Electrostatic charging as an interferendce factor during analytical weighing processes

Dieter Feller and Karl-Armin Opfer

Electrostatic charges

Every one of us will have had experience of electro-static charging. Either in the form of a mild electric shock when getting out of a car or touching a hand rail, or trying to control unruly "flying hair". These are the usually unwanted effects of electrostatic charging.

From thepoint of view of a lab operator involved in weighing processes, this phenomenon couldbe dismissed as an annoyingbuttrivialproblem affecting our private lives, if not for the fact that it causes continual problems when it comes to the process of analytical weighing.

Before we turn our attention to solution possibilities, first of all let us take a brief look at the "phenomenon of electrostatic charging". The first findings in this field stretch back to the Greek scientist Thales (640 to 547 BC.), who also made a name for himself in as a mathematician.

As long ago as 90 years after the founding of Rome, he discovered that a piece of amber rubbed against his clothing attracted lightweight papyrus particles in the same way as a magnet. The Greek word for amber is "electron"; the word static is derived from Latin and describes a standstill or idle status.

So our knowledge about static electricity originates from a long way further than back than our understanding of "electrodynamics", which is more familiar to us as the electrical circuit.

Charging phenomena can beseparated into three categories:

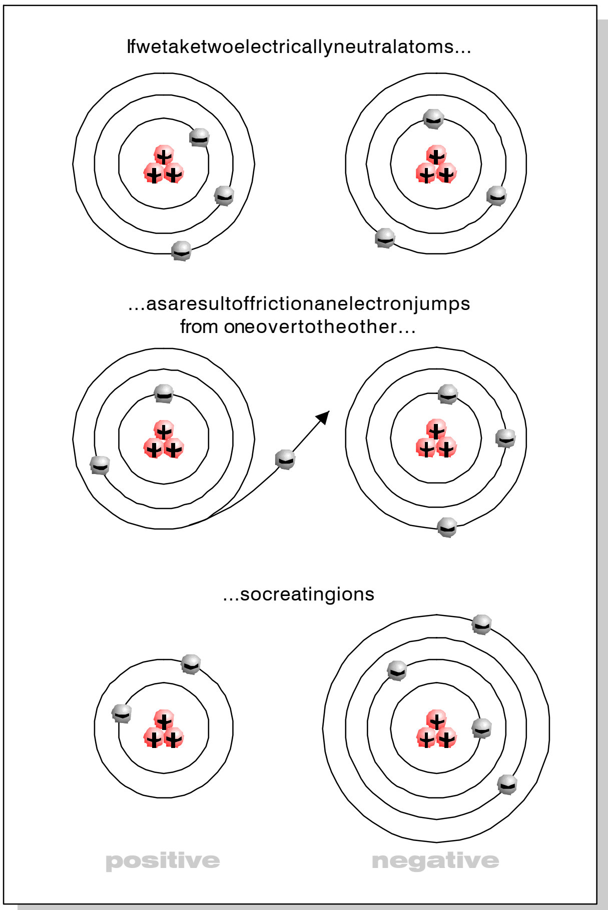
- charging involving relative mechanical motion of objects and surfaces.
- charging as a pure contact phenomenon (no relative macroscopic motion occurs).
- charging as a primarily chemical (or electro-chemical) process.

The first category is one of the oldest known forms of charging. As a result of friction, electrons are "released" from the body with the lower discharge energy (donator). They jump over to the body with the higher dischargeenergy (acceptor). As a result, ions are created which charge the body either negatively (in case of an excess of electrons) or positively (in case of a deficit of electrons). These charges are temporary, i.e. they aredischarged again as soon as they have the opportunity, for example as a result of earthing. As it is regrettably not possible to create a galvanic earth connection everywhere on the surface of an insulating material, a different solution has to be found.

At least in theory, the following conceivable possibilities exist for this:

- To reduce surface resistance levels
- To reduce contact surfaces
- To apply separating or distance agents
- To increase relative humidity
- To apply antistatic agents
- To provide reliable earthing
- Passive or active ionization

From thepractical point of view, most of these optionsarenotfeasible when applicable to analytical weighing processes.



ill.1:Themodelofanatomillustrateselectrontransition.

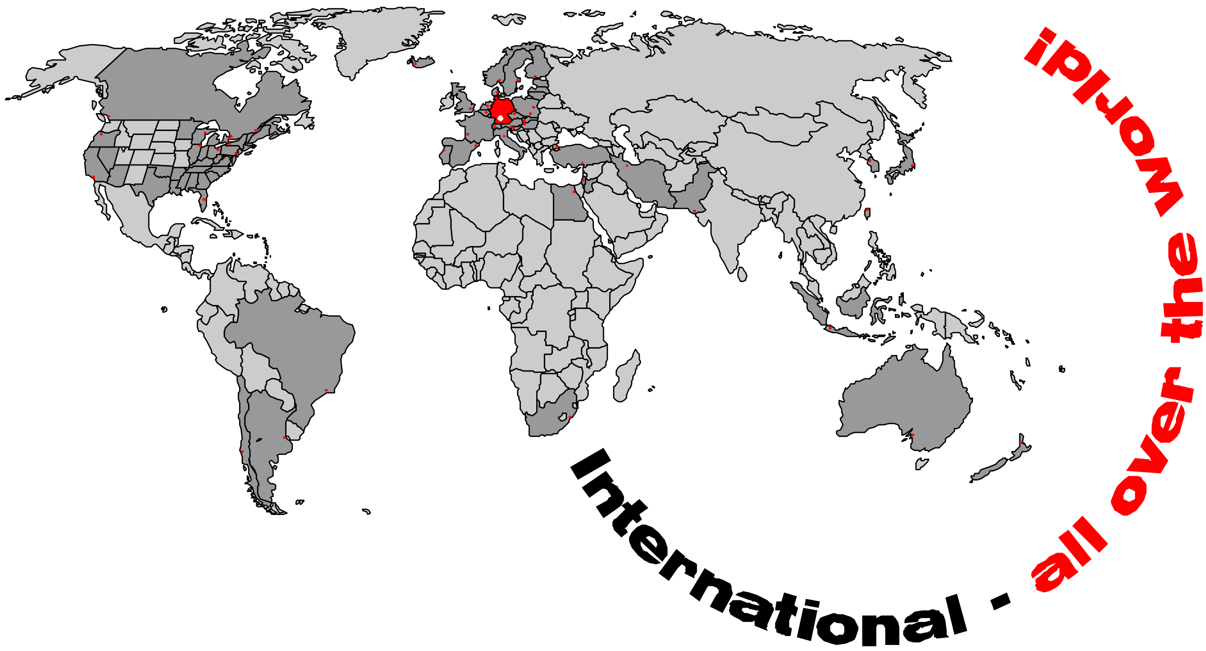
HAUG Ionization

Electrostatic charging as an interference factor during analytical weighing processes

Dieter Feller and Karl-Armin Opfer
HAUG GmbH & Co. KG

Ionizing Systems

D-0134-GB-06/05-V1.2



HAUG ®

HAUG GmbH & Co. KG **Germany**

Friedrich-List-Str. 18
D-70771 Leinf.-Echterdingen
Phone: +49 711 / 94 98-0
Telefax: +49 711 / 94 98-298
www.haug.de
E-mail:info@haug.de

HAUG Biel AG **Switzerland**

Johann-Renfer-Str. 60
CH-2500Biel-Bienne 6
Phone: +41 32 / 344 96 96
Telefax: +41 32 / 344 96 97
www.haug-ionisation.com
E-mail:info@haug-biel.ch

HAUG North America **Canada**

Limited Partnership
1200 AerowoodDrive,Units14&15
Mississauga, ONL4W2S7,Canada
Phone: +1 905 / 206 97 01
Telefax: +1 905 / 206 08 59
www.haug-static.com
E-mail:info@haug-static.com

So what can be done?

There are two possibilities here:

1. The passive option, i.e. to take all the necessary precautions for "proper discharge" in the scale itself. This involves for instance the comprehensive use of high-grade steel from the scale pane through to the power supply unit
2. Active high-voltage ionization

An active high-voltage ionizer is made up fundamen-tally of a high-voltage power supply unit and the actual ionizer. The power supply unit generates an alternating voltage of around 7000 Volts and is connected to the ionizer by means of a flexible high-voltage cable. The positive and negative ions created at the tips of the ionizer neutralize the charge on the surface of the charged material.

A major advantage of high-voltage ionization is that, in accordance with the sinus curve of the applied alternating voltage, both positive and negative ions are created. Therefor it makes no difference whether there is positive or negative charge to compensate.

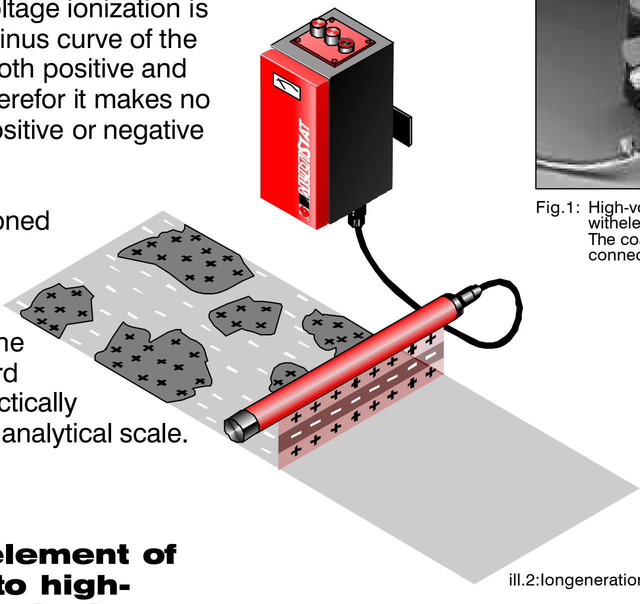
If the an U-electrode is positioned immediately in front of the weighing area, the discharge process takes place at the nearest possible position to the scale pan. This saves awkward handling and takes place practically automatically when filling the analytical scale.

Surface resistance of different materials

Material	Ohm cm	
Wood (dry)	10^{9}	(1 Gigaohm)
Paper	10^{10}	(10 Gigaohm)
Glass	10^{11}	(100 Gigaohm)
PVC (polyvinyl chloride)	10^{14}	(100 Teraohm)
PS (polystyrene)	10^{16}	(10 Petaohm)
PP (polypropylene)	10^{16}	(10 Petaohm)
PE (polyethylene)	10^{17}	(100 Petaohm)

TableI:Specificresistanceofdifferentmaterials.

Fig.1: High-voltagepowersupplyunitMULTISTAT withelectronicfunctionmonitoring. The coaxialconnectionsocketspermit connectionofseveralionizers.



ill.2:Iongenerationusinganactivehigh-voltageionizer.

Is there no element of danger due to high-voltage at the ioniser?

This is something you are certain to have asked yourself. Unfortunately it is the case that certain ionizing equipment manufacturers still work with so-called "hot" electrodes, i.e. electrodes in which the high voltage is actually connected galvanically to the ionizing pin. Although the flowing current is generally only a few milliamperes, contact is not totally without danger.

Modern ionizers, in contrast, are based on the principle of capacitative current decoupling and are accordingly completely shockproof. In conjunction with a modern, self-calibrating analytical scale, it is possible to guarantee both the reliability of measured results and also electrical safety for the operator.

ill.2:Anionizerinfrontoftheweighingareaofananalyticalscaleensuresthat weighedmaterialsareelectricallyneutral.