

TRIBOELECTRICS

Introduction

This document explains the triboelectric effect on which Triboelectric Emission Monitors rely. For more detail on the application of the triboelectric effect to Triboelectric Emission Monitoring, please refer to Advanced Triboelectrics.

The Triboelectric Effect

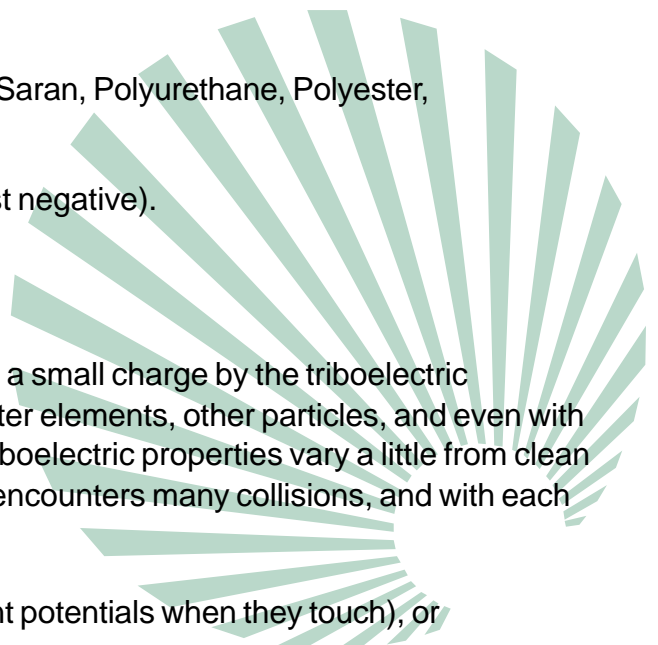
The TRIBOELECTRIC effect is the transfer of electric charge on contact between dissimilar materials by contact (traditionally by rubbing). The outermost electrons of each material are bound to differing degrees, depending on the material itself, the surface smoothness and surface contamination, but a number of tests have been made which show approximately the triboelectric relationship between a variety of materials. Generally, if two materials collide, then the further they are separated on the TRIBOELECTRIC SERIES, the more charge will be transferred. A commonly quoted triboelectric series is as follows (note that the order may depend in detail on how the test is conducted).

- Most positive: Air and most gases, Dry human hands, Asbestos, Rabbit Fur,
- Acetate, Glass, Mica,
- Human Hair, Nylon, Wool, Fur,
- Lead, Silk, Aluminum, Paper, Cotton,
- Steel, Wood, Amber, Sealing Wax, Hard Rubber,
- Mylar, Nickel, Copper, Silver,
- UV Resist for PCB manufacturing,
- Brass, Gold, Platinum, Sulfur,
- Acetate Rayon, Celluloid, Orlon, Styrene, Acrylic, Saran, Polyurethane, Polyester,
- Polyethylene, Polypropylene,
- PVC, KELF, Silicon, Teflon, Silicone Rubber (most negative).

Triboelectrics in Industry

In industrial applications, all moving particles acquire a small charge by the triboelectric mechanism from collisions with the duct, dampers, filter elements, other particles, and even with the gas; like air, flue gas is mostly Nitrogen, but it's triboelectric properties vary a little from clean air. As each particle travels along the duct system, it encounters many collisions, and with each collision some charge is transferred, by either

- electrostatic transfer (between particles at different potentials when they touch), or



- triboelectric generation (between different materials when they touch).

As successive collisions occur, the triboelectric effect tends to continue transferring charge. However these charge transfers create a potential difference between the colliding objects which opposes any further charge transfer. The electrostatic transfers also tend to equalise potential between the objects, so that after a number of similar collisions, a particle will have reached a state of charge equilibrium, at least until the conditions change (eg from fabric filter medium to the dampers to the duct to the probe).

As charged particles pass by or collide with a metallic probe, their electric field induces a small current in the probe which is measurable.

The equilibrium state will have been reached in most industrial processes, ensuring a predictable behaviour, so Triboelectric emission monitors are a most cost effective and reliable method of indicating airborne particulate emissions from industrial plant. Their sensitivity depends on a number of parameters, and covers a wide range of emission levels. Where a quantitative output is required, each probe should be calibrated in situ by conducting an isokinetic test or equivalent while totalising the probe's output, a built in function of the CONNECT software.

