STATIC ELECTRICITY

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INTRODUCTION

Lightning is a dramatic natural example of static discharge. While the details are unclear and remain a subject of debate, the initial charge separation is thought to be associated with contact between ice particles within storm clouds. In general, significant charge accumulations can only persist in regions of low electrical conductivity (very few charges free to move in the surroundings), hence the flow of neutralizing charges often results from neutral atoms and molecules in the air being torn apart to form separate positive and negative charges, which travel in opposite directions as an electric current, neutralizing the original accumulation of charge. The static charge in air typically breaks down in this way at around 10,000 volts per centimeter (10 kV/cm) depending on humidity.[8] The discharge superheats the surrounding air causing the bright flash, and produces a shock wave causing the clicking sound. The lightning bolt is simply a scaled-up version of the sparks seen in more domestic occurrences of static discharge. The flash occurs because the air in the discharge channel is heated to such a high temperature that it emits light by incandescence. The clap of thunder is the result of the shock wave created as the superheated air expands explosively.

ELECTRONIC COMPONENTS

Many semiconductor devices used in electronics are very sensitive to the presence of static electricity and can be damaged by a static discharge. The use of an antistatic strap is mandatory for researchers manipulating nanodevices. Further precautions can be taken by taking off shoes with thick rubber soles and permanently staying with a metallic ground.

Static electricity is a major hazard when refueling an aircraft.

Discharge of static electricity can create severe hazards in those industries dealing with flammable substances, where a small electrical spark might ignite explosive mixtures.[9]

The flowing movement of finely powdered substances or low conductivity fluids in pipes or through mechanical agitation can build up static electricity.[10] The flow of granules of material like sand down a plastic chute can transfer charge, which can be easily measured using a multimeter connected to metal foil lining the chute at intervals, and can be roughly proportional to particulate flow.[11] Dust clouds of finely powdered substances can become combustible or explosive. When there is a static discharge in a dust or vapor cloud, explosions have occurred. Among the major industrial incidents that have occurred are: a grain silo in southwest France, a paint plant in Thailand, a factory making fiberglass moldings in Canada, a storage tank explosion in Glenpool, Oklahoma in 2003, and a portable tank filling operation and a tank farm in Des Moines, Iowa and Valley Center, Kansas in 2007.

The ability of a fluid to retain an electrostatic charge depends on its electrical conductivity. When low conductivity fluids flow through pipelines or are mechanically agitated, contact-induced charge separation called flow electrification occurs.[15][16] Fluids that have low electrical conductivity (below 50 picosiemens per meter), are called accumulators. Fluids having conductivity above 50 pS/m are called non-accumulators. In non-accumulators, charges recombine as fast as they are separated and hence electrostatic charge accumulation is not significant. Leyden jar, device for storing static electricity, discovered accidentally and investigated by the Dutch physicist Pieter van Musschenbroek of the University of Leiden in 1746, and independently by the German inventor Ewald Georg von Kleist in 1745. In its earliest form it was a glass vial, partly filled with water, the orifice of which was closed by a cork pierced with a wire or nail that dipped into the water. To charge the jar, the exposed end of the wire was brought into contact with a friction device that produced static electricity. When the contact was broken, a charge could be demonstrated by touching the wire with the hand and receiving a shock. In its present form, the inner and outer surfaces of an insulating jar are coated with sheets of metal foil. The outer coating is connected to earth, and a suitable connection is made with the inner coating through a central brass rod that projects through the mouth of the jar. In addition to its use for classroom demonstrations, the Leyden jar is of importance as a prototype of capacitors, which are widely used in radios, television sets, and other electrical and electronic equipment. Electric displacement, auxiliary electric field or electric vector that represents that aspect of an electric field associated solely with the presence of separated free electric charges, purposely excluding the contribution of any electric charges bound together in neutral atoms or molecules. If electric charge is transferred between two originally uncharged parallel metal plates, one becomes positively charged and the other negatively charged by the same amount, and an electric field exists between the plates. If a slab of insulating material is inserted between the charged plates, the bound electric charges comprising the internal structure of the insulation are displaced slightly, or polarized; bound negative charges (atomic electrons) shift a fraction of an atomic diameter toward the positive plate, and bound positive charges shift very slightly toward the negative. This shift of charge, or polarization, reduces the value of the electric field that was present before the insertion of the insulation. The actual average value of the electric field E, therefore, has a component P that depends on the bound polarization charges and a component D, electric displacement, that depends on the free separated charges on the plates.

Various compounds of silver have been used for dental purposes such as silver nitrate, as a compound with fluoride, and also with tin .