Static electricity

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Electric charge at rest, generally produced by friction or electrostatic induction. In the sixth century BC, Thales of Miletus, who is usually credited with the discovery of static electricity, described experiments in which rubbed amber induced movement in nearby particles. It was not until the eighteenth century, when Benjamin Franklin carried out his kite-flying experiments in which he "captured" some thunderstorm electricity in a Leyden jar, that it was verified that thunderstorm electricity and static electricity were one and the same. *See also:* ELECTRIC CHARGE.

Triboelectrification is the process whereby charge transfer between dissimilar materials, at least one of which must have a high electrical resistivity, occurs due to rubbing or mere contact. Contact and separation of materials occur during industrial operations such as powder processing and the manufacture of plastic and other materials in sheet form. *See also:* ELECTRICAL RESISTIVITY.

Most organic and polymeric materials have volume resistivities greater than 10^8 ohms per meter and retain charge for periods of many hours. Triboelectric charging is not fully understood, and the magnitude of charging may be strongly influenced by surface contamination of the contacting materials, relative humidity of the atmosphere, and the energy of rubbing. For example, during the grinding of material during powder manufacture, charge levels of about a microcoulomb per kilogram are typical. This is a relatively low level of charge. The more energetic process of pneumatically conveying a powder along a pipe may give rise to charge levels a thousand times greater and an electrostatic hazard may arise. Hazards are due to sparks to ground after a relatively large amount of static charge has accumulated on a body that is improperly grounded. *See also:* ELECTRIC INSULATOR; ELECTRIC SPARK.

In modern industry, highly insulating synthetic materials, such as plastic powders and insulating liquids, are used in large quantities in an ever increasing number of applications. Such materials charge up readily, and large quantities of electrical energy may develop with an attendant risk of incendiary discharges. When, for example, powder is pneumatically transported along pipes, charge levels of up to about 100 microcoulombs per kilogram can develop and potentials of thousands of volts are generated within powder layers and the powder cloud. Energetic sparking from charged powder may initiate an explosion of the powder cloud. Similar problems occur when insulating liquids, such as certain fuels, are pumped along pipes, and it is essential that strict grounding procedures are followed during the refueling of aircraft, ships, and other large vehicles.

The capacity of a person for retaining charge depends upon stature, but is typically about 150 picofarads. Even the simple operations of removing items of clothing or sliding off a chair can lead to body discharges to ground of about 0.1 μC, which are energetic enough to ignite a mixture of natural gas and air. Human body capacitance is sufficiently high that, if poorly conducting shoes are worn, body potential may rise to 15,000 V or so above ground during industrial operations such as emptying bags of powder. Sparking may then occur with energy exceeding the minimum ignition energy of powder or fumes, so initiating a fire or explosion. Conducting footware should be used to prevent charge accumulation on personnel in industrial situations where triboelectrification may occur. *See also:* CAPACITANCE.

In the microelectronics industry, extremely low-energy discharges, arising from body potentials of only a few tens of volts, can damage microelectronics systems or corrupt computer data. During the handling of some sensitive semiconductor devices, it is imperative that operators work on metallic grounded surfaces and are themselves permanently attached to ground by conducting wrist straps. Whenever films of insulating material are wound over rollers, such as in the photographic industry, surface charging and subsequent discharging occur. The discharges observed from charged insulator surfaces are brushlike and are known as brush discharges. *See also:* ELECTROSTATICS.

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