Abstract:

Burning coal as a fuel has been the primary source for electricity generation for over a hundred years. Even now because of its low cost and wide availability it still accounts for the highest percentage of worldwide electricity production. In today's world of environmental awareness, however, environmental targets are set to push for more renewable sources of power generation. Many coal fired power stations are increasingly using biomass fuel mixed with conventional coal to meet these targets.

This paper presents a method of online monitoring of the particle velocity, particle size distribution and particle concentration for the whole cross section of the pipe for a pneumatic bulk solid conveyor system. This would allow the complex multiphase flow associated with coal/biomass mixture to be monitored. This is achieved by using an array structure of electrostatic sensors (to measure particle velocity) and piezoelectric impact sensors (to measuring particle size distribution and particle concentration). This sensing arrangement is shown below in Figure 1. Since the array sensor comes into contact with the particle flow the outer casing is coated with abrasive resistant ceramic. A novel feature of this sensor design is that the signal conditioning circuit for both the electrostatic sensor and piezoelectric impact sensors are housed inside the sensor array itself to reduce the amount of noise that can enter between the signal conditioning circuit and electrodes (for the electrostatic sensors) and piezoelectric film (for the impact sensors). This is especially important for the electrostatic sensors since the cross correlation method is used to determine particle velocity and any noise would affect the quality of the correlation.

Testing and evaluation is conducted using a newly constructed positive pressure pneumatic bulk solid conveyor test rig at the University of Kent which has been designed to be as close as possible to systems found in industry. Experimental results obtained on both horizontal and vertical pipe sections of the test rig are presented and discussed.

Figure 1 Diagram of intrusive array probe sensor: left a single array; right a multi array.

Keywords: pulverised fuel, particle size distribution, velocity profile, mass flow rate, concentration, electrostatic sensor, piezoelectric sensor, array probe.

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