On-line Measurement of Size Distribution and Concentration of Pulverised Fuel using Digital Imaging Techniques

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Summary

- Introduction
- Measurement Principles
- System Operation
- Experimental Arrangement/Results
- Industrial Tests
- Conclusions and Future Work

Background

New Results

Future Work
Introduction

- For efficient and consistent operation of pneumatic conveyors and the burners they feed, the flow parameters must be known.

- On-line particle sizing and mass flow rate measurement of pulverised fuel are the challenges at the heart of the current research.

- The present work employs a cost-effective sensing strategy, through the use of a combination of sensing technologies, that is suitable for industrial use.
Measurement Principles

- For the imaging based sensor a transparent section of pipe is used. A CCD camera looks into the pipe and particles are illuminated by a laser sheet – clear images are produced.

- For the electrostatic sensor signals are received from ring electrodes in the pipe and cross correlated to find velocity.
Mass flow rate = \( \rho \times \text{Concentration} \times \text{Velocity} \)
Test Results

Graph showing mass flow rate versus relative error for different speeds.
Particle size ranges (µm)

Size Distribution Results

0.5% cons.
1% cons.
1.5% cons.
2% cons.
Repeatability Test

Particle size ranges (µm)

- 90-106
- 106-125
- 125-150
- 150-180
- 180-212
- 212-250
- 250-300
- 300-355
- 355-425
- 425-500
- 500-600
- 600-710

Standard deviation of measurement (%)

- Off-Line Laser Diffraction
- Off-Line Imaging
- On-Line Imaging
Industrial Testing
Biomass Analysis

Mean Shape Factor = 0.194

Mean Shape Factor = 0.343
Biomass Analysis

Mean Shape Factor = 0.352

Mean Shape Factor = 0.292
Pulverised Coal Analysis

Mean Shape Factor = 0.318

Mean Shape Factor = 0.262
Pulverised Coal Analysis

Optimum Middleburg

Mean Shape Factor = 0.262

Unknown Coal

Mean Shape Factor = 0.277
Conclusions

• The results so far have demonstrated that the use of imaging sensors is a viable approach for measuring particle parameters in pulverised fuel flows.

• The combination of imaging data with velocity has allowed on-line mass flow rate measurements to be made.

• A close agreement between measured and expected quantities has been demonstrated.

• Low-cost optics and a standard PC have ensured the systems cost effectiveness.

• Future work will consist of more tests at RWE npower CTF and final real world tests at Tilbury power station.
THE END

Please feel free to ask questions

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