

# Hazards and Applications of Electrostatics

## Hazards of Electrostatics

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### 1. Lightning

- The clouds are **charged by friction** between water molecules in the clouds and air molecules in the atmosphere.
- **Negative charges** accumulate at the **bottom** of the clouds.
- These **repel** the **electrons** near the surface of the earth, causing the **surface** of the Earth to be **positively charged**.
- When the accumulation of charges is large, the **air particles** are **ionised**.
- The **ionised air particles** provide a **conducting path** for the electrons in the clouds to reach the Earth.
- When the **electrons travel down** the conducting path to the Earth, **lightning** forms.

### 2. Electrostatic discharge

- Excessive charges may build up on objects due to **friction**
- Electronic equipment, such as computer boards and hard drives, can be easily damaged by electrostatic discharge.
- Such equipment is usually packed in **antistatic packaging**.

### 3. Electrostatic discharge of vehicles

- Electric charges can accumulate on trucks due to **friction** between
  - the road and the rotating tyres of the truck
  - the moving air molecules and the body of the truck
- When a **sudden discharge** occurs, this may cause **sparks** and **ignite** any flammable items that the truck might be carrying.
- Gas tankers are equipped with a **metal chain** at the rear end hanging/touching near to the **ground** to provide an **earthing path** for excess charges.
- During refueling, the gas tankers are also connected to an earth source to prevent static charges from accumulating on the body of the gas or fuel tanker.

## Applications of Electrostatics

### Photocopiers

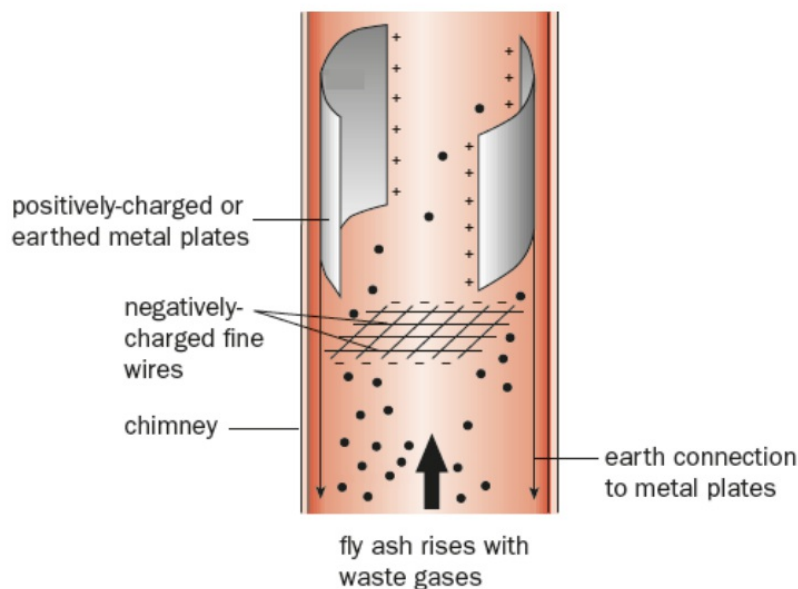
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- Photocopiers make use of static electricity to produce copies of documents.
1. The metal drum inside the photocopier is coated with **selenium**.
- Selenium is a **photoconductor** (light-sensitive semiconductor). It only conducts electricity in the presence of light. When no light shines on the selenium, it is a good insulator.

- The selenium coating on the drum is initially in the dark. Behaving as an insulator, it can be electrically charged. When the selenium is illuminated, it becomes conducting wherever light falls on it.
  - The drum's surface is charged **positively** by a charged wire.
2. The original image to be photocopied is placed on a sheet of clear glass above the drum.
    - An intense light beam is shone onto the image.
    - The **darker** areas of the image reflect less light and therefore, the corresponding regions on the drum remain **positively** charged.
    - The regions on the drum corresponding to the **lighter** areas conductive. Electrons from the surroundings, which are attracted to these regions, discharge them.
  3. The drum continues turning, and the positively-charged image on the drum attracts the **negatively-charged** toner powder.
  4. A **positively-charged** sheet of paper is passed over the drum's surface.
    - The paper attracts the **negatively-charged** toner and the image is formed on the paper.
    - The paper is heated and pressed to fuse the toner powder to the paper permanently.

## Electrostatic Precipitator

- The electrostatic precipitator is used to remove fly ash from the exhaust of a chimney.



### Removing fly ash from the exhaust gas

The fly ash (smoke and dust particles) is passed through a negatively charged wire grid making the particles to become negatively charged. The negatively charged particles are passed through positively charged or earthed plates which attract the negatively charged particles. Hence, air emitted into the atmosphere is cleaner. The fly ash are collected and

used in making cement.

## Spray Painting

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- The electrostatic spray painter is used to provide an even coat on the part to be painted.

### Even Coating

As the paint leaves the nozzle, the droplets are charged by friction. These made all the paint droplets to have the same charge and repel each other. Hence, they spread out evenly. Less paint is needed because the charged droplets are all attracted to the object (neutral or positively charged).