B69: Handling Characteristics of Biomass/Coal Mixes in Co-Firing: Measurement Techniques and Establishing Benchmarks

N S Khan
Introduction
Introduction

• Reduction of CO$_2$ emissions

• Handling Issues in Power plants

• To meet DTI guidelines of 10% UK electricity from renewable energy sources by 2010

• Concerns of power generators for obtaining “Renewables Obligation Certificates” (ROC’s)

• Economic option for a renewable alternative, being used in 13 biomass co firing coal power plants in UK already.
Handling issues

- **Biomass materials are difficult to handle**
  - Biomass fines is a cause of concern
  - They degrade over time and cake
  - Tendency to segregate - wide particle size & shape distribution
  - Moisture content – moisture migration
  - Dust problems

- **Increased problems as the biomass proportion from increases to that of coal**
Aims & Objectives
Aims of project

• Characterisation studies of the coal/biomass mixes
  • internal strength
  • wall friction
  • adhesion characteristics

• Segregation tendency of the biomass material
Objectives of the project

• Determine the most cost effective techniques for measurement.

• Using the identified techniques to establish an understanding of mixes (coal/biomass).

• Establish a series of benchmarks regarding the limits of “handleablity”
Experiments & Results
Identified measurement techniques

- **Wolfson annular shear tester**
  - Determine failure properties of the mixes
  - Caking tests

- **Jenike type wall friction tester**
  - Determine the wall friction characteristics of mixes

- **QPM Segregation tester & large tester**
  - Understand likely segregation problems in handling and storing
Wolfson annular shear tester
Jenike type wall friction tester
Experiments completed

- Wolfson Annular shear test
  - 100% biomass ‘A’ with 8%, 12%
  - 100% coal ‘A’ with 8%, 12%, 16% moisture addition
  - 90:10 coal ‘A’: biomass ‘A’ mix ratio with coal moisture of 8%, 12%

- Particle size distribution work on biomass ‘A’ & coal ‘A’

- Moisture Analysis
  - Determining the moisture of the coal and biomass

- Wall friction tests
  - Coal ‘A’ 5.96% wb and 10% db (wb-wet basis, db-dry basis)
Mix Ratio 90:10 (Coal A: Biomass A) by Volume

Unconfined Failure Strength $f_c$ vs. Major principal Stress $\sigma_1$

- Mix 1: 8%
- Mix 2: 8%
- Mix 3: 12%
- Mix 4: 12%
Conclusions
Conclusions

- Determined that with increase in moisture content of the coal, mixes (fines) become less free flowing and gain strength.

- Caking could be taking place in the bunkers due to moisture migration (needs further investigation) which is the reason for bunker rat holes and flow problems.

- Tests to be carried out on the recently developed large annular shear tester will give better idea about the mixes close to actual plant conditions.
Wolfson large annular cell
Wolfson large annular cell
Benefits & Future
Industrial benefits

- Flowability trials with a range of coal: biomass mix ratios will enable plant users to establish max% biomass that can be successfully used in plant

- More biomass means less coal to use in plant and hence help attain more ROC’s

Scientific benefits

- Mixes results will help in better design of plant equipment for future use and hence avoid problems of flow
Future plans

- Tests on the large annular tester using higher mix ratios using different kinds of potential biomass materials
- Segregation tests to determine tendency to segregate
- Caking tests
- Determine areas which are potential problems of the future in handling biomass
Thank you
Any Questions?