Energetic Utilization of Biomass from Rewetted Peatlands at a 800 kW Heating Plant for Community Heating in Malchin

RRR2021 - Virtual conference on "Renewable resources from wet and rewetted peatlands"

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(Mirko Barz, Guyrod Kabengele, Wendelin Wichtmann, Maximilian Wenzel, Tobias Dahms, Nina Körner, Ludwig Borg)

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Project Introduction (1/2)

Project Title:
“Optimization of Biomass Production and Thermal Utilization of Biomass from Rewetted Peatlands", (BOnaMoor)

Project Partner: Institute for Botany and Landscape Ecology, Greifswald University (Germany)
HTW Berlin – University of Applied Sciences (Germany)

Project Duration: 11/2018-10/2021

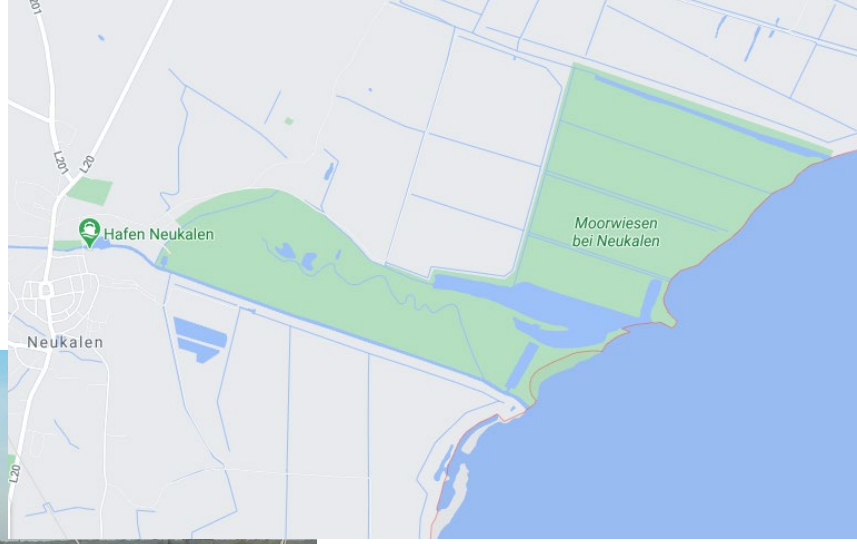
Funded by the German Federal Ministry of Food and Agriculture - BMEL (FNR Project, FKZ 22404418)

Project Introduction (2/2)

Main Objective of the Project:

- **Development of sustainable and economically viable cultivation systems and value chains for biomass produced on wet peatlands (WP Greifswald University)**
- **Optimization of the production of renewable resources on wet peatlands (WP Greifswald University)**
- **Optimization of the thermal utilization of wetland biomass (WP HTW Berlin)**

Biomass supply from the Neukahlener Moorwiesen



Characterization of the Biomass Fuels (1/3)

Plant Species

Common Reed:
- Productivity : 3.6 – 43.5 (Ø 12.0) t_{DM}/(ha*a)
- Energy potential: 17.5 – 210 (Ø 60) MWh/(ha*a)

Reed Canary Grass:
- Productivity : 3.5 – 22.5 (Ø 6.0) t_{DM}/(ha*a)
- Energy potential: 16,7 – 61 MWh/(ha*a)

Sedges:
- Productivity : 3.3 – 12 (Ø 6.0) t_{DM}/(ha*a)
- Energy potential: 16,7 – 61 MWh/(ha*a)

Characterization of the Biomass Fuels (2/3)

Impact of fuel characteristics on the combustion process

	Impact on the combustion process
Chemical composition	
C, H, O	Caloric value, equivalent air ratio, energy output
S, N, Cl	Emission of pollutants, corrosion, material cost
Mg, K, Ca …..	Ash content, ash melting behavior, ash utilization opportunities
Fuel quality parameters	
Heating value	Energy content, fuel demand and design of the boiler
Water content	Energy content, combustion temperature, fuel storage risks
Volatile matter and fixed carbon content	Reaction rate, combustion temperature and combustion burnout times, design of the boiler
Ash content	PM emission, ash quantity and utilization opportunities
Physical/mechanical properties	
Particle size	Reaction rate, combustion temperature and combustion burnout times, design of the boiler
Bulk density	Fuel transportation and storage

Characterization of the Biomass Fuels (3/3)

- To provide a standardized fuel and to reduce storage and transport costs the fuels were compressed into densified fuel products (pellets)
- Pellets, produced from common reed, reed canary grass and sedges were used for initial combustion experiments in a commercial biomass heating plants in Malchin, Northern Germany
- These pellets have uniform size and shape (Ø 8 mm, L 10 – 20 mm) and are characterized by a low water content and a high energy density.

Sample	Reed	RCG	Sedges
Caloric value (wf) in MJ/kg	18.65	18.5	18.19
Bulk density in kg/m³	613	604	616
Energy density in MJ/m³	11,432.5	11,174	11,205

Energy content and bulk density of different wetland biomass pellets used for combustion experiments in Malchin

	TGA Analysis results in %				Elementary composition in %					
	Water	**Volatiles**	**C_{fix}**	**Ash**	**C**	**H**	**N**	**O**	**S**	**Cl**
Sedges	6.92	76.76	9.37	6.97	47.8	5.8	1.0	37.7	0.2	0.5
RCG	6.07	78.42	10.36	5.51	46.7	6.0	0.9	40.2	0.2	0.8
Reed	5.16	82.41	7.88	4.54	47.2	5.8	0.7	41.6	0.1	0.04

Composition of different wetland biomass pellets used for combustion experiments in Malchin

Combustion Experiments

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800 kW heating plant in Malchin (LINKA-Boiler)

15 kW Pellet boiler for small scale combustion experiments

Sampling point inside

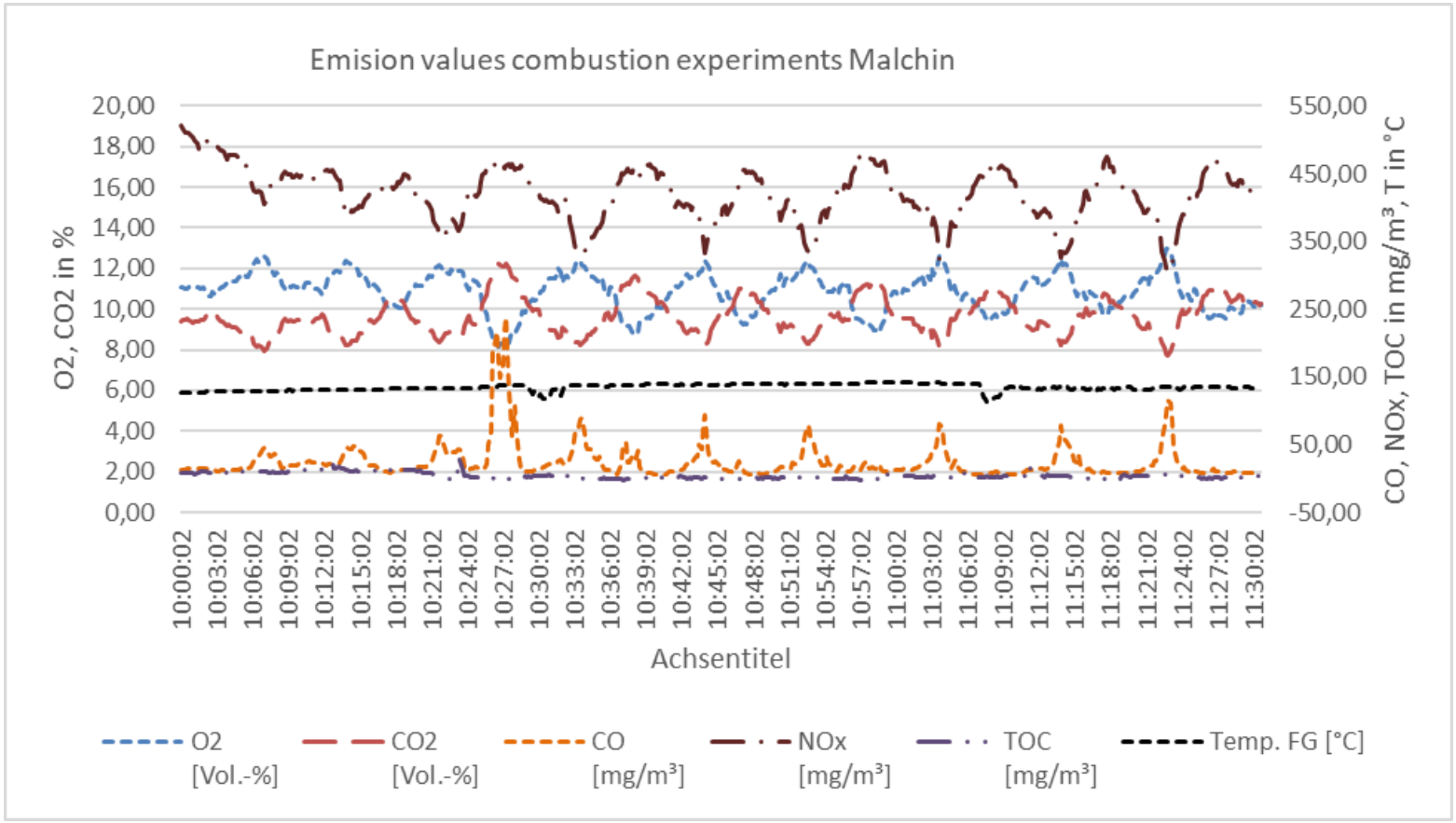
Sampling point outside

Flue gas analyzer (SM 6000)

Results of the measurement campaign at the biomass heating plant in Malchin using pelletized Biomass

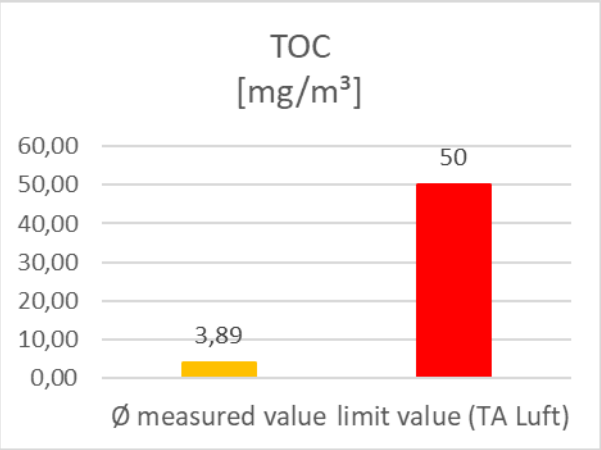
Flue gas component	Emission limit value
CO in g/m³	0.25
NOx in g/m³	0.5
TOC in mg/m³	50
PM in mg/m³	50

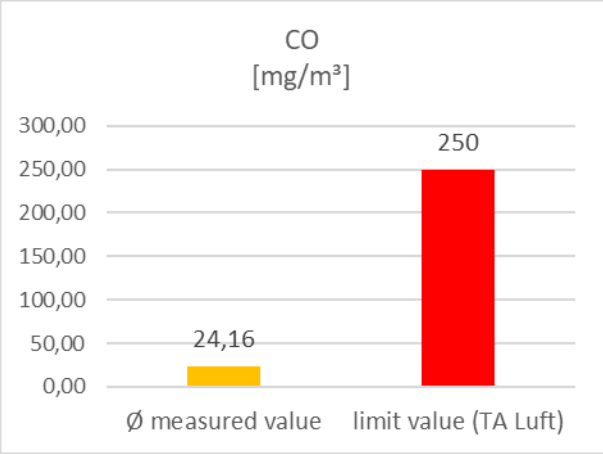
Sampling point outside

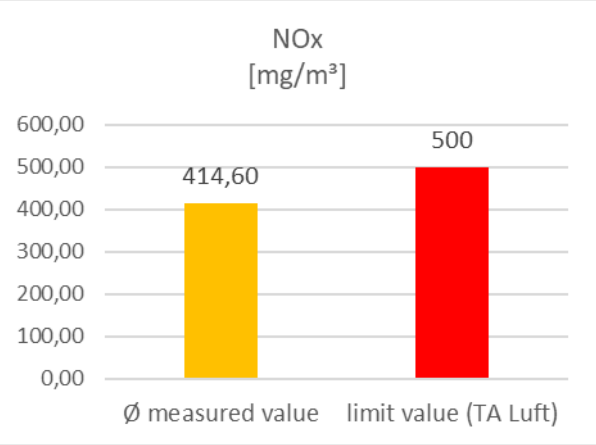


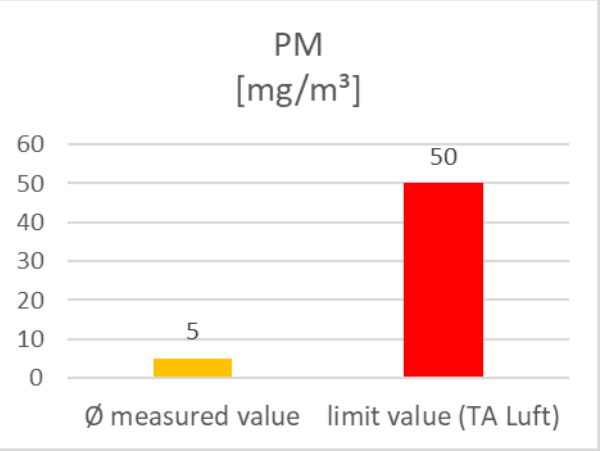
Results of the measurement campaign at the biomass heating plant in Malchin (Febr. 19th 2019)

Combustion prozess





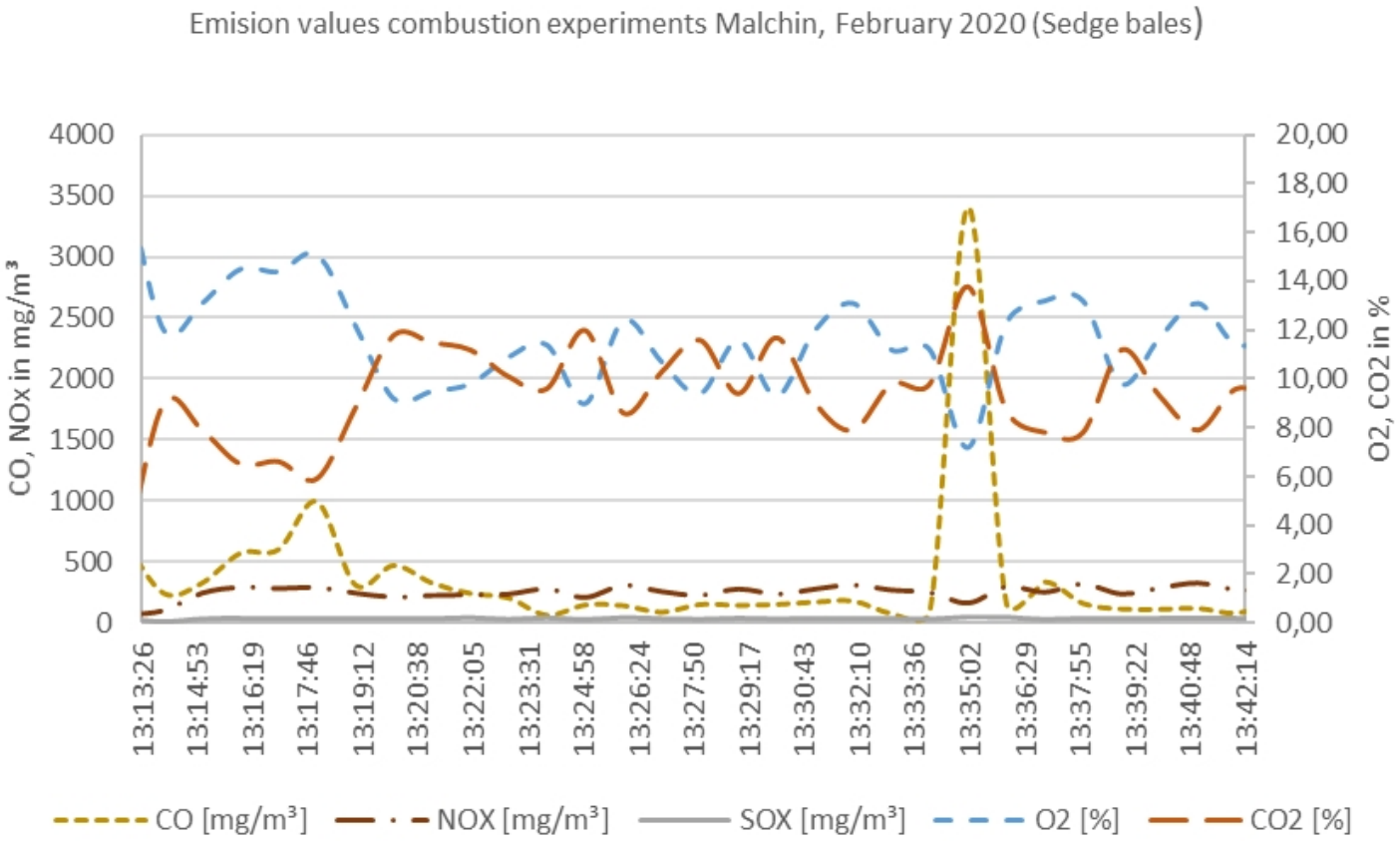




Results of the measurement campaign at the biomass heating plant in Malchin using sedge bales

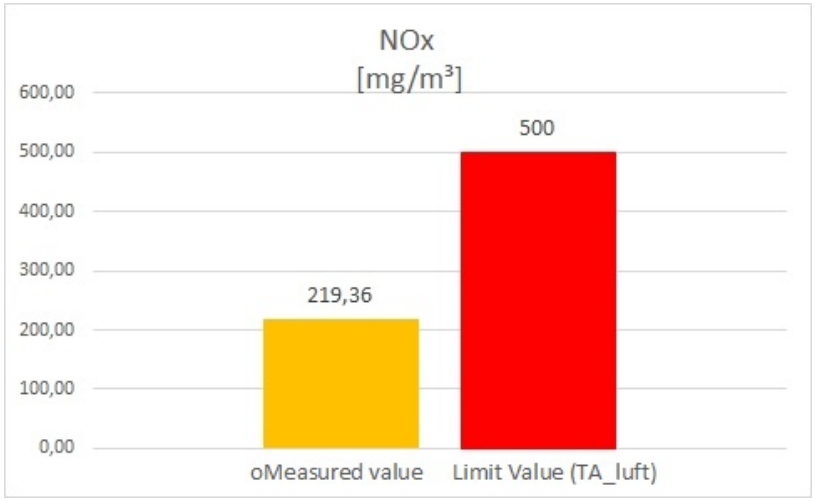
Flue gas component	Emission limit value
CO in g/m³	0.25
NOx in g/m³	0.5
TOC in mg/m³	50
PM in mg/m³	50

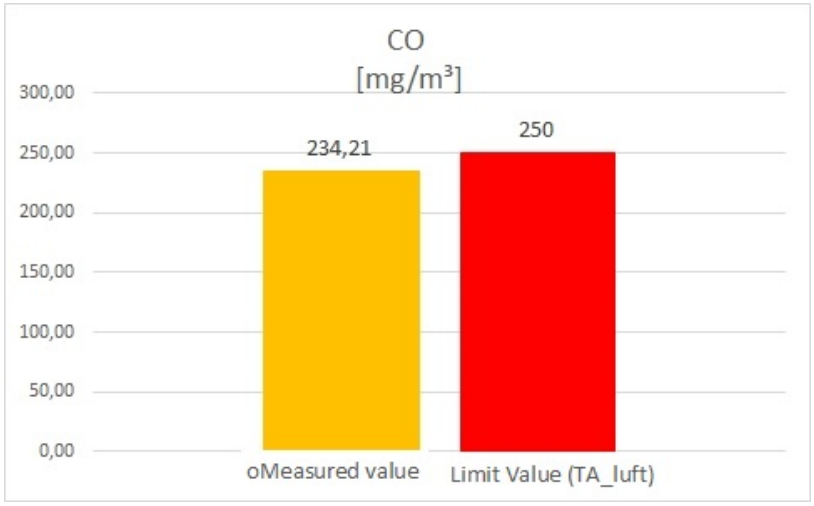
Sampling point outside



Results of the measurement campaign at the biomass heating plant in Malchin (Febr. 05th 2020)

Combustion process





We are still working on measures to optimize the combustion process by:

- **modified combustion air ratios**
- **constructive modifications in the burning chamber**
- **usage of improved fuel qualities**

Hochschule für Technik und Wirtschaft Berlin

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Thank you very much for your attention

contact: barz@htw-berlin.de

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