Magnetic Separation

It is a process in which magnetically susceptible material is extracted from a mixture using a magnetic force. Since 19th century magnetic separation processes have been used to concentrate and separate minerals.

Magnetic separation takes advantage of differences in the magnetic properties of minerals. Minerals fall into one of three magnetic properties: ferromagnetic, paramagnetic and diamagnetic.

Ferromagnetic minerals are themselves magnetic (i.e., magnetite and pyrrhotite) and can be easily separated from other minerals with a magnet since they will stick to the poles of the magnet. These minerals can be separated by wrapping the poles of a magnet in paper, passing the magnet over the mineral mixture. The ferromagnetic minerals will stick to the magnet and may be easily separated by removing the paper covering the magnet.
Paramagnetic and diamagnetic minerals are not magnetic, but they differ in how they interact with a magnetic field. Paramagnetic minerals are weakly attracted into a magnetic field and diamagnetic minerals are weakly repelled by a magnetic field.

**How a Magnetic Separator Works**

- A magnetic separator consists of a powerful magnet that is either laid down or suspended from a ceiling or device.
- Materials can be passed over a tabletop magnetic separator while suspended magnetic separators often dangle above a material in order to extract its impurities.
- Magnetic separators can also be cylinders that objects are passed through.
- The material that a magnetic separator purifies can be in the form of parts, a finished product, or even liquid metal.

**Major Applications**

Magnetic separation has two major applications in mineral processing plants:

- The removal of tramp iron (which would deleteriously affect subsequent processes) from an ore stream. This is usually achieved by a low intensity magnet suspended above, or at the head of, a conveyor.
- Separation of magnetic minerals from less magnetic minerals.

This table shows the more common magnetic minerals and the range of field intensities that may be required to separate them.

**Common Magnetic Minerals**
(*The units given are kilogauss (kG). These are the units most commonly used. The equivalent S.I. unit is the Tesla (T) * 1 Tesla = 10 kilogauss). The extremes of field strength used are based on experience from a magnetic separation testing laboratory over many years.

**IMPORTANT TYPES OF MAGNETIC SEPARATOR**

1. **EDISON SEPARATOR**

Edison separator consists of a bar magnet. The ore as thin streams falls in front of the poles, susceptible particles being deflected inwards & nonsusceptible particles continuing to fall undeflected. This separator was not wholly successful because of inability of control flow of solid in a thin sheet, & because of lack of control over the speed of the falling particles.

2. **BALL NORTON SEPARATOR**

Unlike most magnetic separators which are used to remove relatively small amounts of metal, the Ball Norton Separator is designed to handle large amounts of ferrous material - removing other undesirable elements. A unique combination of alternating magnetic poles and vibratory conveying works to clean the magnetic material. Applications include foundry shot, crushed borings, slag and magnetic ores.

3. **MAGNETIC DRUM SEPARATOR**

Magnetic drum separators are important magnetic separators that removes ferrous metal from dry bulk products in free-flowing processing systems. They are self cleaning unit consisting of drums and housing normally of
stainless steel. The magnetic drum separators are available both in single or double drum configuration.

4. **MAGNETIC COOLENT SEPARATOR**

5. Magnetic coolant separator is a device which cleans the coolant liquid of very fine ferrous particles. It removes the iron chips from the milling or grinding liquid. It is light and compact structure having strong magnetic power which can remove very fine ferrous particles. For precise grinding operations uninterrupted flow of oil is must. The coolant magnetic separator ensures the uninterrupted flow of the liquid.

6. **WET DRUM SEPARATOR**

   - Wet drum magnets have high magnetic recovery and discharge.
   - The feed slurries recover the magnetics.
   - Available in single or multiple drum applications.
   - Recover magnetic solids in as clean a magnetic concentrate as possible.
   - The magnet / pole elements are bolted to a mild steel shaft.
   - The drum is made from thick stainless steel for long service life.
   - Wet drum separators are available in different configuration like single drum, double drum and multiple drum.

**Advantages**

- Magnetic separators are often powerful, portable, and can be adjusted to remove varying types of magnetic materials from a liquid or solid.
- They are most effective when used on a liquid, although the removal of solid impurities is also possible.
- Magnetic separators are quite versatile and incredibly simple in design. In fact, a basic magnetic separator can be built at any time, using only a powerful magnet and a clamp to hold the material down.

**Disadvantages**

The main disadvantage of magnetic separators is that they must be consistently maintained. The magnetic separator must be washed or wiped
down in order to remove magnetic materials that have accumulated, while oil must be added to any moving parts.

In the case of an electromagnetic separator, the electromagnet must be able to be turned off at any time in case of an emergency.