

The Scaling of Triboelectric Charging Powder Drops for Industrial Applications

*Tom F. O'Hara*¹, *Ellen Player*², *Graham Ackroyd*², *Peter J. Caine*², *Karen L. Aplin*¹

¹ University of Bristol, Bristol, United Kingdom

² Syngenta, Huddersfield, United Kingdom

Abstract:

Triboelectrification of granular materials is a poorly understood phenomenon that alters particle behaviour, impacting industrial processes such as bulk powder handling and conveying. At small scales (< 1 g) net charging of powders has been shown to vary linearly with the total particle surface area and hence mass for a given size distribution. This work investigates the scaling relation of granular triboelectric charging, with small, medium (< 200 g), and large-scale (~ 400 kg) laboratory testing of industrially relevant materials using a custom powder dropping apparatus and Faraday cup measurements. Our results demonstrate that this scaling is broken before industrially relevant scales are reached. Charge (Q) scaling with mass (m) was fitted with a function of the form $Q \propto m^b$ and b exponents ranging from 0.68 ± 0.01 to 0.86 ± 0.02 were determined. These exponents lie between those that would be expected from the surface area of the bulk powder ($b = 2/3$) and the total particle surface area ($b = 1$). This scaling relation is found to hold across the powders tested and at varying humidities.

Keywords: triboelectricity granular matter, Faraday cup, powder handling

Category (topic): TOPIC-I Applications and Industry

Preference: Oral

Corresponding author: Tom O'Hara

E-mail: tom.ohara@bristol.ac.uk