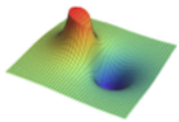
Proceedings of STEP-V
The virtual symposium on Static-Tribo-Electricity of Powder



Date of presentation: 28 November, 2020
STEP-V#4

Electrostatic charge generation of glass beads by sieving

Tatsushi Matsuyama, and
Hazuki Ishii, Miki Kitamura, Hidemi Itai, Junich Ida
Faculty of Science and Engineering, Soka University, Hachoji, Tokyo, JAPAN
E-mail: tatsushi@t.soka.ac.jp

Sieving is a widely used technique in powder processing, not only for size classification but also for evaluation of particle size distribution (test sieving). Because in the sieving processes particles will hit on mesh screen or frame, electrostatic charge may be generated and it is suspected to cause particle adhesion, or hazards due to electrostatic discharge. In such respect, the first question may be how much amount of charge will be generated due to sieving process, although few references are available. In this report, a newly developed experimental set-up to measure charge generation will be reported with some measurements of glass beads.

1. The customized charge measurement system consists of two Faraday-cages, this is the feature of this new device, to allow to measure the charge before and after sieving. Small sieves of 50 mm in diameter were used, and they are made of stainless-steel. A sieve is directly connected to oscilloscope via charge amp., with all the isolation from other parts including an arm of ultrasonic vibrator to activate the sieving: this constitutes the first Faraday-cage. The second one is a Faraday-cup located under the sieve, with a weight measurement system.
2. Glass beads were commercially purchased (AZONE BZ-01 and -02), and pre-classified with a stuck of standard test sieves (ISO 3301-1, R40/3) from 425 to 106 μm. Beads of each size class (fines) were sieved with a closest bigger size sieve, with coarse beads of each bigger size class. In the experimental procedure, a coarse beads were loaded into the sieve in interest with one gram, then fines were loaded with one gram, then ultrasonic sieving were activated to sieve fines.
3. Initial charge of fines, as the charge held by the sample when it was loaded in the sieve, and charge after sieve were measured. The sizes of 'fines' were, in its class value, 112.5, 170, 196, 231, 327.5, 390, 462.5 μm.
4. With all the size range, the charges after sieve substantially increased, in its absolute value, from initial charge, but they were not dominant, or quite competitive with the initial charge. The range of charge-to-mass ratio of charges were single nC/g in its order of magnitude.
5. Only with the combination of 112.5 μm beads as fine and other size a coarse, reversal polarity was obtained. In general, glass beads charged negative, but only the case fines showed positive charge. This did not happen with single experiment, only fines were sieved without mixture with coarse.
6. A multiple regression was tried with independent parameters of initial charge, inversed particle size and relative humidity to the target value of charge after sieve. The results showed a fairly good explanations, but still variation of entire data was relatively large.

Acknowledgements:
The authors acknowledge Tokyo screen co.ltd, for technical support for sieves and ultrasonic sieving system, and Nano seeds co.ltd. for weight measurement system.