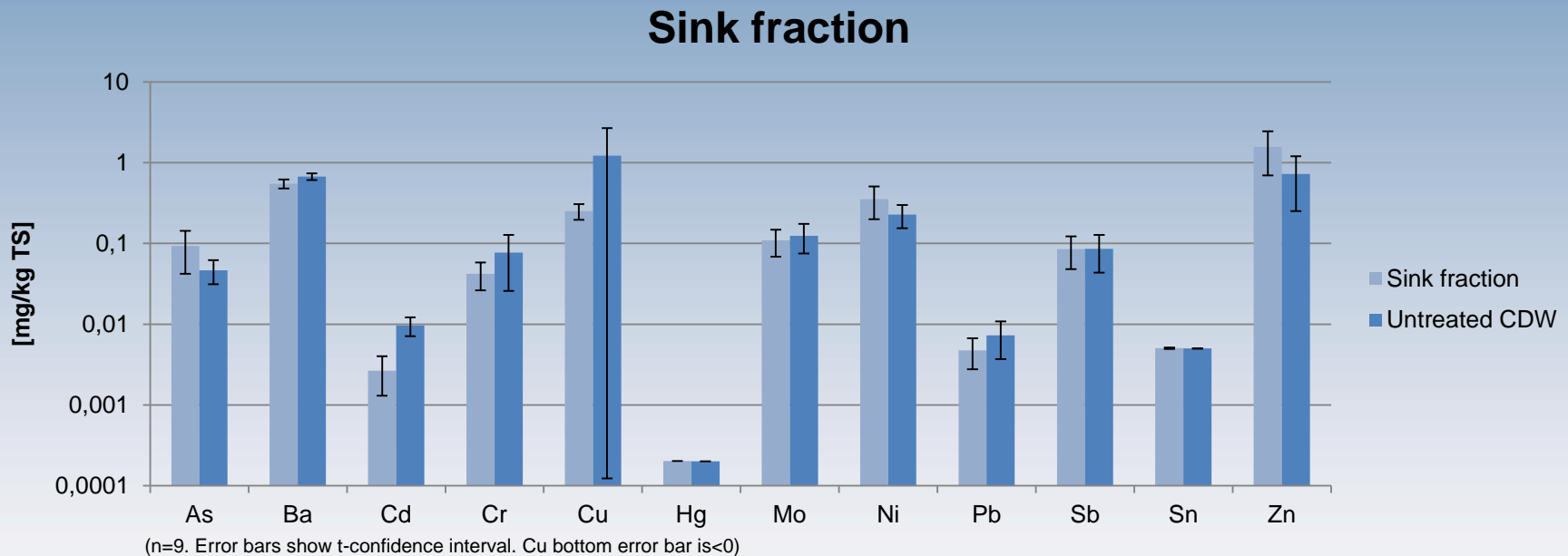
39-47% TOC



4-7% TOC

- ~40% of TOC is separated using sink/float

# How does sink/float affect leaching?



- L/S 10 one step standardized leaching test
- Significant changes for Ba, Cd
- Low levels of leaching



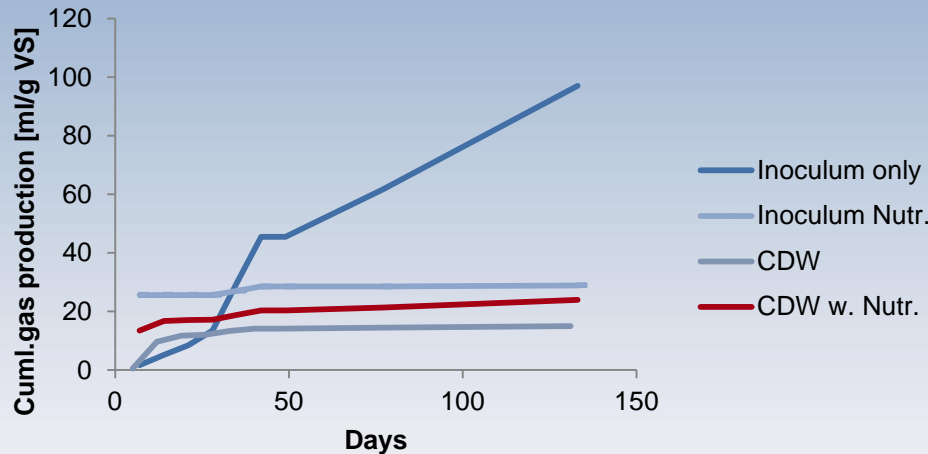
# Would the float fraction be suitable as a fuel?



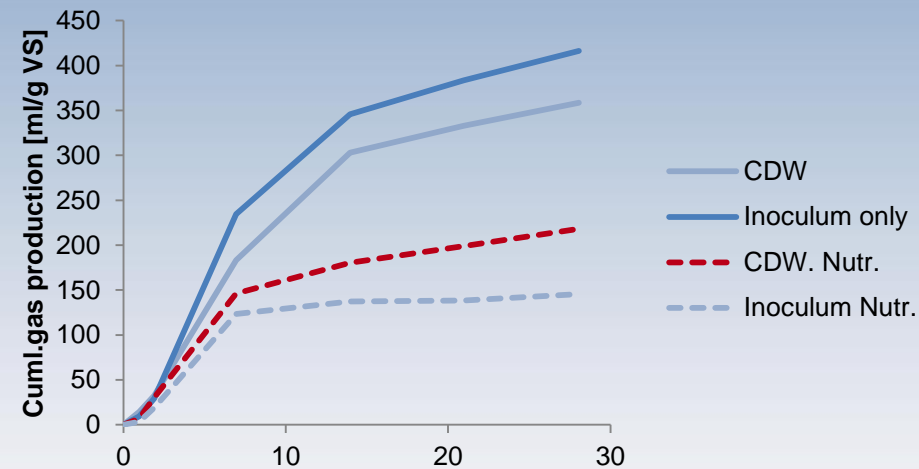
- Average calorific value: 14 MJ/kg TS
- Average LOI<sub>550</sub> 69% -> 31% Ash
- More suitable for MSW incinerators rather than biomass incinerators

# Is the sink fraction biologically active?

**Inoculum/Waste 1:3**



**Inoculum/Waste 3:1**



- Avg. respiration activity AT4: 0.43 mg O<sub>2</sub>/g TS
- Sink fraction has low biological activity



# Is the sink fraction suitable as a construction material?

Element	Total content [mg/kg TS]	Swedish EPA limits* [mg/kg TS]
As	18**	10
Pb	51 ± 9	20
Cd	<15	0.2
Cu	42 ± 3	40
Cr	86 ± 9	40
Hg	<15	0.1
Ni	76 ± 2	35
Zn	345 ± 54	120

(n=18)

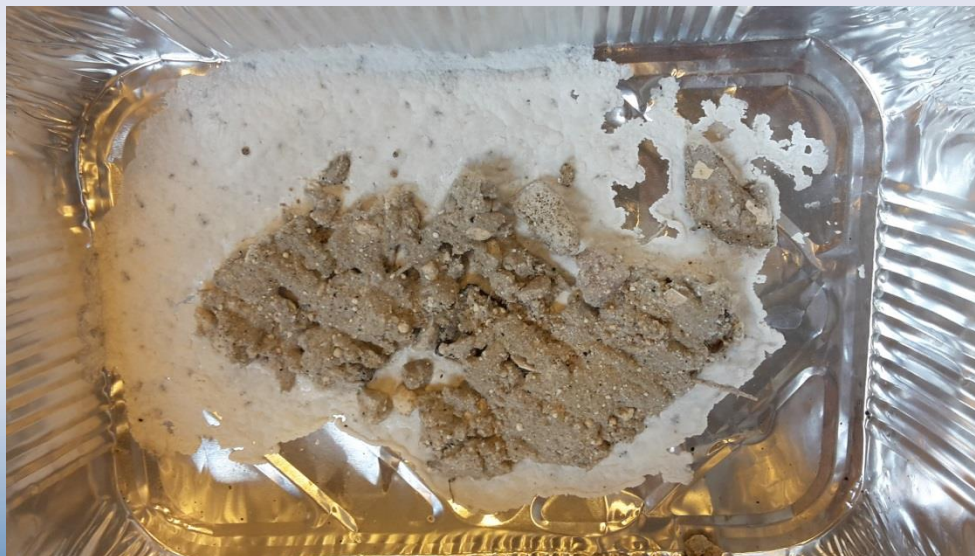
- Sink fraction is not suitable for construction as it is

\*Swedish Environmental Protection Agency. Recycling of Waste in Construction. Handbook 2010:1

\*\*17/18 measurements below LOD

## How about using a denser liquid?

- 300g NaCl per liter of water
- ~50% more material is separated
- ~33% decrease in  $LOI_{550}$  of sink fraction
- ~100% increase of ash content of float fraction





## Conclusion

- Sink/float separation is a simple method for separating mixed construction waste into fractions suitable for class 2 landfilling and waste incineration.
  - Sink/float separation suitable for separating TOC
  - Sink fraction contains high amount of heavy metals, yet leaches only little
  - Sink fraction has low biological activity
  - Float fraction suitable as waste fuel



THE NORTHERNMOST UNIVERSITY  
of Technology in Scandinavia

Thank you for listening  
Any questions?



LULEÅ  
UNIVERSITY  
OF TECHNOLOGY

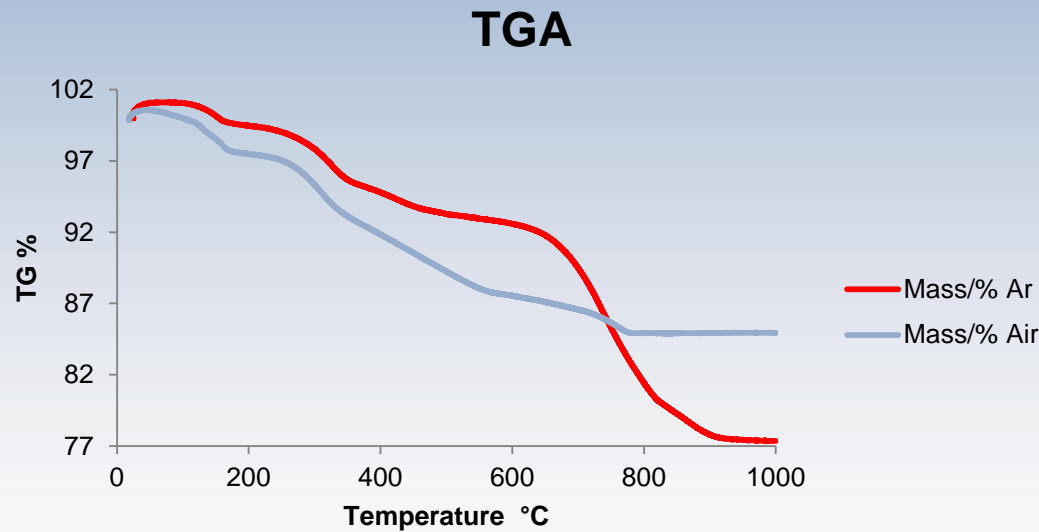




THE NORTHERNMOST UNIVERSITY  
of Technology in Scandinavia

# Appendix

# Thermogravimetric analysis of sink fraction



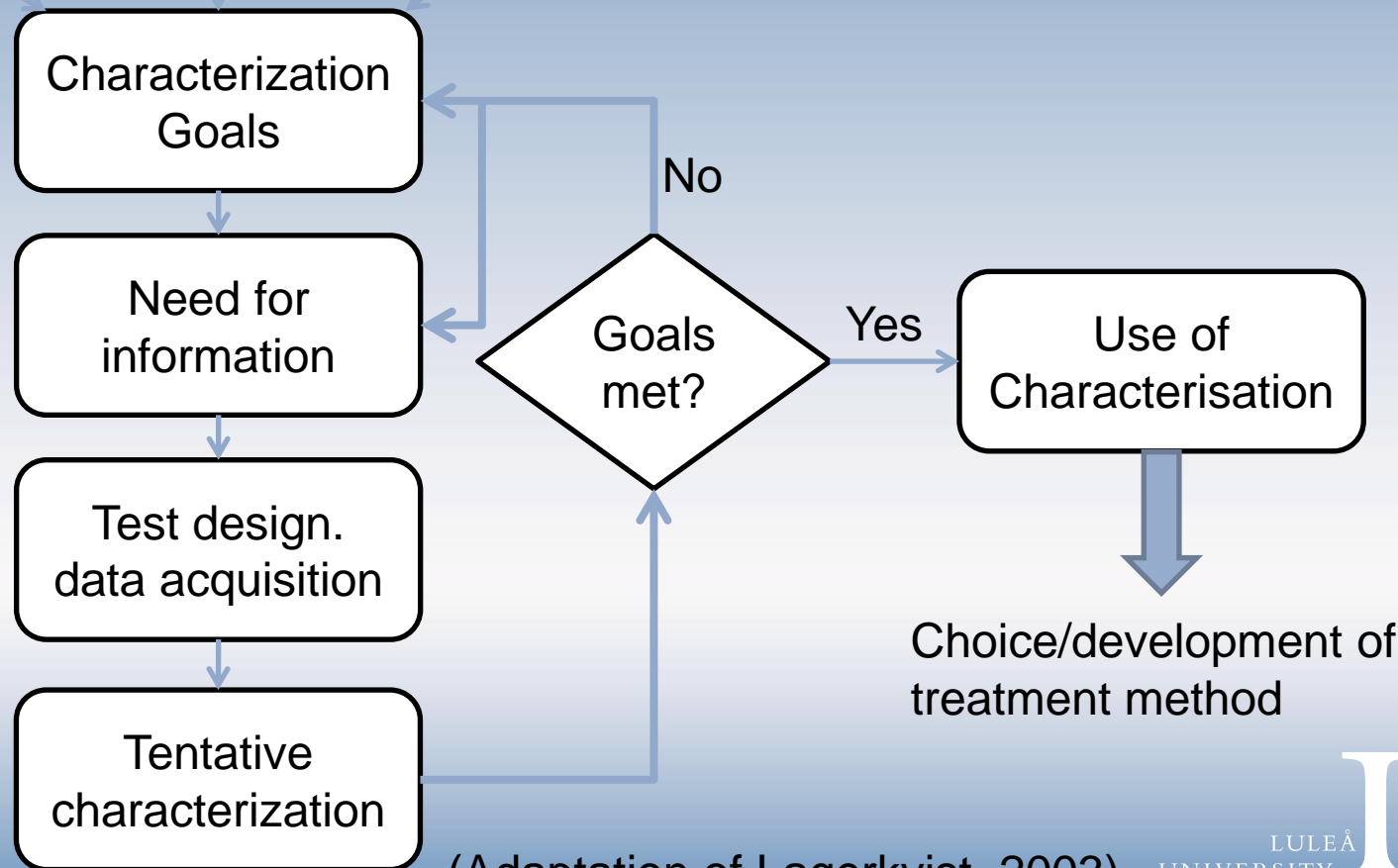
- ~50% of TOC is elemental carbon

# Characterization

Economy/business and practical considerations

Legislation

Treatment goals



(Adaptation of Lagerkvist. 2003)





## Facts about me



- Erik Marklund. 31 years old
- Masters degree from KTH in Industrial Ecology
- Started as a PhD April 2016
- From Sweden

# Waste Science & Technology: Senior staff



Dr Lale Andreas  
Associate professor  
Landfill Technology



Dr Anders Lagerkvist. Chaired Professor  
Waste Science & Technology



Dr Jurate Kumpiene.  
Professor  
Recipient engineering



Dr Lisa Dahlén  
Assistant professor  
Waste management systems



Dr Desirée Nordmark  
Senior research eng.  
Laboratory manager



Dr Rolf Sjöblom. TeKeDo  
Adjunct professor  
Industrial waste utilisation



Dr Peter Heydebreck. Inno AB  
Adjunct professor  
Valorization



# Environmental engineering laboratory

## *Research and teaching*

- Experiments and tests from mg scale to Mg
- Chemical. physical. and biological methods

