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Reactivity of sewage sludge, RDF, and straw chars towards NO

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Introduction - Minimizing NOx emissions from solid fuel combustion is important due to the harmful environmental impact and strict emission regulations. While the gaseous chemistry of nitrogen is fairly well established, the heterogeneous reduction of NO by char is less understood. This study investigated the reduction of NO over sewage sludge, RDF, and straw chars in a fixed bed reactor at varying temperatures and NO inlet concentrations.

**Materials and methods**

- Fixed bed char combustion
  - 10% O2/N2
  - 800°C
- Fixed bed NO reduction by char
  - [400,800,1500] ppmv NO/N2
  - [800,850,900] °C

**Results**

- 1D heterogeneous, transient, non-isothermal packed bed reactor model with one parameter description of flue gas mixing.
- NO formation (R1-R2) proportional to combustion rate with N/C as proportionality constant.
- Char-N to NO and N2O determined by FTIR measurements of combustion experiments.
- Non-convergent optimization problem i.e. strongly dependent on initial guess.

**Conclusions**

- Sewage sludge and RDF chars exhibited a high reactivity towards NO reduction.
- The initial NO reduction reactivity correlated well with the (Ca+Fe+K)/C molar ratio in the unreacted chars.
- A simple mathematical model based on first order kinetics described the conversion of char-N to NO in fixed bed combustion reasonably well.
- The obtained kinetic parameters could be implemented in large scale simulations.

**Future work**

- Investigate the influence of O2 and CO on the reduction reactivity of waste fuel chars.
- Examine possibilities of using waste chars as primary or secondary measures for NOx minimization, e.g. additive in the cyclone.