**IN-LINE ELECTROSTATIC CHARGE MEASUREMENTS OF CONVEYING PHARMACEUTICAL POWDERS USING AN ELECTROSTATIC POWDER FLOW SENSOR (EPFS).**

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Key Words: Electrostatic; tribo-electrification; powder; charging; in-line.

Tribo-electrification of powders during a pharmaceutical process can lead to unwanted issues such as adhesion of powders to the processing equipment (Samiei, 2017). A Faraday Cup can be used to quantify the charge on powders, although the technique is limited to providing a single ‘static’ measurement (Šupuk, et al., 2012). However, the mechanisms of electrostatic charging are dynamic and strongly dependent on powder flow rates and environmental conditions that prevail within the manufacturing process in question. The aim of this study was to develop a methodology for assessing the dynamic charge on a variety of pharmaceutical powders so that a risk rating might be developed in the future which registers the propensity of powder accumulation as a direct result of tribo-electrification. An electrostatic powder flow sensor (EPFS), which measures the electrostatic fluctuation caused by the surface charges on moving particles, provides an alternative and dynamic measurement of electrostatic charge powder, one which captures not only the inherent charges but also those that originate under the active condition of flow. The EPFS comprises of a dual ring-electrode system. The two electrodes act as an electrometer and are linked to a two-channel current to voltage (IVC) converter and a data acquisition module, acquiring measurements at 2 kHz, to produce an electrostatic ‘noise’ spectrum. A two-decimal place solid-state balance captured the mass flow rate at a weighing rate of 20Hz and hence the rate of acquisition of the Root-Mean-Square (RMS) of the electrostatic ‘noise’ was set to the same frequency. The RMS values were recorded for powders conveyed using a volumetric twin-screw feeder (T20, K-Tron), which were normalised against the mass flow rate over a period of consistent flow (see Table 1). Further in this work, Avicel PH102, oven-dried to reduce the moisture content, was used to model the tribo-electrification of powders that experience moisture loss due to exposure to excessive temperatures generated as a result of prolonged processing times. Figure 1 shows how the onset of tribo-electrification could be detected by monitoring the fluctuations in the normalised RMS over time. In conclusion, it is hypothesised that the degree of charge on the powder, as indicated by the normalised RMS, may be influenced by its material attributes and can thus be used to predict whether powders may be susceptible to electrostatic charging within a given process. Furthermore, it is anticipated that tribo-electrification detected using the EPFS may indicate the onset of known failure modes induced by excessive electrostatic charging, such as deviations in content and weight uniformity.

*Table 1 – Normalised RMS values recorded for powders conveyed through a twin-screw feeder.*

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| --- | --- |
| **Material** | **Mean RMS normalised against mass flow rate (mV/g-1s) (n=3)** |
| Lactose 200M | 160 ± 12% |
| Avicel PH102 | 40 ± 4% |
| Avicel PH101 | 30 ± 8% |
| Maize Starch | 16 ± 7% |
| Lactose #316 Fast-Flo | 5 ± 7% |
| Compap-L | 5 ± 9% |

*Figure 1 – Normalised RMS expressed as a function of time recorded for Avicel PH102, oven-dried to reduce moisture content and conveyed through a twin-screw feeder.*

References:

Samiei, et al., 2017. The influence of electrostatic properties on the punch sticking propensity of pharmaceutical blends. PowderTech, **305**, 509-517.

Šupuk, et al., 2012. Tribo-electrification of active pharmaceutical ingredients and excipients. PowderTech. **217**, 427-434.

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