NO and SO$_2$ emissions from combustion of raw and torrefied biomasses and their blends with lignite

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PRESENTATION OUTLINE

- General Aspects
- Methodology
- Results
- Conclusion
NO and \( \text{SO}_2 \) emissions from combustion of raw and torrefied biomasses and their blends with lignite

**Why co-combustion?**

- Simple and economically feasible way of utilizing biomass/waste for replacement of fossil fuels
- Reduction in net \( \text{CO}_2, \text{SO}_2 \) and often \( \text{NOx} \) emissions

**Biomass/waste challenges**

- Low heating value
- High moisture content
- Hygroscopicity
- Excess smoke
- Low combustion efficiency
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- Higher energy density – lower transportation cost
- Improved grindability – suitable for dust burners (coal power stations)
- Hydrophobic – does not absorb water
- No biological degradation – can be transported and stored in the open air
- Clean combustion – suitable for indoor heating/cooking
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**Aim**
Investigation of NO and SO$_2$ release from blends of lignite with four different biomasses

**Fuel**
- Lignite
- Poultry litter (PL)
- Olive tree pruning (OP)
- Torrefied PL and OP Blends (1:3, 1:1, 3:1)

**Pelletization**
Ø 8 mm

900, 1000, 1100 °C

O$_2$, CO, CO$_2$, SO$_2$, NO
NO and SO₂ emissions from combustion of raw and torrefied biomasses and their blends with lignite

<table>
<thead>
<tr>
<th></th>
<th>Lignite</th>
<th>PL</th>
<th>OP</th>
<th>PL-B</th>
<th>OP-B</th>
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<tr>
<td>Ash</td>
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<td>C</td>
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NO and $\text{SO}_2$ emissions from combustion of raw and torrefied biomasses and their blends with lignite

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DOI: 10.1021/ef100571n
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Combustion time: 15 min for olive pruning
20 min for poultry litter
30 min for biochars / lignites
NO and SO$_2$ emissions from combustion of raw and torrefied biomasses and their blends with lignite

- no clear relation between the sulfur content of the fuel and the SO$_2$ emissions
- SO$_2$ emission depends on the amount and the composition of the mineral content of the fuel rather than on the sulfur content
- SO$_2$ emissions from torrefied biomasses are lower than that from that from raw biomasses despite their higher sulfur content
- temperature had effect on the SO$_2$ release
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SO₂ emissions cannot be predicted based on the results obtained using pure fuel.

blending of lignite with torrefied biomass significantly decreased the SO₂ emission compared with the lignite case
NO and SO$_2$ emissions from combustion of raw and torrefied biomasses and their blends with lignite

**Total NO emissions at different combustion temperature**

- NO emission is not purely depend on nitrogen content in fuel, high fuel-N content could enhance De-NOx reaction
- NO release from biomasses was lower than those from torrefied biomasses
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Experimental NO emission values for all blends were lower than the anticipated one.
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**CONCLUSION**

- SO₂ emissions increased with increasing combustion temperature (except olive pruning).

- Although the torrefied biomasses had higher sulfur content, SO₂ emissions from the torrefied biomasses were lower than those of the untreated raw biomasses.

- Co-combustion of lignite with torrefied biomasses had a beneficial impact on SO₂ release.

- No benefit of co-combustion on NO release could be observed for blends of torrefied biomass with lignite.
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