

Uses of static electricity

Electrostatic paint spraying

Painting an awkwardly shaped object such as a bicycle frame with a spray gun can be very time consuming and very wasteful of paint. Using electrostatic spraying can make the process much more efficient.

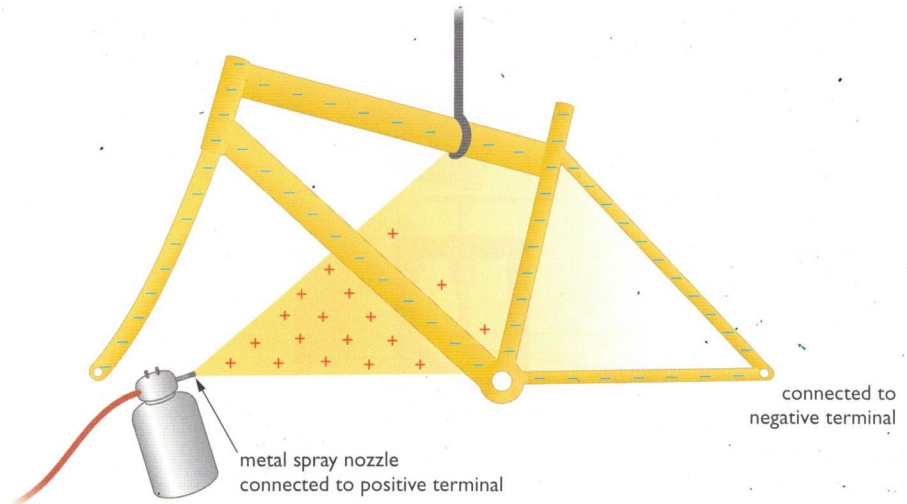


Figure 8.10 The positive paint is attracted to all parts of the negatively charged object.

As the droplets of paint emerge from the spray gun, they are charged. As the droplets all carry the same charge they repel and spread out forming a fine spray. The metal bicycle frame has a wire attached to an electrical supply giving the frame the opposite charge. The paint droplets are therefore attracted to the surface of the frame. There is the added benefit that paint is attracted into places, such as tight corners, that might otherwise not receive such a good coating.

Inkjet printers

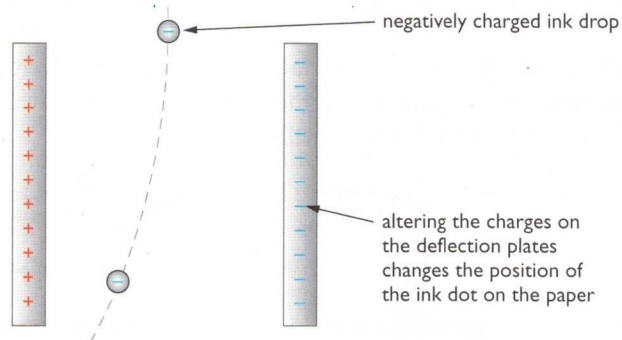
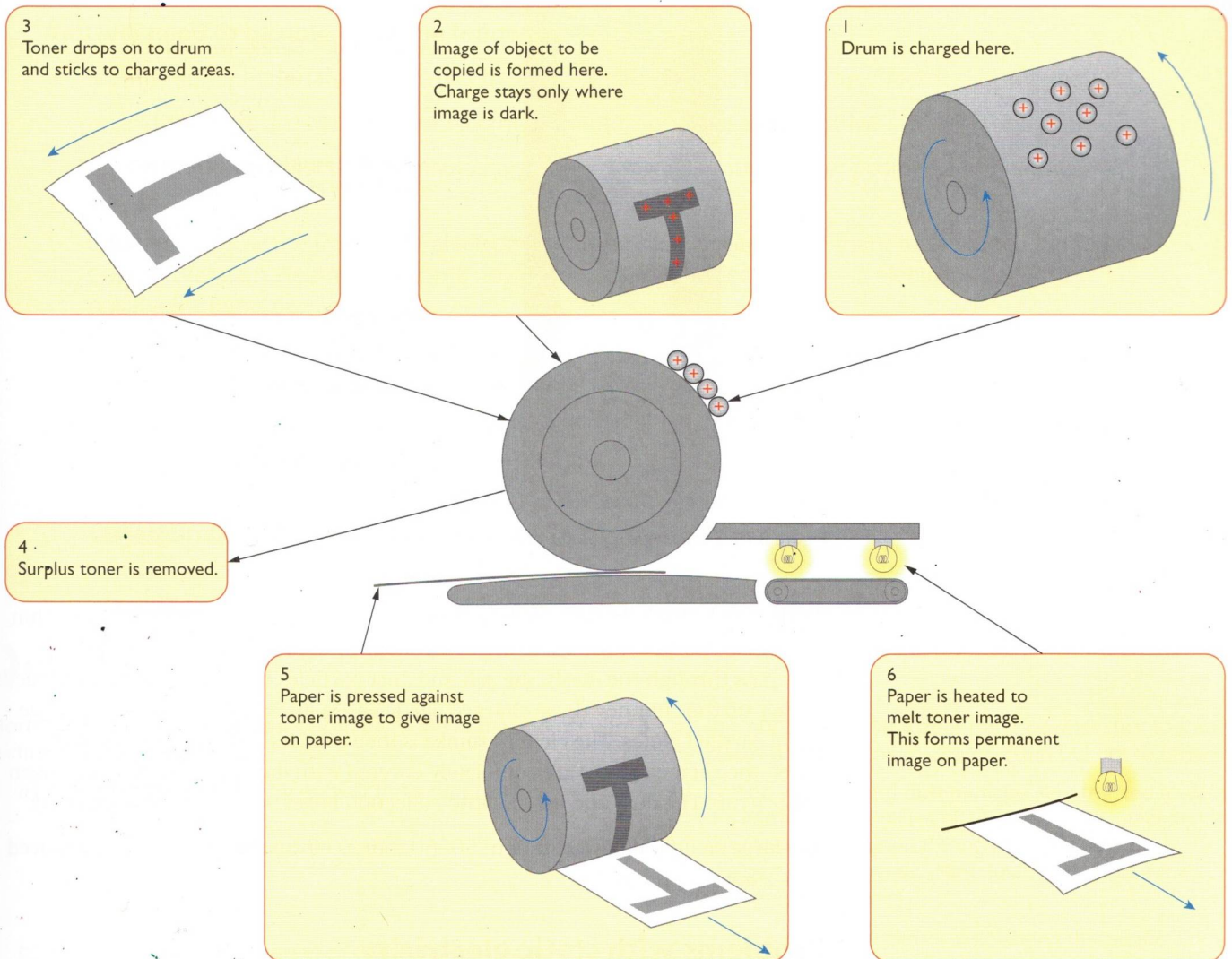


Figure 8.11 The charged ink droplets are deflected into the correct position on the paper.

Many modern printers use inkjets to direct a fine jet of ink drops onto paper. Each spot of ink is given a charge so that as it falls between a pair of deflecting plates, electrostatic forces direct it to the correct position. The charges on the plates change hundreds of times each second so that each drop falls in a different position, forming pictures and words on the paper as required.

Photocopiers



Positive charges are sprayed onto a rotating drum whose surface is coated with a metal called selenium. A bright light is shone onto the sheet of paper to be copied. The white parts of the paper reflect light onto the drum; the dark or printed parts do not. In those places where light is reflected onto the drum the selenium loses its charge but where no light is reflected onto the drum the charge remains. A fine negatively charged carbon powder called toner is blown across the drum and sticks to just those parts of the drum that are charged. A sheet of paper is now pressed against the drum and picks up the pattern of the carbon powder. The powder is then fixed in place by a heater.

Figure 8.12 Static electricity is used in photocopiers.

Electrostatic precipitators

Many heavy industrial plants, such as steel-making furnaces and coal-fired power stations, produce large quantities of smoke. This smoke carries small particles of ash and dust into the environment, causing health problems and damage to buildings. One way of removing these pollutants from the smoke is to use electrostatic precipitators.

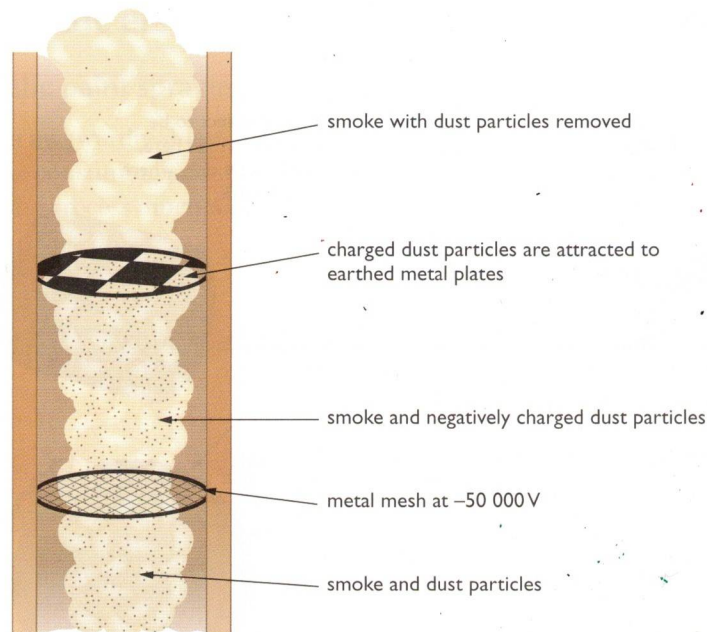


Figure 8.13 Electrostatic precipitators help to cut down the amount of pollution released into the atmosphere.

As the smoke initially rises up the chimney it passes through a mesh of wires that are highly charged. (The wires are at a voltage of approximately $-50\,000\text{ V}$.) As they pass through the mesh, the ash and dust particles become negatively charged. Higher up the chimney these charged particles are attracted by and stick to large metal earthed plates. The cleaner smoke is then released into the atmosphere. When the earthed plates are completely covered with dust and ash, they are given a sharp rap. The dust and ash fall into collection boxes, which are later emptied.

In a large coal-fired power station, 50–60 tonnes of dust and ash may be removed from smoke each hour!

Problems with static electricity

In some situations the presence of static electricity can be a disadvantage.

- As aircraft fly through the air, they can become charged with static electricity. As the charge on an aircraft increases, so too does the potential difference between it and earth. With high potential differences there is the possibility of charges escaping to earth as a spark during refuelling, which could cause an explosion. The solution to this problem is to earth the plane with a conductor as soon as it lands and before refuelling commences. Fuel tankers that transport fuel on roads must also be earthed before any fuel is transferred, to prevent sparks causing a fire or explosion.
- Television screens and computer monitors become charged with static electricity as they are used. These charges attract light uncharged particles – that is, dust.
- Our clothing can, under certain circumstances, become charged with static electricity. When we remove the clothes there is the possibility of receiving a small electric shock as the charges escape to earth.