Liquor-to-Liquor Differences in Combustion and Gasification Processes: ÅAU Black Liquor Database

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Introduction - Background

• BL combustion characterisation has been performed at ÅAU since mid 1980’s
  – Swelling behavior during combustion
  – Sodium and sulfur release
  – Black liquor nitrogen chemistry

• Data available in different sources, forms and formats

→ A need to gather results from different "standard experiments"
Introduction - Purpose

• Gather unique liquor-to-liquor specific combustion information

• Study differences between liquors with various origins

• Act as a base for comparing different "groups of liquors"

• Act as a base for comparing the behavior of individual liquors

• Make experimental data accessible for further studies

Outline

• Introduction
• ÅAU Black Liquor Database
  – Content
  – Examples with results from database
• Experimental Equipment
  – Devices in use
• Conclusions
ÅAU Black Liquor Database

• Includes totally 397 black liquors
  – Currently background information available for 272 liquors

  – Pulp process
    • Sulfate 135, sulfite 13, soda 4, Miscellaneous 10, "Unknown" 110

  – Liquor type
    • As fired 76, virgin 45, "Other background" 44, "Laboratory liquors" 33, "Unknown" 74

  – Raw material
    • Hardwood 31, softwood 55, mixed wood 16, "Unknown" 148, Other 22 (Eucalyptus, Bagasse, Straw, Agro, Acacia, Kenaf)

ÅAU Black Liquor Database

• Experiments performed
  – Combustion characterisation ~280
    • 10mg, 800°C, air
  – Pyrolysis yields ~100
    • 10mg, 700 and 900°C, 100% N₂
  – CO₂ and NO formation ~100
    • 40mg, 900°C, 10% O₂

  – A number of other experiments and special studies has been performed
ÅAU Black Liquor Database- Examples

- Combustion times vs swelling during combustion for liquors from different pulp processes.
- Black Liquor 392 compared to other liquors
Outline

- Introduction
- Black Liquor Database
  - Content
  - Examples with results from database
- Experimental Equipment
  - Devices in use
- Conclusions
Experimental Devices

I. Single Droplet Muffle Furnace

II. Furnace for Pyrolysis Experiments

III. Single Droplet Reactor - Video Filming and Online Gas Analyzers

IV. Pressurized Grid Heater

I. Single Droplet Muffle Furnace

- Combustion times
- Swelling properties

![Diagram of Single Droplet Muffle Furnace]
II. Furnace for Pyrolysis Experiments

- Pyrolysis yield
- Conversion during pyrolysis

III. Single Droplet Reactor - Video Filming and Online Gas Analyzers
IV. Pressurized Grid Heater

- Pyrolysis yield and rate
- High heating rates (3000K/s)
- Thin film of black liquor

Conclusions...

- ÅAU Black Liquor Database includes combustion characterisation results for a variety of liquors
- Background for liquors partly available
- Data reported for certain standard conditions
- Data given in an uniform format
...Conclusions

• Study the main trends for liquor groups
• More detailed data still available for each data point
• Correlations between:
  – Combustion times
  – Pyrolysis yields
  – CO₂ and NO formation
  – Liquor origin

• Data will be publicly available as technical report

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