Development of a four electrode induction probe for charge measurements in fluidized beds

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***Abstract*—Charge of fluidized powder can be measured using an induction probe. The signal arises from variations of the charge density as bubbles are travelling within charged bed of powder. In order to obtain reliable value of charge density, the volume of the bubbles needs to be known in addition to charge. In most of the published literature in this field, the bubbles are confined within a certain volume and the pass the probe via predefined route. In real three dimensional beds, the bubbles travel at random locations.**

The location of a bubble can be measured using a probe consisting of several electrodes. Depending on the size and location of the electrodes, the shape and magnitude of the signals vary according to the size, location, charge and speed of the bubbles. By carefully examining these signals, bubble parameters mentioned above, could be solved. In previous study [1,2], a concentric arrangement of three electrodes was used. The probe provided reasonably good data especially when charged spheres were examined. However, the signal quality was not optimal for fluidized beds, and thus mathematical analysis of the signals was difficult.

In the presented study, a probe consisting of four electrodes has been numerically and theoretically studied. Two cylindrical middle electrodes were aligned vertically to provide velocity information about rising bubbles. Additional two rectangular side electrodes were placed at both sides of the middle electrodes. Intensity ratios between the side electrodes and the middle electrodes provide the distance of the bubble from the probe and the horizontal angle from the probe axis. As the bubble velocity is related to the bubble size [3], the diameter (or volume) of the bubble is obtained from the middle electrode data. Charge of the bubble (or more precisely, absence of charge inside the bubble volume) can be obtained from any of the electrodes after the size and location have been resolved.

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