

Aerosol and volatile emissions control in an amine-based CO₂ capture plant

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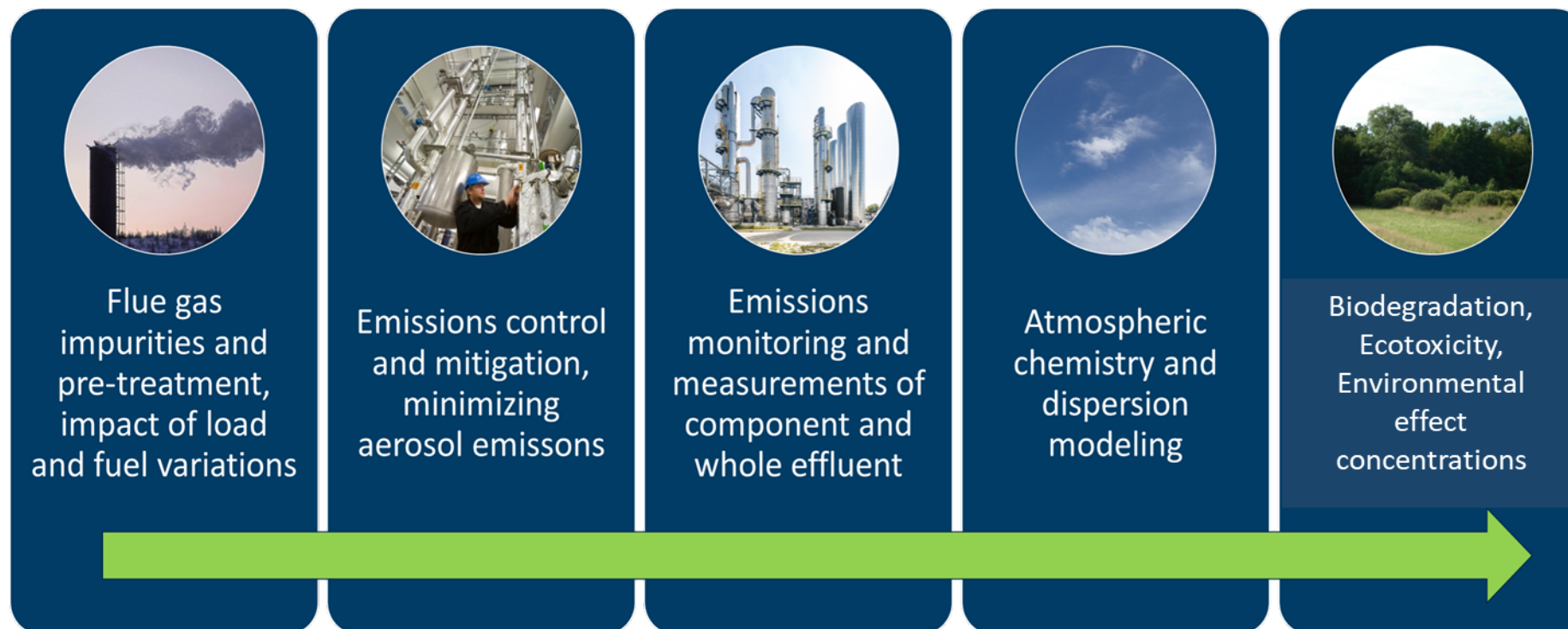


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Background - the SCOPE project

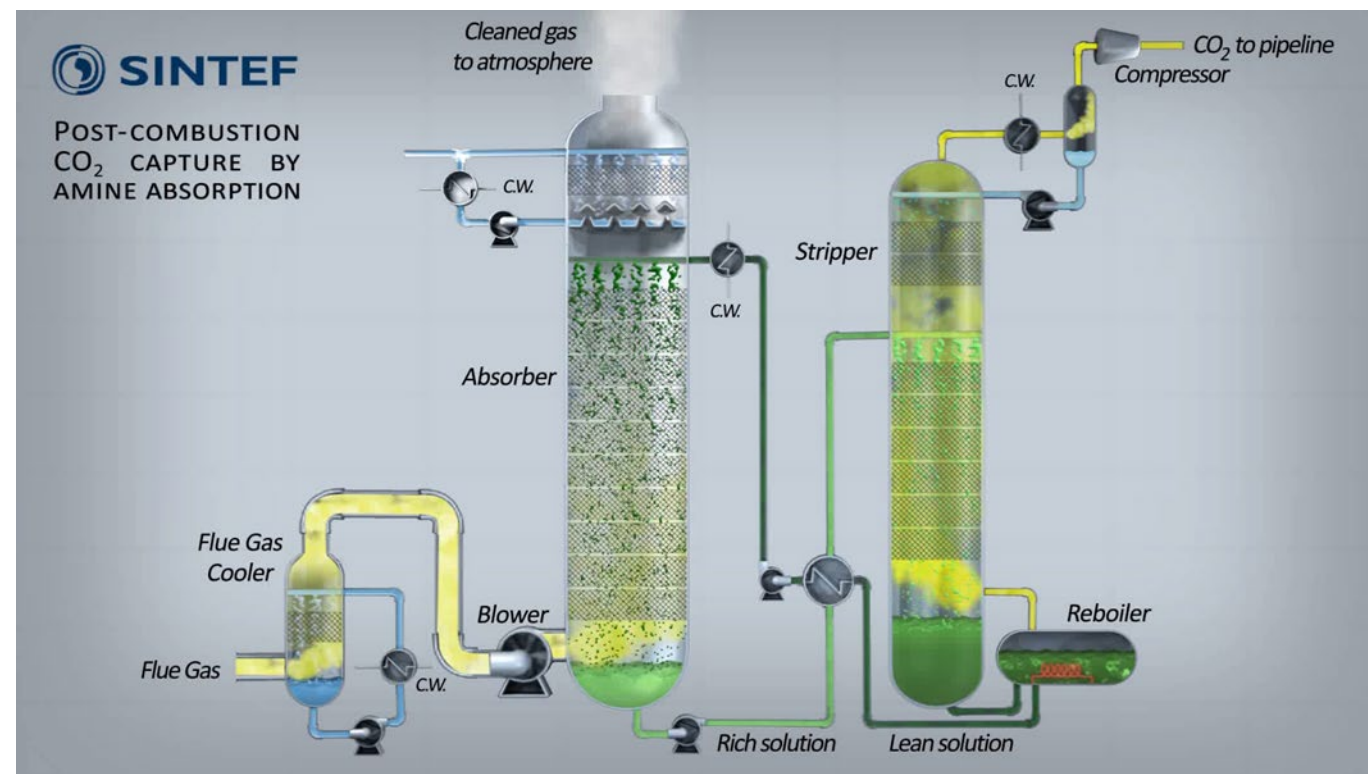
SCOPE – Sustainable OPEration of post-combustion Capture plants

Follow the continuous path of the treated gas from source to recipient and ensure a sustainable and environmentally safe operation of the capture plant



Solvent emissions from a CO₂ capture plant

- Two main mechanisms:
 1. **Volatility** of amine
 2. Via the formation of **aerosols** containing amine
- Aerosol formation may lead to amine excessive amine emissions >100 ppm or more
- Focus on emissions of amine and degradation products:
 - Low amine emission limits to be expected
 - Essential that CO₂ capture plants are environmentally safe and well regulated



Our vision and impact

At the end of the SCOPE project:

1. **Plant operators** will have access to **new tools and data**;
2. **Authorities** will have **new regulatory guidelines** for setting environmental quality and health standards;
3. **Decision-makers** seeking to support CCUS commercialisation will have clarity on the **governance requirements** needed to secure a social license to operate in diverse national settings.

Background - the Twence pilot

The Twence Waste-to-Energy plant



Hengelo, The Netherlands



Total environmental performances 2020

Generated electricity for:
135,800 households

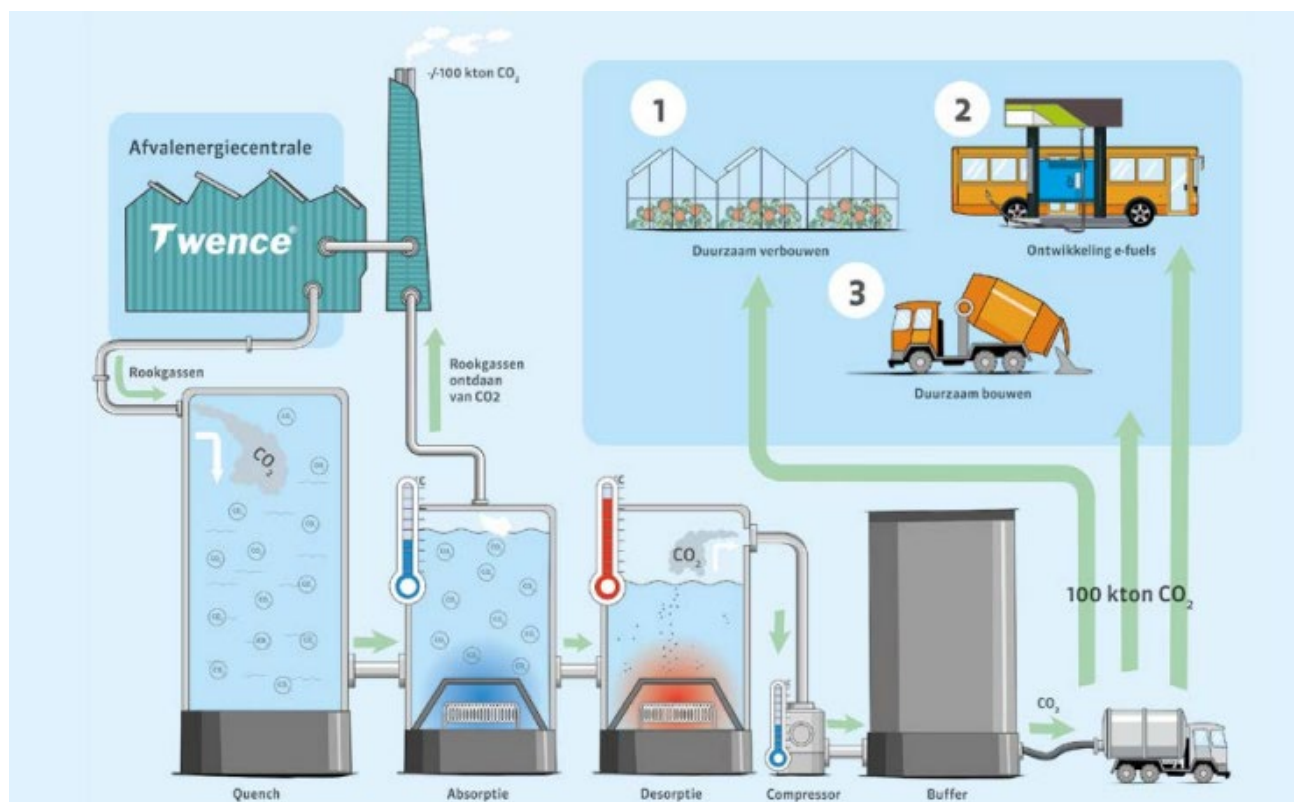


Generated steam for:
62,500 households



Compost for:
34,400 tonnes

The Twence Waste-to-Energy plant



Full scale plant

100 ktonCO₂/year

2023 delivering CO₂ to greenhouses

CCU strategy:

1. food-grade CO₂ to greenhouses
2. e-fuels
3. building materials

The Twence CO₂ capture pilot



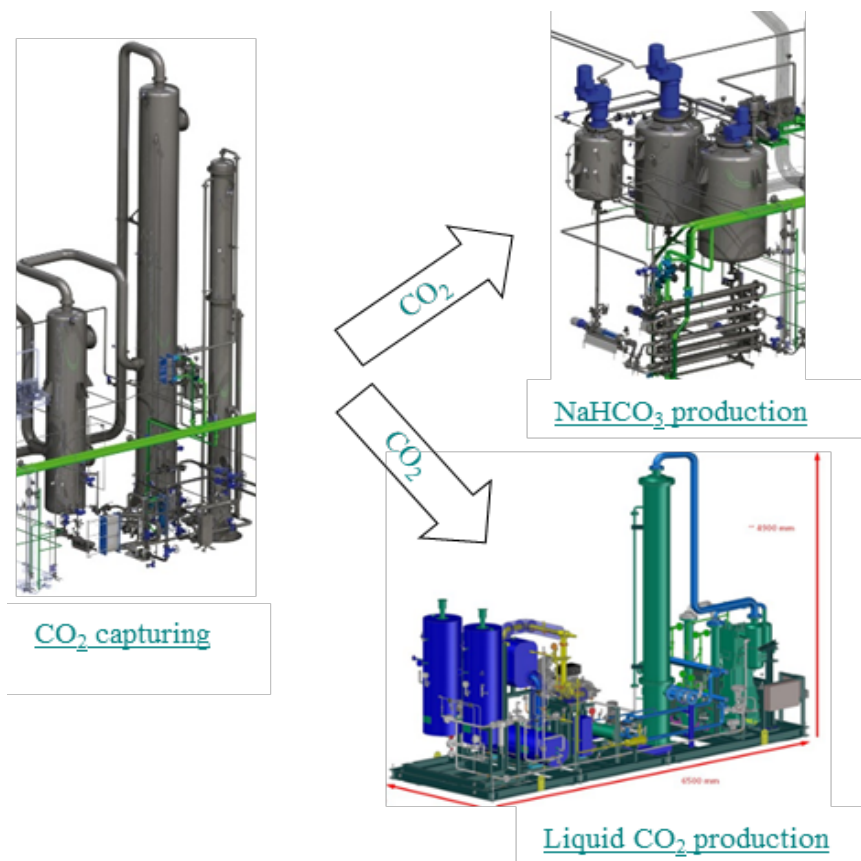
Pilot scale plant

500 kgCO₂/h

1.5 vol% of the flue gas

2014 start of operation

The Twence CO₂ capture pilot



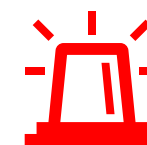
Since 2014
NaHCO₃ for de-SO_x unit

Started in 2020
CO₂ for greenhouse sector

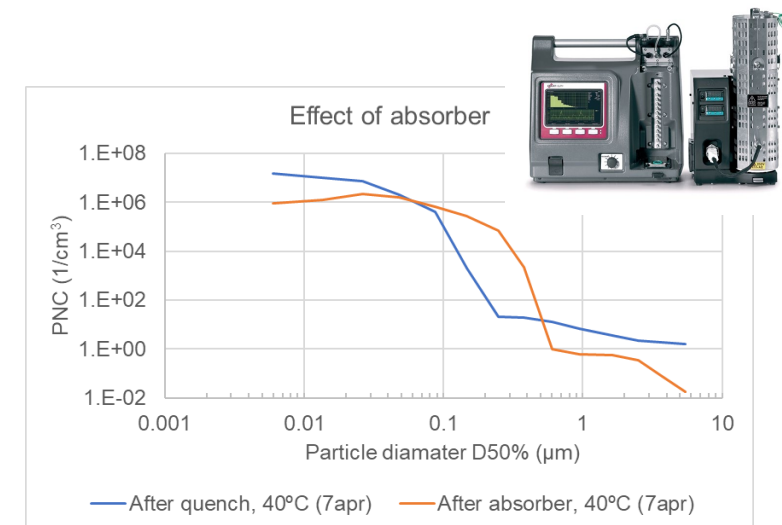
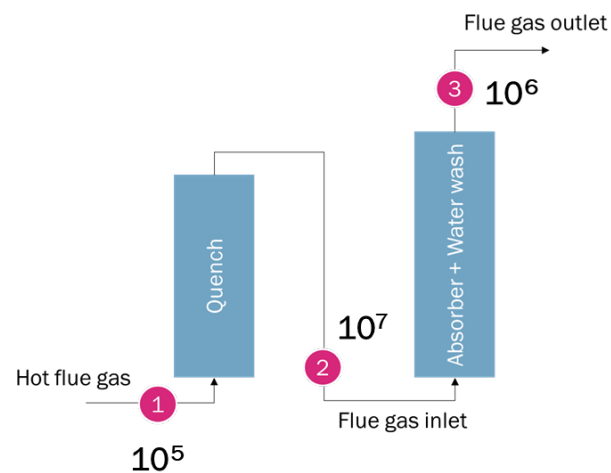
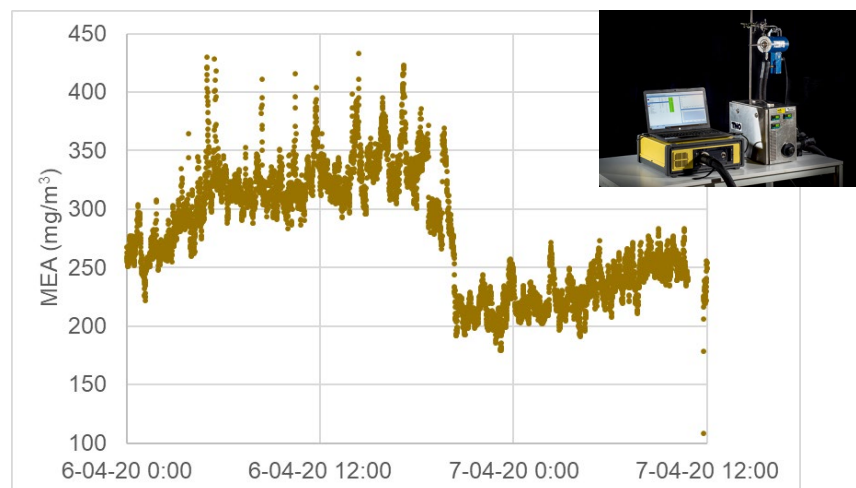


Solvent switch: From
non-volatile aminoacid
salt to MEA

MEA losses much higher
than expected



Emissions measurements



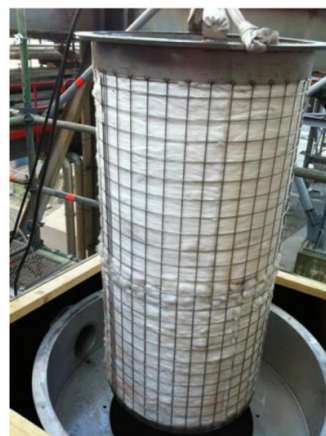
High total MEA emissions
High particle concentration → below 1 μm

→ **Aerosol-based emissions!**

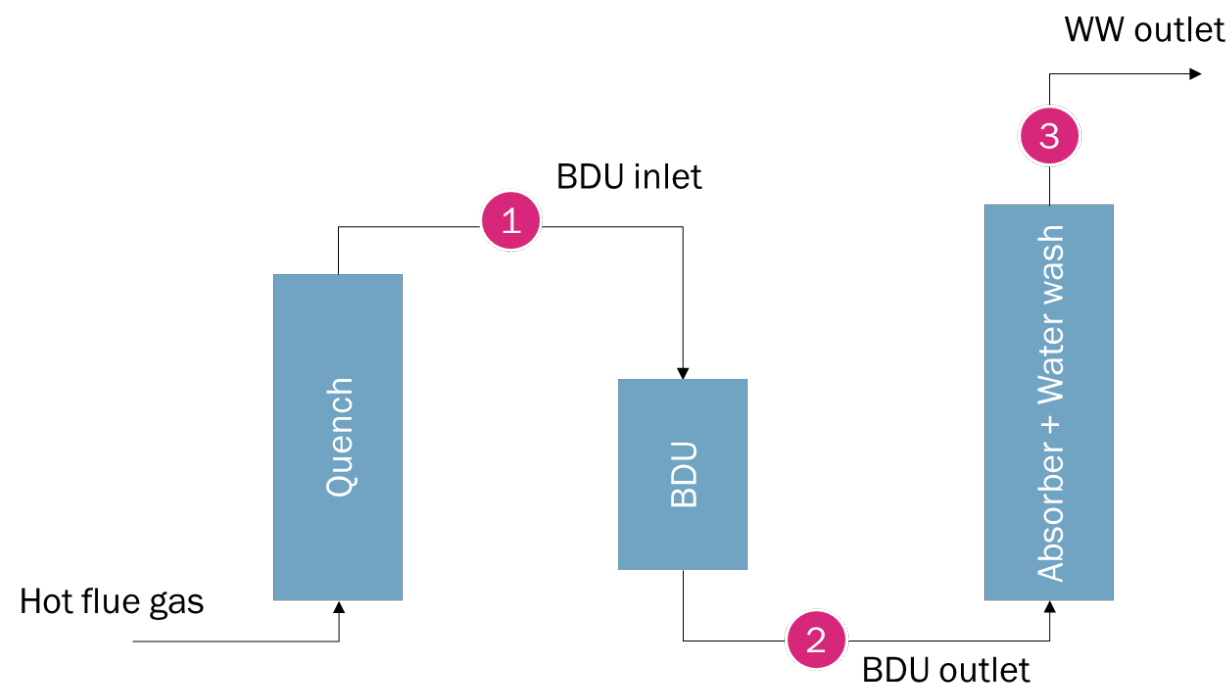
Emissions measurements



Emissions control - BDU

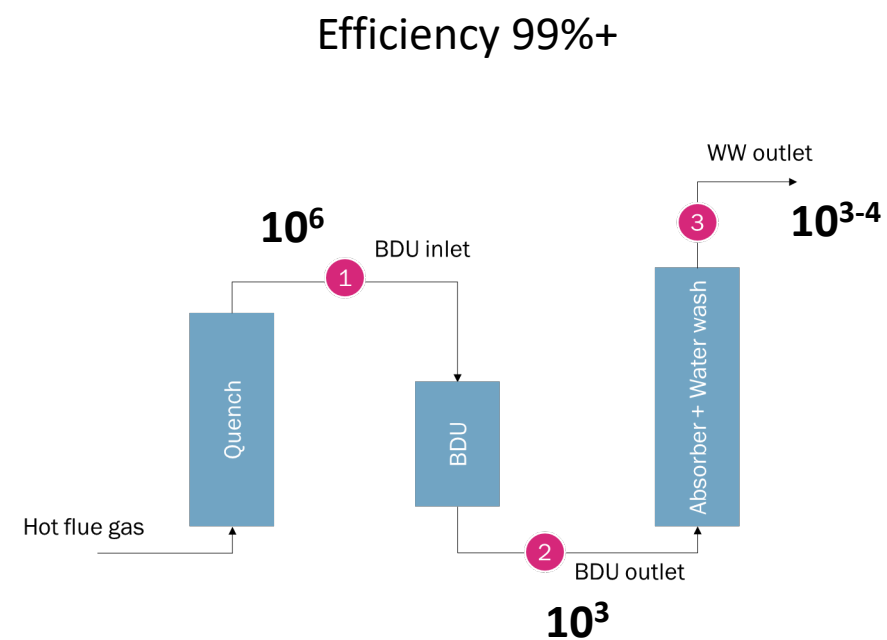
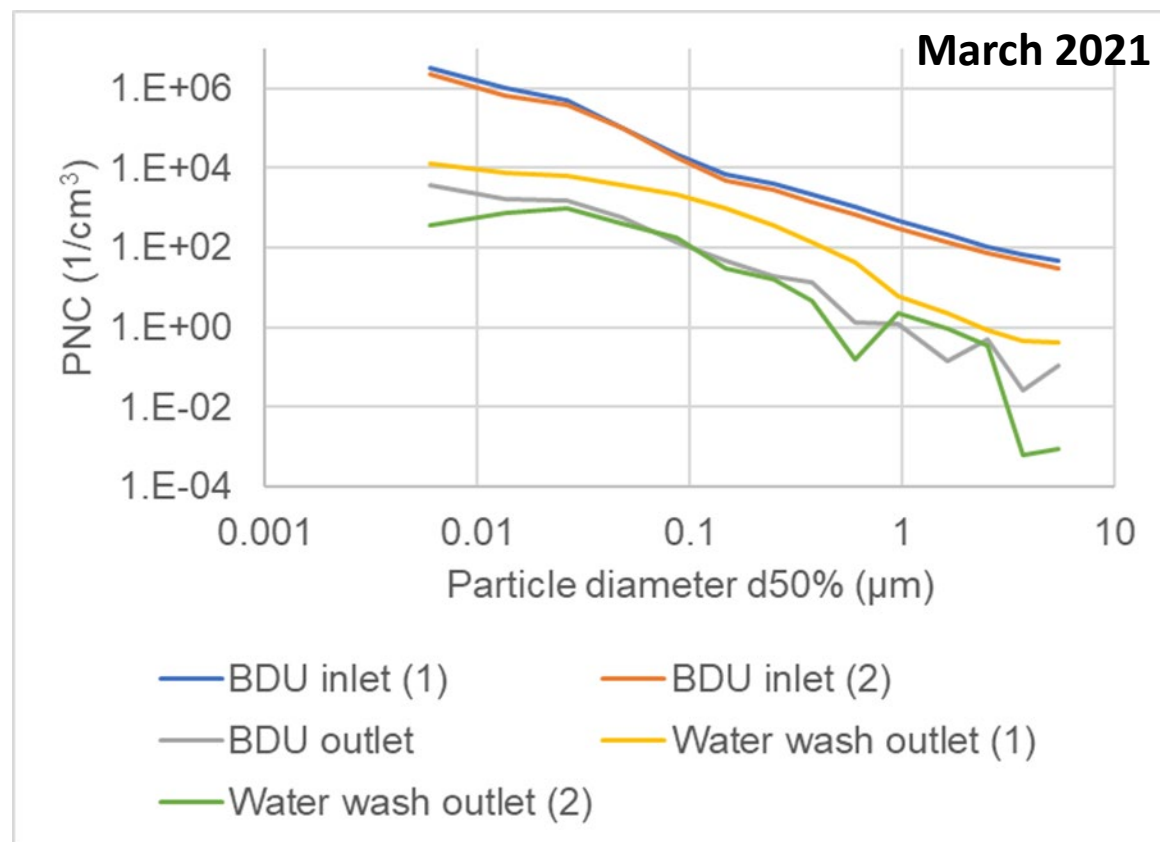


Brownian Demister Unit (BDU)

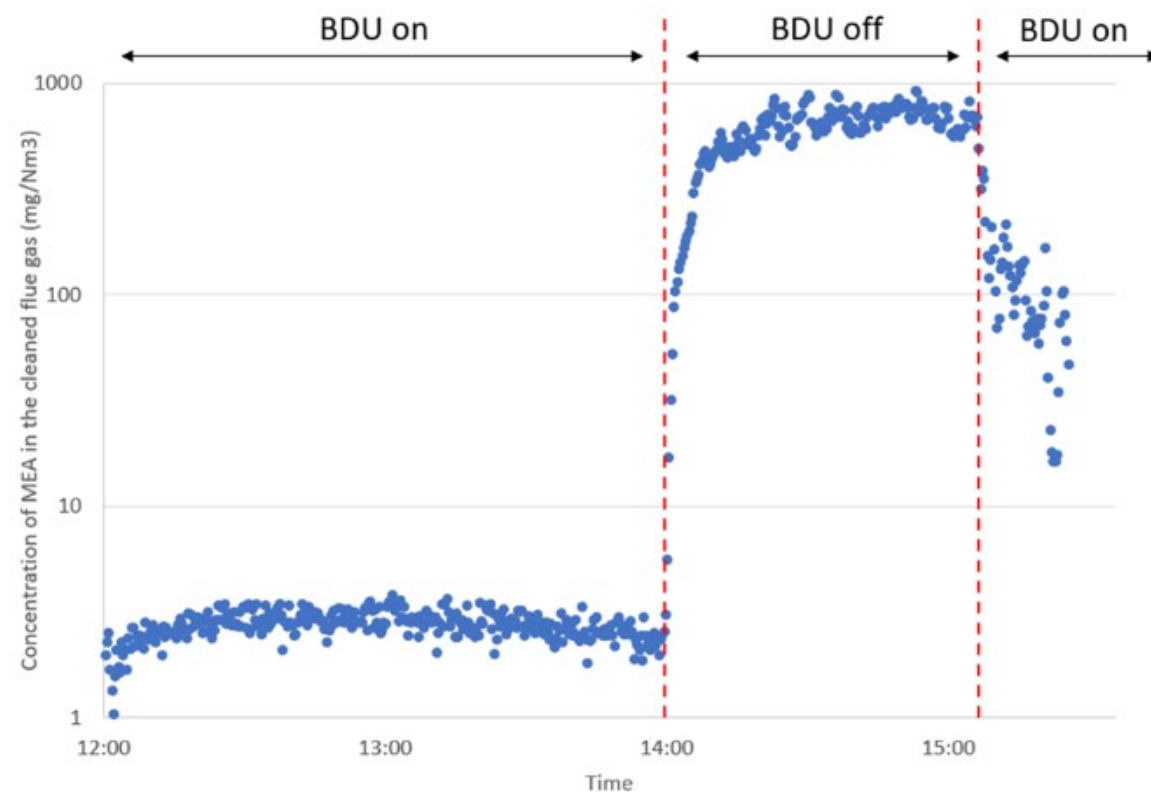


Mitigating aerosol-based emissions

Emissions control - BDU

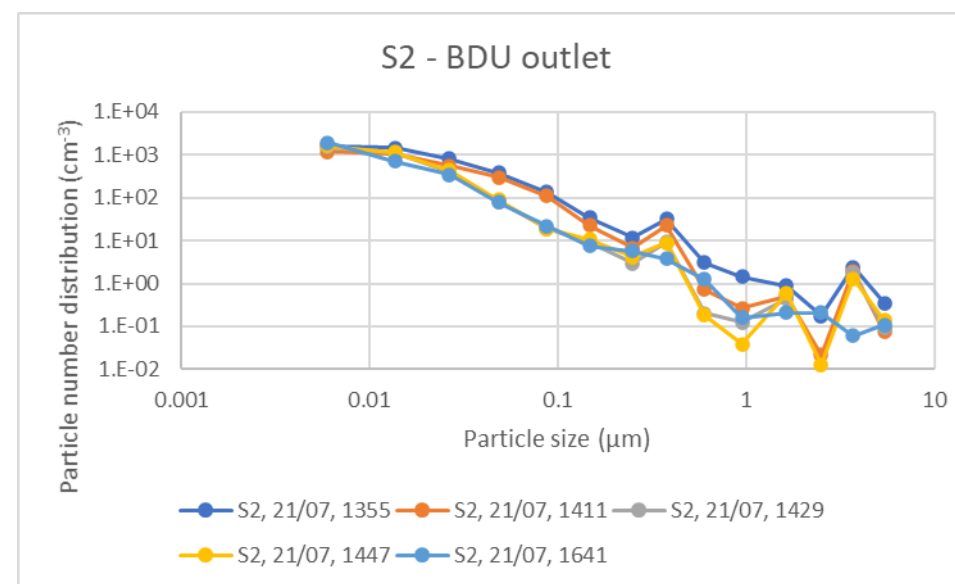
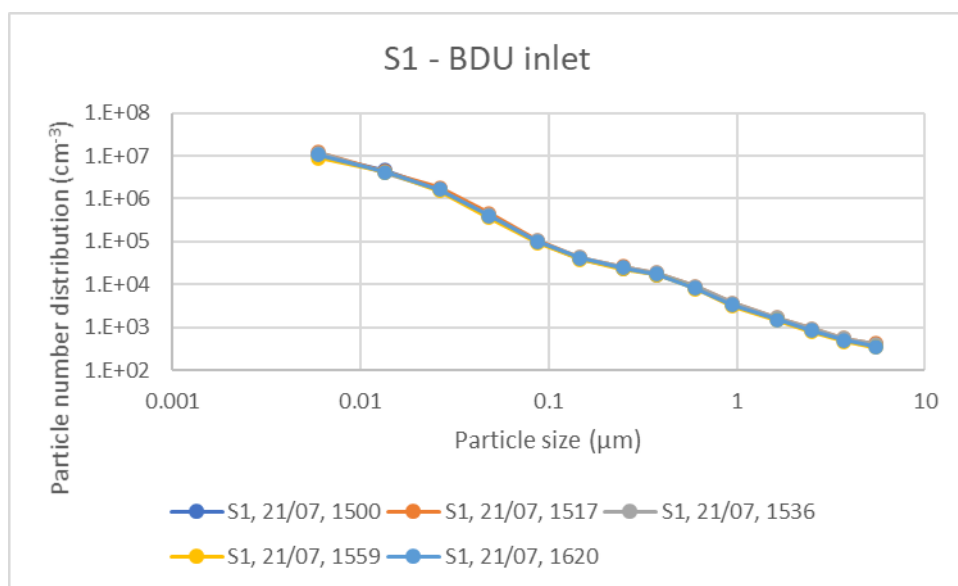
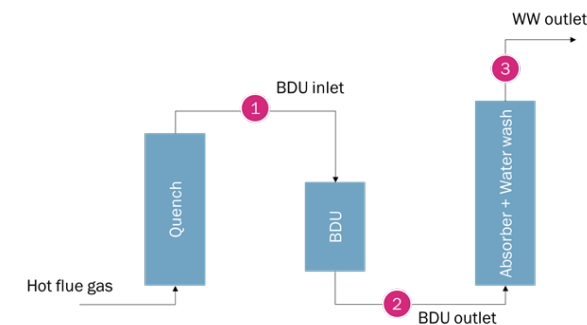


Emissions control - BDU



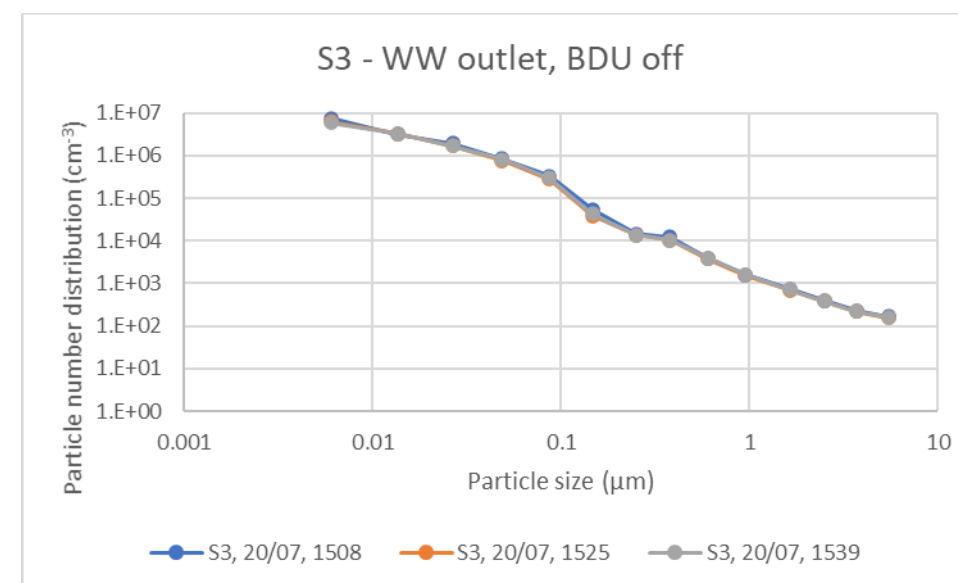
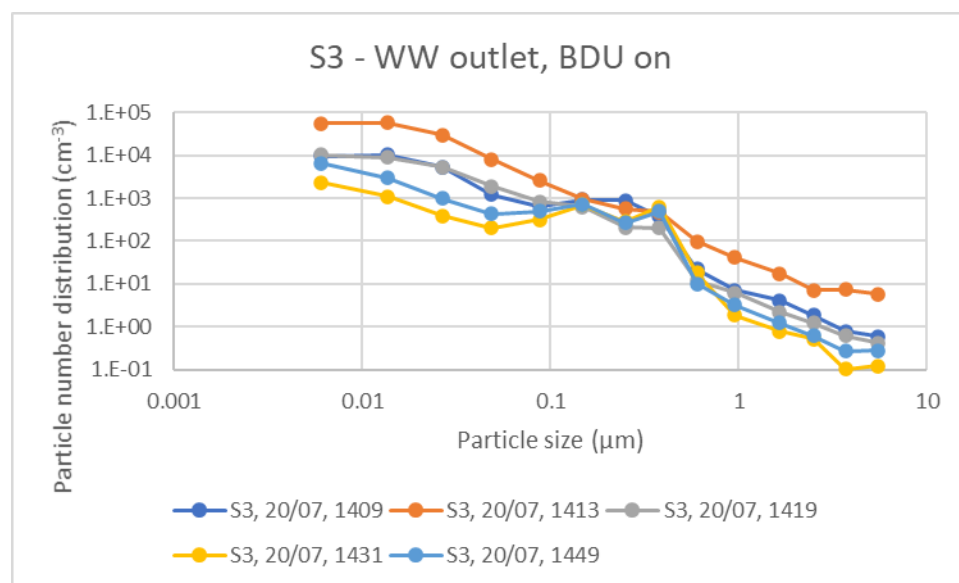
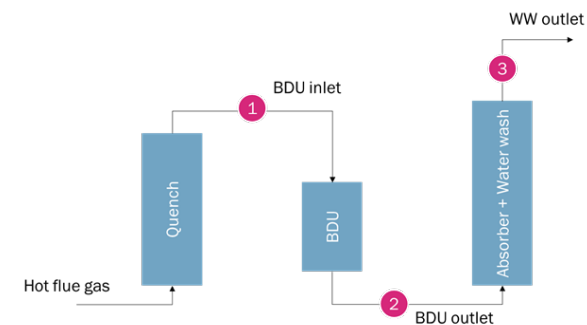
March 2021

Emissions control - BDU



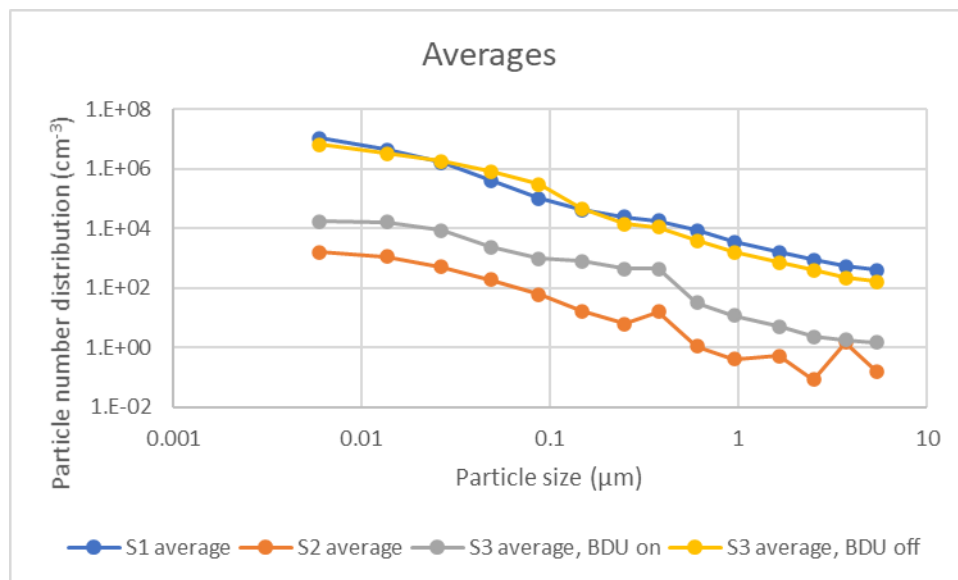
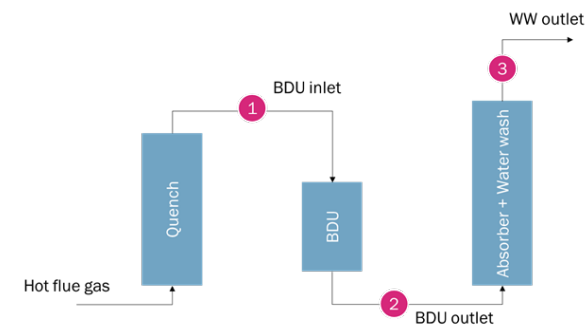
July 2022

Emissions control - BDU



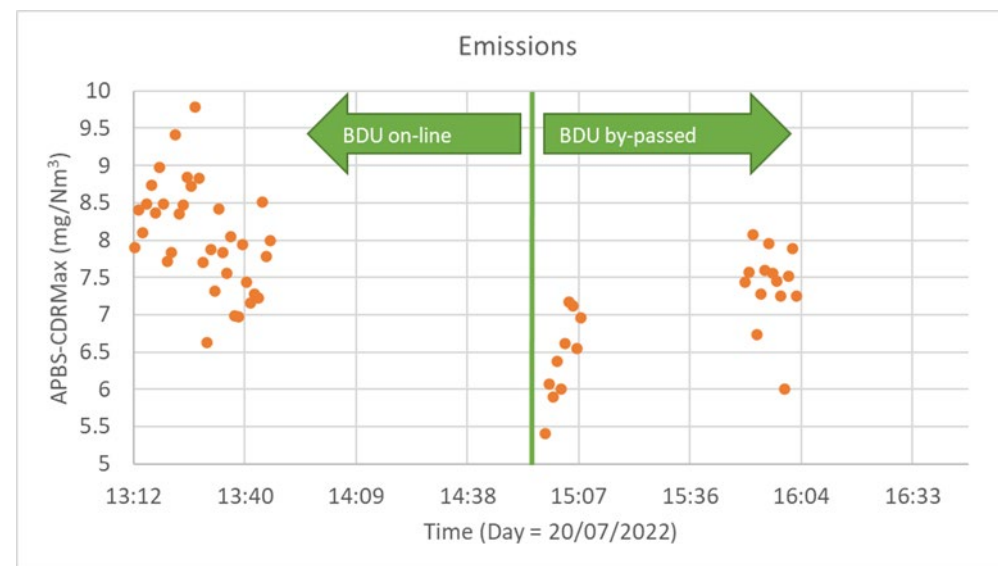
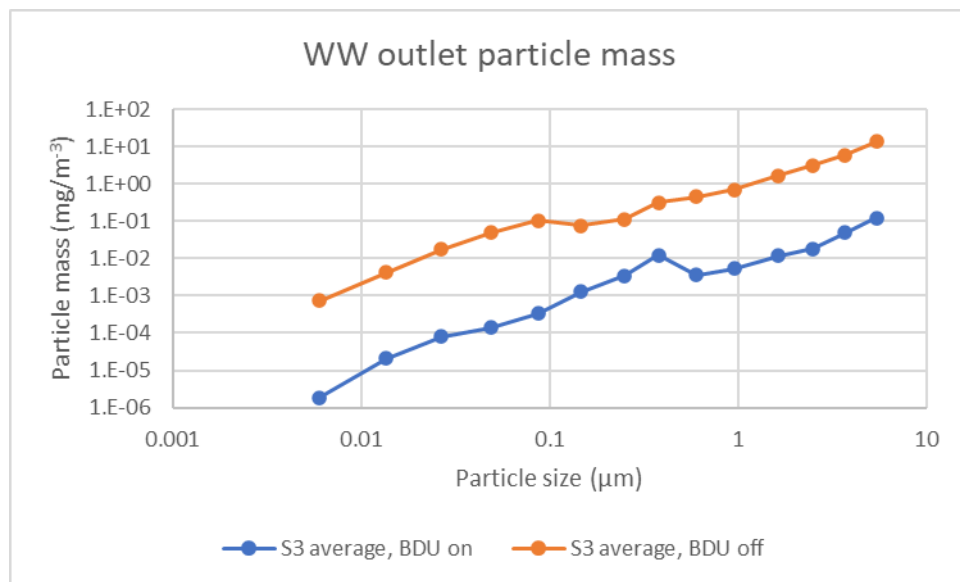
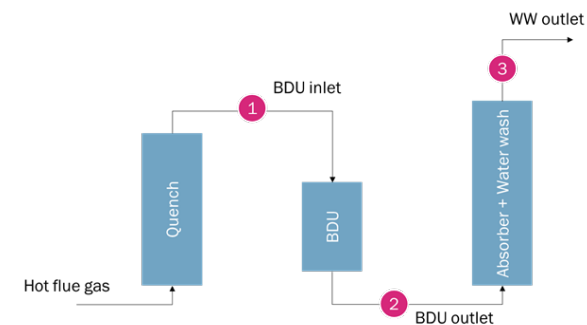
July 2022

Emissions control - BDU



July 2022

Emissions control - BDU

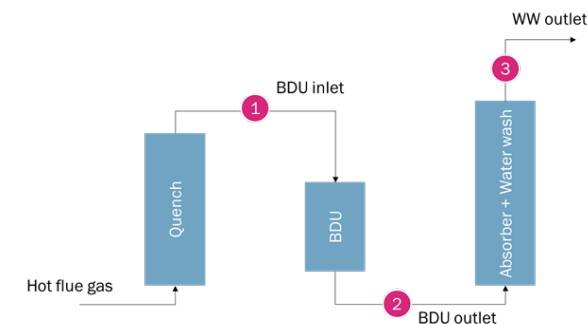
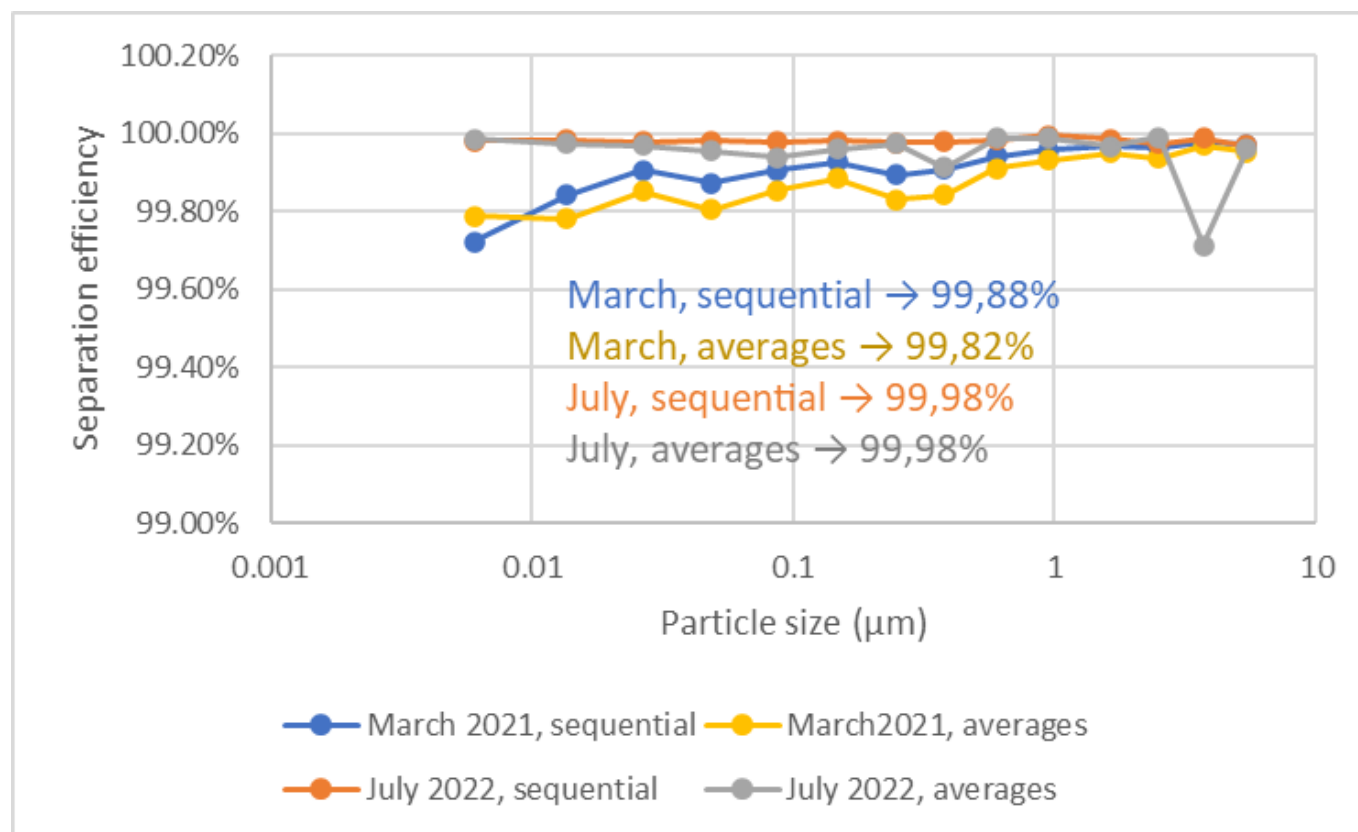


July 2022



Emissions control - BDU

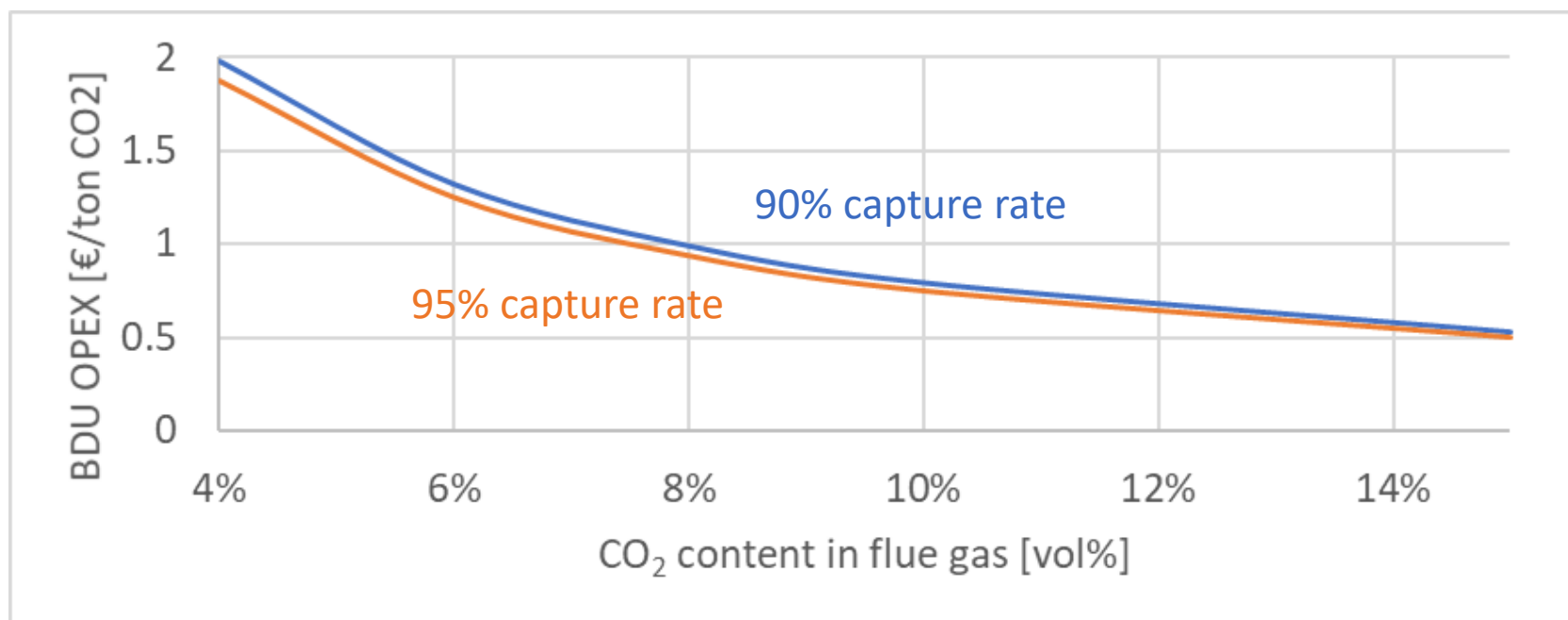
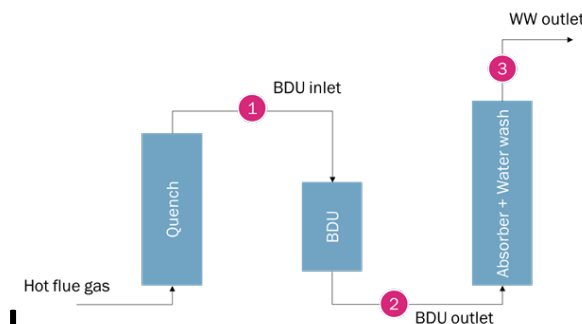
$$\varepsilon_i = 1 - \frac{PNC_{i,S2}}{PNC_{i,S1}}$$



July 2022
10440 hours of operation

Emissions control - BDU

- Average pressure drop over the BDU, July 2022 → 30 mbar
 - Estimated BDU OPEX: 0,14 € 1000 m³ of flue gas



Acknowledgements

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