

## VIII. ELECTROSTATIC SEPERATION

Electrostatic separation is one of those important unit operations where electrical conductivity property of mineral surface is used selectively to separate out desirable mineral from other undesirable minerals. Electrostatic forces are generated by the action of an electric field on a charged particle. Consequently, in any electrostatic separation process one needs a source of electrical potential to generate the electric field and a process by which the individual particles are charged electrically. It is found that the following factors have significant effect on the process :

1. Intensity of electric field
2. Particle size
3. Relative humidity
4. Temperature of the particle/bed
5. Inter-electrode distance

Electrostatic separation has the following advantages over any other processes :

1. The electrostatic forces work on the particles to be separated only; they do not affect the medium in which the particles are located
2. The trajectories of the particles under the influence of the electric field follow the electric field lines. The electric field lines may be shaped to suit the particular application
3. The direction of electrostatic forces may be reversed by either changing the polarity of the charge or the direction of the external electrostatic field
4. The electrostatic forces may be arranged to work in combination with other forces such as gravitational or centrifugal forces
5. The electrostatic separation forces are independent of the substrate of the material on which the surface electric charge is generated. They are determined solely by the product of electric field and charge. In magnetic separators the forces are considerably greater, yet such forces work on magnetic materials only. The electrostatic forces do not differentiate between magnetic and non-magnetic materials. The charged magnetic particle placed in an electric field will be subjected to forces practically equal to those acting on a similar particle made out of non-magnetic material and charged with the same charge.

However, the process is associated with the following disadvantages as well :

1. Limitation of maximum mass that it can effectively work upon.

- The size of the material to be separated should be very small which leads to the increase of comminution cost.

### Electrification Process

The separation by this process can be achieved by selective charging of the particles which is known as electrification. Different electrification processes are utilised in practice. They are Tribo-electrification, Corona electrification and Induction electrification.

### Electrostatic separation Equipment

Generally two types of equipment are used for separation. These are as follows:

#### 1. Drum type electrostatic separation unit

This equipment consists of a rotating drum made of mild steel or some other conducting material, which is earthed through its support bearings as shown below in the Figure 8. An electrode assembly, comprising of a brass tube in front of which is supported a length of fine wire, spans the complete length of the roll, and is supplied with a fully rectified DC supply of up to 50 kV, usually of negative polarity. The voltage supplied to the assembly should be such that ionisation of the air takes place. This can often be seen as a visible corona discharge. Arcing between the electrode and the roll must be avoided as it destroys the ionisation. When ionisation occurs, the minerals receive a spray discharge of electricity, which gives the poor conductors a high surface charge, causing them to be attracted to and pinned to the rotor surface. The particles of relatively high conductivity do not become charged as rapidly since the charge rapidly dissipates through the particles to the earthed rotor. These particles of higher conductivity follow a path, when leaving the rotor, approximating to the one, which they would assume if there was no charging effect at all.

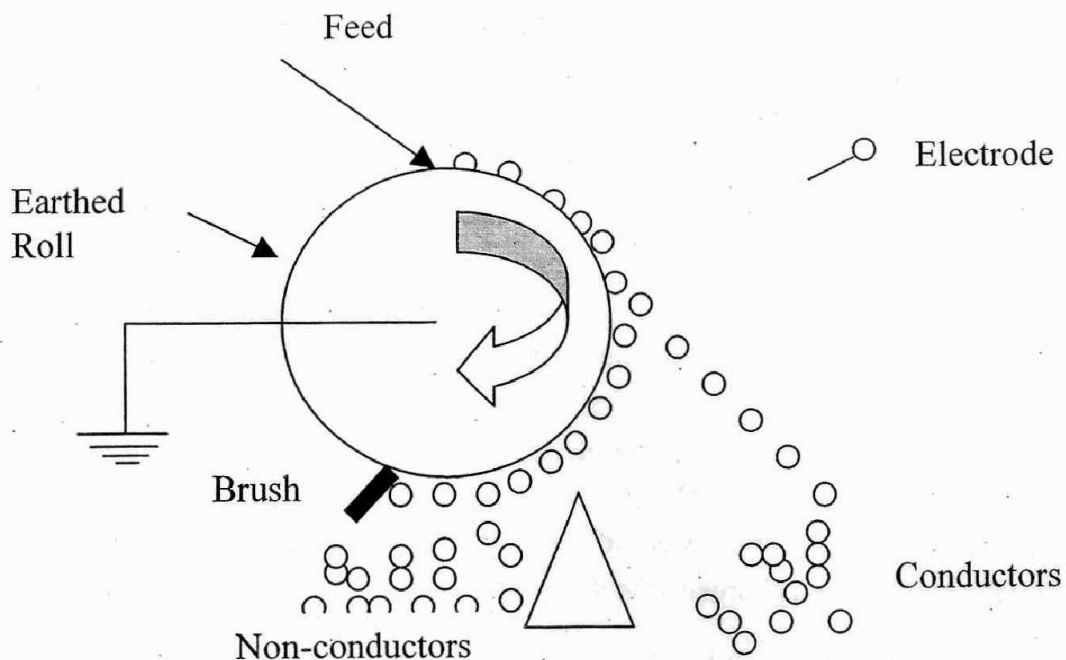


Fig. 8 : Principle of Electrostatic Separation

A combination of pinning and lifting effects can be created by using a static electrode large enough to preclude corona discharge, following the electrode. The conducting particles, which are flung from the rotor, are attracted to this static electrode and the compound process produces a very wide and distinct separation between the conducting and non-conducting particles.

## **2. Plate type electrostatic separation unit**

A plate or screen type electrostatic separator is also used for separation. This type of equipment mainly consists of an oval type, high voltage electrode, which induces the electric field. The material is fed through a sloping, grounded plate under gravity. The electrostatic field is effectively shorted through the conducting particles, which are lifted towards the charged electrode in order to decrease the energy of the system.

### **Application**

Electrostatic separation is used successfully for beneficiation of wide range of minerals. Important examples are:

1. Beach sand beneficiation.
2. Beneficiation of coal.