



Gas cleaning for staged gasifiers

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Gas cleaning for staged gasifiers

GasNET meeting October 2. 2002

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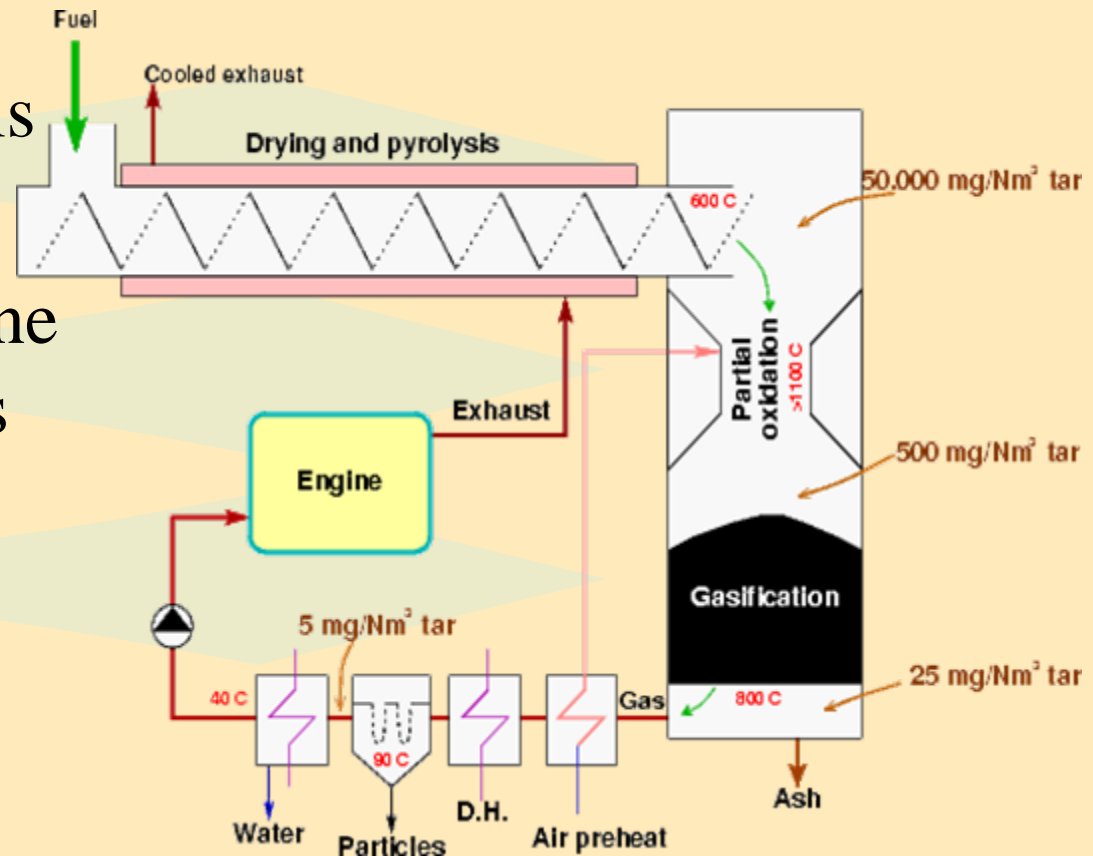
<http://www.et.dtu.dk/Halmfortet>

Outline

- Two stage gasification
- Scrubber performance
- Particle properties
- Relevant particle removal technologies
- Viking gasifier
- Baghouse filter in Viking
 - Performance
 - Waste quality
- Conclusions

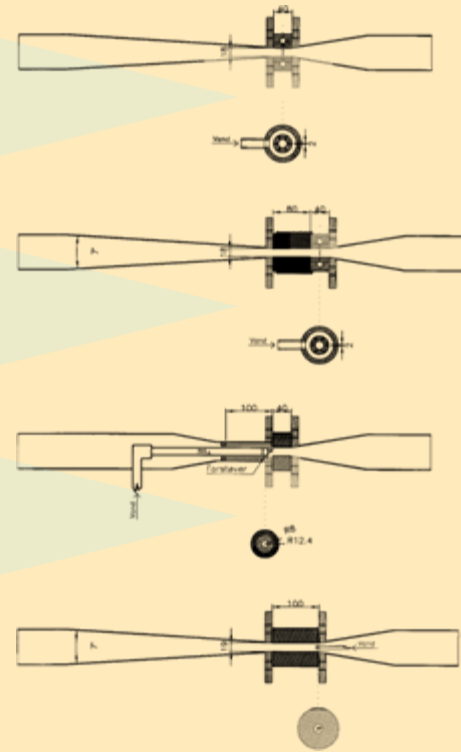
Two-stage gasification

- x Separated pyrolysis and gasification
- x Tar conversion zone for pyrolysis gases
 - No tar in gas
 - nor in waste**
 - High efficiency



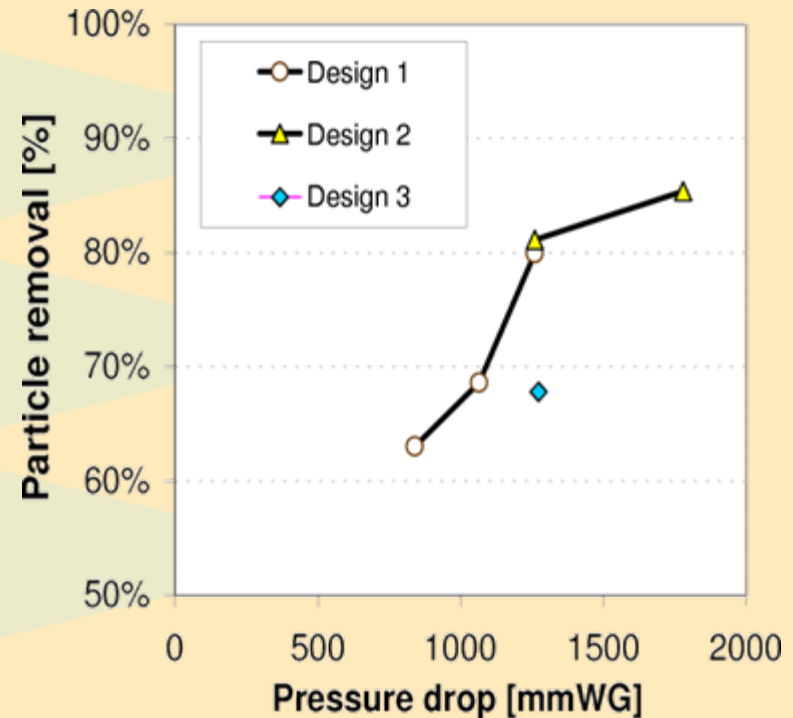
Experience with venturi scrubber system

- Reliable
- Particles in waste water
 - Recycling system



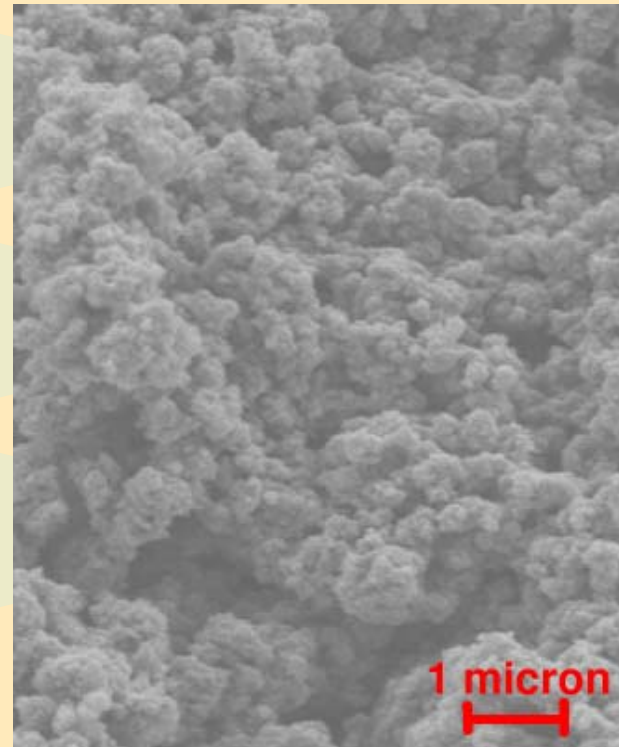
Experience with venturi scrubber system

- Reliable
- Particles in waste water
 - Recycling system
- Particle removal 65-85%
- High pressure drop



Characterisation of two-stage particles

- 6% volatiles (tar)
- Ash 20-30%
- **Submicron**
(>85% mass)



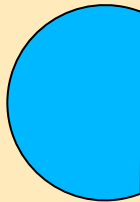
Removing submicron particles

Inertial methods inefficient
(e.g. cyclones and scrubbers)

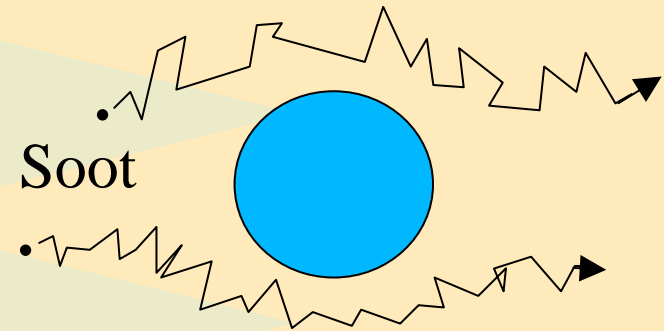
Electrostatic precipitators
efficient but expensive.



Scrubber droplets



Soot



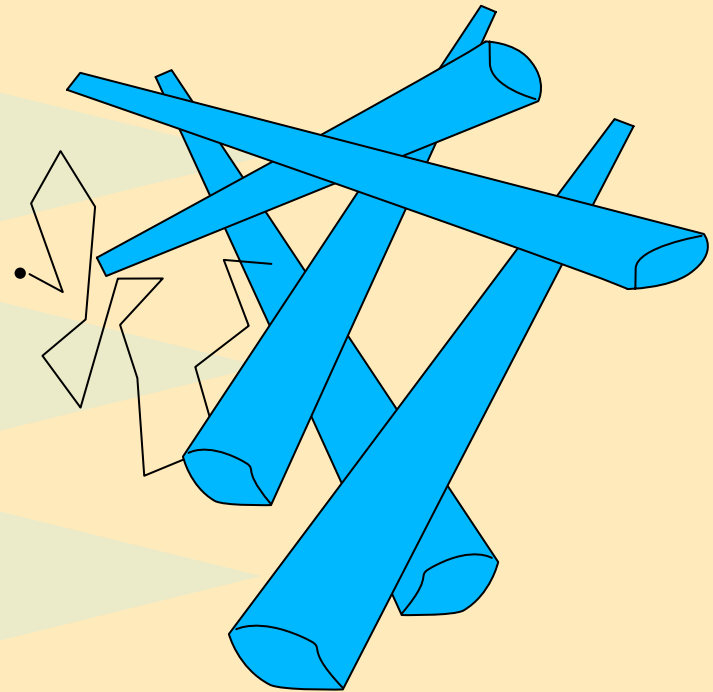
*Venturi scrubber,
high gas velocity*

Removing submicron particles

Inertial methods inefficient
(e.g. cyclones and scrubbers)

Electrostatic precipitators
efficient but expensive.

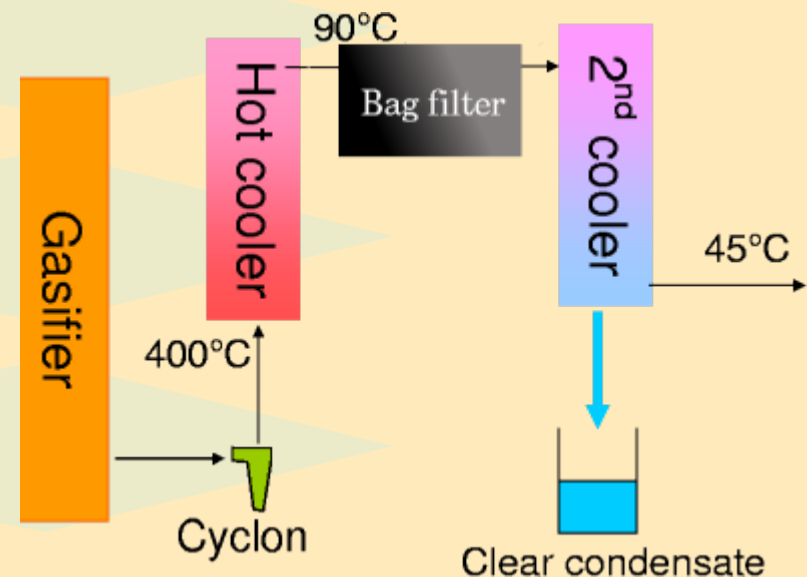
Fibre filtration efficient
due to Brownian motions.



*Fibre filtration with
Brownian motions*

Baghouse filter system

- x Particle removal just above water dew point.
- x Filter cleaning by N₂ backflush.
 - Bulk particles and condensate recovered separately.
 - Pressure <100 mmWG
 - Low energy consumption



Viking gasifier at DTU

Commissioned August 2002

Small scale ($80\text{kW}_{\text{fuel}}$)

Unattended operation

Engine woodgas operation for
400 hours

Using baghouse filtering
(no cyclone)



Gas cleaning performance

- Reliable for >400 hours with no filter change.

- Dust removal >99.5%

- Tar condenses on particles, removed with these

- Tar levels in gas drop from 25 to "no tar" (<5 mg/Nm³)



Police filter after 450 hours

Viking condensate quality

Amounts:	2-6 l/h
NH ₃ :	1 g/l
Naphtalene:	<20 µg/l
Other PAH:	<2 µg/l
Smell:	NH ₃
⇒ OK for standard biological surridge plant!	



Viking dust quality

Amounts: 600 mg/Nm^3
= 30 g/h

Ash: 30-50%

Tar: <5% mass

Bulk particles

→ Low temperature reburning
in boiler should be possible.



Intake Manifold 400 hours Wood Gas



Conclusions

- Dust removal efficiency $>99.5\%$
- Tar removed with particles
 $<5 \text{ mg/Nm}^3$ tar after filter
- Condensate not a waste problem
- Dust can be treated separately
- Absence of tars \Rightarrow simple, cheap gas cleaning for woodgas.

Questions?

