Gas cleaning for staged gasifiers

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Gas cleaning for staged gasifiers

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Outline

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

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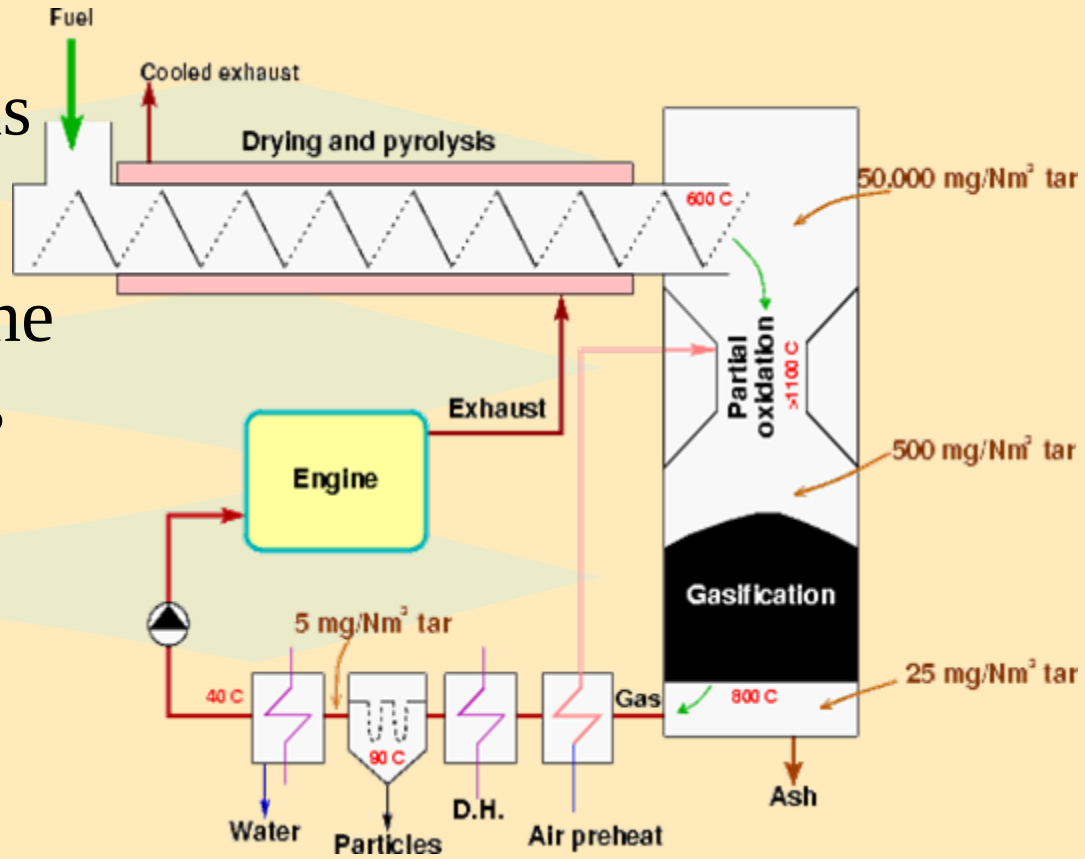
Two-stage gasification

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



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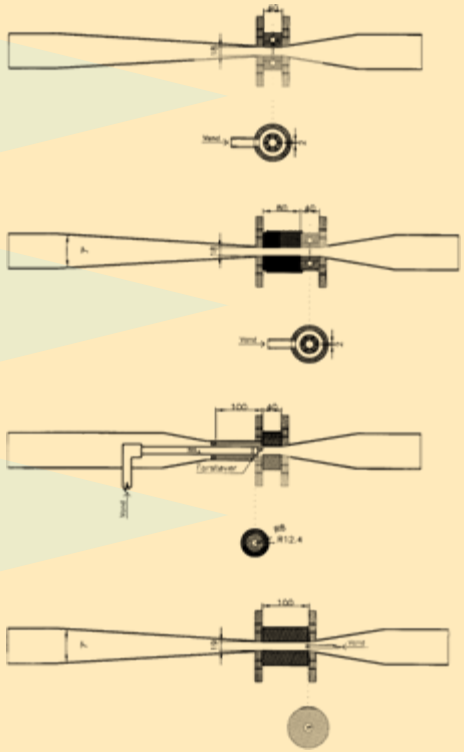
Experience with venturi scrubber system

- Reliable
- Particles in waste water
  - Recycling system



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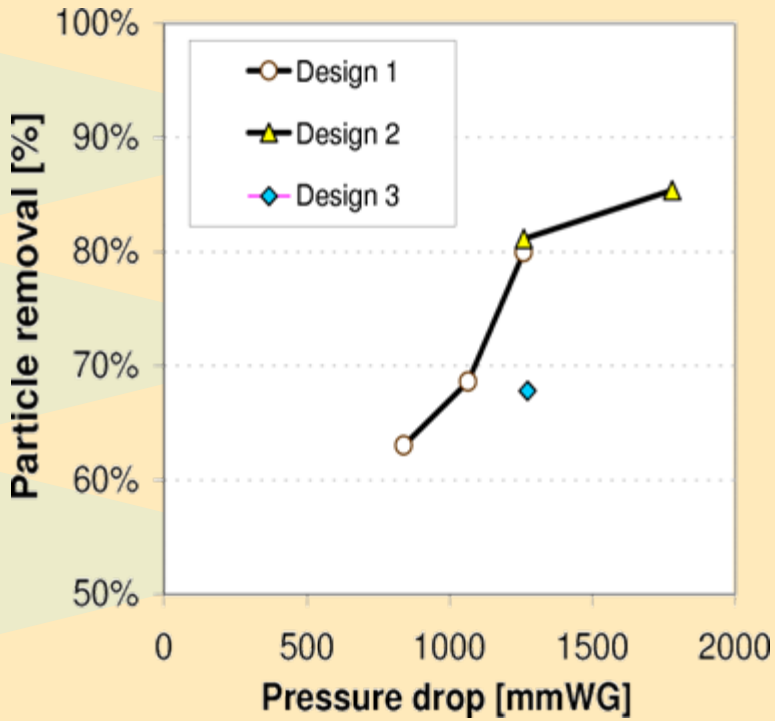
Experience with venturi scrubber system

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



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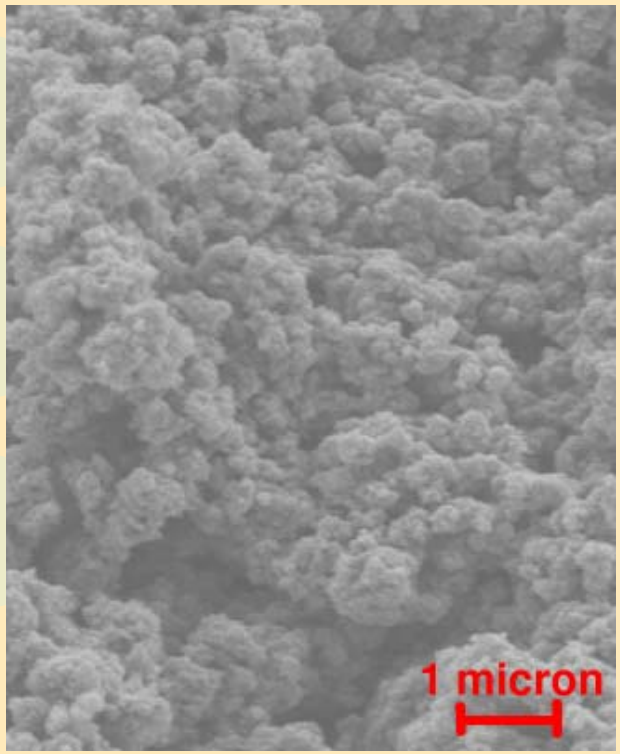
Characterisation of two-stage particles

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



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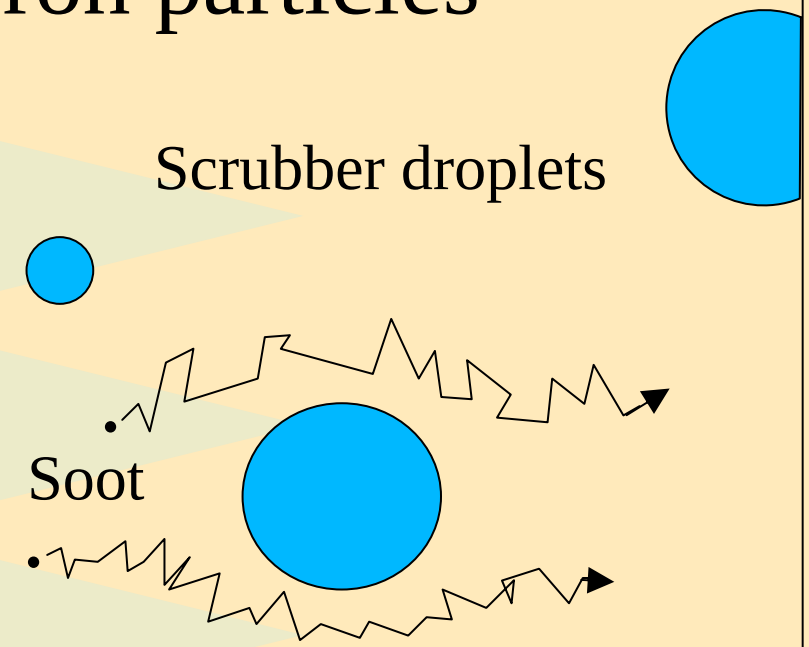
Removing submicron particles

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

Electrostatic precipitators
efficient but expensive.



Venturi scrubber,
high gas velocity

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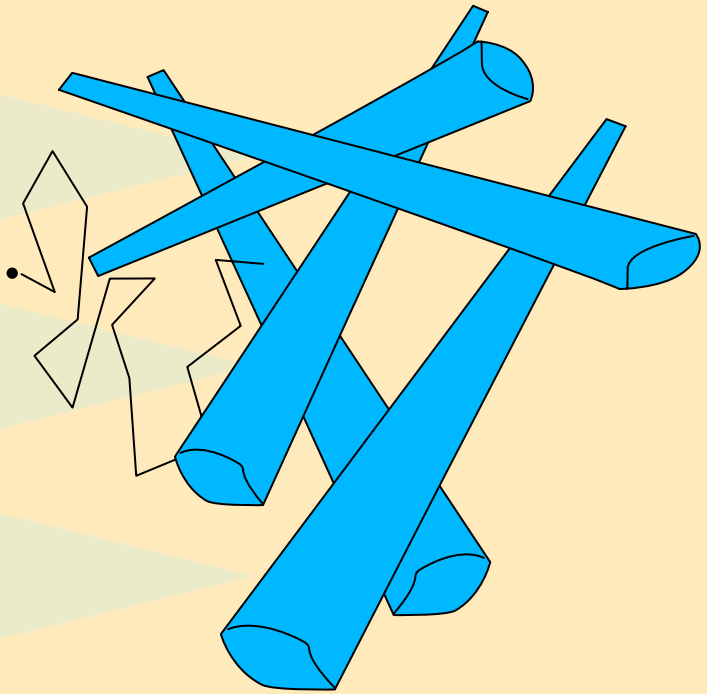
Removing submicron particles

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

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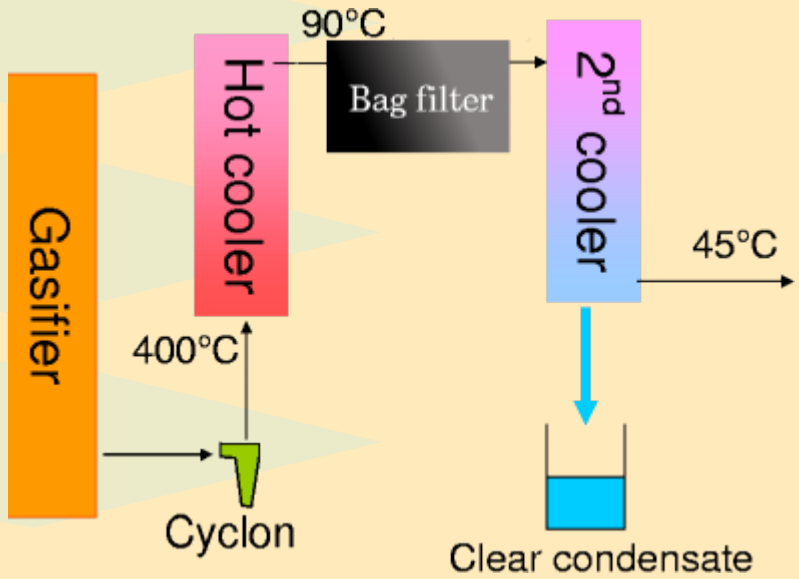
Baghouse filter system

- Particle removal just above water dew point.
- Filter cleaning by N_2 backflush.
  - → Bulk particles and condensate recovered separately.
  - → Pressure <100 mmWG
  - → Low energy consumption



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Viking gasifier at DTU

- Commisioned August 2002
- Small scale (80kW$_{fuel}$)
- Unattended operation
- Engine woodgas operation for 400 hours
- Using baghouse filtering (no cyclone)

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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/Nm^3)

Police filter after 450 hours

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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!

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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.

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Intake Manifold 400 hours Wood Gas

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Conclusions

- Dust removal efficiency >99.5%
- Tar removed with particles

  <5 mg/Nm^3 tar after filter
- Condensate not a waste problem
- Dust can be treated separately
- Absence of tars ⇒ simple, cheap gas cleaning for woodgas.

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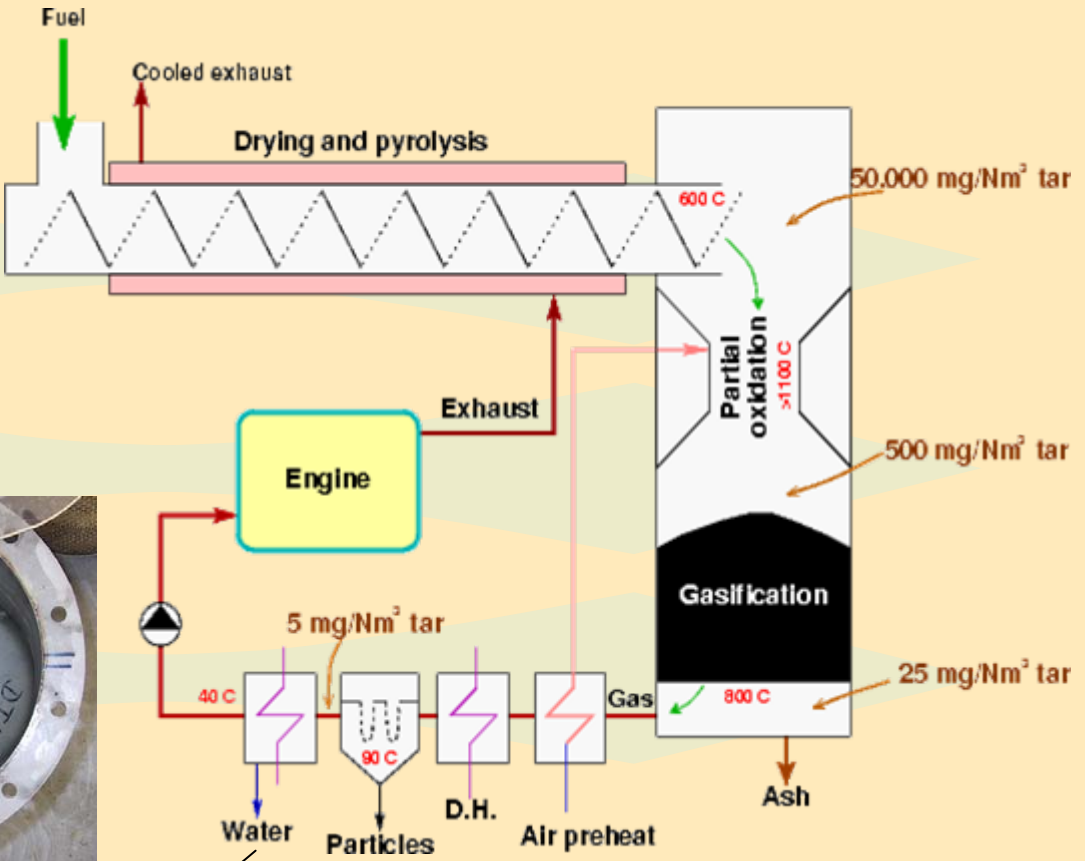
Questions?



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