13.1.2 Sorting classifiers

Sorting classifiers employ the hindered settling conditions to increase the effect of density in order to separate the particles according to their density rather than size. A typical sorting classifier consists of a series of sorting columns as shown in Figure 13.4.

The feed slurry is introduced centrally near the top of the first sorting column. A current of water known as **hydraulic water** is introduced at the bottom of the sorting column at a velocity slightly less than the smallest heavy particle among the particles required to be discharged in the first sorting column. All those particles having settling velocity less than that of rising water velocity will not settle and rise to the top of the column and fed to the second column.

The particles, having a settling velocity more than that of the rising water velocity, settle to the bottom of the first sorting column and get discharged through the spigot. The velocity of the hydraulic water in the second sorting column is less than that of the velocity in the first sorting column so that the particles of low settling velocity settle to the bottom of the second sorting column and get discharged through the spigot. Similarly the particles with still low settling velocity are obtained through the spigot of third sorting column and remaining particles are obtained as overflow from the third sorting column.

Explanation with reference to Figure 13.1 has already been given as to how the particles are separated under hindered settling conditions by using two sorting columns where it is clear that fine heavy and coarse light particles are together discharged as spigot product of the second sorting column, coarse heavy as spigot product of the first sorting column and fine light as overflow product of the second sorting column.

Figure 13.5 shows this separation. If the free settling conditions are maintained, a series of spigot products with decreasing size of particles from first spigot are obtained as shown in Figure 13.6.

As these classifiers use the rising current of water, they are called hydraulic classifiers and vertical current classifiers.

These classifiers are:

• launder type with rectangular boxes attached to it such as the Evans classifier, cylindrical type such as the Anaconda and Richards classifiers, trapezoidal tank type such as the Fahrenwald sizer.

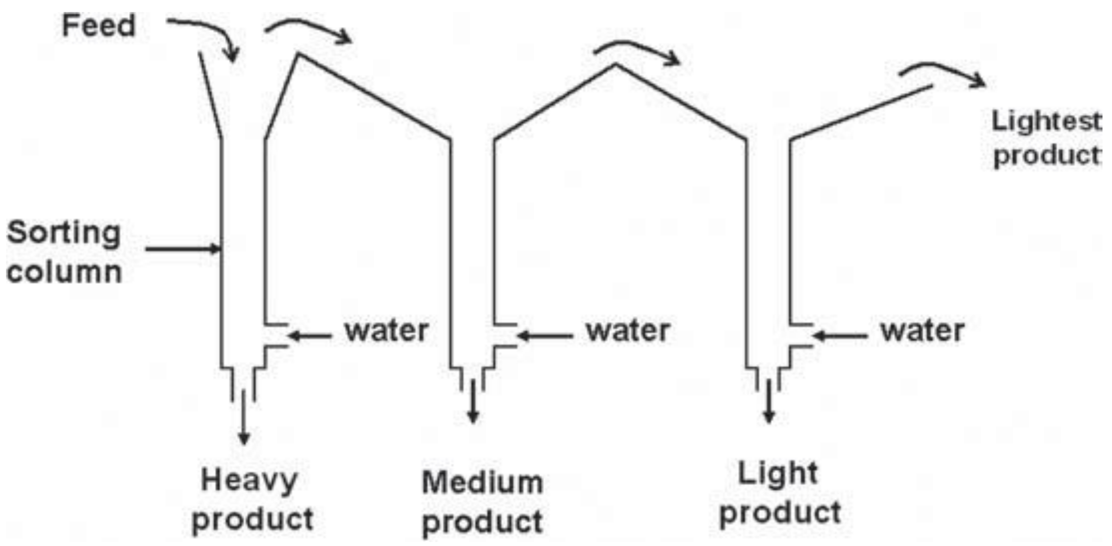

Figure 13.4 **Principle of sorting classifier.**

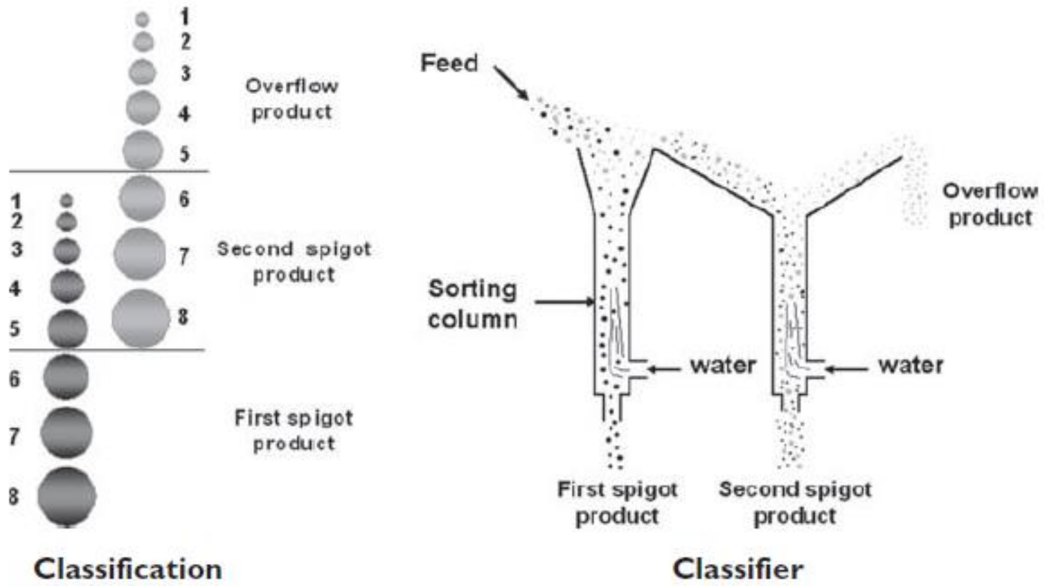

Figure 13.5 Hydraulic classifier with sorting effect.

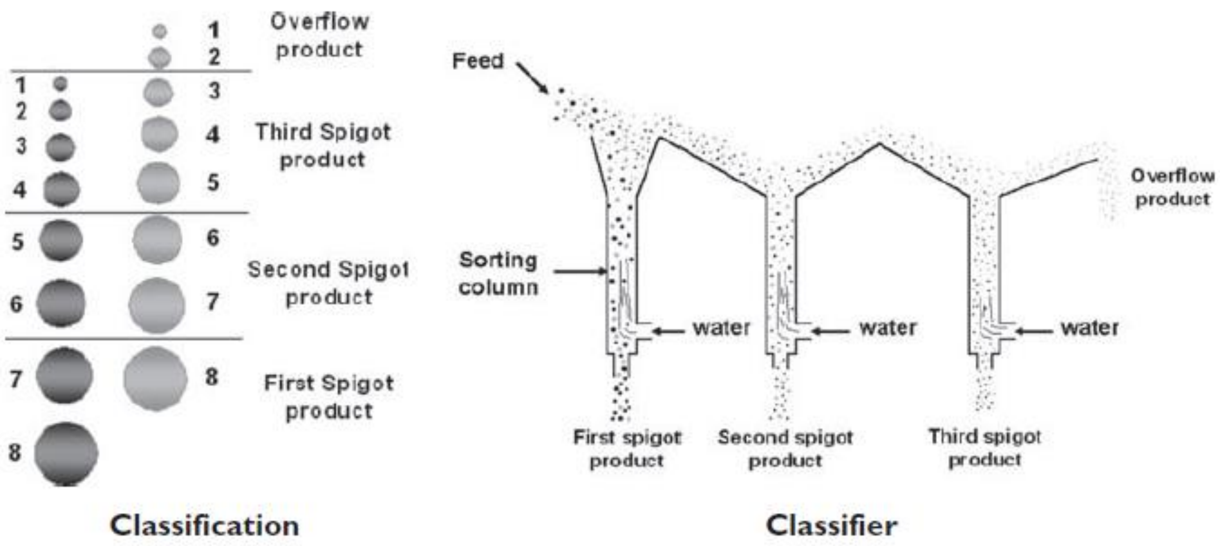

Figure 13.6 Hydraulic classifier with sizing effect.

- Uses rising current of water called hydraulic water.
- Hindered settling classifiers.
- Uses relatively dense aqueous suspension as fluid medium.
- Perform mostly sorting.
- Percent solids are usually 15–30%.
- Yield more products.

Even though sorting classifiers are not truly sizing classifiers, they are sometimes used to sort out the particles in a close size range as shown in Figure 13.6 which are necessary for gravity concentration operations such as tabling. The Stokes Hydrosizer is commonly used to sort the feed to gravity concentrators.

13.1.3 Centrifugal classifiers

Cyclonic separation is a method of removing particulates from an air, gas or liquid stream, without the use of filters, through vortex separation. When removing particulate matter from liquids, a hydrocyclone is used; while from gas, a gas cyclone is used. Rotational effects and gravity are used to separate mixtures of solids and fluids. The method can also be used to separate fine droplets of liquid from a gaseous stream.

Hydrocyclone (Figure 13.7) has no moving parts. It consists of a cylindrical section with a tangential feed inlet. A conical section, connected to it, is open at the bottom, variously called the underflow nozzle, discharge orifice, apex or spigot. The top of the cylindrical section is closed with a plate through which passes an axially mounted central overflow pipe. The pipe is extended into the body of the cyclone by a short, removable section known as vortex finder, which prevents short-circuiting of feed directly into the overflow.

When a pulp is fed tangentially into a cyclone, a vortex is generated about the longitudinal axis. The accompanying centrifugal acceleration increases the settling rates of the particles, the coarser of which reach the cone's wall. Here they enter a zone of reduced pressure and flow downward to the apex, through which they are discharged.

At the center of the cyclone is a zone of low pressure and low centrifugal force which surrounds an air-filled vortex. Part of the pulp, carrying the finer particles with major portion of feed water, moves inward toward this vortex and reaches the gathering zone surrounding the air pocket. Here it is picked up by the vortex finder, and removed through a central overflow orifice (Figure 13.8).

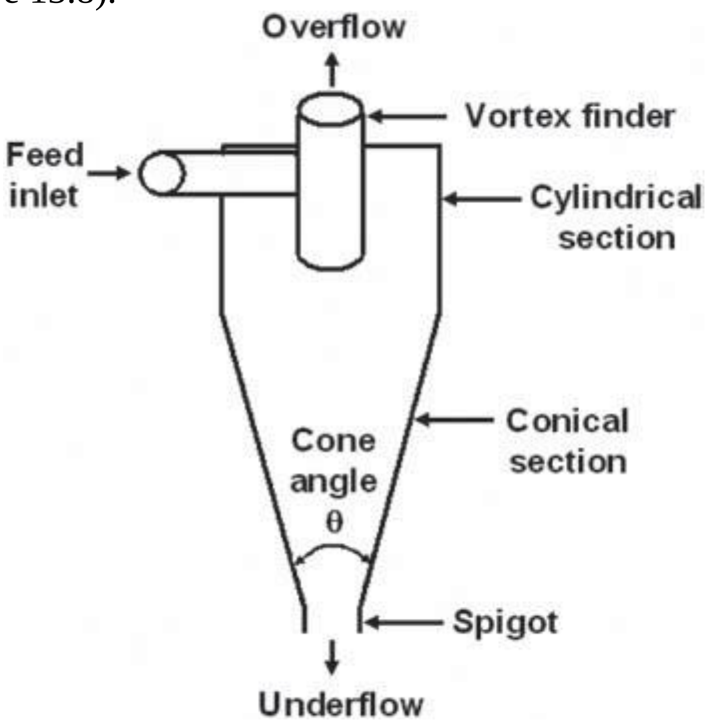

***Figure 13.7* Hydrocyclone.**

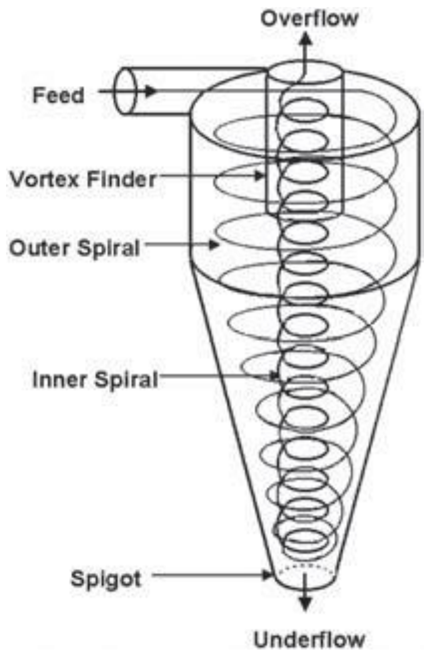

Figure 13.8 **Hydrocyclone operation.**

The size of the hydrocyclone is the diameter of its cylindrical section. The variables that affect the performance of a hydrocyclone can be divided into two groups as design variables and operating variables. Design variables are the size of the hydrocyclone, diameter of feed inlet, vortex finder and apex, and position of the vortex finder.
Operating variables are feed rate, feed pressure, solid-liquid ratio, density, size and shape of feed solids, and density and viscosity of liquid medium.

The cyclone will be instead of many other classification because of it is more efficient and easier used and don’t need to Periodic maintenance , Low operating cost and it is used when have micro size between (5-50 micron).