

CFD MODELING OF WASTE-FUEL BOILER COMBUSTION SYSTEMS



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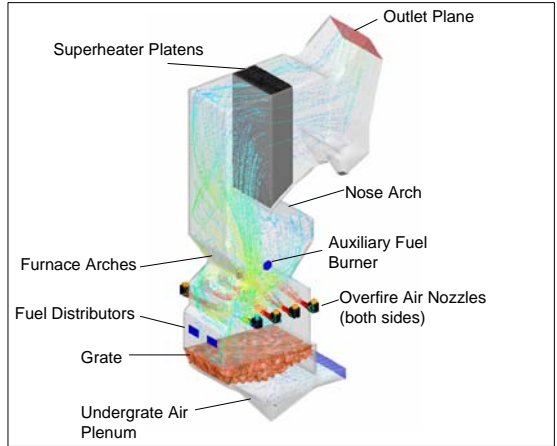
Operating Goals – Waste-fuel Boilers

- Fuels include biomass and other wastes
- Reduce emissions
- Improve efficiency
- Increase load

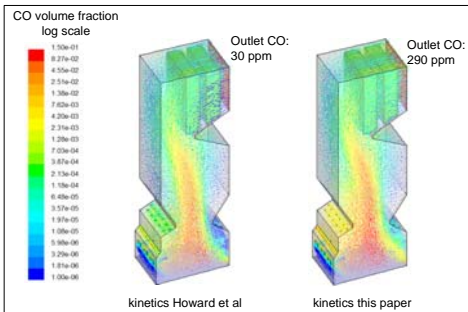
CFD Modeling

- FLUENT based
- Customized for specific solid fuels
- Includes grate burning
- Typically a dozen gas species and reactions
- 50+ Boilers modeled

Typical waste-fuel boiler



Modeling CO kinetics



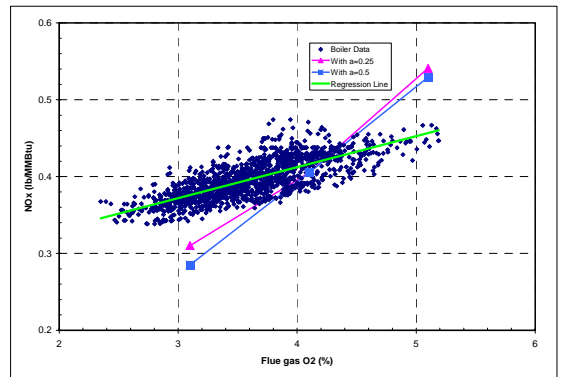
CO Modeling

- Important for temperature and emission predictions
- Need simple, but robust, model
- Kinetic model including [CO], [O₂], [H₂O]
- Tuned with data from over 50 boilers

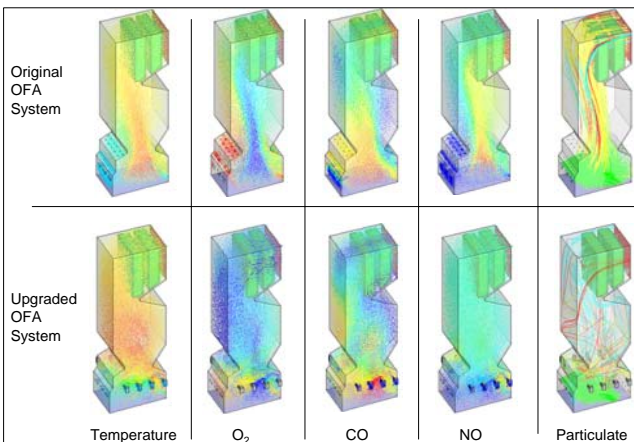
NO_x Modeling

- New model needed for industrial furnaces
- Excess air important for NO_x prediction
- Based on laboratory data (Duo *et al.*)
- Incorporates oxygen concentration
- [O₂]^a dependence is non-linear
- Refined with boiler measurements

Measured and predicted NO_x emissions versus excess air



Improvements with upgraded OFA



Summary

- CFD models essential for air system design
- Help improve mixing of air and fuel
- OFA upgrades of more than 50 boilers
- Improvements in:
 - Waste-fuel burning capacity
 - Efficiency
 - Emissions